Integrating IT Industry Certification into Irish Institutes of Technology: A Stakeholders Perspective

By

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The author hereby declares that, except where duly acknowledged, this thesis is entirely her own work and has not been submitted for any degree in Waterford Institute of Technology or in any other academic Institution

Lucy White

June 2007

To my wonderful mother, Betty
and partner, Derek

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ABSTRACT

This study investigates the potential for integrating IT industry certification into the undergraduate computing curricula in Irish Institutes of Technology (IoTs) from two key stakeholders' perspectives: Heads of Department (HoDs) and lecturing staff. A rich contextual framework is derived using aspects of Soft Systems Methodology, and five research propositions are identified to investigate. Given the complexity of the human-oriented domain of this research, an interpretivist epistemology was deemed appropriate.

A web-based survey was employed to provide a combination of both quantitative and qualitative data for in-depth analysis. Two web-based questionnaires were administered to 13 IoTs in the Republic of Ireland, resulting in 86 responses.

The findings reveal that both HoDs and lecturing staff anticipate that certification integration into Irish IoTs would require lecturing staff to obtain additional training to effectively deliver IT industry certification. Both respondent groups highlighted that resources would also be an issue. Similarly, the evidence shows that lecturing staff would be required to change some of their current work practices to ensure effective delivery of IT industry certification training and testing.

In general, both HoDs and lecturing staff indicated that they would be in favour of integrating certification into the undergraduate computing curricula, though not at the expense of the existing modules. Both respondents agreed to some extent that certification would help improve students' competencies, skills, and employability and it would raise the profile of the IoT. Overall this study concludes that, currently, Irish IoTs do not have the required level of capability or maturity to integrate IT industry certification into the undergraduate computing curricula.

CHAPTER ONE

INTRODUCTION

1.1 Background

In the Information Technology (IT) industry, certification provides independent verification of individual's competency, skills and expertise. The current certifications that are available are extremely diverse; encompassing all aspects of contemporary IT practices. For instance, some certifications are concerned with hardware skills (e.g. Cisco Systems certifications), others with software skills (e.g. Microsoft certifications), and others with business and management type skills (e.g. Project Management Institute certifications).

There are a number of compelling reasons why industry certification could be harnessed and incorporated to potentially benefit students studying IT in third level institutes. Firstly, the literature suggests that graduates with certification are more employable and are more likely to be considered for promotion than those without certification (Schlichting & Mason, 2004). Secondly, there is evidence that the skill sets of new IT graduates are deficient in certain practical areas when they enter industry (Maj et al., 2001). One predominant reason students attend college is to acquire the skills, knowledge and qualification for employment and promotion. Unfortunately, many programmes are deficient in providing the skill set required by industry. In recent years, students have been making a move towards vocational style courses in an attempt to obtain these practical skills (Donaghue, 1997). Certification, given its practical nature, could help redress this skills gap. Professional bodies like the Association for Computing Machinery (ACM) also endorse the use of IT certification in academia (IEEE & ACM, 2001). Given such reasons, integrating certification into IT degree programmes has become a pressing contemporary issue.

1.2 Context and Justification of Research

The IT industry was a major driver behind Ireland's so-called "Celtic Tiger" economy. From 1990 to 2003 Ireland's gross domestic product (GDP) grew from €36 billion to an unprecedented €138 billion (Harris, 2005). In recent years, Ireland's economy has remained reliant on the IT industry to develop a knowledge economy deemed crucial for future competitiveness (Martin, 2004). As a result it relies heavily on its education system to deliver highly skilled IT graduates to sustain this. One of the key factors for the influx of international investment and the growth of the modern technological industry can be attributed to the educated, skilled and motivated workforce that the Irish education system produces (International Education Media, 2005). Given the importance of IT for the Irish economy, it is crucial that IT education trends that are emerging internationally are also considered nationally. Integrating IT certification in third level education is one such trend.

Integrating IT certification into degree courses presents a number of possible challenges. For teaching staff, for example, issues may include course preparation, additional resources, training and support requirements (Schlichting & Mason, 2004). Other issues surround the form the integration might take. For example, integration could range from allowing credit for completed certifications (as a form of Accreditation of Prior Experiential Learning (APEL)) to embedding the certification programme into the existing curricula.

Although IT certification has been incorporated into a number of universities internationally, there is little evidence to suggest that its potential has been adequately considered nationally. This research seeks to help address this gap.

1.3 Research Objective and Questions

The primary objective of this research is:

> To investigate the potential of integrating IT industry certification into the undergraduate computing curricula in Irish Institutes of Technology (IoTs)

The following three research questions are identified to investigate this objective:

1. To what extent do Irish IoTs have the capability to integrate IT industry certification into their undergraduate computing curricula?

2. To what extent are work practices within Irish IoTs mature enough to manage the integration of IT industry certification into the undergraduate computing curricula?

3. What are the wider implications of integrating IT industry certification into the undergraduate computing curricula in Irish IoTs?

1.4 Overview of Thesis

This remainder of this thesis is structured as follows:

Chapter 2 – Literature Review

This chapter contains a holistic review of all the literature consulted for this research in the areas of IT industry certification, education, and change. This study encompasses various aspects from three areas. Section one of chapter two provides an overview and background of IT industry certification. It details the different types of certification training providers and assessment mechanisms available. It also highlights the merits and limitations of IT industry certification, and finally reviews some studies considering certification integration. Section two outlines some of the major educational theories and models from the literature that exist in academia. It examines the difference between traditional and vocational education, and addresses the IT curricula, accreditation and assessment models. Section three investigates the process of change in an educational context. It addresses curriculum change and more importantly resistance to change. Section four combines all three literatures in order to assess the issues and implications of integrating IT industry certification into the undergraduate curriculum of Irish IoTs.

Chapter 3 – Research Framework

This chapter addresses the complex system of educational change specifically in the context of certification integration. It also presents a theoretical framework to illustrate the problem situation using the Soft Systems Methodology (SSM). Several issues and conflicts are highlighted and five propositions are identified for this study to assess.

Chapter 4 – Research Methodology

This chapter describes and identifies an appropriate methodology for this study. It describes the organisation of this research and details the research instrument used to collect the data.

Chapter 5 – Findings

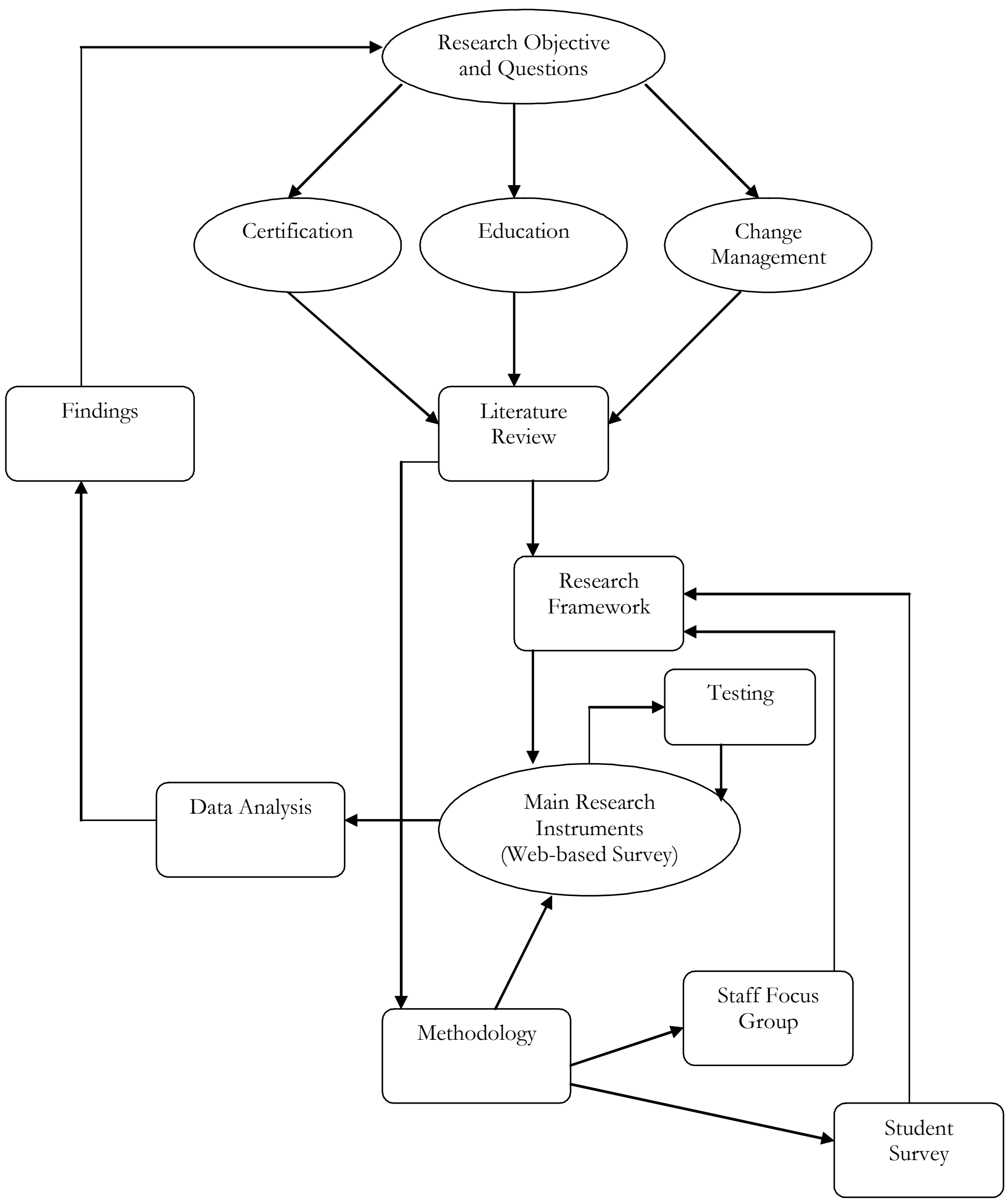
This chapter presents the main findings of this research, and addresses each of the five propositions identified in chapter three. Appropriate statistical analysis and content analysis are conducted in order to accept or reject these propositions. A general discussion is also presented.

Chapter 6 – Discussion and Conclusion

This chapter provides a discussion and interpretation of the main research findings. It also highlights the limitations of this study and suggests avenues for future research.

Figure 1.1 illustrates an overview of the research process, which has culminated in this thesis.

FIGURE 1.1: Research Structure



1.5 Conclusion

This chapter has presented a brief background, context and justification for this research. The primary research objective and questions have been identified and an overview of this thesis has been outline. The following chapter - Literature Review, will explore the existing literature in relation to IT industry certification, education and change.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to examine and review in detail the existing literature on IT industry certification, education, and change. Each of these areas will be addressed separately in order to provide an understanding of the impact of certification integration on Higher Educational Institutes (HEIs). Some case studies will be presented to highlight the variety of methods adopted internationally. To conclude, issues and implications for this research will be addressed.

SECTION ONE: CERTIFICATION

2.2 Introduction

The focus of this section is to examine the existing literature on IT industry certification. Its aim is to highlight awareness of the prevalence of certifications in the IT industry. This section begins with defining IT industry certification, and giving a brief overview of its history and role in the IT industry. Different types of IT certification are identified along with the current trends in industry. Training providers and testing centres are also discussed at this point. Furthermore, the noted merits and drawbacks of IT industry certification are examined. Finally, a review of studies considering certification integration is discussed and some major issues are addressed in relation to the implications for this research.

2.2.1 What is IT Industry Certification?

In the IT industry, certification is a designation earned by an individual to verify their knowledge, skills and expertise within a particular area. Certification, which is a voluntary process, aims to provide the individual with a certain level of competency that is widely recognised by many organisations (Childers, 2001; Cosgrove, 2004; Mason, 2003; McCarthy, 2004; Schlichting & Mason, 2005). It verifies an awareness of specific knowledge and promotes the practical implementation of standards (Tripp, 2002). Certification confirms to an employer that individuals possess the skills that they require, that is, they can perform specific tasks (Shore, 2003; Tripp, 2002).

2.2.2 History and Role of IT Industry Certification

IT industry certification, which originated in the late 1980s by Novell Inc, is a relatively recent phenomenon. They realised that in order for their products to succeed, people would need to be equipped with the necessary skills for their highly technical products. In response, Novell investigated the Certified Netware Engineer (CNE) programme. Using the expertise and experience of product specialists, Novell created tests that incorporated all the knowledge and skills required to work with the NetWare products. CNE became a marketed product that ensured their customers and business partners' skills were reliable. In the early 1990s, many other hardware and software companies, including Microsoft, IBM and Cisco Systems launched technical certifications for their technologies in a bid to replicate Novell's success. In the late 1990s, certification had become the standard for skills measurement in the IT sector (Shore, 2003).

Certification is widespread in the IT industry today. It encompasses all aspects of IT including hardware, software and management skills (Schlichting & Mason, 2004). Although the number of IT certifications offered by industry is not easy to quantify, it is currently estimated to be in the thousands (Hitchcock, 2005). Certification aims to provide a measure of competence that is "valid, consistent and fair" (Shore, 2003, p.4).

Therefore, certification assessments should measure appropriate skills, that is, job specific knowledge and ability. Assessments should be consistent by distinguishing between qualified and unqualified candidates who are equally skilled and prepared. Certification providers must also ensure that examinations are impartial and that no one candidate has an unfair advantage. To maintain the value and integrity of IT industry certification, it is important that providers protect examinations from entering the public domain. Cheating is a major concern for certification providers and testing agencies. Brain-dump websites, discussion groups and chat rooms are frequently flooded with test material, which potentially decreases the value of certification (Hunt & Mulkey, 2005).

2.2.3 Types of IT Industry Certification

Many certifications carry considerable value and are championed by some of the major players in the IT industry, offering certifications concerning their own products. These vendor-specific certifications provide highly specialised training in the deployment and use of specific technologies, and are extremely practical in nature. Vendor-neutral certifications also exist, and are typically sponsored by professional groups. This type of certification is more generic, focusing on technological principles and methodologies rather than specific product lines. Certifications offered by CompTIA are exemplary in this regard (Shore, 2003).

2.2.4 Current Trends of IT Industry Certification

There is very little literature available relating to industry certification and of those that exist, there is a very strong marketing emphasis (Hitchcock, 2005). The number of industry certifications directly related to computer scientists is estimated in the thousands. The five most common certifications according to Gabelhouse (2001) are as follows:

1. CompTIA A+ certification. This is the premier hardware exam which validates the knowledge and skills of entry-level computer service technicians. It demonstrates competency in areas such as installation, configuration, diagnostics, maintenance and basic networking. CompTIA is a vendor-neutral provider that is internationally renowned in all aspects of IT. A+ is recognised as part of the certification track for corporations such as Microsoft, Hewlett-Packard, Cisco and Novell. A+ certification is obtained by successfully completing two exams; the hardware exam (also known as the core exam) and an operating system exam, where particular emphasis is on the Microsoft operating system. The exams are based on practice and are in multiple choice format. The hardware exam is recognised as the most important exam because this is what certifies the professional technician. CompTIA's exams are administered through the Pearson VEU and Prometric testing centers.

2. Microsoft's MCSE (Microsoft Certified Systems Engineer). This is the premier software certification (Schlichting & Mason, 2004). Microsoft is a vendor-specific provider offering certification for their own products. The MCSE is available for Windows 2000 and Windows Server 2003 which test candidate's ability in the areas of network security, computer network infrastructure, Active Directory, Microsoft Exchange, Microsoft SQL Server and more general areas of networking and other specific Microsoft products. Candidates must pass both compulsory and elective exams in order to attain the MCSE certification.

3. Novell's CNE (Certified NetWare Engineer). This is a network software specific certification which is designed to test the detailed knowledge and skills required for Novell's Netware operating system. This is considered to be the first formal certification available. Novell is another example of a vendor specific provider. The CNE certification examines the competency of candidates in specific areas including server installations, NDSs e-Directory management, storage space allocation, printing, e-mail and managing security. In order for candidates to obtain the CNE certification they must pass a series of exams. Novell also provides continuing certification requirements ensuring individuals skills are regularly updated.

4. Cisco's CCNE (Cisco Certified Network Engineer). This is a manufacturing specific certification which tests skills and knowledge in both hardware and software areas. There is an increasing interest and demand within the IT industry for Cisco certifications, as many of the technologies used by the internet are dependent on these products (Schlichting & Mason, 2004) . CCNE along with the more advanced expert level certification CCIE are considered to be the hardest certifications to obtain (Nagel, 2004). Candidates are required to pass both extensive written and practical exams. Certified CCNE's can usually command a larger salary than those who do not hold this designation.

5. Oracle's OCP (Oracle DBA Certified Professional). This certification is software specific. It examines knowledge and skills in areas of database application, development and maintenance and is validated at several levels. There is an increasing demand for individuals who have obtained Oracle DBA certification. Industry usually offers substantial salaries to those who have obtained this credential.

2.2.5 Certification Training Providers

Certification training is a highly lucrative industry, and consequently, there are many certification and training providers available to choose from (Tittel, 2003). There are many ways to successfully train and prepare to obtain certification. Some options that are available include self-study, online training and classroom training (Tittel, 2006).

The self-study method, which is undoubtedly the cheapest method of certification training, relies on materials, mainly books and practical exams that candidates acquire and use on their own. The online method involves reading, exercises and lab work within a web-based interface and often involves scheduled video based lectures. Other beneficial features of online training involve mentor or instructor interaction. This method incurs moderate costs. Classroom training on the other hand, can be very costly but is extremely effective, providing arguably the best learning experiences for candidates. Instructor interaction, access to state of the art labs, the ability to put theory into practice with the latest platforms, technologies and products, all make this method of training very effective. 'Boot camps', which promote guaranteed success, is another option that is advertised on the Internet or in IT publications (Shore, 2003). However, it is considered the most expensive version of classroom training. In contrast, technical schools and community colleges that offer certification training are considerably more affordable. Computer-based training is also offered as a training method for some certifications (Montante & Khan, 2001). All of the above methods of training typically include the use of practice exams from reputable vendors.

2.2.6 Certification Testing Centres

Individuals become certified by passing an internationally recognised standardised exam (Nelson & Rice, 2001). Exams are an extensive test of the skills and knowledge of an individual in specific areas of hardware and software (Schlichting & Mason, 2004). Even though certifications are offered by a wide variety of organisations, the actual testing is typically administered by just a few dedicated organisations. These include Pearson VUE, Prometric, Nivo International, and CatGlobal (cf. Nelson & Rice, 2001). These organisations provide test sites in many countries and administer certification examinations, which are often closed-book, proctored and computer-based.

Although some certifications can be interminable, many others occasionally require renewal in order to keep certified individuals skills current and also to show evidence of continued competence. This is to ensure that individuals remain up to date with the latest product enhancements and technologies for which they are certified (NRC, 2001).

2.2.7 Merits of IT Industry Certification

There is some literature available that highlights the benefits of certification. Individuals view certification as a means of obtaining recognised skills which are sought after by industry, thus leading to more employment opportunities, greater recognition and reward (Mason, 2003; Shore, 2003). Potential employers use certification as verification of individuals' expertise in specific areas of IT as it demonstrates a higher level of competence, confidence and recognition. Industry often require potential employees to hold certifications in order to be considered for employment, as they believe it minimises the initial training requirements for new employees (Hitchcock, 2005; Montante & Khan, 2001; Wonacott, 2003). Candidates that do not have any experience will sometimes be considered for employment if they have obtained a relevant certification (Hitchcock, 2005). Research also suggests that candidates who have obtained certification may be considered more for employment than candidates without certification (Bartlett et al., 2005).

Consumers believe that certified individuals are knowledgeable professionals and that they can deliver products and services that meet the desired professional standards. It is seen to reduce the possibility of incompetent practitioners. There is some indication that certification promotes excellence, raising the overall competency level within the industry (Brandt, 1998; Hitchcock, 2005; Werth, 1998). The true value of certification is the measure in which it tests skills, experience and expertise of an individual in various areas of IT. Certification is believed to ultimately "raise the benchmark for individual performance in achieving software quality and productivity" (Tripp, 2002, p.31).

2.2.8 Criticisms of IT Industry Certification

There is a great deal of concern surrounding the value of knowledge-based certifications. This type of certification examines concepts taken from product documentation, and also some practices, however they do not examine the practical skills required to perform the specified job. Such certifications are deemed "paper" that is, they do not evaluate the practical application of knowledge and individuals who are incapable of performing competently may pass them (Connor, 1999; Warner, 2006). Although knowledge based certifications are still in existence, the trend is notably towards performance-based certification. These certifications test knowledge, experience, skills and the ability to perform at a certain level in the real world (Childers, 2001; Hitchcock, 2005; Shore, 2003; Whitney, 2006).

The cost of preparing for some IT industry certification can be very expensive depending on the source and delivery method of training, the location of training and the level at which training is required (Adelman, 2000b). According to Adelman (2000a) some specialist certification programs, for example, Sun Microsystems Java programme can cost up to $7,500 (which includes courses to obtain prerequisite knowledge and skills and several foundation courses). He comments that this is "cheap" in relation to the high-end estimate of $20,330 to obtain the Certified Internet Webmaster (CIW) (this includes self-study texts, examination fees and CDs). Course material and re-certification are also added expenses. However, there are some arguments to suggest that the benefits of certification outweigh those costs (Robertson, 2003).

Some evidence suggests that certifications are fallible and do not always prove competence (cf. Wood, 2006). There is no substitute for real work experience, and individuals with experience believe certification to be a waste of time. In a survey conducted by Cegielski, HR professionals believed certification to be advantageous for potential candidates. However, very few IT professionals believed certification correlated to ability and that it certainly did not justify a hire nor did it confirm ability (Cegielski, 2004).

Another study conducted by Cegielski et al. (2003) found that end-users of LANs administered by certified network professionals did not have better awareness of the network than end-users of LANs administered by non-certified network professionals. In this study it was found that certifications should not be the basis for hiring or compensation, as it is not the most appropriate designation for competence.

After completing an in-depth look at IT industry certifications it is important to investigate where IT certifications has been considered in academia.

2.2.9 Review of Studies Considering Certification Integration

There is limited literature surrounding IT industry certification and its relevance in academia (Hitchcock, 2005). However, the following are documented examples where certifications have been considered to some degree in higher education.

International College in Florida have integrated certification into their Computer Information Technology curricula (Nelson & Rice, 2001). The approach adopted was to identify individual courses, or a sequence of courses, which would support certification with minimal modifications to the existing curricula. Microsoft Office User Specialist (MOUS), CompTIA's A+, Cisco's CCNA and Microsoft's MCSE are some of the certifications that International College integrated into their curriculum.

Numerous other colleges offer credit for industry certifications. For instance, the Project Management Institute's PMP certification carries credit towards Master degree programmes at the University of Wisconsin at Platteville, Aspen University, and Thomas Edison State College. Excelsior College, New York, will similarly accept certifications from various providers such as Microsoft, CompTIA and Cisco Systems towards degree credit requirements. Other examples also exist of certification integration and training in academia (cf. Freeman & Aspray, 2000; Mullane, 2000).

The Maths, Computer Science and Statistics department in Bloomsburg University Pennsylvania are refining their network and database curricula to assist students to obtain certification while working towards their bachelor's degree. As a result of the needs of employers, their objective was to "prepare our graduates with the appropriate depth of material and experience to meet overall job requirements along with the breadth of education that is a hallmark of a collegiate degree" (Montante & Khan, 2001, p.373). Funding was provided by the Commonwealth of Pennsylvania to assist this change.

Some organisations like IBM, through their Scholars Program, encourage Higher Educational Institutes (HEIs) to integrate their technologies by offering assistance in the form of skills transfer at instructor level and course material free of charge. Classroom and lab software is also free and they offer discounts to students and instructors certification fees. Candidates who successfully obtain the certification through the Scholars Program will be eligible to post their resume to a database where IBM business partners have access, giving students international exposure (Shore, 2003).

2.2.10 Implications for this Research

Although there is a lot of commercial literature discussing the value, benefits and drawbacks of IT Industry certification, there is little published on certification and its place in academia Mason, 2003). One of the main scholarly articles is written by research analyst Clifford Adelman, who hypothesises that certifications are part of a "parallel universe" and that they are a result of the creation of a global "Information Technology Guild" (Adelman, 2000b). Adelman's research has serious implications for "traditional" computing education including competition from third party training centres and a paucity of computer science students. Therefore academia must address this growing concern.

There is some evidence to suggest that employers prefer graduates who have a mix of backgrounds including education, certification and experience (Nelson & Rice, 2001; Warner, 2006). Familiarity with all three areas will highlight to employers that potential candidates have a range of knowledge, skills and practice required to perform competently (cf. Shimonski, 2003). Keeping the educational curricula current with industry is vital to the Information Technology labour market (Montante & Khan, 2001).

HEIs educate students on a broad range of topics and do not like to focus on specific vendor's products. Employers require graduates with knowledge and skills relevant to specific products so that they can be immediately effective in industry. Students endeavour to have the relevant knowledge and skills required for employment post-graduation (Wunder, 2006). It is believed that a balance between industry and academia can be achieved (Ortiz, 2003).

This section has highlighted both common and disparate interests that commerce and academia have in relation to IT industry certification. It is important for this study to investigate the apparent dichotomy between the real world and the world of academia in relation to certification training. The next section will examine education in more detail with particular emphasis on certification training and testing in Higher education and the potential issues and concerns that may arise with certification integration.

SECTION TWO: EDUCATION

2.3 Introduction

The unprecedented rate of change in Information Technology (IT) over the last few decades has highlighted the IT skills shortage that exists within the IT industry (Bailey & Stefaniak, 2001; Benamati & Lederer, 2000). Employers are continually searching for skilled professionals to meet their growing needs and this has a direct impact on Higher Educational Institutes (HEIs). There is a widespread view within the IT industry, that HEIs are somewhat responsible for these shortcomings. It is thought that graduates who enter the workplace, do not have the knowledge and skills required to perform competently (Moe & Sein, 2001; Pham, 1997). The IT industry is looking towards HEIs to directly address this turbulent situation and urge HEIs to provide graduates with the necessary skills for employment and advancement when they enter the workforce (Davis, 1989; Nabi & Bagley, 1998). Skilbeck (2001) highlighted some common attributes that IT graduates should posses when entering the workforce. These skills include flexibility and adaptability, problem-solving, analytical skills, creativity and initiative and communication skills. Skilbeck also notes that employer's satisfaction surveys indicate the value placed on these skills.

The continuous rate of change in Information Technology (IT) is also creating major obstacles for HEIs. Students potentially graduate Higher Education (HE) with obsolete or irrelevant skills (Maj et al., 2001). Faculty have additional workloads in modifying out of date teaching materials. Resources such as hardware and software, necessary to teach current technologies, are not available to the HEIs (Dorris, 2000). It is important that industry and academia work together in order to bridge the 'skills gap' in the constant changing IT environment. Industry involvement could help identify current technologies and skills that are required of graduates when entering the workplace (Courte & Bishop-Clark, 2005; Dorris, 2000; Heiat et al., 1995; Sumner, 2001).

2.3.1 The IT Profession

Due to the integral function of IT in business today, there is a duty of all IT practitioners to be responsible for the development of systems and their impact on society and others. According to Little et al., (1999) this raises concerns about the competency and education of IT practitioners, and indeed, their level of professionalism. There is considerable pressure for professionalism in all areas of IT, in the hope to establish generic competencies for IT practitioners worldwide (Shaw, 2000). Educators are required to respond efficiently and effectively to the growth of the IT profession, as they are responsible for preparing all IT professionals for the workforce (Kovacs et al., 2005).

IT industry certifications have been used to establish professionalism and competence in certain aspects of IT. There is a range of IT professional certification programs currently offered by industry organisations (Hitchcock, 2005; Neveda & Seidman, 2005; Tripp, 2002). Having briefly addressed the IT profession the next section endeavours to explore what constitutes as an IT professional.

2.3.2 The IT Professional

According to Werth (1998) certification (voluntary process) and licensing (mandatory process) are the primary ways to demonstrate that an individual is qualified as a professional. Professionals are people who show a personal commitment and take pride in their work. They follow a professional-development path of education, accreditation, skills development, certification, licensing, a code of ethics and professional standards (Tripp, 2002). According to Maister (1997) professional individuals are those who are considered competent in all areas of their profession and are extremely respected and deemed trustworthy.

There is much literature on what constitutes a competent individual. Competent individuals must be able to transform what they know and can do to enhance their performance outside of formal learning situations (Down et al., 1999). Competence includes the knowledge, understanding and skills which underpin performance (ECUK, 2005). Competencies describe traits that an individual should posses in order to carry out their work in a professional manner (Strebler et al., 1997). IT professionals require a number of basic competencies including up-to-date technical skills, commercial awareness, technical understanding, and strong interpersonal skills. Some argue that Information Technology workers should not be called professionals (Orlikowski & Baroudi, 1989). However, this study aligns with the dominant stance in the literature that IT workers are professionals.

2.3.3 Professional Certification

Professional certification demonstrates that individuals have mastered the appropriate knowledge, skills and abilities that are required to competently perform a specific job. Certifications are awarded by professional bodies who attest to an individual's competence in the related discipline and their adherence to standards (Neveda & Seidman, 2005). Professional certification is a voluntary process and is not required by law. There are many certifications offered by the IT industry, but only professional certifications allow post-nominal letters to be used. Some certifications may be perpetual others may need to be renewed periodically but it is common that all certification bodies will require evidence of continuing education and professional development.

A US-based organisation, the National Organisation for Competency Assurance (NOCA), provides information to certification bodies regarding the latest trends and issues of interest to organisations and practitioners in relation to certifications. There are many certification bodies connected with the Association of Test Publishers (ATP). Two major professional organisations involved with computing and software development, the IEEE (Institute for Electrical and Electronic Engineers) and the ACM (Association for Computing Machinery), encourage professional practice within computing curricula. They recommend that IT students at undergraduate level have a good understanding of professional practice as most of them will ultimately enter the workforce post graduation (Joint Task Force, 2001, p.59). The ACM/IEEE Joint task force believe that industry representatives are looking for graduates who are "job ready" and "students expect to practice computing in the work place upon graduation without significant additional training".

2.3.3.1 Competencies of the Chartered Engineer (CEng)

The term Chartered Engineer (CEng) is a UK professional certification of competence in engineering and is a benchmark set by the Engineering Council UK (ECUK), which is recognised worldwide as a trademark of quality (ECUK, 2005). To obtain the designation of CEng, the ECUK, Institute of Engineering and Technology (IET) requires demonstration of competence and commitment in five distinct areas known as "Roles and Responsibilities". Evidence of achievement in each of these areas is required to obtain and sustain membership. These roles and responsibilities used to present a framework for assessing the competency and commitment are outlined in Table 2.1.

TABLE 2.1: Roles and Responsibilities Framework

Competence	A	Knowledge and Understanding
	B	Application to Practice
	C	Leadership/Management/Supervision
	D	Interpersonal Skill
Commitment	E	Professional Conduct

Adapted: (ECUK, 2005)

Chartered Engineers must be competent in all aspects of their working lives including education, training and experience. Although it is not mandatory, the IET, for example, promotes and encourages continued professional development and requires demonstration of continuing competence. There are many benefits in obtaining the CEng designation, including professional recognition, personal and professional developments, greater employment opportunities and reward. According to the ECUK (2005, p.5), employers of registered CEng's "have the assurance of knowing that their employees have had their competence assessed, their credentials verified, and their commitment to continuing professional development established".

The competencies of the Chartered Engineer (CEng) are an exemplar model for Information Technology (IT). Potential candidates must apply through a recognised professional body, for example, the Institute of Engineering and Technology (IET) and the British Computer Society (BCS). They provide a route to chartered status, which undoubtedly represents the most prestigious level of membership. The IET and BCS are licensed by the Engineering Council to award Chartered Engineer status (CEng) and Incorporated Engineer status (IEng) to individuals that match the specified criteria (BCS, 2006). The Chartered Engineer designation in Ireland is similar to that in the UK and is administered by Engineers Ireland. Professionals who obtain the Chartered Engineer designation can use the CEng as post-nominal letters. Some CEng competencies cannot be taught, they have to be learned through experience. However an example of a CEng competency that can be taught is knowledge and understanding. The following section investigates the area of pedagogy and addresses theories and models for teaching and learning.

2.3.4 Pedagogy

As discussed in the previous section, CEng competencies are considered an excellent model for IT. In order to teach these types of competence in the computing curricula, it is imperative to address the area of teaching and learning. Both pedagogy and andragogy, which are sometimes used interchangeably, refer to the art and science of teaching (Knowles, 1984). For the purpose of this research, 'pedagogy' will be the term of reference.

2.3.4.1 Instructional Design Theory

Instructional Design (ID) theory is the discipline of how to teach (Reigeluth, 1999). It provides guidance to help people learn and develop. ID theories have several characteristics in common. These theories are 'design-oriented', which are extremely useful to educators as they focus on *how* to achieve specific goals for learning and development. ID theories also identify *methods* and *situations* of instruction. Methods of instruction detail ways to facilitate and support learning while situations highlight when the methods should be used. More detailed component methods can be derived from the methods of instruction which provide more direction to educators. Also, methods are defined as probabilistic meaning that chances are increased of instruction goals being achieved, opposed to ensuring they will be achieved (Reigeluth, 1999).

2.3.4.2 Learning Theory

In the context of education, learning theories attempt to describe how individuals learn. Two of the main paradigms of learning will be discussed in the section below.

<u>Objectivist Paradigm</u>

The objectivist paradigm has been recognised in the field of education for many years. Most of the traditional approaches to learning and teaching are based on assumptions that are fundamental in objectivism. Objectivists believe knowledge is objective and it exists independently and external to the learner. It does not consider that learners may have different backgrounds, abilities, cultures, and experiences (Mezirow, 1996). Objectivism is the traditional teacher-centred pedagogy, where the instructor is considered the expert and the primary source of knowledge. The learning process is where the instructor transfers the knowledge to the student and the method of instruction is usually direct in nature and is typified by the classroom lecture (Wulf, 2005). One example of instruction design which is based on the objectivist philosophy and behaviourist theory is Robert Gagné's "Nine

Events of Instruction" model, which is a set of instructions, if adhered to, will ultimately lead to learning. These instructions are outlined in Table 2.2.

TABLE 2.2: Nine Events of Instruction Model

1. Gain attention	Present problems to students to increase interest
2. Inform learner of objectives	Students must know what is expected for them
3. Stimulate recall of prior learning	Recall previously acquired, relevant knowledge
4. Present stimulus material	Emphasise relation to performance objective
5. Provide learner guidance	Using examples, case studies or analogies
6. Elicit performance	Practice new skill by carrying out task
7. Provide feedback	Specific and immediate feedback on performance
8. Assess performance	Formal assessment regarding students' performance
9. Enhance retention transfer	Task to ensure that learning is transferable

Source: (Gagné et al., 1992)

Gagné's work also involved applying theory of instruction to the design of computer based training and multimedia based learning. Although this method of instruction is extensively used and highly regarded, it's focus on process, which means that all learners are expected to learn in the same manner irrespective of their background and experiences (Vrasidas, 2000).

Constructivist Theory

Constructivism is a central theory of learning. Piaget's work was extremely influential in the development of this theory. Many researchers believe that learning is a dynamic processes in which students construct new ideas based upon their current and past knowledge and experiences (Bruner, 1966). Each student is considered to be an individual therefore; each student will construct a distinctive version of the knowledge which is imparted by the instructor because they are building on existing experiences and knowledge.

The constructivism theory suggests that students learn better through exploration and active learning as opposed to memorising information from textbooks and lecturers. They construction of mental models assists in the process of effective learning (Ben-Ari, 2001).

Learners use their cognitive structure to understand and further develop the information given. Instructors ideally present information in a context that the learner's understands, and both should continually engage in active dialog. Learning is recursive, that is, the construction of new knowledge builds on pre-existing information the student already has and therefore the curricula should be organised to facilitate this. Some consider teaching methods arising from this theory to be more successful than more traditional methods. Constructivism is a student-centred pedagogy and is often collaborative in nature (Wulf, 2005). Unlike traditional approaches adopted in higher education, where the instructor communicated the materials to the class, student-centred learning shifts the responsibility to the student. The instructor takes on the role as a facilitator, mentor or coach where they observe the learners work and provides feedback (Wilson, 1996). Techniques like active learning, assigning open ended problems and problems that require critical skills, self paced and cooperative learning are being adopted. Changing to student-centred learning is not immediate or automatic (Felder, 1996).

There is much support for the move from teacher-centred approach to a learner-centred approach where the teacher is no longer the expert and the student is no longer the passive recipient of knowledge (Jonassen et al., 1995). They view the web and other technologies to be paramount to facilitate this move in instructional style. The resource learning theory, which is a change form traditional learning, identifies the instructor as a resource to the learner, where the learner has a multitude of resources available to them. A summary of the differences between traditional and resource-based learning is provided by Rakes in Table 2.3.

TABLE 2.3: Traditional versus Resource-based Learning

Traditional learning	**Resource based**
Teacher as export model	Teacher as facilitator/guide
Textbook as primary source	Variety of source/media
Facts as primary	Questions as primary
Information is packaged	Information is discovered
Emphasis on product	Emphasis on process
Assessment is quantitative	Assessment is qualitative/quantitative

Source: (Rakes, 1996)

Action learning – a form of constructivism - is another learning theory that transfers the responsibility of learning from the instructor to the student. Its main objective is to place emphasis on the action through 'doing' and experience. Learning is not just acquiring facts, it is an active role played by the student to determine what they need to know to perform competently (cf. Burns & Janicki, 2003).

The cognitive apprenticeship, which is a form of constructivism, models the process of an apprentice in a craft or trade school where the individual can master the subject area. This method focuses a great deal on active learning and is ideal for the emerging computing curricula. Students learn in an environment similar to that of industry and are measured by the goal of a degree program (Wulf, 2005).

Bloom's Taxonomy

Bloom's 'Taxonomy of Learning Domains' or 'Taxonomy of Educational Objectives' was created by Benjamin Bloom, an American academic and educational expert together with a group of educational psychologists in 1956 (Bloom, 1956). This taxonomy was one of the first codifications of the learning process. They identified three domains of learning behaviour, namely cognitive, affective and psychomotor (Krathwohl et al., 1964). These are often referred to as knowledge, attitude and skills respectively. Each of the three domains has several levels, or degrees of difficulties associated with them. An important principle of Bloom's Taxonomy is that each level must be mastered before continuing onto the next level.

Cognitive domain revolves around knowledge and the development of intellectual skills. The affective domain focuses on the manner in which individuals deal with things emotionally such as feelings, values, emotions and attitudes. The Psychomotor domain focuses on change and development in behaviour and skills. Originally, Bloom's Taxonomy did not detail levels for this domain, however, many researchers have since investigated this further (Dave, 1975; Harrow, 1972; Simpson, 1972).

Bloom's Taxonomy has been discussed and expanded over many years (Anderson & Krathwohl, 2001; Anderson & Sosniak, 1994). It continues to be useful and relevant in the planning and design of university education. It remains the most widely used model in education due to its effectiveness in the application of learning objectives, the measurement of learning outcomes and teaching and training methods.

Instructional design has evolved over the last few decades and it integrates the strengths of various learning theories (Coverstone, 2003). Some research suggests that there is no single theory to best fit instructional designs but it depends on the context of the learner group. According to Ertmer and Newby (1993), "a behavioural approach can effectively facilitate mastery of the content of a profession (knowing what); cognitive strategies are useful in teaching problem solving tactics where defined facts and rules are applied in unfamiliar situations (knowing how); and constructivists strategies are especially suited to dealing with ill-defined problems through reflection-in-action". Although there is much debate surrounding learning theories, both objectivism and constructivism are still widely used today.

2.3.4.3 Learning Styles

Learning styles are different approaches or ways individuals prefer to learn. Currently the most common approach to education is the delivery of standard material by an instructor in the classroom environment. Students have a variety of learning styles therefore no one instructional approach can be optimal for everyone (Claxton & Murrell, 1987). There is a view that instructional design should be multi-modal (visual, auditory, etc.) in order to facilitate each learner's preferences (Wulf, 2005). Blended learning enables students to learn using a combination of multiple approaches. Self-paced, collaborative or inquiry-based studies are some forms of these approaches. This can be achieved through the use of 'blended' virtual or physical resources like traditional printed materials and technology based materials. There are many learning style models available, which provide comprehensive taxonomy of learning and teaching styles, including David Kolb's

Experiential Learning Theory (Kolb, 1984) and Felder and Silverman's Learning and Teaching Styles (Felder & Silverman, 1988).

2.3.5 Traditional versus Vocational Education

Higher Education Institutions (hereafter known as HEIs) award degrees, for example BSc, MSc or PhD as formal recognition that a student has successfully completed an approved study plan. The quality of this type programmes is measured by two factors; reputation and accreditation (Bishop & Frincke, 2004). The value of the degree coincides with the reputation of the institute that the degree is obtained from. Therefore the higher the reputation of the institute, the more favourable the degree is sought after. Programmes that are accredited are thoroughly reviewed every few years in order to determine adherence to the accrediting bodies' standards. Accreditation ensures quality assurance and reliability that all the major principles are incorporated into the program. The Accreditation Board for Engineering and Technology (ABET) and its participating body, the Computer Science Accreditation Boards are examples of these accrediting bodies within computing, information systems and software engineering.

Traditionally, Higher Education (HE) is education provided by Universities, Institutes of Technology (IoTs) and other institutes that award academic degrees at post-secondary or third level education. Their emphasis is on theoretical education. Teaching and research are the predominant activities offered by HE that emphasise undergraduate and postgraduate degree programmes. Vocational Education (or Vocational Education and Training (VET) prepares students for practical employment relating to a specific trade, occupation or vocation. Often referred to as technical training, students develop expertise with specific techniques or technologies. Vocational education is accessible at secondary and post-secondary level. It is usually provided through vocational institutes of technology and community colleges. These institutes recognise prior learning and allow academic credit for continuing education into tertiary education. However, vocational education is usually not independently recognised as a form of higher education. Differences between vocational education and traditional education are often highlighted. The major argument is that while VETs offer training for employment, traditional education prepare their students in theory and abstract conceptual thinking, which is very much characterised by tertiary education.

2.3.6 Curriculum, Accreditation and Assessment

A curriculum is "a plan for educating students, providing them with the knowledge and skills needed both for living and competently practicing a profession. *The curriculum must anticipate the shifting world in which graduates will live and work*" (Denning, 1992, p.88). Research has long suggested that IT curricula should be flexible enough to keep up with industry developments and that it should have a strong focus on practical work (Freeman et al., 1976). Computing faculties in Higher Education continually face the challenge of keeping the curriculum up to date with the rapid technological changes in industry (Lee et al., 2002). As a discipline, computing education has grown to encompass a large array of sub-disciplines within the computing field. The ACM and the IEEE joined forces to provide guidance for all computer related fields and introduced the broad term 'computing' to cater for all aspects of computing discipline. They published a set of computing guidelines, Computing Curriculum 2001, that can be applied to all computing programs (Steelman, 2001).

Pressure for change has become a constant in Higher Education (Gruba et al., 2004). Henkel and Kogan (1999), define the curriculum in terms of programs that are designed to satisfy "academic" objectives which lead to "individualistic" curriculum. Programs designed for "vocational" objectives lead to a "directed" curriculum. Individualistic curriculum is based on a broad combination of subjects, choices for students and staff and little emphasis or concern on vocational or practical skills. Directed curriculum has strong emphasis on course design, consistency and employment objectives. There is less flexibility for teachers with the directed curriculum.

Accreditation is a quality assurance mechanism that is adopted by higher educational institutes to measure 'fitness for purpose'. Accreditation bodies requires institutes to specify the skills or outcome that students are expected to achieve by graduation. The assessment measures individual performance that test if skills or outcomes have been achieved (Aasheim & Gowan, 2007; Longenecker & Feinstein, 2005).

2.3.7 Irish Tertiary Education

Ireland's tertiary education system is diverse and incorporates the university sector, the technological sector, the colleges of education, private independent colleges and NUI College. Universities, Institutes of Technology (IoTs) and colleges of education are funded considerably by the state, are autonomous and self-governing. The Higher Education and Training Awards Council (HETAC) confers awards and sets and monitors standards throughout third level education and training institutions, excluding the university sector. Through delegated authority from HETAC, some IoTs are authorised to confer their own awards. Irish educational awards recognised by HETAC and authorised institutions are renowned globally. The National Framework for Qualifications (NFE) includes all recognised Irish awards and it is maintained by the National Qualifications Authority of Ireland (NQAI). The framework, which is comprised of ten levels, is designed to meet the needs of all learners. It incorporates all types of awards from all types of learning environments including schools, employment, training centres and universities. It supports the national objective of progressing towards a "lifelong learning society" (NQAI, 2007). As the learner is at the centre of the framework it promotes and recognises prior leaning.

Eleven of the fourteen Institutes of Technology (IoTs) in Ireland were formerly Regional Technical Colleges (RTCs). They were upgraded to IoTs between 1997 and 1998. With the exception of Dublin Institute of Technology (DIT) which validates its own programmes, all other Institutes are validated by HETAC. The IoTs offer programmes from certificate level right through to postgraduate degrees in a variety of disciplines. Many programmes within IoTs have strong emphasis on vocational and applied education schools such as science, engineering and technology and business. Some IoTs have also developed programmes in areas such humanities and languages, healthcare, art and design and tourism.

2.3.8 Implications for this Research

This section has considered the rapidly changing IT industry (Jaffee, 1998). It has also examined the IT profession and professional and the need for highly competent graduates was noted. The IT industry is looking towards higher education to address this situation and to provide students with the skills necessary to perform competently in the workplace. Pedagogy, competencies, the different types of learning theories, styles and instructional designs have all been examined. Findings show that computing students have many different learning styles and backgrounds and faculty should design their course material and practical works that will appeal to all learners (Trucker, 1996). Twigg (1994) argues that there is a need to create new ways of delivering higher education in order to overcome the shortcomings of the current one-size-fits-all approach to teaching. Therefore it is evident that the IT industry are looking towards HEIs to address the skills gap and make the relevant changes to produce competent, highly skilled and knowledgeable graduates for industry. The next section will examine the process of change in an educational context.

SECTION THREE: CHANGE

2.4 Introduction

Employers seek IT workers who possess a combination of specific technical skills, industry knowledge, education and experience. It is considered that traditional computing education is not providing quality graduates with the appropriate skills that meet employers' needs (Shaw, 2000). The difference between what Higher Education is teaching IT students and what industry requires of IS graduates is known as the "expectation gap" (Al-Imamy & Farhat, 2005; Cappel, 2002; Evans, 2003; Trauth et al., 1993). Often organisations are required to retrain graduates, as they do not possess the current skills that are required by industry.

It is important for higher education and industry to collaborate in preparing students for careers in the IT industry (Evans, 2003). Academic preparation of future IT professionals requires industry involvement. Lee et al. (1995) found the IT curricula to be "ill-matched" with business needs. This study also highlighted that generic curricula for all IT professionals had become outdated, and efforts should be made to tailor the curricula for different IT careers. According to Heiat et al. (1995) change is one of the few constants in technology; and therefore business and academic connections must be revisited often.

The IT profession, unlike many other professions, has undergone significant changes over the past decades (Benamati & Lederer, 1998; Lee et al., 1995). Unprecedented growth and pace of change within the IT industry has had a direct impact on Higher Educational Institutes and their ability to reflect those changes within their curricula. This section will consider the process of change in an educational context. It will investigate if HEIs could adapt or change in order to integrate IT industry certification into the curricula in an effort to address this situation.

2.4.1 Educational Change

Change is extremely prevalent in the education sector (Conner, 1992). It is influenced by many factors including globalisation and improving the quality of the learning experience for students. The effective management of change is essential for the success of education reform. Educators can be certain that "today there is more change to contend with than ever before. The volume, momentum, and complexity of change is accelerating at an increasing rate" (Conner, 1992, p.38). The growing technology industry has had a major impact on educators. "Teaching has become incredibly more complex over the past few years. Breadth of teachers' classroom repertoires is expanding because of the developments in the science of teaching, the spread of information technologies, and the challenge of adapting instruction to the needs and learning styles of students…" (Hargreaves & Fullan, 1992, p.50).

The role of HEIs is to build a competent workforce. Although some improvements have been made, graduates often leave tertiary education ill-equipped to meet employers' requirements or needs (Gregory, 1996). Teaching staff often deliver the same material for long periods of time and subsequently course content becomes irrelevant and obsolete (Gruba et al., 2004). Therefore, it is worthwhile to question if this suggests a requirement for change in HEIs.

2.4.2 The Change Process

There are many theories and models that help to manage change within an organisation (Ely, 1990; Fullan & Steigelbauer, 1991; Hall & Hord, 1987, Reigeluth & Garfinkle, 1994; Zaltman & Duncan, 1977). Some factors including people, processes and culture can play an important role in the process of change. Change is assisted when participants are open and motivated to become agents of change (Ringel, 2000). According to Schein (2002) there are three types of change. These are natural evolutionary changes, planned and managed changes and unplanned revolutionary changes.

Change represents a transition that occurs when something goes from being the same to being different. Change requires people to adapt, it may happen slowly through gradually modifications of the mindset or suddenly through revolutions. Kurt Lewin, a social psychologist and a pioneer of organisational change, described the change process in three basic steps: unfreezing, movement and refreezing. Conner (1992) adopted this theory to illustrate the effects of change on individuals. He classified the change process into three phases: the present state (the status-quo), the transition state (change process) and the desired state. Unfreezing occurs at the present state. At this stage it is important to create motivation and readiness for change. The movement stage involves taking action. The transition state is often referred to as a state of limbo, where "the equilibrium of the present state has been disrupted, but the stability of the desired state is yet to be attained" (Conner, 1992, p.88). This stage can cause individuals to lose a sense of control, discomfort and uncertainty. Refreezing is the process where the change is implemented and the desired state is achieved. According to Schein (2002, p.36), "no change will occur unless a system is unfrozen and no change will last unless the system is refrozen". The stages of change according to Schein are outlined in Table 2.4.

TABLE 2.4: Stages of the Change Process Source

Stage 1	Unfreezing: Creating the motivation to change
Stage 2	Changing: Learning new concepts, new meanings, and new standards
Stage 3	Refreezing: Internalizing new concepts, meanings, and standards

Adapted: (Schein, 2002)

2.4.3 Curriculum Change

Gruba et al. (2004) conducted a study within their institute and identified ten factors influencing curriculum change to the computing discipline. The ten factors are listed in Table 2.5.

TABLE 2.5: Ten Factors Influencing Curriculum Change

1. Influential or outspoken individuals
2. Financial pressures, including resource availability
3. Staff availability and workload
4. Employer or industry viewpoints
5. Current or prospective student viewpoints
6. Student abilities or limitations, or intake considerations
7. Pedagogical argument, or academic merit
8. University or government requirement or regulation
9. Professional accreditation needs, or syllabi set by professional bodies
10. Academic "fashion", including the desire to remain in step with other institutions

Source: (Gruba et al., 2004)

Gruba found that the main drivers to curriculum change within the computing discipline were individuals, politics and fashion, while factors such as academic merit and external curricula impacted less.

Some research suggests that within HEIs, curriculum change is implemented gradually "without a deep understanding about what collegiate learning really means and the specific circumstances and strategies that are likely to promote it" (Ewell, 1997, p.3). Lachiver and Tardiff (2002), identify a logical five-step process to manage curriculum change. The steps are:

1. An analysis of the current offerings and context
2. The expression of key program aims in a mission statement
3. A prioritisation of resources and development strategies
4. The implementation of the targeted curricula change and
5. The establishment of monitoring tools and processes

However, Gruba et al. (2004) suggests that the process of implementing curriculum change is not as uncomplicated as this ideal.

There are many issues that are common to the curriculum debate, including maintenance of academic standards, academic versus vocational values, the development of transferable skills and the effective use of courses (Henkel & Kogan, 1999). In major institutional change the focus is on the transition of a subject-based, knowledge-centred teaching approach to a student-based, competence-centred, learning approach where the instructor's role is one of a facilitator as opposed to a transmitter of knowledge (Gruba et al., 2004). According to Becher and Barnett (1999), older universities are slower to change and adopt new approaches than the post-war universities and polytechnics.

2.4.4 Resistance to Change

Resistance to change is a natural reaction taken by people who perceive change to be a threat to them. The more profound the change, the more resistance will occur (Van Schoor, 2003). Conner (1992, p.125) suggests that "resistance is natural part of the change process; it is the force that opposes any significant shift in the status quo".

Resistance is process-oriented, where individuals first deny it, then resist it and finally commit to the change (Bovey & Hede, 2001). According to Van Schoor (2003) one reason why individuals resist change is due to the loss of "mastery", where the change has such an impact on a person's job that new skills have to be learned in order to perform competently in their role. Trader-Leigh (2002) identified more specific factors that contribute to the resistance of change. These factors are: self-interest, psychological impact, tyranny of custom, the redistributive factor, the destabilisation effect, culture incompatibility and the political effect.

There are many reasons why people resist change. Schuler (2003) identified 10 reasons individuals have for resisting change. These reasons are outlined in Table 2.6.

TABLE 2.6: Reasons People Resist Change

1. The risk of change is seen as greater than the risk of standing still
2. People feel connected to other people who are identified with the old way
3. People have no role models for the new activity
4. People fear that they lack the competence to change
5. People feel overloaded and overwhelmed
6. People have a healthy scepticism and want to be sure new ideas are sound
7. People fear hidden agendas among would-be reformers
8. People feel the proposed change threatens their notions of themselves
9. People feel a loss of status or quality of life
10. People genuinely believe that the proposed change is a bad idea

Source: (Schuler, 2003)

Change can be resisted overtly and covertly. Overt resistance is easier to handle and resolve as it is out in the open and it can be adequately addressed. Covert resistance is often hidden and can go unnoticed until it is too late and has damaged the change process. Low trust and inadequate participation can be the route of this type of resistance. Conner (1992, p.xii-xiii) suggests that "understanding and respecting the natural patterns of resistance" will help to overcome individual's resistance to change.

Conner also suggests that if organisations understand, account for, interpret, and encourage openness to the resistance of change, then they will be better able to deal mange it. It is important to note that while there are obvious resistance to change emerging from the literature there is also the presence of resilience. Conner (1992, p.6) asserts "the single most important factor to managing change successfully is the degree to which people demonstrate *resilience*: the capacity to absorb high levels of change while displaying minimal dysfunctional behaviour". These individuals welcome change seeing it as both a challenge and an opportunity. The change process requires individuals that are willing, able and believe in the change, if the process is going to succeed.

2.4.5 Sociotechnical Systems

A Sociotechnical system is an approach to complex systems development that recognises the interaction between people and technology in the workplace. It is considered that different individuals and groups have their own needs, values and interests and that these must be addressed appropriately in order for change to be willingly accepted by individuals. Therefore the design of human work systems must closely fit with any technical system to ensure employee job satisfaction as well as a high level of technical efficiency. The following section will briefly outline three major sociotechnical system approaches that could be considered relevant for the analysis and implementation of change in complex human activity systems.

2.4.5.1 ETHICS

Effective Technical and Human Implementation of Computer-based Systems (ETHICS), developed by Enid Mumford, is a systems design methodology based on the participative approach to information systems development (Mumford, 1983). The main premise of ETHICS is that, users at all organisational levels who participate in the design of information systems will achieve greater job satisfaction, increased productivity and improved quality of working life.

The ETHICS method views the development of a computer-based system as a change process, and in order for technology to be successful it should fit closely with the organisational and social factors. ETHICS enables those involved in the design of a new system to consider both the human and technical elements of that system. The ETHICS methodology is comprised of seven distinct stages, namely; diagnosis of business and social needs, setting efficiency and human objectives, developing alternative design strategies, selecting a strategy to achieve objectives, design, implementation and evaluation (Mumford, 1983).

2.4.5.2 Multiview

Multiview, also know as Multiview1, is an Information Systems Development (ISD) methodology that encompasses human, social and organisational elements as well as Information Technology (IT). Multiview1 equally considers those individuals who develop the system and the users who will ultimately use the system. It is considered a contingency approach as it is adapted to particular problem situations, work environments and the specific skills of the analysts. There are five distinct stages of Multiview1, namely, analysis of human activity, analysis of information, analysis and design of socio-technical aspects, design of human-computer interface, and the design of technical aspects. According to Avison and Wood-Harper (1990) the five stages "move from the general to the specific, from the conceptual to hard fact, and from issue to task" (p. 34).

Multiview which has been used in several action research projects has since been revised and redefined as Multiview2 to make provisions for changes in the methodology. Although Multiview2 encompasses many of the original themes of Multiview1 the scope has been extended to include software development, implementation and production operation (Avison, et. al, 1998). The aim of this is to incorporate all aspects of the process of building, implementing, and maintaining an information system as a whole. The interpretive scheme of the Multiview2 methodology, which is used when developing and implementing information systems within an organisation, consists of four components, namely, organisational analysis, information systems modeling, sociotechnical analysis, and software development. Organisational analysis is concerned with understanding the organisational needs for which the information system will support. Information system modeling is the process of technically representing the information system using object-oriented analysis and business process modeling. Sociotechnical analysis counter balances the IS activity using elements of methodologies such as ETHICS and ethnography. Software development component includes the design and development of internal and external software, hardware and communications technologies for the information system.

An integral part of Multiview2 is the notion of mediation and the temporary separation of social and technical elements to obtain a better understanding of the particular situation. Multiveiw is described by Iivari (2000) as a "methodology that explicitly attempts to reconcile ideas from several information systems development approaches, most notably the Soft Systems Methodology" (p. 199).

2.4.5.3 Soft Systems Methodology

Soft Systems Methodology (SSM) was developed by Peter Checkland (Checkland, 1980, Checkland & Scholes, 1990). SSM originated through the understanding that applying "hard" systems thinking was inadequate for the purpose of dealing with large, complex mainly human-centred systems. SSM is a method for dealing with real world human or social, cultural and political problem situations. It gives unstructured and complex human-centred problem situations some structure so that they can be dealt with in an organised manner. Due to the complexity of some human-centred systems, SSM with its specific techniques provides the rigour to deal with these sometimes "messy" issues. SSM is based on systems thinking which enables less well-defined problem situations to be defined to represent the complex situation where there is conflicting opinions about the problem situation. It can be used for generic problem solving or in the management of change.

SSM has evolved over time moving from the seven-stage model to the four-activities model. This has allowed for a more flexible use of the methodology (Checkland, 1999). The four activities set out by Checkland are; investigating the problem situation including the cultural and political aspects, create appropriate purposeful activity models, identifying the changes that would be desirable and feasible to improve the situation and also the accommodation of conflicting interests, and taking action in the situation to assist improvement.

2.4.6 Implications for this Research

Jaffee (1998) recognises that teaching staff are the central agents of change in HEI as they ultimately approve and accept the transformation process. The rate of change in Information Technology is growing at an alarming rate and this is affecting educational delivery methods (Benamati et al., 1997). Emphasis for educators to respond to these changes has been evident throughout the literature. Research has shown that considerable attention has been given to training students in this rapid changing environment. This has a direct impact on the computing curricula. For some time re-evaluation of course topics and pedagogic approaches has been evident with the computing curricula (Trucker, 1996). These curricula become quickly out-of-date in this changing environment, therefore it is important to identify new course content as well as obsolete topics. Educators must remain current in order to keep their knowledge and skills updated. Trucker (1996, p.839) noted that "institutions give insufficient consideration to the needs of industry which employs most of the graduates" in computing discipline. It is thought that courses should be aware of industry advances and consider them while maintaining their "sound pedagogical practices". Jaffee (1998, p.23) notes "that obstacles to change are closely associated with the established practices and cultural traditions of teaching staff". These need to be understood in order to effectively implement change.

The following section provides a brief description of some case studies where IT industry certification has been integrated in various modes into HEIs internationally.

SECTION FOUR: CERTIFICATION INTEGRATION CASE STUDIES

2.5 Introduction

There are many examples where IT industry certification is being offered at undergraduate level within traditional tertiary education (Ortiz, 2003). Although Section 2.2.9 discusses this briefly, this section outlines it in more detail. The modes of integration vary according to each institute. White (2006) suggests that many courses within the IT curricula can be mapped with IT industry certifications. This will better aid graduates entering the marketplace and align industry and academia together. The following section details some example of how IT industry certifications have been integrated into HEIs internationally.

2.5.1 Case Studies

Example One

Charles Stuart University, the largest provider of distance education in Australia, integrated IT industry certification with its traditional university courses with "outstanding academic and commercial success" (Messing & Atlas, 2006, p.30). They attribute their success to the flexible delivery of distance education, well-established university infrastructure, online examinations, extensive ICT experience and support from commercial IT training organisation. They believe that the success will resolve some of the ongoing difficulties surrounding obsolete courses and their relevancy to the IT industry. Certification integration into higher education is evidence that university education and IT certification need not be parallel universes.

Example Two

Victoria University (VU) in Australia has implemented several IT certifications in various modes including course mapping and curriculum inclusive, in a bid to connect university schools with industry requirements (Jovanovic et al., 2005). VU, which are members of the SAP University alliance, linked their existing course content with SAP accredited programs. On completion of the course, students receive SAP industry accreditation. The Information Technology Infrastructure Library (ITIL) certification incorporates all areas of service support and service delivery. An alliance has been formed between the school of Information Systems within VU and a private ITIL training provider. VU receive a 50% discount on the e-learning training. The exam is not subsidised as it is out of the control of the university. Participation is optional and does not effect a student's assessment in the subject. VU have also incorporated CompTIA i-Net+ into their Electronic Commerce Technologies subject where i-Net+ section is implemented in workshops. Students are encouraged to sit i-Net+ certification exams at the end of the course. Students can obtain this certification at a significantly lower price because VU have obtained the educational CompTIA membership.

Example Three

Edith Cowan University (ECU), developed a new course in the field of computer and network technology. The drive to provide industry with the relevant graduate skills required a new course with the appropriate level of technical depth and considerable practical elements with "real equipment" (Maj et al., 2001).

Schlichting & Mason (2005), propose that implementing free-standing certifications could cause some problems. However aligning certification with existing courses, for example, Oracle OCP with databases and MCSE with the existing networking classes, accreditation problems would be minimal. However, Koziniec & Dixon (2002), argue that aligning certification with existing courses is not an easy task. To ensure consistency certification programs require HEIs to deliver an entire course in sequence. Students expect to sit the certification exam and it is rare for curriculum to include material that is not going to be examined.

Example Four

One example of popular vendor-specific training offered by higher education is the Cisco Network Academy. They provide curriculum material and resources to enable the students to become competent with networking issues. Both teachers and students have access to web-based content, online assessment, the ability to track performance and hands on lab experience.

Example Five

Some attempts have been made to develop the IS curricula based on the IS2002 model and ABET requirements with the inclusion of IT certification. One proposed model provides a framework to integrate IT certification at various levels in the IS curricula (Al-Rawi et al., 2005). Al-Rawi et al. identified four areas of the IT curricula that would support IT certification, namely personal productivity tools, networking, programming and problem solving and hardware and software. The corresponding certifications were identified for these particular areas. These certifications are MS MOUS or ECDL, CompTIA Network+, Cisco CCNA, CompTIA A+ and Sun Certified Programmer for Java 2 platform. The purpose of the model is to achieve industry certification while achieving the course objectives. This will inevitably have a positive effect for graduates, academia and industry alike.

The case studies highlighted above have been presented to illustrate the different modes of certification integration adopted by HEIs internationally. The literature discussed hitherto has highlighted many issues involved with IT industry certification, education and change in general. It is necessary at this point to address the implications of these areas which are explicit to this research. The next section will examine the issues and implications of IT industry certification and how it relates to academia.

SECTION FIVE: ISSUES AND IMPLICATIONS FOR THIS RESEARCH

2.6 Introduction

This literature review so far has considered IT industry certification, education and change separately, and has illustrated examples of different modes of certification integration in HEIs internationally. The focus of this study requires all of these aspects to be addressed collectively. Therefore it is important at this stage to bring the previous discourse together in order to address some of the issues concerning the integration of IT industry certification into academia

2.6.1 IT Education, Industry and Certification: A Synopsis of Emerging Trends

The gap between the supply and demand of competent and skilled IT professionals is on the increase (Moe & Sein, 2001). A common perception within the IT industry is that Higher Education is not preparing skilled graduates for the workforce and are finding it hard to keep abreast with this unprecedented growth (Duggins & Thomas, 2002; Lee et al., 1995; Schlichting & Mason, 2004).

Certification already exists in academia in the form of degrees (Schlichting & Mason, 2004). According to Mason (2003) universities adapt to their environment. For example, institutions that offer accounting degrees usually place emphasis on taxation. Computer Science departments offer degrees with business and scientific emphasis, therefore Mason asks "why not 'network emphasis' (for MCSEs) or 'database emphasis' (for Oracle DBAs)" which could lead to both degree and industry certification? Vendor-neutral certifications are considered more relevant to higher education as they deal with more generic knowledge and skills (Montante &Khan, 2001).

As of January 2000, 2.4 million IT certifications have been awarded worldwide (Adelman, 2000a). Adelman conducted a study of nearly 4000 job postings in US newspapers and concluded that IT certifications were as important as university degrees for careers in the IT industry. He described the rise of IT industry certification as a "parallel universe" that threatens to challenge the value of a traditional IT degree programs in Higher Education.

Higher Educational Institutes are competing with IT industry certifications. Certification focuses on keeping current within the rapid changing IT environment. Academic institutions and administration staff are constantly challenged to meet deadlines and keep curriculum up-to-date in the rapidly changing industry (Messing & Atlas, 2006). Educational institutions need to be aware of the requirements of the IT industry and develop the required knowledge, skills and abilities for their students through instructional offerings and course contents (Evans, 2003). Some evidence suggests that higher education must accommodate certification where appropriate (Denning, 1998). This has been met with some criticism form academic staff. Some IT academics believe their role is not to educate students how to use specific tools but instead to educate students how to adapt to the changing technologies. Even so, there is still a prevailing view by employers that IT graduate's lack practical skills required by industry (Ortiz, 2003), and they are not suitable for employment (cf. Nwana, 1997). Some evidence suggests that graduates themselves believe that overall they were self-taught in many of the skills required to perform their job (cf. Maj et al., 2001). However some argue that the skills obtained by certifications are too narrow to be of any use, therefore claiming that this will not help the shortage (Bailey et al., 2000). ACM and IEEE recognises the importance of IT industry certification (Al-Rawi et al., 2005).

There is much support for the integration of IT industry certification within higher education (Simmonds, 2002). However when considering such a change it is important to address the issues that have emerged form the literature regarding certification integration in academia.

2.6.2 Certification Integration Issues

According to Randall & Zirkle (2005), higher educational institutes have been slow to add Industry Certification to their curricula. Although certifications have been integrated within tertiary IT programmes Rothke (2000), suggests that it has been reactionary and little has been done to investigate this process in detail.

Incorporating IT industry certification into academia requires extensive consideration. Schlichting & Mason (2005) highlight some issues that need to be addressed. These issues include, certification integration methods for example freestanding or integrated into existing courses, the possibility of requiring new-hires or retraining existing faculty and resource issues including time, the acquisition of new course material and monetary costs. If certifications were implemented as free standing courses this may cause some problems. However, if certification training were implemented into existing courses that aligned with particular certifications for example, Oracle OCP with databases and MCSE with the existing networking classes, then other problems would be minimal.

Perceptual barriers also occur with certification integration into HEIs. Academic staff, after initial employment may not be required to further validate their ability to teach. In contrast, Instructors of certification programmes are constantly required to maintain and update their skills for every certification program they deliver as well as obtaining an overall instructor certification. There are many difficulties that exist, including the requirement to constantly validate knowledge and skills and the fear of not achieving certification, which could potentially hinder the integration of industry certification into HEIs. Reasons including constant validation and the potential embarrassment of not achieving certification are potential explanations as to why certification programs may be dismissed in HEIs (Jaffee, 1998).

Issues that have been identified according to Koziniec and Dixon (2002) include, certification is deemed too vocational for traditional education, where focus is put on specific technologies or products as opposed to the course curriculum. The certifications carry too much marketing emphasis for specific product lines. Costs associated with integrating industry certifications are extensive and include purchasing new hardware and software, fees associated with running the program, licences and equipment, instructor training costs and time and adoption of new delivery methods. Re-certification for instructors to keep their skills up to date with industry is also another issue.

Some HEIs have been criticised for not providing the skill set required by industry. Too much emphasis is placed on theory and not enough on practice, out of date curricula (in relation to industry), and students have little experience in practical applications (Anthony, 2003). However some academics believe that "training on any particular name brand is a big mistake, because it will soon be obsolete", but the theory in computer science education "will last a lifetime" (Mason, 2003, p.40). Donaghue (1997), suggests that this could place IT graduates at a disadvantage in industry. A study conducted in Australia indicated that some student have become dissatisfies with traditional HE and have moved towards vocational education and training (VET). One of the main reasons why students were attracted to TAFE course was to gain the practical skills not obtained in higher education (Donaghue, 1997). It is imperative that HEI give their students the knowledge, skills and experience required by industry. Industry tends to agree that graduates who have obtained certification are more employable, considered more for promotion and are rewarded accordingly (Lee, 2006). According to the Joint Task Force (2001) industry representatives are looking for graduates who are "job ready" and that students expect to practice computing in the work place upon graduation without significant further training.

2.6.2.1 Cost

Most four year universities only offer certification courses through their continuing education offices (Wunder, 2006). Some for-profit institutions in America such as the University of Phoenix and Herzog College recognise the demand for certification. Some "traditional" universities are following suit by preparing students for certification. The concern is that these universities offer certification training through continuing education, which means certification is too costly for most undergraduate students. This may explain why many students are choosing alternative study options to include certification. This potentially could hurt traditional universities in the long term. HEIs also will not offer degree credit to students who obtain certification by means of continuing education (cf. Mason, 2003).

2.6.2.2 Inertia

Although academics believe certification to be beneficial for the employment of graduates they do not believe that the preparation of these to be their departments' responsibility (Schlichting & Mason, 2005). Schlichting and Mason suggest some reasons why academics may not wish to implement certification into their curriculum. These issues include:

- Self-efficacy
- Fear of their inability to master the material of certifications
- Preference for the status quo
- Not having to retrain to learn and implement new material
- Consideration that certification material is beneath their academic dignity, for example, it is trade school material
- Uncertainty of the availability of budgets, time for retraining and the acquisition of relevant hardware and software
- Distrust the validity of certifications
- Pomposity, "I've learned it the hard way; they can too" attitude

The budgets that some computing departments are working with makes it difficult to keep personnel up-to-date, however it is the responsibility of those departments to provide graduates with the skills necessary for them to be successful in industry (Heiat et al., 1995). The authors notes that educators are finding it extremely difficult to keep their skills up-to-date in this constant state of change. They continually are faced with obstacles such as, lengthy curriculum reviews, limited budgets, and obsolete hardware, software, course material and faculty skills. It is also has become apparent that students are graduating with obsolete skills. The authors believe that this will only get worse unless industry and academia work together to resolve these problems. Denning (1998), notes that if HEIs accommodate professional practice, continuing professional education and certification where appropriate, the dichotomies such as education versus training may subside.

2.6.2.3 Resistance

IT industry certification is regarded as an established method of obtaining specific practical based expertise. However many tertiary courses lack the ability to provide these skills or they choose not to get involved (McCain, 2001). IT academics believe that their role is not to educate and train to use specific tools, but instead to educate students on adapting to changing technologies (Ortiz, 2003).

There is some evidence to suggest that there is some reluctance to change by computing staff in HEIs. Schlichting and Mason (2004) conducted a study of Heads of Departments across the United States to determine the perceptions of certification training in academia. In general they found that although some schools offered certification training within their extension programs, most did not offer academic training for the certification training. However over 76% of the respondents agreed that certification would give their students a competitive edge in the marketplace. Less than one in three of the respondents indicated that certification training was a legitimate function of the academic department even though most respondents considered this training to be too "trade school" for academia. The majority of respondents did not feel threatened by certification training centres, and half of the respondents thought that certification did not equal competence.

Although academics believe certification to be beneficial for the employment of graduates they do not believe that the preparation of these to be their departments' responsibility (Schlichting & Mason, 2004). Schlichting and Mason (2004, p.8) observed that the academic world generally refuses to offer academic credit for courses that prepare students for certification. They found that academics consider certification training as a "trade school" function and "beneath the dignity of the rigorous computer education". However both the ACM and the IEEE encourage academia to use "industry-standard tools" if possible, (Joint Task Force, 2001). Mason (2003) argues that by continuing to ignore certification in HE, an opportunity will become a problem and will put the role of "traditional" department at risk.

2.6.3 The Benefits of Integrating IT Industry Certification into HEIs

Partnerships between HEIs and industry benefit students, industry and the academy. By choosing to integrate certification programmes into their curricula, HEIs could obtain ready-made industry sponsored curricula which are responsive to the changing industry. This could potentially benefit industry with assurance that graduates are skilled with their products and increasing their market share. Students would be more employable as they meet industry requirements (Randall & Zirkle, 2005).

Jovanic et al (2005) have identified strengths and weaknesses of certification programs in academia. They are outlined in Table 2.7.

TABLE 2.7: Benefits and Pitfalls of Certification Programs

Strengths	Weaknesses
▪ Adding value to degree programs	▪ Exist to support training industry
▪ Work related experience	▪ Proprietary nature
▪ Practical rather than just theoretical focus	▪ Lack of educational rigor
▪ "Up-to-date" nature of certification programs	▪ Often lacks "real-world" experience
▪ Specific targeted content very relevant to employers	▪ Industry partnership inadequate or unstable
▪ Industry liaison opportunities	▪ Too focused
▪ Adjunct to education programs offering verifiable testing of skills and knowledge	▪ Training oriented rather than education oriented
▪ Potential employment advantages for graduates	▪ "Value-for-money" ignorance of certification
▪ Precursor to licensing requirements	▪ Too market and popularity driven

Source: (Jovanovic et al., 2005, p.5)

2.7 Conclusion

IT industry certification and its place in HE is currently a topical issue for debate. As discussed there is very little research in this area and what exists is recent, often commercial and limited to the United States and Australia. Employers in the IT industry are disillusioned with the graduates emerging from HEIs and there has been some call for academia to address this situation. Industry requires graduates with current and up-to-date skills. They suggest that the integration of IT industry certification into the computing curricula might possibly be one way to address this issue. This section has reviewed the literature relating to certification integration into HE and addresses issues on implementation methods, cost, resources, benefits and drawback and issues concerning resistance.

This chapter has reviewed the essential literature relating to this study. It is evident that certification integration into HEI raises many questions in relation to IT industry certification, education and change. However there are also potential and important benefits to be harnessed. Some HEIs internationally have attempted and successfully integrated IT industry certification into academia, however this has not been adequately addressed in an Irish context. Therefore it is considered worthwhile to investigate the integration of IT industry certification into the undergraduate curricula in Irish Institutes of Technology (IoTs). Since certification integration into HEIs would impact the institute and lecturing staff significantly it is considered essential for this study to understand the human and political aspects of this system before attempting to implement any form of educational change. Due to the enormity of this debate it is important to identify all elements of this complex human centred system. This will be discussed in detail in Chapter Three - The Research Framework.

CHAPTER THREE

RESEARCH FRAMEWORK

3.1 Introduction

It is evident from the literature that the IT industry is in a constant state of rapid change and it is imperative that higher educational institutes keep up-to-date to ensure that future graduates have the knowledge and skills that industry requires. There is a growing concern that some disparity exists between higher education worldwide and industry and this gap needs to be addressed. Some tertiary educational institutions internationally have attempted to address this gap by integrating IT industry certification into their curriculum. It is important too, that Ireland addresses this gap to keep itself current in this competitive international knowledge economy.

The main focus of this chapter is to present a theoretical framework for this study, outlining the complex nature of educational change that would be required by certification integration and the major stakeholders affected by such change. The chapter addresses the difficulties facing this research and identifies the Soft Systems Methodology (SSM) approach as being an appropriate method to use (Checkland & Scholes, 1990). Aspects from SSM such as root definitions, CATWOE elements and rich pictures are used to illustrate the complexity of the problem situation. From this, the research propositions are identified and discussed and finally a summary of the research propositions is presented.

3.2 Soft Systems Methodology as a Suitable Approach

As discussed in section 2.4.5 there are several sociotechnical systems approaches that could have been adopted to analyse this complex human activity system undergoing change. However, for the purpose of this study, the Soft Systems Methodology was chosen as the most suitable approach.

Higher education (HE) systems are an example of complex, multi faceted environments that have strong human and social elements. There are many stakeholders involved in higher educational systems, however, due to the complexity of these systems it would be impossible to investigate and understand all aspects of such a domain in a single study. Therefore the scope of this research will be to examine the integration of IT industry certification into Irish IoTs from the two key stakeholder's perspectives, namely the Head of Departments (HoDs) and lecturing staff. These stakeholders were identified as the most central, influential and affected elements of this study through the process of modelling the rich picture, which is illustrated in Figure 3.1. Although other stakeholders will be discussed, they are considered to be beyond the scope of this study.

Elements of the four-activities model are considered suitable for this study given its strong cultural and social emphasis. It will examine the key stages that will allow the rich representation of the transformation process of integrating IT certification into Irish IoTs. Root definitions, CATWOE and rich pictures are considered relevant for constructing a theoretical framework for this research. It is important to note however, this study aims to analyse and understand the implications of certification integration into Higher Education from the two key stakeholders' perspectives. It will not attempt to take action or implement change. Therefore it is not a true action research study. Elements from the four-activities model are used only as a method to illustrate the complex problem situation of educational change with respect to certification integration, and to inform the main research instrument.

3.2.1 Root Definitions and CATWOE

The core of root definitions explains the transformation process of the perceived problem situation that is being represented. In relation to the integration of IT industry certification into Irish IoTs the root definition is described as:

> *Irish IoTs, in response to a continuous need for higher quality graduates for the IT industry both nationally and internationally, the need to deliver quality courses and the need to attract future students and funding, integrates IT industry certification into the curriculum, within constraints of HoDs and lecturing staff's core tasks as managers and educators respectively.*

The essence of CATWOE is in relation to the transformation process and the worldview, that is, the transformation from the initial problem situation to a desired state for which it is perceived as meaningful. All other elements in CATWOE deal with the stakeholders and the environmental constraints. CATWOE analyses the root definition by identifying elements of the system. 'C' identifies the customers of the system, that is, those who will benefit from the transformation. For the purpose of this research the customers have been identified as Students and Industry. 'A' identifies the actors of the system, that is, those who perform the transformation process. HoDs and lecturing staff have been identified as the actors for this study. 'T' identifies the transformation process itself, that is, the conversion of inputs to outputs. Changes in pedagogy, training and certification integration are the transformations identified which are considered within the scope of this study. 'W' represents Weltschauung or worldview which provides a meaningful context for the transformation. Competency and skills, reputation, certification value and industry will provide the context for this study. 'O' identifies the owners of the system who ultimately have the power to control the transformation. For the purpose of this study the owners have been identified as IoTs. Finally 'E' represents the environment outside the system that also requires consideration. Teachers' Union of Ireland (TUI), EU Policy, Government Education Policy and Funding are factors that have been identified for this study. Table 3.1 summarises the CATWOE elements of SSM, gives a brief description of each and identifies each element for this study.

TABLE 3.1: CATWOE Elements

	Element	Description	CATWOE elements for this study
C	Customers	The victims or beneficiaries of the system	Students and Industry
A	Actors	Those who perform activities defined in the system	Lecturers and Heads of Department (HoDs)
T	Transformation process	The conversion of inputs to outputs	Pedagogy changes, Training and Certification Integration
W	Weltanschauung	The worldview which makes the transformation meaningful in context	Competency and Skills, Reputation, Certification Value and Industry
O	Owners	Those with the power to stop the transformation	Institution
E	Environmental constraints	Elements outside the system which must be considered	TUI, EU Policy, Government Education Policy and Funding

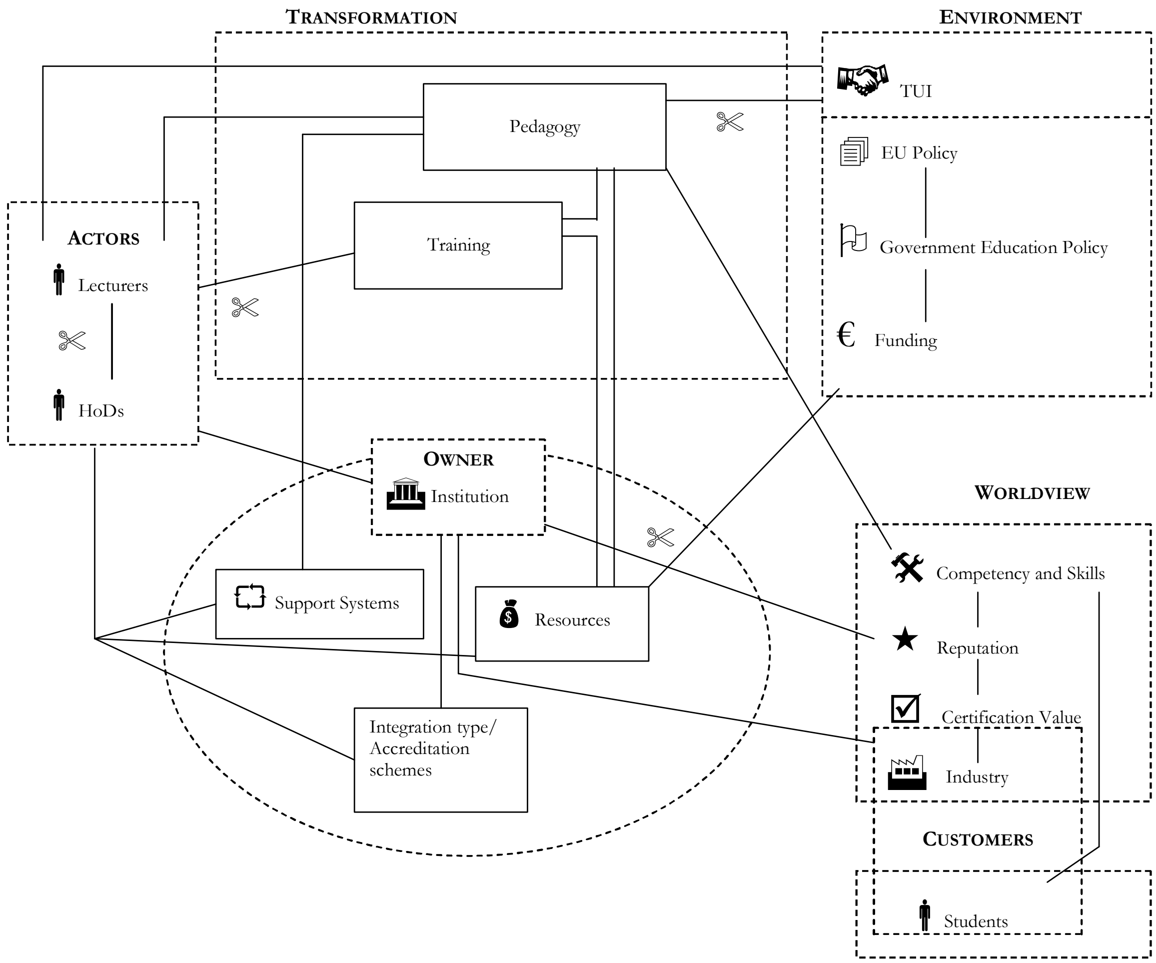
Adapted: (Checkland, 1990)

As the root definition and the CATWOE fundamentals have been identified, an in-depth representation of all of these elements is illustrated by the use of a rich picture.

3.2.2 A Rich Picture for Certification Integration

A rich picture was constructed to capture the current complexity of the education system in Irish IoTs. The rich picture represents all aspects of the system that would potentially be impacted by the integration of IT industry certification into Irish IoTs and is informed by the literature review. This rich picture is illustrated in Figure 3.1.

FIGURE 3.1: Rich Picture of the Problem Situation in Higher Education



As certification integration involves considerable human accommodation, this study will limit itself to those human actors that are most immediately affected, HoDs and Lecturing Staff. According to Monk and Howard (1998), "at the core of SSM is a desire to understand human activity systems in a way that is meaningful to the actors in that system" (p.22). Therefore the human actor's perspective is especially important. It is also ethically prudent to understand the impact of change on those people directly involved before implementation. As discussed in section 2.4.4, actors of complex human-centred systems can and do influence the change process through covert methods when threatened and overtly. Therefore it is vital to understand the actors' position prior to commencing the process of change. Figure 3.2 illustrates the CATWOE elements, where the grey area within the bold line is the considered the scope of this study, that is, investigating the key actors and owners of the transformation of integrating IT industry certification into Irish IoTs. Although all aspects of the system will be addressed to some extent those elements outside the bold circle are considered beyond the scope of this research.

FIGURE 3.2: CATWOE Elements Identified as the Scope for this Study

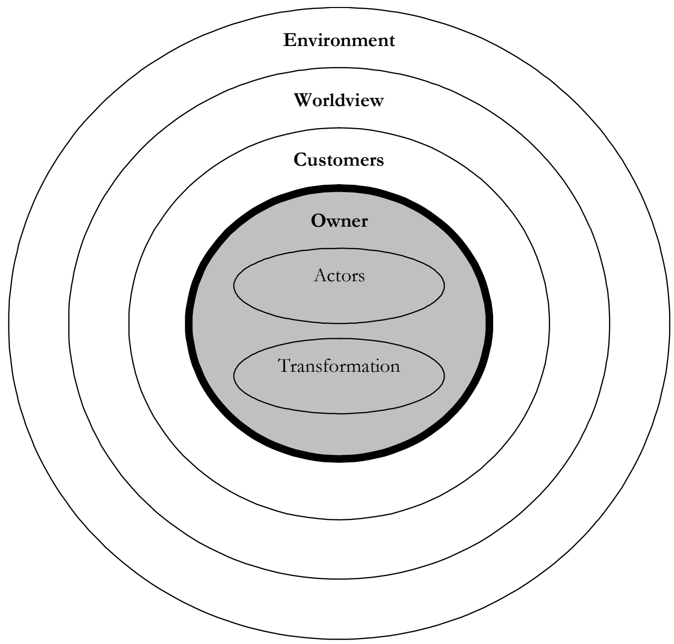
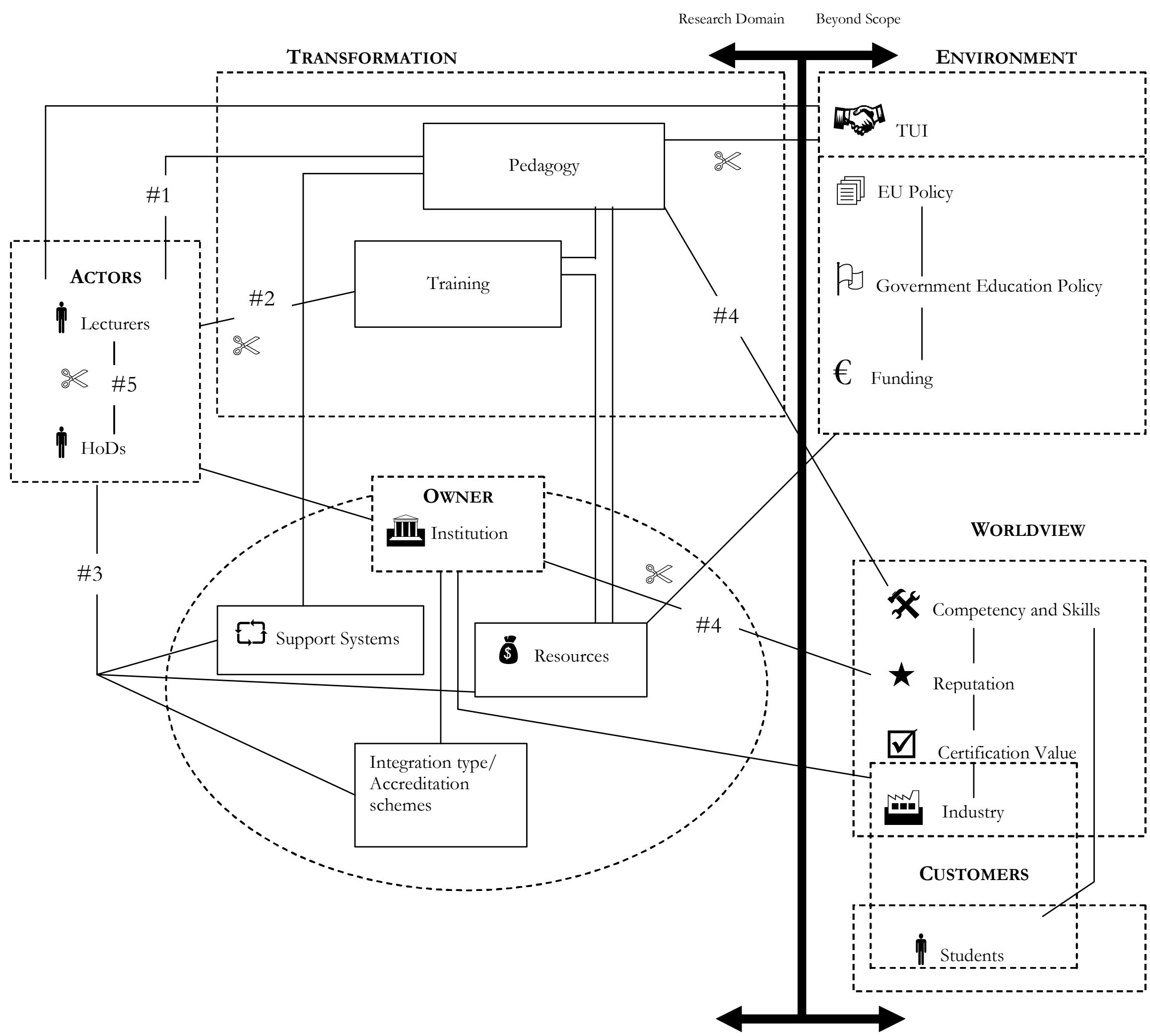


Figure 3.3 illustrates, with the use of a rich picture, the same complex facets that need to be considered for the scope of this study. This study will be limited to consider the primary actor-related aspects and touching only on the wider or extra-institutional issues as required. The bold line represents what is considered to be the research domain (left side of the line) and those elements that are beyond the scope (right side of the line) of this research. Therefore all internal links involving actors will be considered as well as a number of institutional links.

FIGURE 3.3: Rich Picture Representation of the Problem Situation in Higher Education Including Five Issues for Investigation



The institutional links that are deemed appropriate for this study are numbered from 1 to 5 on the rich picture as illustrated in Figure 3.3. These links highlight the issues that are chosen as distinct and exemplar for this study and thus forms the basis of the propositions. The following section will develop these five issues which have been theoretically informed and five propositions will be defined for each of the corresponding issues.

3.3 Discussion of Framework Issues

3.3.1 Issue One

Section 2.3.4 noted how certification integration would inevitably impact lecturing staff and the way in which they currently teach. There are several issues relating to pedagogy that need to be addressed. Lectures would need to be structured in order to incorporate the relevant materials required for certification. The use of PCs and computer based training might also be a requirement to effectively deliver the course material, and the methods of assessment would need to be flexible in order to administer the certification exams. At present the learning environment for students is predominantly lecture based with some timetabled hours for practical work. By proposing to incorporate certification into the computing curriculum of Irish IoTs, more scheduled timetable hours for practical classes may be required. Student participation would be essential for student learning; therefore a move towards a student-centred approach to teaching may be required. Therefore the first research proposition is:

Proposition 1: *Integrating IT industry certification into Irish IoTs would require lecturing staff to change their current teaching methods*

3.3.2 Issue Two

Integrating IT industry certification into Irish IoTs would require lecturing staff to retrain and up-skill. As noted in section 2.3 the IT industry requires graduates to have up-to-date, current skill when entering the marketplace and view certification as a means to verify those skills. In order for lecturing staff to successfully deliver certification within the computing curriculum, they would need to possess the skills and the expertise and indeed the designation to do so. There are many ways in which lecturing staff could obtain the training to become certified at instructor level. Methods include, online, offsite/onsite, self-study. However, lecturing staff might not see the value in IT industry certification therefore avoiding the opportunity for learning new material. As discussed in section 2.4, lecturing staff may also have difficulty mastering the certification material, which could lead them to resist the proposed implementation of certification into the curriculum. An alternative would be to recruit new hires that already have the skills to effectively deliver those courses. Therefore the second research proposition is:

Proposition 2: *Integrating IT industry certification into Irish IoTs would require lecturing staff to obtain additional training to effectively deliver certification*

3.3.3 Issue Three

Support systems in higher education vary among institutions. Several factors need to be addressed when considering certification integration in relation to these systems. As highlighted in section 2.6.2, current support systems would need to be flexible and adaptable to allow for certification integration and the possible changes that would be required. One potential issue might be that the accrediting bodies may not offer or allow credit for IT industry certification.

Resources are always a contentious issue in any organisation. Higher Education is no exception. As noted in section 2.3 and 2.6.2, time, cost, course materials, hardware and software are some of the resources that would be required for integrating IT industry certification into Irish IoTs. Course materials for certifications are extremely expensive and IoTs would be required to cover some of the cost. Lecturing staff would need to be trained to teach these courses which would require HoDs to manage the time and monetary expense. Some certifications have practical elements and would therefore require additional software and hardware to facilitate integration within already restricted budgets. The IT industry is changing rapidly with new technologies being developed constantly. IoTs are required to respond and manage the obsolete skills, hardware and software in this rapid changing environment.

As discussed in section 2.5.1, integrating certifications into the computing curriculum can be achieved by several methods. They can be integrated as standalone modules or integrated into existing courses. Upon completion of certification modules it is optional as to whether a certification designation is obtained or if it is simply preparation for an impending exam taken outside higher education. Considerations must also be given to the current learning outcomes and the quality of courses currently in place. Careful consideration must also be given to how IT industry certifications could be incorporated into the Irish IoTs, while ensuring minimal issues arise in relation to the institute's accreditation system. Students might seek to gain credit or module exemption through APEL by obtaining the certifications. They may also be more focused on the short term goal of certification as opposed to the academic qualification. All of the above factors need to be addressed appropriately. Therefore the third research proposition is:

Proposition 3: *Current support systems, resources and existing courses could accommodate certification integration into Irish IoTs*

3.3.4 Issue Four

IT industry certification provides a guarantee of knowledge, competency and skills for a particular subject area as discussed in section 2.2.1. Section 2.4.3 notes that integrating IT industry certification into Irish IoTs, would require lecturing staff to shift from the current lecture based classroom to a more student-centred approach where hands on, practical method of teaching would ensure the students do actually obtain the skills necessary to achieve the certification. With the rapid change in the IT industry, lecturing staff would be required to update coursework and their skills to keep abreast with the pace of change. They would also be required to teach both the current coursework and the certification without placing emphasis on one or the other. As noted in section 2.3.3.1, certification integration may help to achieve a higher competency and skills set for the students.

As outlined in Section 2.5.1, the IT industry is a very competitive market both nationally and internationally and higher educational institutions are making every attempt to attract potential students. Integrating IT industry certification into Irish IoTs could potentially enhance the institute's reputation making it an attractive environment for students to study and maintaining and/or improving enrolments. Students may consider the Institute to have a competitive advantage over those that do not offer such programmes. Certification could potentially aid the academic fashion of the institute, for example, most up-to-date, greatest industry relevance, best teaching. In contrast however, certification may be viewed as trade school work which could potentially compromise the institute's core values which is addressed in section 2.2.10. Some may believe that teaching certifications could be viewed as promoting vendor specific products as opposed to teaching well-rounded curriculum, and this would be beneath the academic dignity of the institution. Therefore the fourth research proposition is:

Proposition 4: *Integrating IT industry certification into Irish IoTs would improve the institutes' reputation*

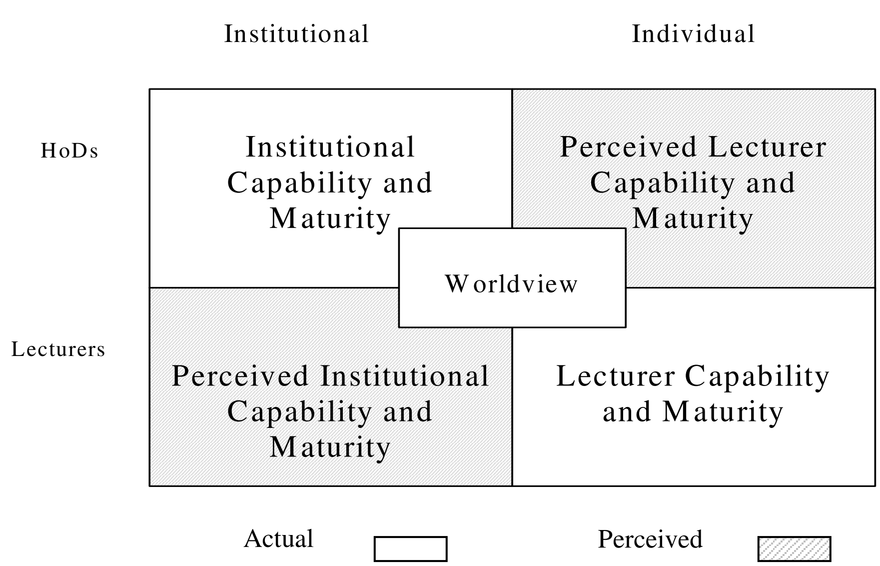
3.3.5 Issue Five

Integrating IT industry certification into academia requires careful planning and an appreciation of all attitudes and opinions of the key stakeholders' central to this change. As identified in the rich picture, Heads of Department and lecturing staff are the central key figures for this transition. It is inevitable that some issues and/or conflicts will arise between the stakeholders in this volatile environment. A discussed in section 2.6.2, conflicts might include; the ability of the institute to effectively mange the change with regard to budgets, resources, timetabling, lecturing staff's willingness and ability to implement the change, and whether the change is warranted by the key stakeholders. Heads of Department and Lecturing Staff in Irish IoTs may not recognise, understand or even care for the merits of certification integration into the existing computing curriculum. Some might distrust the validity of the certification process again questioning its place in higher education. The effort to integrate IT industry certification into Irish curriculum may be viewed as too much "hassle". Therefore the fifth research proposition is:

Proposition 5: *Heads of Department and lecturing staff would have conflicting opinions regarding IT industry certification integration into Irish IoTs*

Potential conflict may arise between HoDs and Lecturing staff regarding the perceived and actual capability of both the institution and the individual. HoDs will ultimately be aware of the actual institutional capabilities whereas lecturing staff will have a perception of what they think the institutional capabilities might be, sometimes drawing on past experiences to substantiate their perceptions. Lecturing staff on the other hand will know exactly the actual capabilities of the individual whereas the HoDs will only have a perceived notion of the lecturing staff's capability. However, this idea is not infallible as individuals usually tend to bias there opinion and answers and therefore it is never known if feedback is truly representative. This idea is illustrated in Figure 3.4.

FIGURE 3.4: Certification Integration Capability and Maturity Model



In order to explain this further an example is provided. HoDs recognise the actual capability of the Institution with regards to support systems and resources whereas lecturing staff have a perceived notion of the institute's capabilities. Similarly, lecturing staff realise the actual capabilities of the individual in relation to teaching and training. However, HoDs will only have a perceived notion of the teaching and training requirements of the individual. Conflict may arise between HoDs and lecturing staff because of the differences in perspectives of the actual versus perceived capabilities of the key stakeholders. Integration methods, competency and skills and reputation are recognised by both stakeholders

3.4 Summary of Research Propositions

The following is a summary of the five research propositions highlighted in this chapter:

Proposition 1: Integrating IT industry certification into Irish IoTs would require lecturing staff to change their current teaching methods

Proposition 2: Integrating IT industry certification into Irish IoTs would require lecturing staff to obtain additional training to effectively deliver certification

Proposition 3: Current support systems, resources and existing courses could accommodate certification integration into Irish IoTs

Proposition 4: Integrating IT industry certification into Irish IoTs would improve the institutes' reputation

Proposition 5: Heads of Department and lecturing staff would have conflicting opinions regarding IT industry certification integration into Irish IoTs

Table 3.2 highlights the relationship between each of the five propositions identified in section 3.3 with the relevant research question set out at in section 1.3.

TABLE 3.2: Relationship between Research Questions and Propositions

	Research Question	Proposition
Q1	To what extent do Irish IoTs have the capability to integrate IT industry certification into their undergraduate computing curricula?	Proposition 2 Proposition 3
Q2	To what extent are work practices within Irish IoTs mature enough to manage the integration of IT industry certification into the undergraduate computing curricula?	Proposition 1 Proposition 5
Q3	What are the wider implications of integrating IT industry certification into the undergraduate computing curricula in Irish IoTs?	Proposition 4

3.5 Conclusion

This chapter has reviewed the use of the SSM methodology in relation to the complex situation of implementing change in Irish IoTs. A framework has been derived through the use of rich pictures to illustrate this change. Five research propositions have been identified and addressed in relation to the Certification Integration Capability and Maturity model. Now that the research propositions have been posed, we must turn attention to how they can be rigorously answered. This is considered in Chapter Four – Methodology.

CHAPTER FOUR

METHODOLOGY

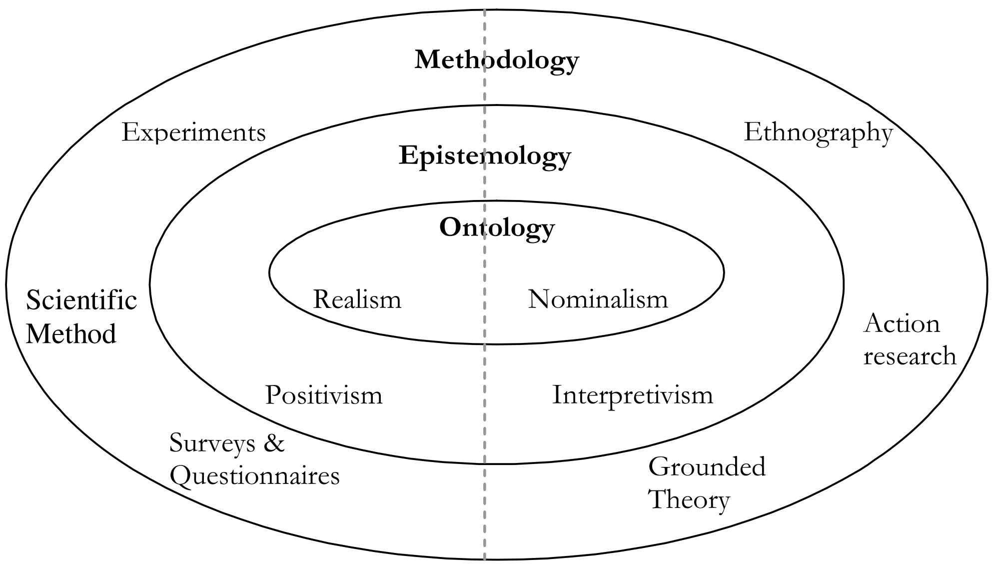
4.1 Introduction

The purpose of this chapter is to examine the research methodologies applicable to this study and to determine and select the most appropriate research instrument to use. A research methodology is a "strategy of enquiry which moves from underlying philosophical assumptions to research design and data collection" (Myers & Avison, 2002, p.5). A review of underlying philosophical assumptions is given and the appropriate epistemology is selected for the purpose of this study. Some relevant research methodologies are discussed, detailing their strengths and weakness and their suitability for this research is considered. Methods for data gathering are also discussed and a justification is made for the strategy adopted. The design of the research instrument is outlined and finally the organisation of this study is discussed.

4.2 Philosophical Paradigms

Philosophical paradigms are shared suppositions or ways of thinking about how to carry out research (Myers & Avison, 2002). Ontological and epistemological perspectives determine what philosophical paradigm a community belongs to (Oates, 2006). Ontology is concerned with the nature and state of the world; is 'reality' and the world objective and external to the individual (realism) or it is subjective and the result of individual cognition (nominalism). Epistemology, or the theory of knowledge, relates to the way groups of people believe that they can obtain knowledge about the world. This premise is divided mainly into two extremities, that is, can knowledge be acquired or measured through "hard' or physical means or is it something that has to be experienced? (Burrell & Morgan, 1979). The philosophical position of the research domain will help inform the choice of research methodologies that will be chosen to provide a means in which this knowledge is investigated and obtained. Figure 4.1 provides a simplified overview of the different ontological, and epistemological assumptions, and their related methodological approaches.

FIGURE 4.1: Underlying Philosophical Assumptions



4.2.1 Positivism

Positivism is considered one of the oldest and more established research paradigms in existence. It underlies the scientific method approach to research and is based around two basic assumptions. They assumptions are that the world is ordered and it can be investigated objectively, and the social world exists externally and is independent of individual's experiences (Oates, 2006). Positivist research is usually carried out through experiment, searching for evidence of cause and effect. Reductionism, repeatability and refutation are the three basic techniques of the scientific approach. Reductionism is concerned with examining complex 'things' in smaller more manageable elements. Repeatability is concerned with reiterating experiments to test existing results. Refutation is concerned with testing results of an experiment by repeating the same experiment in order to disprove it (Easterby-Smith et al., 1991). Positivists believe that assumptions and methods transfer from the natural to social science (Robson, 2002). Positivism suggests that a researcher is functioning within an "observable social reality" and the results of such research can be the derivation of "law-like generalisations" (Remenyi et al., 1998). Orlikowski and Baroudi (1991) suggest that the positivists approach is more appropriate where there is evidence of formal propositions, quantifiable measures of variables, hypothesis testing and the drawing of inferences about a phenomenon from a sample to a stated proposition. Positivism also uses other research strategies, including surveys, where experiments are not feasible.

According to Oates (2006), the validity of positivist research is examined by assessing the following criteria:

- Objectivity: Is the research devoid of the researcher bias and distortions?
- Reliability: Are research instruments neutral, accurate and reliable?
- Internal validity: Is the research well designed to examine the right things from the right people?
- External validity: Are the research findings generalisable to different people?

Source: (Oates, 2006)

Much debate surrounds the use of the positivistic approach when researching in the social science, with some suggesting that it is not effective to produce interesting and insightful meaning into complex problem situations (Remenyi et al., 1998). Oates (2006) considers the tenets of validity, and suggests that complex human centred systems cannot be broken down into smaller, individual parts as the essence of the 'whole picture' could be lost. Some research cannot be repeated and often does not require generalising. He also suggests that as the world is perceived in many ways by individuals, it is important to study those multiple interpretations of the world. The positivist paradigm also suggests that research is 'value-free', however it is argued that human interests, beliefs and values are fundamental to and affect the inquiry process (Easterby-Smith et al., 1991).

4.2.2 Interpretivism

Interpretivism is based on the assumption that the world and reality are not objective, but are socially constructed with multiple realities which must all be considered (Orlikowski & Baroudi, 1991). The interpretivist paradigm suggests that the social world can only be understood by individuals who are directly involved in the activities being studied (Burrell & Morgan, 1979). The interpretivist paradigm proposes that the researcher is not independent of the subject matter but rather their individual experience is an important part of it (Remenyi et al., 1998). Interpretivists believe that the world can be modelled not only mathematically but also through rich descriptions of the situation either verbally or diagrammatically (Oates, 2006). Unlike the positivist approach, interpretivists will include themselves and the methods being used as part of the phenomenon being studied (Mumford et al., 1985). Generalisations to a population are not required, as the intent is to understand the deeper complexities of the phenomenon (Orlikowski & Baroudi, 1991).

According to Oates (2006), the validity of interpretivist research is examined by assessing the following criteria:

- Trustworthiness: How much trust can be placed in the research?
- Confirmability: Is there enough data to adequately judge the results of the study?
- Dependability: How well is the research process recorded and data documented?
- Credibility: From the research process, was the subject of the inquiry accurately identified and described?
- Transferability: Can the findings be transferred form one case to another?

Source: (Oates, 2006)

The interpretivist paradigm has also received some criticism. Data collection can take considerable time and resources, data analysis is difficult and often the credibility of some interpretivists research is often questioned (Easterby-Smith et al., 1991). Generalisations are less conducive to interpretivists research (Remenyi et al., 1998).

Easterby-Smith et al., use Burrell and Morgan's paradigm distinctions to summarise the main differences between positivism and Interpretivism as illustrated in Table 4.1.

TABLE 4.1: Key Features of the Positivist and Interpretivist Paradigms

	Positivist paradigm	Interpretivist paradigm
Basic beliefs	The world is external and objective	The world is socially constructed and subjective
	Observer is independent	Observer is part of what observed
	Science is value-free	Science is driven by human interests
Researcher should:	Focus on facts	Focus on meaning
	Look for causality and fundamental laws	Try to understand what is happening
	Reduce phenomena to simplest elements	Look at the totality of each situation
	Formulate hypothesis and then test them	Develop ideas through induction from data
Preferred methods include:	Operationalising concepts so that they can be measured	Using multiple methods to establish different views of phenomena
	Taking large samples	Small samples investigated in depth or over time

Source: (Easterby-Smith et al., 1991, p.27)

4.2.3 Philosophical Position Adopted

After analysing both epistemological positions the interpretivist approach has been chosen as the appropriate underlying philosophy for which this research will be based. The predominant reason for this is that the research is trying to ascertain the opinions of the key stakeholders, that is, Heads of Department (HoDs) and lecturing staff, in relation to certification integration into Irish IoTs. Although there will be a large amount of quantitative and qualitative data obtained, it will ultimately be used to interpret the opinions of the respondents.

4.3 Research Methodologies

The following section outlines various research methodologies that could be deemed suitable for this interpretative study. The methods are briefly described and their advantages and disadvantages are highlighted. The suitability of each method will also be considered in relation to this study.

4.3.1 Action Research

Action research has been an established research method in social and medical sciences since the mid-twentieth century, and its importance has grown in the field of Information Systems since the end of the 1990s (Baskerville, 1999). Kurt Lewin pioneered action research in the 1940's. He maintained that the best method of learning about organisations was to change them.

The purpose of action research is to influence or change some aspect of the focus of the study. Two key components of this type of study are improvement and involvement (Robson, 2002). Improvement focuses on improving some work practices and ensuring the relevant people gain an understanding of the modified practices and the situation where the practices reside. Involvement relies heavily on collaboration between the researcher and the participants of the changing process. The researcher is not an independent observer, but a participant, and the process of change becomes the subject of the research (Benbasat, et al., 1987).

The fundamental belief of action researchers is that complex social systems can be studied best by introducing changes and observing the effects of those changes. In terms of educational change, protagonists of action research believe practitioners are better informed to make decisions if they are directly involved in educational research. It is suited to the flexible nature of qualitative design. Action research is an iterative process which involves planning and implementing the change, observing and reflecting on the process of change and planning further action, and repeating the process if required (Robson, 2002). Oates (2006) identifies the main advantages and disadvantages of action research which are as follows:

Advantages of Action Research:

- Research is focused on actually improving real practices relevant to individual in specific situations
- Builds connections with the academic world and the everyday world of the general community
- It is well suited to problem-solving methods
- It creates a greater awareness and appreciation of all types of knowledge
- It goals can be more substantial than other methods, i.e. changing the way people live

Disadvantages of Action Research:

- It is criticised for lack of rigour, inability to determine cause and effect and results not being generalisable to other studies
- It can be confused with consultancy
- It is not a suitable method for people who are not open to work democratically in complex problem situations
- It can be difficult to meet all needs and expectations

Adapted: (Oates, 2006)

Action research would have been an ideal approach to this study, with the researcher actively involved in the change to observe, assist, and gain knowledge of the process, however, the political and ethical issues ruled it out. Although action research is widely used in educational research (McNeill & Chapman, 2005), this study has rejected the adoption of this method. Integration of IT industry certification into Irish IoTs would require considerable support from the key stakeholders of the institution, that is, HoDs and lecturing staff. It would be unethical to implement such changes without first considering the opinions of those directly involved.

4.3.2 Ethnography

Ethnography, which originated in anthropology, is widely used in social research. It portrays, interprets and describes the culture and structure of a social group (Robson, 2002). Ethnography requires the researcher to become immersed in the culture of the particular study so that they can describe in detail the workings of the group (Myers & Avison, 2002).

Ethnographers are required to observe and to take part in the day-to-day tasks of the group in order to gain a complete understanding of the group and culture being studied (Denscombe, 2001). Participant observation is an important aspect of ethnography, however it can be difficult, time-consuming and demanding (Robson, 2002). Ethnographers gather and record data through interviews, observations, documents and personal field notes. They reflect on the process and acknowledge their possible impact on the people involved in the study. The researchers' observations are then linked back to existing literature (Oates, 2006).

Ethnographies are usually comprised of extremely descriptive data that is free from external influences. It represents a rich description of how people exist within the social environment for which they are being studied. The ethnographic method is more a matter of style then following a set of procedures. Usually ethnographic studies take several years to complete to ensure the researcher has experienced the true nature of the cultural environment being investigated. However, this raises issues regarding the over involvement of the researcher and their impact on the natural environment possibly altering it and effecting the quality of the research.

Advantages of Ethnography Research:
• It gives a rich detailed representation of particular situation or work practices which are described within the right context • The findings emerge from the natural environment of the situation and people being studied • It can be used in the context of institutions encompassing all the relevant stakeholders and the human, social and organisational aspects of the system • It is excellent in studies that deal with complex issues and embedded in social settings • It can be used in studies that are carried out over many years
Disadvantages of Ethnography Research:
• It places great demands on the researcher • It can cause conflict within the researcher, i.e. reporting what is actually happening and recognising their own bias • It has the potential to become a story-telling exercise as opposed to an account of the analysis of the findings or contribution to theory

Adapted: (Oates, 2006)

As discussed, observation is a key element to ethnographic research. Observations can be carried out both overtly and covertly. Although overt observation gains informed consent it also may lead to participants changing their way in order to be perceived in a different light, that is, the 'Hawthorn effect'. Covert observation on the other hand is carried out without the participants knowing that they are taking part in a particular research study, allowing the researcher to see what people actually do as opposed to what they say they do. The advantage here is that the natural environment is not disturbed by outside influences, however this approach can be quiet dangerous for the researcher, that is, it may potentially violate ethics and lose the trust of the subjects.

Ethnography research could possibly be used for this study. Current work practices of lecturing staff could be observed to ascertain their amenability to change to accommodate certification integration. However due to the intrusive nature of this method, participants could alter their actions which could potentially distort the findings. Covert methods could also be used whereby the researcher might pose as a student and observe the actions of the lecturing staff without consent. However this type of observation would certainly raise many ethical considerations. Also an ethnographic study for this research may not allow full insight into the complex asynchronous environment as some aspects of the IoTs cannot be observed, for instance, determining resource issues and budget constraints. Furthermore undertaking an ethnographic study for this research would require considerable time and therefore it would not be feasible given the time constraints for this study.

4.3.3 Grounded Theory

Grounded theory according to Strauss and Corbin (1990) is a "qualitative research method that uses a systematic set of procedures to develop and inductively derives grounded theory about a phenomenon" (p.24). Grounded theory endeavours to generate a theory from a particular study, which in turn forms the focus of the study. The theory is 'grounded' in the data gathered throughout the study from individuals' actions, interactions and processes. The underlying premise of grounded theory is that concepts and hypothesis are discovered though analysing the data from the study enabling the researcher to generate specific theories (Robson, 2002). Interviews and observations are the most common methods of data collection, although other sources of data have also been used (Stapleton, 2001).

Although it is closely associated with qualitative approach to research, Strauss and Corbin propose that grounded theory can be used in both quantitative and qualitative studies. Usually, data is collected several times from the field by the researcher. Between every visit the data will be analysed by classifying the information gathered into specific categories until they become 'saturated'. The theory evolves throughout the research process by continuous interactions between analysis and data collection (Denzin & Lincoln, 1994).

Advantages of Grounded Theory Research
• Provides precise procedures for generating theory in research • The research strategy is flexible, systematic and co-ordinated • Provides precise procedures for analysing data • It is a useful research method where the theoretical method is not clear or which does not exist • It is widely used in research
Disadvantages of Grounded Theory Research
• It is impossible to commence research without any theoretical ideas or assumptions • Conflicts arise between the evolving flexible study and the systematic approach to grounded theory • It can be difficult to know when categories are 'saturated' or when theories are adequately developed • Prescribed categories of grounded theory may not be appropriate for particular studies

Adapted: (Robson, 2002)

As seen in Section 2.2.5, there exists an abundant of theory relating to IT education. In order to consider the grounded theory approach to investigate the integration of IT industry certification into Irish IoTs without any prior knowledge of the existing theory would not be considered appropriate. The complexity of the educational system would require pre-existing knowledge of the inner workings of the institution in order to select the relevant scope of the study. There is a need to be an informed. However, content analysis which is a method of coding qualitative data from open-ended questions from the research instrument would be considered useful.

4.3.4 Mixed Method

Mixed method research, also known as multi-method, triangulation and pluralism, is "an approach to study phenomena by using multiple data collection techniques to generate multiple data sets" (Petter & Gallivan, 2004, p.2). Mingers (2001) suggests that "research results will be richer and more reliable if different research methods, preferably from different (existing) paradigms, are routinely combined together" (p.1). He argues for the pluralist approach to IS research and suggests that different methods generate information about different aspects of the world.

Using only one method will give limited results of a particular research situation, whereas combining research methods will yield better and more interesting results. Methods are influenced by underlying philosophical assumptions. There is an array of literature that suggests that research methods and philosophies are appropriately linked, that is, qualitative research methods are aligned with interpretivism and quantitative research methods with positivism. This perspective suggests that that they are mutually exclusive categories that will never meet. However, Knox (2004) argues that research methods are not fundamentally applicable to any one particular argument. He believes that researchers will inevitably limit themselves from potentially innovative or creative data collection methods. Regardless of philosophical stance, the researcher must use the methods appropriate to the particular research questions. According to Knox (2004), if the focus is continuously on a specific approach there is the distinct possibility the researcher will lose sight of the bigger picture.

Blending methods where appropriate for specific pieces of research is paramount to obtain appropriate rich data. Morgan and Smirch (1980) suggest that "if one recognises that the social world constitutes some form of open-ended processes, any method that closes the subject of study within the confines of a laboratory, or merely contents itself with the production of narrow empirical snapshots of isolated phenomena at fixed points in time, does not do complete justice to the nature of the subject" (p.498). However there is some criticism of this approach. Burrell and Morgan (1979) for instance, argue against the synthesis of research methods.

Triangulation refers to use of multiple data generation methods to corroborate findings (Remenyi et al., 1998). This approach involves checking inferences from one set of data sources against data from other sources. It seeks to improve the accuracy of results through different approaches of data gathering and analysis. Triangulation can assist with addressing the weakness of a research approach with the strengths of another (Petter & Gallivan, 2004). However a potential drawback is that multiple sources may not lead to convergent data. Denzin (1988) identified four types of triangulation. These are listed in Table 4.2.

TABLE 4.2: Four Types of Triangulation

Data triangulation	The use of more than one method of data collection (e.g. observation, interviews and documents)
Observer triangulation	Using more than one observer in the study
Methodological triangulation	Combining quantitative and qualitative approaches
Theory triangulation	Using multiple theories or perspectives

A mixed method approach was deemed suitable for this study. The combination of quantitative and qualitative data would provide more rich and in-depth findings, which are required to gain further insight into the opinions of the two key stakeholders of this study.

4.4 Data Source

The most common types of survey methods used are face-to-face interviews, telephone interviews, postal questionnaires, Internet surveys. Each method will be considered in turn.

4.4.1 Surveys

Surveys endeavour to obtain the same type of data from a large group of people in a systematic and standardised way. The objective is to identify patterns from the data so that the researcher can generalise to a larger population (Oates, 2006). Surveys are generally linked to questionnaires for data collection but interviews, observations and documents can also be used (Fink & Koescoff, 1998). Survey strategy is closely linked with the positivism paradigm that is, identifying patterns and generalisations however it can also be used in the interpretative paradigm.

Advantages of Surveys:

- they cover a wide audience therefore they are more representative of the wider population, i.e. results can be generalised
- They can produce a lot of data, at low cost in a minimum space of time
- They can be replicated with different sample populations
- Survey via the internet or post are suited to people with weak interpersonal skills

Disadvantages of Surveys:

- The lack depth regarding the research topic (the why questions!)
- They focus on what can be counted and measured, everything else can be potentially discounted or overlooked
- They provide information based on a particular moment in time and not of ongoing process and change
- They do not establish cause and effect
- Honesty and accuracy cannot be judged form the response of questionnaires. Have to trust the them

Adapted: (Oates, 2006)

Questionnaires, which are a method of carrying out surveys, are a "predefined set of questions assembled in a predefined order" (Oates, 2006, p.219). The respondents answer the questions, providing the researcher with data required to analyse and interpret the findings. Usually the researcher will try to identify patterns and to make generalisations of the wider population. Questionnaires can be self-administered, that is, the respondent completes the questionnaire without the researcher being present or research-administered, where the researcher is present and asks the respondents the questions and records the answers. The later method of administration is usually conducted face-to-face or over the telephone. Questionnaires are suited to research that require obtaining data from large quantities of people. Extreme consideration must be given to the wording and position of each question to ensure each questions is understood by all respondents in the same way and interpret the answers provided in the way intended (Peterson, 2000). The questions on the questionnaire must relate back to the overall research questions or hypothesis.

4.4.2 Face-to-face Interviews

Face-to-face interviews require the researcher to personally administer the questionnaire to the respondent while recording and coding the responses throughout the process. The researcher is present at all times therefore they can answer questions, clarify answers and probe respondents to answer open-ended questions (De Vaus, 2002). Interviews can be structured, semi-structured and unstructured (Robson, 2002). Structured interviews have predetermined set of questions, with fixed wording and are usually specified in a specific order. Semi-structured interviews also have a predetermined set of questions but the order and wording can be modified where deemed appropriate by the researcher. The researcher can also include or exclude questions depending on the flow of the interview. Unstructured interviews have a general agenda however it is based more on conversation than on a list of questions that need to be addressed. Although there is a great deal of flexibility for the researcher when using interviews, they are time consuming, biases are difficult to control and the lack of standardisation raises questions about reliability.

4.4.2.1 Focus Groups

Focus groups are a particular type of group interview which involves a number of people coming together to discuss a specific topic, that is, the interview has a focus (Robson, 2002). Focus groups, which are a form of qualitative research, rely heavily on the interaction of a group to produce data that would be difficult to obtain outside of group discussions (Morgan, 1997). The group discussion, which usually exceeds one hour, is open-ended and guided by the researcher. The researcher's role is one of a moderator or facilitator to the group. They maintain order and control within the group while making sure the group runs effectively.

Managing focus groups can be a difficult task and requires the researcher to have extensive skills and experiences in order for the focus group to be effective (Robson, 2002). The researcher must strike a balance between actively generating interest among the participants and being vigilant not to lead the discussion to reinforce their own expectations (Sim, 1998). Note taking is an essential role of the researcher. It is often considered advantageous to have a second researcher present at a focus group to assist with observing the situation and non-verbal interactions.

Another method of data collection within focus groups can be with the use of audio-taping equipment. This method of data collection however is sometimes criticised in cases where the topic could be of a sensitive nature. Individuals or even the group may not wish to participate, refusing to impart their opinions and experiences. If the focus group is informal in nature, the use of tape-recording equipment may be seen as intrusive. Data analysis includes the general principles and procedures of qualitative data analysis, such as, content analysis, and it should always consider the context in which the data is collected. Focus groups can be used as the primary method of data collection or can be used in conjunction with other methods, for example, they can be supplementary to the primary method of data collection or they can be used in multimethod studies (Morgan, 1997).

Advantage of Focus Groups Research:

- the amount and range of data collected is greater because it is being collected by several people at the same time
- There are natural quality controls, extreme opinions are weeded out
- Group dynamics allow the focus on the main issues
- It is an enjoyable experience for the group, the participant also have a sense of empowerment, they can contribute freely and more taboo subjects can be addressed more openly
- They are inexpensive, flexible and quick to organise

Disadvantages of Focus Groups Research:

- Much few questions can be covered, usually less than ten major questions can be covered
- The facilitators role can be difficult if they do not process the skills to effectively manage the session and to get the most out of the participants
- Conflicts may arise within the group,
- Confidentiality is a major concern
- The results are not generalisable and cannot represent a wider population

Adapted: (Robson, 2002)

For the purpose of this study a focus group was used as a precursor to the main research instrument, namely two questionnaires. The focus group which comprised of six experienced lecturing staff in Waterford Institute of Technology (WIT) was conducted in order to ascertain participants' opinions in relation to certification integration in Irish IoTs. This method was used to source preliminary data to help compile the main research instrument.

4.4.3 Telephone Interviews

Telephone interviews require the researcher to make telephone contact with the sample population and to administer the questionnaire over the telephone. The responses are recorded by the researcher using through the written word, tape-recording and computer assisted equipment (De Vaus, 2002). It is a relatively cheap and easy method to conducting surveys. The researcher can establish a good rapport with the respondents while also maintaining considerable respondent anonymity. The advantage of using telephone interviews is that they are cost efficient and their ability to obtain results quickly (Salant & Dillman, 1994). However a major concern with telephone interviews is that not all people have telephones and telephone directories become out of date or were originally incomplete. Random digit dialling and add-a-digit dialling is a sampling technique used to combat this problem.

4.4.4 Postal Questionnaires

Postal surveys are self-administered questionnaires, which are sent to the sample population via the post service. This type of questionnaire must be well structured and easy to read and understand. The success of questionnaire completion is dependent on the ability of the respondent to understand the questionnaire (De Vaus, 2002). Postal surveys can also reduce the researcher's biases as the respondents are less likely to try and please the researcher by giving answers that they perceive are the desired results (Denscombe, 2001; Oates, 2006). Although the cost of applying this method of administration is relatively cheap, the response rate is usually much poorer than the telephone or face-to-face interview. The intractable issue of non-respondents may pose significant sampling error.

4.4.5 Web-based Surveys

Web-based surveys have become a recognised and popular method of administering questionnaires over the internet (De Vaus, 2002). The internet has been used in several ways to conduct surveys. Email questionnaires can be sent as plain text and as part of the email, it can be sent as an attachment, for example a Word document or it can be an interactive questionnaire. They can also be placed on a web server where the respondents can visit the web page to complete the questionnaire. These web-based questionnaires are usually constructed with specialised and easy to use internet survey software. They have various interactive and dynamic features as well as impressive visual enhancements for respondents' ease of use. Some software is available to interactively construct questionnaires while others require the questionnaire to be developed before uploading it to the server (De Vaus, 2002). Responses are usually coded automatically when the respondents complete the questionnaire.

Unlike paper questionnaires, web-based questionnaires are relatively cheap, obtain faster response rate, easy to send reminders to participants, easier to process data as responses can be downloaded to spreadsheets, data analysis packages, ability to randomise questions, and apply complex skip logic relatively easily. Keeping the design of web-based questionnaires relatively simple by reducing the amount of graphics, multiple colours and an array of tables will increase the response-rate (Gunn, 2002). It has been found that simple, easy to use web-based questionnaires will have a positive effect on the response rate (Dillman, 2000). Other possible factors that may increase the response rate is to include a cover letter, keep it brief and concise, conduct a pilot study and using a confidentiality statement. Personalised email cover letters, follow-up reminders, and pre-notifications of the study also positively affect the response rate (Solomon, 2001).

Web-based questionnaires were chosen as the method for the main instrument for this study. One of the main reasons for choosing this method was due to the nature of the population. As this study will be focusing on the perspectives of computing HoDs and lecturing staff it was considered appropriate to use Web surveys as most university campuses have universal internet access which reduces the element of sample bias (Gunn, 2002).

4.4.5.1 Principles of Quality Questionnaire Design

Question design is a crucial to the success of the questionnaire (Oates, 2006). It is imperative that researcher asks the appropriate questions that will generate the relevant data. According to Peterson (2000) questions should be brief, relevant, unambiguous, specific and objective. In other words it is essential that questions are precise, they must be related to the overall purpose of the research, specific in the sense that words with multiple meanings are discarded and jargon is forbidden. Questions must be clear so that the respondent will be sure of what is being asked of them. It is essential also not to ask multiple questions in one. This will only confuse the respondents and will affect their enthusiasm to complete the survey. Questions should not be leading and direct the respondents to a particular answer.

Questionnaires can obtain factual data and opinions. Questions can be divided into open-ended and closed questions. Open-ended question allow the respondent to decide what answer to give, while closed questions force the respondents to choose from a set of pre-defined answers. The questionnaire should leave appropriate space for the respondents to answer open-ended questions. The respondent will become frustrated if too much or too little space is left, potentially affecting their willingness to complete the question (Oates, 2006). They do allow the researcher to get a rich understanding of the opinions and views of the respondent. They require more effort from the respondents and are more difficult to code and analyse then closed questions. Closed questions are more difficult to develop because all possible answers must be considered and pre-defined. However it is easier to code and analyse the data. Closed questions are quicker to for the respondent to answer but they may also cause frustration if the pre-defined answers are not there for the respondent to choose. They have also been criticised because respondents might not give much consideration to their answers.

Questionnaires should have an introduction that explains the purpose of the survey, the timescale of the survey and the return address. It should express that responses given are confidential and that the process is voluntary. They should be thanked for their time. Clear instructions should be given. The questions should be ordered logically and intuitive to the respondents. Easier and less sensitive questions should be asked first and the harder more sensitive questions are later. Factual data such as demographics should not be asked at the start as this bears no relevance to the questionnaire that you described in the introduction. Filter questions are good means of guiding the respondents through the questionnaire. Be careful not to over use these are it may frustrate the respondent. The questionnaire should be attractive, clear, and easy to read. It should not be too long, (respondents will be reluctant to finish it) or short (will not get all the data necessary).

Questionnaires should be evaluated by an expert in the research domain or to experts in questionnaire design. This is to help refine and improve the questionnaire. The questionnaire can then be piloted with a target audience to highlight difficulty in understanding questions and completing it.

According to Lazar and Preece (1999), the four main steps to successfully implement a web-based survey are, design the survey on paper, choose a methodology, convert the paper survey to a web-based survey and inform the population of interest about the survey.

4.5 Research Design

A mixed method approach was deemed the most suitable strategy for this study. This approach consisted of two preliminary studies: a student questionnaire, and a focus group for lecturing staff. Both of these studies, as well as the literature review, were a precursor to and informed the composition of the main research instrument. It was considered important that students and lecturing staffs' opinions be considered as they would ultimately be affected by curriculum change and change necessitated by implemented certification integration.

The focus of the student questionnaire (Appendix A), was to ascertain the respondents' awareness of IT industry certification, their value and support of IT industry certification, and to ascertain if they would be in favour of certification integration into Irish IoTs. The one page self-administered questionnaire was distributed, by lecturing staff, to 86 students in WIT, across a number of IT related courses, incorporating both full time and part time students across all years of these courses. Overall, 91% of the respondents were in favour of integrating IT industry certification into the undergraduate curriculum. The data obtained from this preliminary study was used to help construct some of the questions used in the main research instrument.

The purpose of the focus group (Appendix B) was to establish the perceptions of lecturing staff in relation to certification integration into Irish IoTs. The focus group consisted of six experienced staff members of WIT. The discussion was relatively informal, and it was therefore decided that the use of tape-recording equipment and the assistance of another researcher was not necessary. This decision also allowed the group freedom to express their honest opinions in relation to sensitive topics without fear of repercussions. The data obtained from the focus group was analysed using content analysis in order to identity emerging major themes. These themes subsequently informed the design, structure and content of the main research instrument.

4.5.1 Questionnaire Design

Initially, a list of questions was compiled in paper form to capture the relevant issues highlighted by the literature review, the one-page student questionnaire and the lecturing staff focus group. Questions were organised into relevant sections, which related to specific aspects of the study. These sections are detailed in Table 4.3.

TABLE 4.3: Structure of HoDs and Lecturing Staff Questionnaires

Questionnaire	Section	Section Title
HoD	A	Industry Certification Awareness
	B	Effects of Certification Integration
	C	Training Requirements for Lecturers
	D	Certification Integration
	E	Modes of Integration
	F	Resources
	G	Student Competencies
	H	Reputation of IoT
	I	Summary of Basic Opinion
	J	Demographics
Lecturing Staff	A	Industry Certification Awareness
	B	Current Teaching Styles
	C	Learning Styles
	D	Assessment
	E	Effects of Certification Integration
	F	Training Requirements for Lecturers
	G	Certification Integration
	H	Resources
	I	Student Competencies
	J	Reputation of IoT
	K	Summary of Basic Opinion
	L	Demographics

Several revisions were made to the questions in order to ensure the questions were obtaining the required information relating to the research questions and that any leading or ambiguous questions were omitted. The questionnaire contained some redundant questions for validation purposes.

The questionnaire was designed to obtain both quantitative and qualitative data in order to gain further insight to the responses acquired. The questions consisted mostly of five point Likert and nominal scales with additional categorical scales and open ended questions. The Likert scales obtained the quantitative data regarding the "what" and "how" and the open-ended questions obtained the qualitative data, i.e. "why" information. Fictional statements were used to provoke responses from respondents and an appropriate amount of space was given so that additional information could be provided. According to Oppenheim (1992) the most effective attitude statements are those that are meaningful, interesting and possibly excite the respondent. Careful consideration was given to the construction of the attitude statements. Statement construction followed the general principals of question wording; however language is less formal and direct in nature. As attitudes are essentially emotions, it is important to use wording that is emotive and will trigger an array of responses (Oppenheim, 1992).

After several revisions were made to the paper survey, the process of reviewing the available web surveys was conducted. An existing online web-survey, namely SurveyMonkey was deemed appropriate and selected for this study. However, the service had limited logic therefore two online surveys were created, one for HoDs and one for lecturing staff.

An expert statistician from WIT was consulted throughout the survey design process. A pilot study was conducted at WIT using 10 lecturing staff, which enabled the survey to be pre-tested by colleagues, fellow academics and researchers within the Institute. The results of the pilot study highlighted the need for some small revision to both questionnaires, which were corrected and implemented before commencing the main study.

4.6 Organisation of Research

This study seeks to explore the perceptions of Heads of Departments (HoDs) and lecturing staff in relation to integrating IT industry certification into the undergraduate computing curriculum in Irish IoTs. Two web-survey questionnaires were designed for the two participating groups of this study, namely HoDs and lecturing staff.

A list was compiled of current computing HoDs and their contact details in all IoTs in the Republic of Ireland, excluding Dublin Institute of Technology (DIT). The IoTs relevant to this study are listed in Appendix C.

This list was verified by contacting each IoT and confirming details. An email was sent to all computing HoDs in early February, to invite them to participate in the study (Appendix D). A telephone call was made to HoDs the following day to confirm receipt of the email and to establish personal rapport. It was considered appropriate to obtain cooperation from HoDs as their participation was essential to the study. HoDs were also considered 'gatekeepers' to their lecturing staff, which were also vital for this study. Once cooperation was established, an email (Appendix E) was sent to the HoDs with a link to the HoD questionnaire (Appendix F). A confidentiality statement was also sent to HoDs at this point (Appendix G). The following day (8th February), another email was sent to the HoD (Appendix H) containing the lecturing staff questionnaire (Appendix I). The HoDs were instructed to forward this to all computing lecturing staff in their department. The study was conducted over a three week period. Midway through the study a reminder was sent to the HoDs to encourage all remaining lecturing staff to participate (Appendix J). At the end of the three week period a final email was sent to the HoDs to thank them for their cooperation (Appendix K).

The population targeted in this study was straightforward to ascertain. All current computing HoDs and their departmental lecturing staff were identified as the population, and therefore it was considered a finite population. The HoD questionnaire elicited 12 responses and the lecturing staff questionnaire elicited 74 responses, giving an overall total of 86 responses.

Statistical inference assumes that the sample obtained is a random sample from the population. In this study, as with many studies of this kind, the condition of randomness may not have been met. It is possible that those taking part in this survey may have done so because of their strong opinions regarding some of the research questions and to this extent may not be representative of the wider population. Tests comparing, for example, mean responses from the HoDs and the lecturing staff therefore may not be valid. However, the results are still of interest, interpreted merely as sample descriptive statistics. Nearly all current HoDs and 74 lecturing staff had responded to this survey and our research has revealed many interesting differences in attitude both within and between these two groups.

Two data analysis techniques were adopted to analyse the two types of data obtained from the main research instrument. Quantitative and qualitative questions were used in both questionnaires. The quantitative questions (Likert, nominal and categorical scales) were analysed using the standard SPSS statistical software package. The qualitative questions (open-ended, attitude statements) were analysed using the content analysis technique.

Questions from both HoDs and lecturing staff questionnaires were mapped to each proposition identified in Section 3.3. The purpose of this is to ensure that each proposition is adequately addressed during data analysis. This proposition and question mapping is illustrated in Table 4.4.

TABLE 4.4: Questions Mapped to Propositions

Research Proposition	HoD Questionnaire	Lecturing Staff Questionnaire
Proposition 1	Q3	Q8
	Q4	Q9
	Q5	Q11
	Q6	Q15
	Q25	Q29
		Q4
		Q5 a-d
		Q6 a-b
		Q7 a-b
Proposition 2	Q7	Q16
	Q16	Q20
		Q3
		Q10
		Q12 a-b
		Q13
Proposition 3	Q11	Q18
	Q13	Q19
	Q9	
	Q10	
	Q12	
	Q15	
Proposition 4	Q17	Q21
	Q18	Q22
	Q19	Q23
	Q20	Q24
	Q21	Q25
	Q26	Q30
	Q22	Q26
	Q23	Q27
	Q24	Q28
Proposition 5	A comparison of responses from HoDs and lecturing staff across both questionnaires will address this proposition	

4.7 Conclusion

This chapter highlights the various research strategies available and appropriate for this study. It identifies the a mixed method approach as the most appropriate method to carry out this research and argues for the use of web-based surveys as the research instrument to gather the data. The documentation and questionnaires for this study are contained in the appendices section of this thesis. The next chapter presents the findings and analysis of the data obtained using the research instrument previously described.

CHAPTER FIVE

FINDINGS

5.1 Introduction

The purpose of this chapter is to present the findings of the field study. It is structured around the five research propositions outlined in section 3.3. This chapter presents the quantitative and qualitative results supplied by the respondents of the web-based survey. Quantitative data obtained from HoDs and lecturing staff are presented in tabular form in Appendix L and Appendix M respectively. According to Walsham (1993) there is no right or wrong theories in an interpretive study; but only interesting and less interesting ways in which to view the world. Therefore, a plausible interpretation of findings will be provided for each research proposition and the central themes are then discussed. Due to the interpretive nature of this study, the positivist criteria are deemed inappropriate.

5.2 Background

As shown in section 4.6, two online surveys were sent to 13 Institutes of Technology (IoTs) in the Republic of Ireland. The first questionnaire was sent (via an email link) to all computing Heads of Department (HoDs). The second questionnaire was sent in the same manner, to all lecturing staff within those computing departments, via the HoDs. Out of 13 HoDs contacted, 12 responded. The one non-respondent, while initially enthusiastic about this study, was not able to participate due to unforeseen circumstances at the time of conducting the study. Out of a population that exceeded over 200 lecturing staff, 74 responded. Some of the lecturing staff within the computing department, were possibly not lecturing in computing subjects, so a response rate of 74 is deemed sufficient and satisfactory for this study. Table 5.1 collectively shows the percentage of HoDs and lecturing staff from Irish IoTs that were involved in this study. The IoTs are not displayed alphabetically and the identities are not provided to help realise the confidentially statement.

TABLE 5.1: Percentage of Participating Respondents from Irish IoTs

Institute of Technology (IoTs)	N	Valid percent
Institute 1	3	4.9%
Institute 2	2	3.3%
Institute 3	1	1.6%
Institute 4	2	3.3%
Institute 5	3	4.9
Institute 6	7	11.5%
Institute 7	21	34.4%
Institute 8	6	9.8%
Institute 9	3	4.9%
Institute 10	4	6.6%
Institute 11	1	1.6%
Institute 12	3	4.9%
Institute 13	5	8.2%
Missing/Respondents who did not identify an IoT	**10**	-

5.2.1 Respondent Demographics

Table 5.2 details the demographics of both groups of respondents (HoDs and lecturing staff). Out of the 12 HoDs who responded, 54.5% obtained a doctorate, 36.4% obtained a masters degree while only 9.1% had obtained an honours degree or equivalent. Out of the 74 lecturing staff that responded, 16.0% have obtained a doctorate, 78.0% have obtained a Masters, while only 6.0% have obtained an honours degree or equivalent. It is important to note that out of 74 respondents for the lecturing staff survey, several respondents (24) exited the survey and did not complete the demographics section of the questionnaire. The percentages used in this chapter will be based on valid percentages.

TABLE 5.2: Demographics

		HoD	Lecturing staff
Gender	Male	90.9%	66.0%
	Female	9.1%	34.0%
Age groups	<30	-	14.0%
	31-40	27.3%	52.0%
	41-50	45.5%	28.0%
	60+	27.3%	6.0%
Level of education	Honours Degree or equivalent	9.1%	6.0%
	Masters	36.4%	78.0%
	Doctorate	54.5%	16.0%
Year of experience (Higher education)	<= 14	36.4%	71.4%
	15-24	36.4%	22.3%
	25 +	27.3%	6.1%
Year of experience (Industry)	<= 5	72.8%	73.1%
	6-10	18.2%	18.8%
	11 +	9.1%	8.4%

5.2.2 Subject Area

A list of subject areas was outlined in the lecturing staff questionnaire, which comprehensively covered the major areas of the computing curriculum. Lecturing staff were asked to highlight the areas in which they lectured. Multiple subjects could be selected for each respondent. From the subjects presented, areas such as web and multimedia, project, database, programming and IT fundamentals were the most common subjects taught by lecturing staff. Table 5.3 shows a breakdown of the subjects and the number of lecturing staff that lectured in theses areas.

TABLE 5.3: Subject Area

Subject Area	Number of Lecturing Staff
Web and Multimedia	19
Systems Architecture	4
Project	22
Networking and Communications	12
Management	5
Database	14
Programming	21
Artificial Intelligence	6
Systems Analysis and Design	11
Distributed Systems	7
IT Fundamentals	15

5.3 Main Findings

This section will report the main findings of this research. A general overview will be provided, followed by an in-depth analysis of each of the propositions identified in chapter three. Finally an overall discussion of the findings will be presented.

5.3.1 General Overview

In general, mean scores for HoDs and lecturing staff are compared using 2-tailed tests. Hence the null hypothesis in each case is:

$$H0: \mu 1 = \mu 2$$

with alternative hypothesis:

$$H1: \mu 1 \neq \mu 2$$

where: $\mu 1$ represents the population mean score of lecturing staff and

$\mu 2$ represent the population mean score of HoDs

One exception to this is in section 5.4.1.1 where 1-tailed test is appropriated. These tests assume equal variance of scores in the two groups being compared. Levine's test is a test of equality of variance and occasional variations of this assumption are noted in the text.

A list of certifications, which are displayed in Table 5.4, was presented to both groups of respondents (HoDs and lecturing staff) to ascertain their level of awareness for some of the current IT industry certification available. The respondents were asked to indicate on a scale of one to six (1 = Never heard of and 6 = Very familiar) their level of familiarity with these certifications. The results are detailed in Table 5.4.

TABLE 5.4: Certification Awareness

Certification		N	Mean	Std. Deviation	p-value (2-tailed test)
PMP	HoD	12	1.75	1.422	.220
	Lecturing Staff	73	1.21	.799	
Project+	HoD	12	1.50	.674	.441
	Lecturing Staff	73	1.32	.780	
CCNE	HoD	12	3.92	1.929	.008
	Lecturing Staff	73	2.37	1.799	
Network +	HoD	12	3.58	2.021	.010
	Lecturing Staff	73	1.75	1.392	
OCP DBA	HoD	12	2.17	1.642	.153
	Lecturing Staff	73	1.42	1.135	
IBM CDA	HoD	12	1.75	.866	.146
	Lecturing Staff	73	1.37	.835	
SCJP	HoD	12	2.25	1.712	.104
	Lecturing Staff	73	1.36	1.046	
MCAD	HoD	12	2.67	1.875	.077
	Lecturing Staff	73	1.85	1.391	
RHCE	HoD	12	1.42	.900	.666
	Lecturing Staff	73	1.29	.964	
CNE	HoD	12	3.33	1.614	.004
	Lecturing Staff	73	1.93	1.484	
A+	HoD	12	3.67	1.923	.018
	Lecturing Staff	73	2.30	1.808	
CCP	HoD	12	2.08	1.730	.392
	Lecturing Staff	73	1.73	1.261	
MCP	HoD	12	3.92	1.564	.011
	Lecturing Staff	73	2.41	1.892	
CIW	HoD	12	1.42	.669	.539
	Lecturing Staff	73	1.26	.834	

1 = Never heard of 6 = Very familiar

From the certifications provided, Project+, IBM CDA, RHCE and CIW were among the least recognised certifications for both groups of respondents, with MCAD and CCP being recognised only by the acronym. There is some sample evidence to suggest that HoDs had a greater level of familiarity than lecturing staff in relation to CCNE, Network+, CNE, A+ and MCP, with p-values of .008, .010, .004, .018 and .011 respectively. On further analysis, the results show that although the HoDs did not indicate a greater significant difference in mean for PMP, OCP DBA and SCJP, they did show a statistically significant greater variance in responses than lecturing staff (SD: 1.422, 1.642, 1.712). This was also true for Network+.

The survey asked both groups of respondents if they had ever obtained an IT industry certification. One third of the HoDs and 23.6% of lecturing staff indicated that they had obtained an IT industry certification. The results are displayed in Table 5.5.

TABLE 5.5: Number of Respondents who Obtained IT Industry Certification

	N	Yes	No
HoD	12	4 33.3%	8 66.7%
Lecturing Staff	72	17 23.6%	55 76.4%

1 = Yes 5 = No

HoDs were asked if the had previously attempted to integrate IT industry certification into their undergraduate curriculum. The results show that 9 (75.0%) of the respondents reported that they previously had attempted certification integration into the undergraduate curriculum. The comments provided by the respondents highlighted that many of the IoTs had considered it to some extent but only two respondents indicated that they had implemented specific certifications into their undergraduate curriculum. One IoT noted that they offer Cisco's CCNA and CCNP and Microsoft Certified Professional (MCP) as part of their undergraduate degree.

HoDs were also asked if their Institute offered IT industry certification in any other mode, for example, evening courses. 10 (83.3%) of the respondents indicated that they did offer IT industry certifications in this form. From the comments provided, all of the respondents indicated that they offer some Cisco certification, with CCNA being the most common certification provided. Other certifications offered by the IoT**'s** included CompTIA's A+, Network+, Linux+, Novell Certified Linux and some Microsoft certifications.

5.4 Analysis of Propositions

The following section will address and discuss each proposition in detail and ultimately accept or reject the propositions based on the findings.

5.4.1 Proposition One

Proposition 1: *Integrating IT industry certification into Irish IoTs would require lecturing staff to change their current teaching methods.*

In order to accept or reject proposition one, the researcher had to first identity the current work practices of lecturing staff in Irish IoTs. Questions were taken from several sections of both questionnaires (HoDs and Lecturing staff). Sections included for this proposition are: Current Teaching Styles, Current Learning Styles and Assessment.

Table 5.6 highlights the results to question 4 from the lecturing staff questionnaire where the respondents (lecturing staff) were asked, on a scale of one to five (1 = Use rarely and 5 = Use regularly), how often they used the materials listed in the table, in their classroom.

TABLE 5.6: Materials Used by Lecturing Staff

Materials	Use rarely (1)	2	3	4	Use regularly (5)
Acetates	47 (68.1%)	8 (11.6%)	9 (13.0%)	1 (1.4%)	4 (5.8%)
PowerPoint slides	10 (14.5%)	5 (7.2%)	6 (8.7%)	2 (2.9%)	46 (66.7%)
Prescribed textbooks	16 (23.2%)	16 (23.2%)	13 (18.8%)	16 (23.2%)	8 (11.6%)
Photocopied handouts	18 (26.1%)	11 (15.9%)	20 (29.0%)	8 (11.6%)	12 (17.4%)
Custom written handouts	17 (24.6%)	7 (10.1%)	4 (5.8%)	7 (10.1%)	34 (49.3%)
Websites	7 (10.1%)	7 (10.1%)	16 (23.2%)	16 (23.2%)	23 (33.3%)

1 = Use rarely **5 = Use regularly**

The evidence shows strong support for use of PowerPoint slides for delivering course material in the classroom, with over two thirds (69.6%) of the respondents indicating that they use them to some degree. Other popular materials used by lecturing staff are custom written handouts (59.4%) and the internet (56.5%). However, there is less support for the use of acetates in course delivery, with 79.7% of respondents indicating two or less on the Likert scale.

Question 5 on the lecturing staff questionnaire asked the respondents their opinions in relation to the structure of lectures, how they thought the syllabus should be used, their opinions on student participation, and if they used problem cases and scenarios in their lectures. Similarly, question 6 on the lecturing staff questionnaire asked the respondents their opinions on the effectiveness of problem based learning and the benefits of using personal computers in the classroom. The responses are detailed in Table 5.7.

TABLE 5.7: Methods Used by Lecturing Staff in the Classroom

Opinion	1	2	3	4	5
Question 5 (a-d)					
Lectures *(1 = flexible, 5 = well structured)*	0 -	5 (7.2%)	19 (27.5%)	29 (42.0%)	16 (23.2%)
Syllabus *(1 = use rigidly, 5 = use as guide)*	3 (4.3%)	18 (26.1%)	22 (31.9%)	15 (21.7%)	11 (15.9%)
Student participation *(1 = not at all important, 5= very important)*	0 -	1 (1.4%)	6 (8.7%)	10 (14.5%)	52 (75.4%)
Problem cases and scenarios *(1 = never use, 5 = always use)*	2 (2.9%)	7 (10.1%)	16 (23.2%)	34 (49.3%)	10 (14.5%)
Question 6 (a-b)					
Problem Based Learning *(1 = not at all effective, 5 = very effective)*	1 (1.4%)	3 (4.3%)	22 (31.9%)	29 (42.0%)	14 (20.3%)
PC used in the classroom *(1 = not at all beneficial, 5 = very beneficial)*	3 (4.3%)	12 (17.4%)	19 (27.5%)	21 (30.4%)	14 (20.3%)

There is strong evidence to suggest that lecturing staff believe that lectures should be structured to some degree, with 65.2% of the respondents indicating four or more on the Likert scale. Although, there was some support (7.2%) for elements of flexibility within lectures, almost one third of the respondents were undecided (or related equally well to both ends of the scale). Opinions regarding syllabus were reasonably evenly distributed, with approximately one third of the respondents suggesting that the syllabus should be used rigidly, with another third (approx.) suggesting it should be used as a guide. The remaining third of respondents were undecided regarding how the syllabus should be used. This could suggest that the syllabus is followed rigidly by lecturing staff if it is well structured, current and comprehensive for both the lecturer and the student, otherwise it may only be used as a guide. Another possible reason for using the syllabus as a guide could be if lecturing staff have sufficient experience in teaching a particular subject and are aware of what is required to be covered in the syllabus. 90% of the respondents thought that student participation was an important aspect within the classroom environment. No respondent suggested that student participation was not at all important.

Problem cases and scenarios are commonly used by lecturing staff during lectures, with 63.8% of respondents indicating that they use them to some degree of regularity for course delivery. Only 13% of the respondents specified they did not use or almost never used this method of delivery in their lectures. 62.3% of respondents thought that Problem Based Learning (PBL) was an effective method when used in the classroom. Half of the respondents (50.7%) thought the use of personal computers would be beneficial in the classroom, however 21.7% thought their inclusion would have little or no benefits. A further 27.5% were undecided.

Question 7 on the lecturing staff questionnaire was broken down into part A and B. Part A asked the respondent to indicate on a scale of one to five, how often they used the specified methods of testing. Part B asked the respondents how they administered those assessments. The results are detailed in Table 5.8.

TABLE 5.8: Methods of Testing and Assessment Used by Lecturing Staff

Methods of testing (a)	Use rarely (1)	2	3	4	Use regularly (5)
Multiple choice questions	31 (44.9%)	10 (14.5%)	14 (20.3%)	8 (11.6%)	6 (8.7%)
Essay style exams	35 (50.7%)	9 (13.0%)	8 (11.6%)	6 (8.7%)	11 (15.9%)
Structured exams	7 (10.1%)	6 (8.7%)	9 (13.0%)	6 (8.7%)	41 (59.4%)

1 = Use rarely 5 = Use regularly

Exam administration (b)	Never Use (1)	2	3	4	Always Use (5)
Written exams	4 (5.8%)	10 (14.5%)	11 (15.9%)	15 (21.7%)	29 (42.0%)
Computer-based exams	20 (29.0%)	8 (11.6%)	13 (18.8%)	16 (23.2%)	12 (17.4%)

1 = Never use 5 = Always use

Over two thirds (68.1%) of the respondents indicated that they use structured type exams on a regular basis as their method of testing. Almost two thirds (63.7%) of the respondents indicated that essay style exams were seldom used. Interestingly, 59.4% of the respondents indicated that they hardly ever used multiple choice exams as a testing method. As noted in section 2.2.4, multiple choice exams are commonly used by certification testing centres as a preferred method of testing. From these results, it is evident that lecturing staff would have to adopt a similar method of testing for certification in order to align themselves with the testing procedures that need to be adhered to. 63.7% of lecturing staff indicated that they use written exams for exam administration. 40.6% of respondents indicated that they almost never use computer-based exams when administering assessments. Computer-based testing is almost always used for certification testing, with the exception of laboratory based testing for practical exams, for instance, the practical aspects of CCNE certification as noted in section 2.2.4. The results suggest that lecturing staff would be required to change their methods of assessment in order to facilitate certification testing.

5.4.1.1 Comparing HoDs and Lecturing Staff Responses to Certification Integration Issues

Both groups of respondents, HoDs and Lecturing staff, were asked to indicate their level of concern on a scale of one to five (1 = No concern at all and 5 = Major concern), relating to a set of pre-defined certification integration issues, as listed in Table 5.9. Before analysing the result for these issues, a presumption was made that lecturing staff would show a higher level of concern than HoDs regarding some of the issues outline in Table 5.9. Therefore 1-tailed tests were deemed appropriate. Hence the null hypothesis in each case is:

$$H0: \mu1 = \mu2$$

with alternative hypothesis:

$$H1: \mu1 > \mu2$$

where: $\mu1$ represents the population mean score of lecturing staff and

$\mu2$ represent the population mean score of HoDs

TABLE 5.9: Certification Integration Issues

Issues		N	Mean	Std. Deviation	p Value *(1-tailed test)*
Time (updating knowledge and skills	HoD	12	3.42	.996	.350
	Lecturing Staff	67	3.28	1.516	
Development of new course material	HoD	12	2.58	.996	.074
	Lecturing Staff	67	3.48	1.348	
Flexibility (integrating certification into existing courses	HoD	12	3.33	1.073	.461
	Lecturing Staff	67	3.37	1.335	
Teaching Style	HoD	12	2.75	1.138	.388
	Lecturing Staff	67	2.87	1.325	
Learning Style	HoD	12	2.92	1.240	.418
	Lecturing Staff	67	3.00	1.291	
Resources (physical resources, i.e. classrooms, hardware and software	HoD	12	3.25	1.357	.490
	Lecturing Staff	67	3.24	1.468	

1 = No concern at all   5 = Major concern

From the data, it emerged that on average, HoDs and lecturing staff thought there would be some level of concern in relation to time for updating lecturing staff's knowledge and skills in order to deliver certification within the computing curriculum. Further analysis shows that lecturing staff showed a greater variance in responses (SD: 1.516) in relation to the time issue. Table 5.10 highlights the extensive variation of responses from lecturing staff.

TABLE 5.10: Variation of Responses in Relation to Specific Certification Issues

Issue		N	No concern (1)	(2)	(3)	(4)	Major concern (5)
Time (updating knowledge and skills)	HoD	12	0 .0%	2 16.7%	5 41.7%	3 25.0%	2 16.7%
	Lecturing staff	67	11 16.4%	14 20.9%	9 13.4%	11 16.4%	22 32.8%
Development of new course material	HoD	12	2 16.7%	3 25.0%	5 41.7%	2 16.7%	0 .0%
	Lecturing staff	67	11 16.4%	9 13.4%	17 25.4%	17 25.4%	13 19.4%

1 = No concern at all   5 = Major concern

Regarding the issue of developing new courses, on average HoDs indicated less concern (mean score of 2.58) than lecturing staff (mean score of 3.48). Again further analysis shows that lecturing staff showed a greater variance in responses (SD: 1.348) in relation to concern surrounding the development of new course material. This is also highlighted in Table 5.10.

HoDs and lecturing staff also highlighted some concern with the flexibility of integrating certification into existing courses and obtaining physical resources such as classrooms, hardware and software to deliver certification. All these issues had on average a mean score greater than three. The evidence suggests that there would be less concern from both types of respondents in relation to teaching styles and learning styles, where the mean scores on average were lower than three. The mean and standard deviations corresponding to these issues are detailed in Table 5.9. All these issues have a p value greater than 0.05, which suggests that there was insufficient sample evidence to conclude that lecturing staff would be more concerned than HoDs about these issues.

Furthermore, HoDs and lecturing staff were asked about the effectiveness of Computer-based Training (CBT) in assisting certification delivery within the computing curricula. Both sets of respondents on average indicated 3 or more on the Likert scale which suggests that CBT would be somewhat effective in delivering certification within the curricula.

5.4.1.2 HoDs and Lecturing Staff's General Opinion of Certification Integration

Both HoDs and lecturing staff were presented with a list of fictional quotes and were asked to select the response that most represented their opinions ranging from one to five (1 = Strongly disagree and 5 = Strongly agree). The respondents were given additional space to elaborate if necessary. Each of theses quotes will be addressed individually. Table 5.11 summarises the opinions of HoDs and Lecturing staff regarding certification integration and its effects on the current work practices of lecturing staff.

TABLE 5.11: Opinions of Certification Integration and its Effect on Current Work Practices

Question		N	Mean	Std. Deviation	p Value *(2-tailed test)*
"Vendors will dictate what and how we teach"	HoD	12	2.58	1.240	.016
	Lecturing Staff	69	3.39	1.018	
"Certification will disrupt our current way of teaching and our traditional courses will suffer"	HoD	12	2.33	1.073	.135
	Lecturing Staff	67	2.87	1.086	
"There is no need to integrate certification, our existing approach has worked in the past"	HoD	12	2.42	1.084	.784
	Lecturing Staff	51	2.51	.809	

1 = Strongly disagree 5 = Strongly agree

<u>Statement One</u>

> *"Integrating IT industry certification into the undergraduate curriculum will mean that vendors will dictate what and how we teach, potentially affecting the quality of our courses"*
>
> A. N. Other

From the results shown in Table 5.11, there is some sample evidence to suggest that HoDs and lecturing staff vary in opinion in relation to this statement, with a p-value of .016. On average HoDs indicated less than three on the Likert scale, with a mean score of 2.58, suggesting that they somewhat disagreed with the notion that integrating IT industry certification into the undergraduate curriculum would mean vendors would dictate what and how we teach. On further analysis of the comments provided by the HoDs it emerged that although they seem to recognise the potential risk of vendors dictating what and how to teach, they believe if certification integration was managed properly the challenges could be addressed appropriately. One respondent noted that their particular institute offered a number of certifications as an addition to their programs, but "it did not dictate what they do". The respondent suggested that where certification "fits" they were "happy to offer the option to students".

In contrast, lecturing staff on average indicated three or more on the Likert scale with a mean score of 3.39, suggesting that they, to a greater extent, agreed that certification integration will mean that vendors will dictate what and how we teach. From the comments provided by lecturing staff it emerged that some respondents thought that certification could potentially "shift the focus from the syllabi". One respondent, who is directly involved with delivering a certification course (CCNA), noted that certification preparation is time consuming and it places additional work on the students. Although some respondents thought that certification integration could be worthwhile, many question the merits of integrating vendor specific products suggesting corporations such as Microsoft would "dictate course content", enhance their "clout in the market" and "guarantee profits for shareholders". One respondent strongly resisted "corporate intrusion into the academic domain", and asks why considerations should be made for "corporate services that have no moral or ethical commitment to providing future employment for our graduates". Another respondent commented that third level education was not about providing what industry requires immediately, they suggest that higher education is about "what society needs today and industry might need in the future".

Although it is accepted that certification integration may enhance student enrollments in the future, some respondents question certifications place in higher education, with one respondent stating that "training should not supplement education". However it was noted that "certifications can be motivating for students above and beyond what our syllabus is teaching". Some suggested that most entry level certifications cover the standard set of introductory material and could be advantageous in first and second year courses. Some suggest that certification integration could improve the quality of courses because they will be combined with existing courses and if implemented correctly, course content could match industry needs. One respondent suggests that any initiative that helps graduates gain employment should be welcomed.

Statement Two

> *"Integrating IT industry certification at undergraduate level will disrupt our current way of teaching and our traditional courses will suffer"*
>
> A. N. Other

On average HoDs indicated less than three on the Likert scale, with a mean score of 2.33, suggesting that they disagreed with the notion that certification integration would disrupt the current way of teaching and the traditional courses would suffer as a result. Some respondents suggested that certification integration and its impact on the current way of teaching might not be a "bad thing" with another suggesting that it could potentially be a "major help". This would suggest that there is a belief that the current methods of teaching and traditional courses according to HoDs require some form of change.

Likewise, lecturing staff on average indicated less than three on the Likert scale, with a mean score of 2.87, indicating that they too disagreed with this statement. On further analysis of the lecturing staff comments, there appeared to be some conflict of opinions regarding this statement. However there is a strong feeling that the so-called existing approach requires some element of change. One respondent suggests that current "methods of delivery probably need to evolve" which was supported by another respondent who remarked that although the courses would certainly change, it may not be a "bad thing" as another respondent remarked that the current approach is "not producing enough good graduates at the moment". One respondent stated:

> *"our tradition at present is patchy quality and needless overlap of models (every course with its own version). The quicker we shake this up and have a smaller number of better designed modules, and staff training so we can all deliver to the required standard, the better".*

However, some respondents indicated that traditionally higher education is about "educating" students how to think about computing concepts so that they can later apply this knowledge to specific areas of computing. Another respondent noted that integrating certification into the computing curriculum would certainly require additional work of the students and it would have a "negative impact on their learning experience". One respondent highlighted the preference for certification to be an "optional module in addition and separate to the existing courses".

<u>Statement Three</u>

> *"There is no need to integrate IT industry certification into the curriculum. Our existing approach has worked for us in the past!"*
>
> A. N. Other

On average HoDs indicated less than three on the Likert scale, with a mean score of 2.42 (SD: 1.084), suggesting that they disagree with the statement that certification integration was not necessary as the existing approach is working satisfactorily. The comments were limited by HoDs regarding this statement however one respondent did note that integrating certification into the curriculum could "add something" to the existing approach.

Lecturing staff also indicated less than three on the Likert scale, with a mean score of 2.51, suggesting that on average they disagreed with this statement. The results suggest that there was consensus among the lecturing staff regarding their opinions with this statement. One common theme that emerged from the lecturing staff's comments is that the existing approach "hasn't worked too well" in the past in producing quality IT professional. One respondent stated that "at one time it worked for sure", while another respondent posed the questions "is it working for us now?" There seems to be some element of dissatisfaction with the current approaches to teaching. Some evidence suggests that it is important to "roll with the times" with one respondent suggesting that "things are much more competitive now" and by not considering certification could be an "excuse to avoid work". Another respondent suggested that there should be some element of industry training and if coupled with the existing approach it would provide students with a more "rounded educational experience".

These comments suggest that there is a need to address the existing approach and perhaps implement some form of change. However some respondents do not consider certification integration to be the answer. One respondent suggests that "improving the traditional approach to promote critical thinking would be a wiser avenue" to explore. There was also some evidence to suggest that "we should be doing more research".

The findings show that there are several areas of lecturing staff's current work practices that would need to be addressed and potentially changed if IT industry certification was to be integrated into the undergraduate curriculum into Irish IoTs. The respondents indicated strong support for the use of PowerPoint slides and custom written handouts as a preferred method of course delivery. Most certification training programmes involve extensive use of computer-based training and online resources that accompany study materials to deliver coursework and practical examples as seen in Section 2.2.5. Lecturing staff would be required to use these methods to deliver certification courses. Some change would be required by lecturing staff that currently use non-computer based delivery methods in their lectures.

IT industry certifications follow very rigid syllabi to ensure full coverage of all the material required for the standardised exam. Lecturing staff were somewhat divided on how the course syllabi should be used, with one third indicating that they use it as a guide. Again, lecturing staff would have to follow the certification syllabi rigidly to guarantee successful completion of the certification training for their students.

Overall the findings addressed for proposition show that MCQ-type exams, and computer-based exams, are rarely used by lecturing staff. As addressed in section 2.2.4 certification testing is usually carried out through the use of Multiple Choice Questions (MCQ's) and now, to a lesser extent, essay type questions, which are usually administered as computer-based exams. Certification integration would require lecturing staff to adopt these methods of testing and administration in order to successfully implement certification into the undergraduate curriculum in Irish IoTs. Time to update knowledge and skills and to develop new courses would also impact on the current work practices of lecturing staff. Therefore on balance, proposition one is accepted.

5.4.2 Proposition Two

Proposition 2: *Integrating IT industry certification into Irish IoTs would require lecturing staff to obtain additional training to effectively deliver certification.*

In order to accept or reject proposition two, the current skills of lecturing staff firstly had to be identified. Questions were analysed from several sections of both questionnaires (HoD and lecturing staff). Sections included for this proposition are: (1) current teaching styles, (2) effects of certification integration, (3) training requirements for lecturers and (4) resources.

In this survey, 19 (26.8%) of the lecturing staff indicated that they had received some type of formal teacher training, while 52 (73.2%) respondents indicated that they had not. Although there are many educational theories and models that exist in education as detailed in section 2.3.4, officially there is no prerequisite for lecturing staff to have obtained formal teacher training in order to lecture in Irish IoTs.

Question 12 on the lecturing staff questionnaire asked the respondents to indicate on a scale of one to five (1 = Not at all comfortable and 5 = Very comfortable) how comfortable they would feel about delivering a certification programme as part of one of their existing modules. The responses were relatively evenly distributed with 37.8% of respondents indicating two or less on the Likert scale signifying that the would not be comfortable delivering some form of certification in their modules. 33.4% of lecturers suggested that they would be comfortable and a further 28.8% of lecturers were undecided. For those who indicated 3 or more on the likert scale they were asked to suggest the certification and disciplines for which they would be comfortable in delivering the certification. Table 5.12 lists the results.

TABLE 5.12: Lecturing Staffs' Comfort with Certification Delivery for Specific Disciplines

Participant	Certification	Discipline
Participant 1	Cisco CCNA	Computer networking
Participant 2	Java (Sun) certified programmer	Computer Programming
Participant 3	MCP	IT
Participant 4	Cisco	Networking subject
Participant 5	Cisco CCNA and CCNP	Computer Networks
Participant 6	CCNA, Office certification	Networking, IT applications
Participant 7	CCNA	Networking
Participant 8	PMP, PRINCE2, A+, NETWORK+,	Project Management, Networking
Participant 9	Oracle (if training provided)	Database
Participant 10	CCNA	Networking
Participant 11	CCNE	Networking
Participant 12	SAP OR ORACLE	IS & Databases
Participant 13	Macromedia and Adobe	Multimedia and Design
Participant 14	MCDBA	Databases
Participant 15	Cisco CCNA	Computer networks
Participant 16	Sun – java	Programming
Participant 17	CIW	Web Development
Participant 18	SCJP (Sun Certified Java Programmer)	Programming
Participant 19	CCNA	IT Networking
Participant 20	Network+	Intro to networking
Participant 21	CCNA	Computer Networking
Participant 22	SCJP	OO Programming

It is clear from Table 5.12 that the respondents would be more comfortable delivering certifications in three main areas; networking, programming and databases. The respondents specified that Cisco certifications such as CCNA and CCNE as well as A+ and Network+ were the most popular. SCJP (Sun Certified Java Programmer) was also common in relation to programming certifications and Oracle was also popular for database certifications.

5.4.2.1 Lecturing Staffs' Current Skills

Lecturing staff were presented with the following fictional statement and were asked to choose on a scale of one to five (1= Strongly disagree and 5 = Strongly agree) the response that most represented their opinion. A space was provided to allow the respondents to elaborate if necessary.

<u>Statement Four</u>

> *"People get rusty; we can't help it! Lecturing staff would no be able to effectively deliver industry certifications at undergraduate level as most of us do not have the current and up-to-date expertise to do so".*
>
> A. N. Other

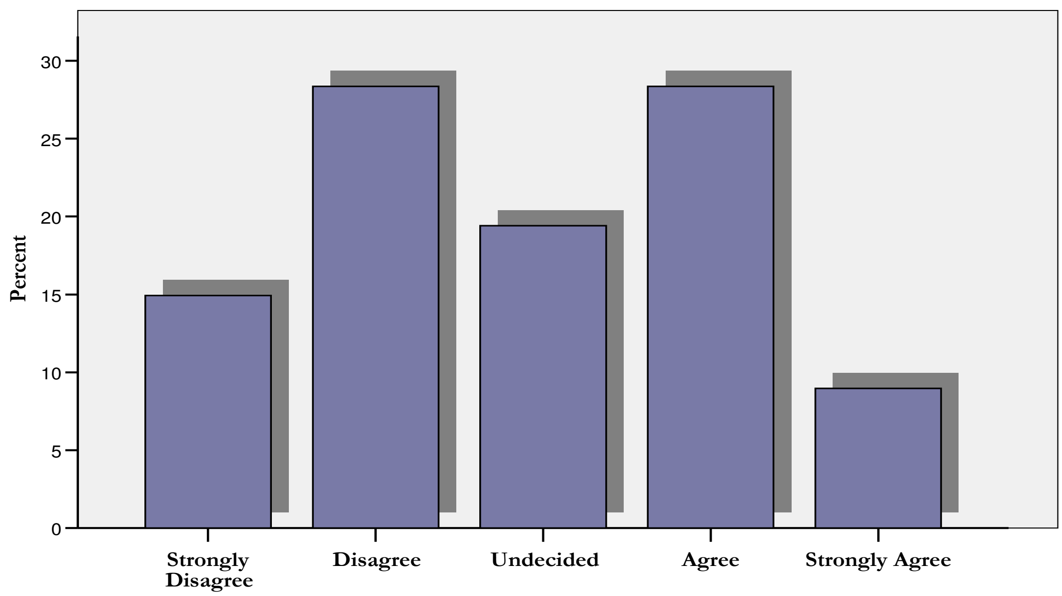
TABLE 5.13: Lecturing Staffs' Opinions in Relation to Current Skills

N	Strongly Disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly Agree (5)
67	10 14.9%	19 28.4%	13 19.4%	19 28.4%	6 9%

1 = Strongly disagree 2= Strongly agree

Table 5.13 shows that respondents' opinions relating to this statement were fairly evenly distributed. However there is a slight tendency to disagree with the notion that lecturing staff would not have the current and up-to-date skills to effectively deliver a certification at undergraduate level, with 43.3% of the lecturing staff choosing 2 or less on the Likert scale. However there was some level of agreement with this statement with over a third of the respondents indicating 4 or more on the Likert scale. Figure 5.1 further illustrates the split in opinion in relation to this statement.

Figure 5.1: Current and Up-to-date Skills of Lecturing Staff



Further examination of comments provided by lecturing staff provided some interesting insight into some lecturing staff's perspectives on this. One respondent suggested that lecturers tend not to get "rusty" if they have a specialty area. Another respondent suggested that all lecturers should have "at least one area of expertise" and that "getting rusty" should not happen "within the first 20 years". Another respondent noted that it is the lecturer's responsibility to keep abreast of the current developments. While it was also noted that teaching industry certifications can help keep skills current, another respondent noted "the curriculum that is often out of date".

Another aspect that was highlighted was in relation to time to train. It was suggested that keeping current would only be possible if training and hours were made available in the timetable for this. It was also noted that it "might be beneficial for lecturers to do 'real work' from time to time to keep a hand in what is actually going on and being used", while another respondent agreed, commenting that "we need to be up to speed, this would keep us on our toes". However, it was also noted that although "all ICT staff need regular updating" it could be "managed through engagement in research" as well as industry certification.

Some respondents suggested that it is very difficulty to keep skills current "especially in highly technical areas". Another respondent noted that "training within the IoT sector is poor and consequently there is a degree of de-skilling over time". However another respondent suggested that "computing evolves quickly, [and] courses are always updated and lecturers need to update their skills on a regular basis anyway". It was also suggested that keeping current would not be a problem for "young lecturing staff", but the "older staff would have a problem…as they cannot use the majority of the software" available. This could suggest that more senior staff lecturer in subjects that do not require the use of software and therefore they are not required to be up-to-date with the latest technologies.

One respondent commented, in relation to their specific Institute, that "there is no guarantee that anyone is being taught by an expert in the relevant field". The respondent implied that "timetabling and scheduling of resources seems to be seen as the exercise of putting every class group in a room, no matter how inappropriate, and putting a body in front of them, on a per hour detail". Implications for students of certification integration were also mentioned with one respondent commenting that they would have "trouble keeping up with the breadth of material required by such accreditation".

Question 13 on the lecturing staff questionnaire asked the respondents their level of concern in relation to their current knowledge of vendor technologies and if it was current enough to deliver a certification programme. The results showed that 40.9% of the respondents indicated that they would have some level of concern that their knowledge of vendor technologies may not be current enough to deliver a certification programme, while a third (33.3%) of the respondents believe that there would have little concern regarding this. 25.8% of the respondents were undecided in relation to this.

Statement Five

> *"IT industry certifications are moving targets, and are frequently changing. The computing department would not be able to manage the changing skills and resources required for delivering the IT industry certification in the undergraduate curriculum. It is not easy keeping up with industry developments".*
>
> A. N. Other

TABLE 5.14: Respondents' Opinions in Relation to Managing Skills and Resources

	N	Mean	Std. Deviation
HoD	12	3.00	.739
Lecturing Staff	58	3.03	1.123

1 = Strongly disagree 5 = Strongly agree

On average, HoDs, with mean scores of 3.00 suggests that in general they were undecided in relation to this statement. On further analysis of the comments provided by the HoDs it emerged that some respondents recognised that although there is constant change within the IT environment, it "can be solved with suitable resourcing". This was echoed by another respondent who suggested "that the main difficulties are already stretched resources and the amount of time required for staff who have a full teaching load to remain current with developments in industry". However another respondent argues that "if we cannot educate and keep up with industry developments at an appropriate level that begs a very large question". Costs were also highlighted as a problem.

Lecturing staff on average had a mean score of 3.03, which indicates that they too were undecided regarding this statement. On further analysis of the comments provided by the lecturing staff it emerged that resourcing is an ongoing continuous issue. One respondent noted that although it is not easy keeping up with industry developments, it must be attempted in order to "prepare students for industry requirements". It was mentioned by a respondent that this statement was possibly true, even though it should not be and commented that there should be "greater liaison between colleges and industry including flexible modes of training and work placements in industry". Some suggest that it could be managed properly with greater efforts but were skeptical as to the reality of this, with one respondent commenting that this is "a major part of our remit".

One respondent strongly suggested that "willingness and ability of the teachers to update skills is a small detail" and suggests that "the problem would be more to do with whether management would be willing to spend money updating to the latest software licenses and hardware as this becomes necessary with new product releases. Tying education to the profits of software companies means that management have to step up to the plate and deliver on training and resources…Otherwise it's a case of yesterdays technology tomorrow…". The computing discipline is constantly changing and therefore there is a constant requirement to keep skills updated anyway. "Well established programmes are regularly updated….but not any more than the general requirement for staying current in ICT". Cost again was highlighted as an issue, with one respondent suggesting that updating skills would be too "expensive". However, another respondent commented that not doing it would "probably mean an easier life" for lecturing staff.

5.4.2.2 Modes of Certification Training

Both HoDs and lecturing staff were asked on a scale of one to five (1 = Very much dislike and 5 = very much like) their preference regarding modes of certification training for lecturing staff. The results are shown in Table 5.15.

TABLE 5.15: Modes of Certification Training for Lecturing Staff

Modes of Certification Training		N	Mean	Std. Deviation	p Value *(2-tailed test)*
Self-study texts, workbooks and videos	HoD	12	3.33	.985	.281
	Lecturing Staff	63	2.94	1.190	
Computer Based Training (CBT)	HoD	12	3.67	.778	.028
	Lecturing Staff	63	2.89	1.152	
Onsite (with expert external facilitators)	HoD	12	3.67	1.073	.935
	Lecturing Staff	63	3.70	1.253	
Offsite (bootcamps, workshops)	HoD	12	3.33	1.073	.793
	Lecturing Staff	63	3.34	1.160	
Special Interest Groups (SIGS) and peer learning	HoD	12	4.00	.853	.003
	Lecturing Staff	63	2.92	1.154	
Online classes	HoD	12	4.00	.853	.002
	Lecturing Staff	63	2.83	1.212	

1 = Very much dislike 5 = Very much like

It is clear from the results that on average, both HoD and lecturing staff showed preference for certification training methods such as self-study texts, onsite training and offsite training. These modes of training had on average a mean score greater than three for both HoDs and lecturers, but there was no real evidence to suggest greater preference by either group ($p>0.05$ in all cases). However in contrast to this, the results also show that, on average HoDs seemed to be more in favour of Computer Based Training (CBT), Special Interest Groups and online classes as modes of training for lecturers than the lecturers themselves. HoDs showed a statistically significant greater mean for these types of training than lecturing staff, with a p-value less than 0.05 in all three cases.

HoDs and lecturing staff were given the opportunity to add additional comments in relation to training for lecturing staff, and this provided more insight into the opinions of both groups of respondents. One HoD suggested that it is vital to "select carefully" certifications for integration as it requires "significant resources" to incorporate these into existing courses. Cost was considered an issue by several respondents however one respondent noted the upside that "staff is up to date on products".

Another respondent commented that certification integration is a "great idea" but there are many obstacles to overcome "especially time". Although another respondent noted that upskilling lecturers could be done relatively quickly as the fundamentals, which are thought to be the difficult part, are already there. Some respondents that have some types of product and/or discipline training suggested that they would like to have the opportunity to obtain the relevant certifications for them if there was a support system to handle the time and workload issues for it. For subjects like programming there seems to be support that lecturers should be encouraged to keep their skills up to date. One respondent suggested that some certifications might require "rote learning" and implies that lectures may not be in favour of this.

While one lecturer noted that Cisco and Microsoft certification integration is working well in their Institute, another respondent questions why certification integration is "necessary" in what is generally a "knowledge specific program of study". Others agreed suggesting that maybe certification should be left to the private sector or post-graduate training and not "impinge on our delivery modes".

Cost, time and budgets are some of the issues that have been raised in relation to lecturing staff's training requirements for certification integration. However, overall the general impression in relation to proposition two is that lecturing staff would require additional training in order to effectively deliver IT industry certification at undergraduate level in Irish IoTs. However there are mixed opinions amongst both types of respondents as to whether certification integration is appropriate for Irish IoTs. These issues will be addressed later in this chapter. Therefore, on balance proposition two is accepted.

5.4.3 Proposition Three

Proposition 3: *Current support systems, resources and existing courses could accommodate certification integration into Irish IoTs*

In order to accept or reject proposition three, an investigation of how the current support systems, resources and existing courses could accommodate the integration of IT industry certification into Irish IoTs is required. Questions were taken from several sections of both questionnaires (HoDs and lecturing staff) in order to address proposition three. Sections included for this proposition are: (1) certification integration, (2) modes of integration, (3) resources and (4) summary of basic position.

Question 9 from the HoD questionnaire asked the respondents to indicate on a scale of one to five (1 = Not at all and 5 = Major extent), if they thought that IT industry certifications could be easily integrated into their IoT. From the responses, 41.7% of HoDs thought that certification integration would be to some extent easily integrated into their IoT while 16.7% suggested that certification could not be easily integrated into their IoT. 41.7% were undecided about this.

HoDs were also asked (question 12 on the HoD questionnaire), if they had previously attempted to integrate IT industry certification into their undergraduate curriculum. The results show that 9 (75.0%) of the respondents reported that they had previously attempted certification integration into the undergraduate curriculum; 2 (16.7%) had never attempted certification integration; while a further 1 (8.3%) didn't know. Additional comments provided by the HoDs show that although many of the IoTs had considered it to some extent, only two respondents indicated that they had implemented specific certifications into their undergraduate curriculum. Cisco and Microsoft were some of the certifications that had been implemented.

HoDs and lecturing staff were also asked to indicate on a scale of one to five (1 = Not at all and 5 = Major extent) if they thought that the learning outcomes would alter with the integration of IT industry certification. On average, both HoDs and lecturing staff agreed that learning outcomes would alter with the integration of certification into the undergraduate curriculum, with both types of respondents indicating three or more on the Likert scale. However, there is no statistical significance (p-value = .144) to suggest that HoDs and lecturing staff differed in their opinions. Some comments provided by both groups provided some interesting insights into the respondents' opinions. One HoD noted that "the concerns of industry are not necessarily the concerns of full time education although they overlap significantly". It was suggested (by the same respondent) that there would be major concern if there were only a single vendor focus with some suggesting that it could be "very dangerous"…Another HoD suggested that "the core programmes cannot be compromised" and that integration should only happen where it works. Others believe that outcomes could change but not significantly

One Lecturing staff respondent commented that the learning outcomes would change and in some cases they might "take over as the dominant goals of the module". A major theme emerging from the comments provided by lecturing staff is that as the certification changes so too will the learning outcomes. One respondent noted that "any change in the syllabus or the way we teach will slightly alter the learning outcomes but that it is also necessary to adapt to the change in the business environment". Another respondent noted that there would be a slight change but the major changes would be with the practical elements of the course. There would be more focus on "practical" skill as well as the current critical thinking skills, with one respondent suggesting that "it may not be a bad thing". Some even suggest that the current learning outcomes need "alteration" and that "industry certification may improve [the] course syllabus". Another respondent suggests that it would raise the standard and graduates would be more employable. Students would gain much more practical skills. One respondent noted that the shift would be from "explain and demonstrate" to "implement and setup".

5.4.3.1 Management Issues

HoDs were asked (question 10 on the HoD questionnaire), to indicate their level of concern on a scale of one to five regarding the management issues with certification integration as listed in Table 5.16.

TABLE 5.16: Management Issues

Management Issues	No concern at all (1)	2	3	4	Major concern (5)
Budget	0 -	1 8.3%	3 25.0%	2 16.7	6 50.0%
Lecturing staff's ableness	2 16.7%	4 33.3%	5 41.7%	1 8.3%	0 -
Lecturing staff's willingness	0 -	3 25.0%	5 41.7%	3 25.0%	1 8.3%
Timetable flexibility	1 8.3%	2 16.7%	5 41.7%	2 16.7%	2 16.7%
Support systems adaptability	0 -	3 25.0%	2 16.7%	4 33.3%	3 25.0%
Physical resources	0 -	3 25.0%	3 25.0%	5 41.7%	1 8.3%

1 = No concern at all **5 = Major concern**

The results show that management issues such as budgets and support systems adaptability and resources would be a cause of some concern for HoDs with 66.7%, 58.3% and 50.0% of the respondents respectively indicating more than three on the Likert scale. The results also indicate that 50.0% of the respondents did not think that lecturing staff's ability was a concern for them. Over one third of the respondents believed that there would be some concern in relation to lecturing staff's willingness and timetable flexibility.

5.4.3.2 Modes of Certification Integration

Both HoDs and lecturing staff were asked to indicate on a scale of one to five their preference for different types of certification integration (1 = Very much dislike and 5 = Very much like). The results are displayed in Table 5.17.

TABLE 5.17: Modes of Certification Integration

Modes of Certification Integration		N	Mean	Std. Deviation	p-value (2-tailed test)
No certification obtained upon completion of undergraduate program	HoD	12	2.25	.754	.587
	Lecturing Staff	58	2.40	1.169	
Certification obtained upon completion of undergraduate program	HoD	12	3.33	1.155	.904
	Lecturing Staff	58	3.38	1.211	
APEL: Credit should be given to students that hold certifications	HoD	12	3.58	1.165	.676
	Lecturing Staff	58	3.43	1.141	
Certification offered as separate mode by the Institute	HoD	12	3.83	1.115	.274
	Lecturing Staff	58	3.43	1.156	

1 = Very much dislike **5 = Very much like**

From the data it emerged that on average, HoDs and lecturing staff disliked the mode of certification integration that would allow undergraduate degree programmes to resemble modules offered by industry certification but would not allow students to obtain certification on completion of the course. Further analysis shows that, while lecturing staff did not show a statistically significant greater mean difference in relation to this mode of integration, they did show a statistically significant greater variance in responses (SD: 1.169), that is lecturing staff appear to have a wider divergence of views regarding this mode of integration. HoDs and lecturing staff indicated preference for certain modes of certification integration including, certification to be obtained upon completion of an undergraduate programme, allow credit to be given to students who already held an industry certification and certifications that were offered as a separate mode. All of these modes of certification integration had an average mean score greater than three for both HoDs and lecturing staff, however there was no evidence of greater preference by either group ($p>0.05$).

5.4.3.3 Resources

Question 15 on the HoD questionnaire asked the respondents to indicate on a scale of one to five (1 = Not required at all and 5 = Very much required), their requirements for the resources listed in Table 5.18 for certification integration.

TABLE 5.18: Resources

Resource Requirements	Not required at all (1)	2	3	4	Very much required (5)
Vendor course material	0 -	1 8.3%	1 8.3%	3 25.0%	7 58.3%
Staff training	0 -	0 -	0 -	4 33.3%	8 66.7%
Additional hardware	1 8.3%	4 33.3%	4 33.3%	1 8.3%	2 16.7%
Additional software	0 -	0 -	5 41.7%	4 33.3%	3 25.0%
Dedicated classrooms/labs	1 8.3%	4 33.3%	2 16.7%	2 16.7%	3 25.0%
Time to train (training days)	1 8.3%	0 -	3 25.0%	3 25.0%	5 41.7%
External trainers for staff	0 -	1 8.3%	3 25.0%	6 50.0%	2 16.7%
New employees	4 33.3%	4 33.3%	2 16.7%	2 16.7%	0 -

1 = Not required at all 5 = Very much required

The findings indicate that HoDs consider staff training (100%) and vendor course material (83.3%) to be the main resource required for certification integration. Training days

(66.7%), and external trainers for staff (66.7%) were also considered necessary. 58.3% of the HoDs also thought that additional software would also be a requirement for certification integration. In relation to dedicated classrooms the responses were evenly distributed. New employees were not considered necessary with two thirds of the respondents indicating two or less on the Likert scale. 41.3% of the HoDs also did not consider additional hardware to be a requirement for certification integration.

Both respondent groups were asked if they considered IT industry certification as a "proper function" of IoTs. The responses are displayed in Table 5.19.

TABLE 5.19: IT Industry Certification as a Proper Function of IoTs

		N	Mean	Std. Deviation	p-value (2-tailed test)
Proper function	HoD	12	3.67	.985	.044
	Lecturing Staff	51	3.08	.868	

1 = Not at all **5 = Major extent**

The results show that on average, both HoDs and lecturing staff considered to some degree that IT industry certification is a proper function of IoTs, with mean scores greater than three. However the mean differences are statistically significant ($p = .044$), indicating that HoDs are more in agreement that IT industry certification is a proper function of IoTs than lecturing staff.

The findings show that although 41.7% of HoDs thought that IT industry certification could be easily integrated into the undergraduate curriculum, much concern surrounds the management issues of budgets, support systems adaptability and resources. HoD also indicated that they would be concerned about lecturing staff's willingness to change and flexibility of timetables. Therefore, on balance proposition three is rejected.

5.4.4 Proposition Four

Proposition 4: *Integrating IT industry certification into Irish IoTs would improve the Institutes' reputation*

In order to accept or reject proposition four, analysis of opinions regarding IoTs reputation and students' competency and skills in relation to certification integration need to be addressed. Questions were taken from several sections of both questionnaires (HoDs and lecturing staff). Sections included (1) reputation of IoTs, (2) student competencies and (3) summary of basic position.

5.4.4.1 Student Competencies and Skills

Both HoDs and lecturing staff were asked to indicate on a scale of one to five (1 = Impact negatively and 5 = Impact positively) how they thought certification integration would impact specific student competencies. The results are listed in Table 5.20.

TABLE 5.20: Impact of Certification Integration on Student Competencies

Student competencies		N	Mean	Std. Deviation	p-value (2-tailed test)
Critical thinking skills	HoD	12	3.00	.953	.795
	Lecturing Staff	56	2.91	1.100	
Practical skills	HoD	12	4.25	.965	.428
	Lecturing Staff	56	4.02	.904	
Problem solving skills	HoD	12	3.25	.965	.958
	Lecturing Staff	56	3.23	1.079	
Analytical skills	HoD	12	3.25	1.055	.959
	Lecturing Staff	56	3.23	1.079	
Communication skills	HoD	12	2.92	1.084	.986
	Lecturing Staff	56	2.91	1.032	
Creativity	HoD	12	2.67	.888	.931
	Lecturing Staff	56	2.70	1.111	
Initiative	HoD	12	2.92	.793	.437
	Lecturing Staff	56	3.18	1.097	
Flexibility and adaptability	HoD	12	3.00	.739	.577
	Lecturing Staff	56	2.82	1.046	

1 = Impact negatively **5 = Impact positively**

From the data it emerged that, on average, HoDs and lecturing staff indicated that certification integration would have a positive impact on student's practical skills, with an average mean score of greater than four for both types of respondents. Integrating IT industry certification into the undergraduate curriculum would also have a positive impact on student's problem solving skills, analytical skills and critical thinking skills, with an average mean score of greater than three, for both HoDs and lecturing staff. However there was no real evidence to suggest that HoDs and lecturing staff opinions differed significantly regarding the impact of certification integration on these competencies ($p>0.05$ in all cases).

The evidence suggests that certification integration could have negative impact on student's communication skills and creativity, where on average the mean scores were lower than three. The mean and standard deviations corresponding to these competencies are detailed in Table 5.20. There was no sample evidence that HoDs and lecturing staff differed greatly in opinions regarding the impact of certification integration on these competencies ($p>0.05$ for both).

The results also show that on average, there was no significant difference between both groups (HoDs and lecturing staff) in relation to the impact of certification integration on initiative, flexibility and adaptability student competencies. Overall the mean scores for both groups for these competencies were around three.

Both groups of respondents were also asked to indicate on a scale of one to five (1 = Strongly disagree and 5 = Strongly agree) if IT industry certification could help achieve competence in the disciplines listed in Table 5.21.

TABLE 5.21: Certification and Competence Disciplines

Competencies		N	Mean	Std. Deviation	p-value (2-tailed test)
Professional	HoD	12	2.83	.937	.154
	Lecturing Staff	56	3.30	1.043	
Database	HoD	12	3.67	.651	.621
	Lecturing Staff	56	3.52	.991	
Programming	HoD	12	3.42	.793	.849
	Lecturing Staff	56	3.48	1.128	
Networking and Communications	HoD	12	4.00	.603	.223
	Lecturing Staff	56	3.71	1.124	
Systems Analysis and Design	HoD	12	3.17	.577	.979
	Lecturing Staff	56	3.16	1.125	
Web and Multimedia	HoD	12	3.25	.754	.557
	Lecturing Staff	56	3.45	1.094	
Project Management	HoD	12	3.33	.651	.972
	Lecturing Staff	56	3.32	1.114	
IT Fundamentals	HoD	12	3.33	.985	.973
	Lecturing Staff	56	3.32	1.146	

1 = Strongly disagree 5 = Strongly agree

From the data it emerged that, on average, HoDs and lecturing staff agreed that IT industry certification could help achieve competency in areas such as database, programming, web and multimedia, project management and IT fundamentals. All of these competencies had on average a mean score greater than three, for both HoDs and lecturing staff, with no real evidence to suggest that opinions varied significantly between both groups. Both groups of respondents also agreed that certification integration would also help networking and communications and systems analysis and design competencies, with average mean scores of greater than three. Further analysis showed that although there was no statistical significance greater mean between the HoDs and lecturing staff in relation to these competencies there was a statistically significant greater variance in responses. Lecturing staff seem to have a wider divergence of views regarding the impact of certification integration on these competencies. The variances of opinions are detailed in Table 5.22.

TABLE 5.22: Variance of Opinions Regarding the Impact of Certification Integration on Specific Competencies

		N	Strongly Disagree (1)	(2)	(3)	(4)	Strongly Agree (5)
Networking and communications	HoD	12	0 .0%	0 .0%	2 16.7%	8 66.7%	2 16.7%
	Lecturing staff	56	3 5.4%	4 7.1%	15 26.8%	18 32.1%	16 28.6%
Systems analysis and design	HoD	12	0 .0%	1 8.3%	8 66.7%	3 25.0%	0 .0%
	Lecturing staff	56	5 8.9%	8 14.3%	24 42.9%	11 19.6%	8 14.3%

1 = Strongly disagree 5 = Strongly agree

HoDs and lecturing staff were also presented with five roles and responsibilities that were identified in assessing competence and commitment in section 2.3.3.1. Both groups were asked to indicate on a scale of one to five (1 = Strongly disagree and 5 = Strongly agree) how they thought IT industry certification could achieve such competence. The results are outlined in Table 5.23.

TABLE 5.23: Roles and Responsibilities to Assess Competence and Commitment

Roles and Responsibilities		N	Mean	Std. Deviation	p-value (2-tailed test)
Knowledge and understanding	HoD	12	3.75	.622	.281
	Lecturing Staff	53	3.49	1.120	
Application to practice	HoD	12	3.83	.718	.758
	Lecturing Staff	53	3.92	.958	
Leadership/management/ supervision	HoD	12	2.58	1.084	.821
	Lecturing Staff	53	2.66	1.055	
Interpersonal skill	HoD	12	2.50	1.087	.720
	Lecturing Staff	53	2.62	1.060	
Professional conduct	HoD	12	3.17	1.030	.436
	Lecturing Staff	53	2.91	1.043	

1 = Strongly disagree 5 = Strongly agree

The findings show that on average, HoDs and lecturing staff agree that certification could help achieve competencies such as knowledge and understanding, application to practice and to a lesser extent professional conduct. All of these roles and responsibilities have mean scores greater than three for both groups of respondents, with no real evidence to suggest that responses varied greatly between these two groups. On further analysis, the results indicate that there was a significant divergence in opinion amongst the lecturing staff in relation to the certification helping to achieve the knowledge and understanding competence (SD: 1.120). HoDs and lecturing staff on average somewhat disagreed with the notion that integrating IT industry certification could help achieve competence in the areas of leadership/management/supervision and interpersonal skills, with an average mean score lower than three. The mean and standard deviations are detailed in Table 5.23.

HoDs and lecturing staff were asked on a scale of one to five (1 = Not at all and 5 = Major extent) if they thought that IT graduates currently had all the skills necessary for Industry. The results are displayed in Table 5.24.

TABLE 5.24: IT Graduate Skills

	N	Mean	Std. Deviation	p Value *(2-tailed test)*
HoD	12	3.58	1.240	.014
Lecturing Staff	52	2.50	1.111	

1 = Not at all 5 = Major extent

The results show that there is some sample evidence to suggest that there is a difference in opinion between HoDs and lecturing staff in relation to IT graduates currently having all the necessary skills for industry, with a p-value of .014. Lecturing staff on average tend to think that graduates do not have all the skills necessary for industry whereas HoDs indicated that students do have the necessary skills.

5.4.4.2 Reputation of IoTs

HoDs and lecturing staff were asked to indicate on a scale of one to five (1 = Negatively affect and 5 = Positively affect), what effect certification integration would have on student skills, student employability and on the reputation of the institute. The results are listed in Table 5.25.

TABLE 5.25: Effect of Certification Integration on the Reputation of the Institute, Student Employability and Skills

		N	Mean	Std. Deviation	p-value (2-tailed test)
Reputation of Institute	HoD	12	4.08	.669	.569
	Lecturing Staff	56	3.89	1.107	
Student employability	HoD	12	4.17	.577	.732
	Lecturing Staff	56	4.27	.981	
Student skills	HoD	12	3.75	.866	1.000
	Lecturing Staff	56	3.75	1.031	

1 = Negatively affect 5 = Positively affect

The results show that on average, HoDs and lecturing staff thought that integrating IT industry certification into the undergraduate computing curriculum in Irish IoTs would have a positive effect on student employability, with mean scores of greater than four. Both groups also indicated that certification integration would also positively affect the reputation of the institute and student skills, with mean scores of greater than three. There was no real evidence to suggest that HoDs and lecturing staff varied significantly in their responses ($p > .05$ in all cases).

Statement Six

> *"If the Institute offered students a means to obtain certain certifications during their time in college, more students would be attracted to study in that institute".*
>
> A. N. Other

HoDs and lecturing staff were asked to indicate their opinion, on a scale of one to five (1 = Strongly disagree and 5 = Strongly agree), concerning certification and its potential to attract students to study in a particular institute. The results are displayed in Table 5.26.

TABLE 5.26: Opinions in Relation to Certification Attracting More Students

	N	Mean	Std. Deviation	p Value *(2-tailed test)*
HoD	12	3.50	.905	.401
Lecturing Staff	52	3.75	.926	

1 = Strongly disagree 5 = Strongly agree

The data shows that on average, HoDs and lecturing staff agree that, if IT industry certifications were integrated into IoTs more students would be attracted to study in that institute, with a mean score of greater than three. The data also indicates that there was no statistically significant difference between the groups in relation to this (p-value = .401).

Further analysis of the comments provided by both groups of respondents highlighted some interesting insight into these opinions. Only one HoD commented and suggested that such consideration may not influence students at present. Lecturing staff on the other hand showed conflicting opinions in relation to this. One respondent noted that IoTs would be more attractive for students because they would get an "additional qualification" and the "few letters" obtained from certifications would "ultimately…make graduates… more marketable" in industry. However it was also noted that "the so-called buzz words HR managers place in employment sections of newspapers give a false impression of what makes a good IT professional. An excellent programmer or networking trouble-shooter might never have looked at half the technologies specified in Job adverts yet could be the best person for the job". One respondent commented that although it could be a good marketing tool the reality is "students seem unwilling to take on extra workload to achieve certification".

Another respondent noted that one of the main drivers for certification integration would be to raise the profile of the IoT and to attract more students; it has "nothing to do with pedagogical issues", but suggests that this is perfectly acceptable. Another respondent noted that it could work in the short term as a "gimmick" to attract students but in the long term the reality of management keeping current with the latest hardware and software for certifications is doubted. Another respondent noted that certification coupled with work experience already existing in courses could only "strengthen" students' attraction to an Institute. It was also stated that "due to the level of competition between different educational institutions…. If an institute can offer something extra within their courses such as IT industry certification, they will have an advantage in attracting more students and developing a good reputation with employers and prospective students".

Statement Seven

> *"Institutes that offer IT industry certifications at undergraduate level are at the cutting edge of IT Education".*
>
> A. N. Other

HoDs and lecturing staff were asked to respond to this statement by indicating on a scale of one to five (1= Strongly disagree and 5 = Strongly agree) their opinion about certification integration making IoTs at the cutting edge of IT education. The results are detailed in Table 5.27.

TABLE 5.27: Opinions in Relation to Certification and the Cutting Edge of IT Education

	N	Mean	Std. Deviation	p Value *(2-tailed test)*
HoD	12	2.92	.900	.989
Lecturing Staff	51	2.92	1.111	

1 = Strongly disagree 5 = Strongly agree

The data shows that, on average, HoDs and lecturing staff somewhat collectively disagree that IoTs who offer certifications at undergraduate level are at the cutting edge of IT education. Both respondent groups had a mean score of less than three and there was no statistically significant difference between both respondent groups in relation to this.

Further analysis of the comments provided by both groups of respondents provided some interesting insight and conflicting opinions as to what is perceived as the "cutting edge of IT education". Only one HoD commented on this statement suggesting that "these two variables are probably uncorrelated" and that perhaps industry certifications within IoT may not make the Institute at the cutting edge of IT education.

From the comments provided by lecturing staff, there also seems to be some rejection of this statement. One respondent noted that such an initiative should be handled with caution "one or two additional IT certifications within a degree is one thing, but a future where IoTs are dictated to about what and how to teach by certification bodies is not a good thing". The same respondent notes that "the knowledge and skills obtained from a degree course should be something that can be built upon over a lifetime, not something that will be useless to the graduates on the next upgrade". Another respondent commented that if IoTs don't use "industry prescribed [syllabi]" this doesn't mean that these institutes are not "hitting the target".

One respondent noted that IoTs that adopt "well defined industry modules … often have not been developed according to leading edge educational modules" and therefore cannot be at the cutting edge of IT education. The same respondent suggests that "research within the institute will drive knowledge creation and generate the intellectual capital needed to keep us at the cutting edge", with another respondent agreeing that "IoTs that do research are at the cutting edge". Course lecturers with industry experience are also thought to be of "real benefit to the students". However there were some comments that suggest that IoTs who offer this type of "flexibility [does] lead". Another respondent suggests that IoTs that offer IT industry certifications are possibly "cutting edge in supplying what the student needs, but not necessarily at the cutting edge of the subject area".

<u>Statement Eight</u>

> *"Integrating IT industry certification into Irish IoTs is not what we are about. That is a trade school function. We are educators and not trainers".*
>
> A. N. Other

HoDs and lecturing staff were asked to respond to this statement by indicating on a scale of one to five (1= Strongly disagree and 5 = Strongly agree) their opinion about certification being a trade school function. The results are detailed in Table 5.28.

TABLE 5.28: Opinions in Relation to Certifications as Trade School Function

	N	Mean	Std. Deviation	p Value *(2-tailed test)*
HoD	12	2.25	1.055	.050
Lecturing Staff	51	2.94	1.085	

1 = Strongly disagree 5 = Strongly agree

The data shows that on average, HoDs and lecturing staff disagree that certifications are a trade school function and that IoTs are educators and not trainers, with a mean score of less than three. However the data also shows that there is some sample evidence to suggest that HoD and lecturing staff varied in opinion in relation to this with a p-value of .050. It appears that HoDs disagree more than lecturing staff that certification is a trade school function.

Additional comments were provided by both groups of respondents in relation to this statement. One HoD suggested that "if it adds value and is achievable then we should do it". Lecturing staff on the other hand had mixed feelings about this. One respondent noted that "a little integration would only be a good thing" while another respondent indicated that certifications "tick boxes" but "real education is about dealing with what comes after the current wow standard". Another respondent commented that "there is a significant difference between education and training. We are an academy (academic centre of learning) not a training company". However the same respondent also notes the "industrialization of education through IT seems to be driving an increasingly training oriented mentality".

Some respondents urged that IoTs should be focusing on research. However there were some comments provided that supported the inclusion of IT industry certification, suggesting that was a proper function of IoTs with one respondent noting that the objective is to "produce competent IT professionals, who have a range of skills. IT industry certification will strengthen students' skill set". Yet another respondent noted that the "ethos of the IoTs is to bridge the gap, to do both [certification integration and concentrate on research], not to ignore the practicalities". It was also suggested that "training is what we are about, trying to skill the students the best way possible. Change is always good".

Overall, on average both HoDs and lecturing staff tend to agree that IT industry certification could help improve student competencies and skills and competence in specific discipline areas. They also agree that IT industry certification integration would have a positive affect on student employability and the reputation of the IoT. However both HoDs and lecturing staff did not support the notion that certification integration would make Irish IoTs at the "cutting edge" of IT education. With consideration to all aspects of this issue, on balance proposition four is accepted.

5.4.5 Proposition Five

Proposition 5: *HoDs and lecturing staff would have conflicting opinions regarding IT industry certification integration into Irish IoTs.*

In order to accept or reject proposition five, analysis of HoDs and lecturing staff opinions in relation to various aspects of this study are examined. Some of these differences of opinions are discussed throughout the findings chapter and will now be discussed in more detail. The main differences of opinions between HoDs and lecturing staff are now summarised.

As discussed in section 5.3.1, the findings show that HoDs and lecturing staff on average, indicated different levels of awareness for some IT industry certifications, with HoDs being more familiar with certain type of industry certifications than lecturing staff, namely CCNE, Network+, CNE, A+ and MCP. These results can bee seen in Table 5.4.

As noted in section 5.4.1.1, lecturing staff on average, tended to agree more than HoDs that integrating IT industry certification into Irish IoTs would mean that vendors would dictate what and how we teach. Theses findings are illustrated in Table 5.11. There was some evidence to suggest that HoD and lecturing staff varied in opinion in relation to some modes of certification training for lecturing staff. HoDs on average indicated greater preference to training modes such as CBT, SIGS and peer learning and online classes than lecturing staff. Tale 5.14 details these results.

As discussed and represented in Table 5.22, the evidence suggests that on average, HoDs tend to believe to a greater extent than lecturing staff that IT graduates currently have all the necessary skills required by industry. Both groups of respondents were asked if they considered IT industry certification a proper function of IoT. The results show that on average, HoDs though it was more a proper function of IoTs than lecturing staff (see Table 5.17 for details). This is also evident with the findings corresponding to the responses by lecturing staff in relation to certifications being considered as a trade school function. On average, HoDs tend to disagree that IT industry certification is a trade school function more so than lecturing staff. This is highlighted in Table 5.26.

It is evident form the data that there are some differences in opinions between the two groups of respondents (HoDs and lecturing staff) and amongst the groups themselves. Therefore, on balance proposition five is accepted.

5.5 General Discussion

Overall HoDs and lecturing staff were asked if they would be in favour of IT industry certification integration into Irish IoTs. On average, both groups of respondents indicated that they would be in favour of certification integration to some degree, with average mean scores of greater than three. There was no statistical evidence to suggest that HoDs and lecturing staff varied in opinion regarding this (p-value = .644).

Some final comments were provided by both HoDs and lecturing staff in relation to this study. One HoD commented that "IT industry certification would be a welcome addition" to computing programmes and these programmes would be "more attractive" to students. However it was stressed that certification would have to "fit" with existing programmes. Another HoD suggests that certification integration is a "balancing act", whereby there is a "need to preserve our educational remit but [also] help students with some applied skills as we go".

Lecturing staff presented some conflicting final opinions in relation to certification integration. One theme emerging from the lecturing staff's comments is that IT industry certification can provide "good training [for students] that is sought after by employers" and that it provides a "benchmark" to employer of student capabilities. However some lecturing staff suggest that while it might make students more "employable", they are wary of the commitment required by the students to undertake additional workload. One respondent, who teaches Cisco's CCNA certification on a networks degree, remarked that "it makes the best students better [but] less motivated students cop out". Another theme which is prevalent from the lecturing staff's comments is that certification integration takes "real effort". One respondent suggested that certification integration should only take place if it is "evaluated" and deemed "suitable" for the course in question. Another respondent commented that "integrating [certifications] into the institutes is not the issue. Modifying existing well designed and strongly mandated courses to make room for certification components is the issue". One respondent noted that there would be "major training issues to be tackled to facilitate the introduction of certifications properly".

Some lecturing staff were also concerned for the integrity of existing courses with one respondent suggesting that although integrating IT industry certification into the undergraduate curriculum was a positive initiative that there must be "balanced elements for a wider educational context". Another respondent commented that "it would take up a lot of our time and prevent us from teaching things we think the students should know but may not be necessary for certification". However one lecturer stated that "students that do not have IT industry certification upon graduation are going to major training companies to achieve such certification. What a waste of time and money when the IoTs should be providing an option to receive such certification".

5.6 Conclusion

It is evident from all these findings and opinions provided by HoDs and lecturing staff that there are many views both similar and conflicting in relation to IT industry certifcation and its integration into Irish IoTs. This chapter has highlighted the major finding that emerged from this research study in relation to certification integration. The next chapter (Chapter Six) discusses an interpretation of the findings. General conclusions will be made about the research, including identifying the limitations of this study and identifying areas for future research within this research domain.

CHAPTER SIX

DISCUSSION AND CONCLUSION

6.1 Introduction

The previous chapter presented and interpreted the findings of this study. Chapter Six, outlines a summary of the finding and on reflection, discusses the interpretations of these findings in accordance with the research questions that were set out in section 1.3. General conclusions are drawn about the current capability and maturity of Irish IoTs to accommodate the integration of IT industry certification into the undergraduate computing curriculum. The wider implications of certification integration are also discussed. The remainder of the chapter focuses on the implications and limitations of this study. Finally, a number of opportunities for further research are identified.

6.2 Summary and Discussion of Findings

This research has investigated in some detail the integration of IT industry certification into the undergraduate computing curriculum in Irish IoTs from the perspectives of two key stakeholders: Heads of Department (HoDs) and lecturing staff. In order to carry out this investigation, five main propositions as identified in section 3.3 were addressed to gain a better insight into the complex, multifaceted, human centred problem situation of what would be required by IT industry certification integration.

With the aid of two web-based questionnaires (one for each group of respondents), an exploration was undertaken into the respondents' awareness of IT industry certification, current teaching and learning styles of lecturing staff, issues surrounding certification integration, training requirement of lecturing staff, resources required to effectively deliver IT industry certification, the potential impact of certification integration on student competencies and skill, employment and the reputation of Irish IoTs. The following sub-sections provide a discussion and interpretation of the strongest themes emerging from the findings in an attempt to answer each of the original research questions outlined in section 1.3. As this research takes and interpretivist epistemological position, as noted in section 4.2.3, the possibility for multiple interpretations and alternative interpretations is acknowledged. Therefore, the interpretation provided can only aim to provide a coherent and self-evidently sound account of the domain findings.

6.2.1 Research Question One

Research Question 1:

To what extent do Irish IoTs have the capability to integrate IT industry certification into their undergraduate computing curricula?

In order to answer question 1, an investigation into, (1) the training requirements of lecturing staff, (2) resources required to implement the change and (3) current support systems of IoTs was undertaken.

As seen in section 5.4.3, the findings show that many (75.0%) Irish IoTs had attempted some form of certification integration into the undergraduate computing curriculum within their Institute. 83.3% of HoDs also indicated that their institute offered certain types of certifications training in the form of evening courses. This would suggest that IoTs consider IT industry certification to have a role within the tertiary educational system and that there is also a market and requirement for it by students. However less than half of the respondents thought that IT industry certification could be easily integrated into their IoT.

Section 5.4.1.1 shows that HoDs and lecturing staff show some level of concern in relation to time to update lecturing staff's knowledge and skills to effectively deliver IT industry certification at undergraduate level. This could indicate that both groups of respondents are aware that lecturing staff do not have the current skills to effectively deliver certification although this would be true for any new subject or initiative that is incorporated into the curriculum. The data also shows that there was some variance in opinion among the lecturing staff themselves. This could be because some lecturing staff may be teaching subjects that are highly influenced by industrial products whereas others may be teaching more generic subjects that would require greater time in order to update their skills. It is not so unexpected that HoDs showed less concern for this than lecturing staff. Lecturing staff are directly impacted by curriculum change and therefore are more aware of the time required to implement those changes. Lecturing staff thought that there would be less concern for teaching and learning styles which somewhat suggests that they are confident of their ability to effectively deliver new course material and that their current method of teaching is adaptable to change.

As highlighted in section 5.4.3.1, there was some concern from both groups of respondents (HoD and lecturing staff) in relation to the budgets, support systems adaptability, flexibility of existing courses, timetable and the resources required to successfully integrate IT industry certification into Irish IoTs. The computing departments' existing budget may already be stretched to capacity and any further pressure on it, such as additional hardware, software, training days, and training courses may be problematic. HoDs consider staff training and vendor course material to be the main resources required for certification integration. Time to train, external trainers and additional software would also be required. Training is noted as being poor within the IoT sector and inevitably there is an element of deskilling. Upskilling is only achievable if lecturing staff have access to training and if hours are made available in their timetable. Although HoDs did not consider lecturing staffs ability to be an issue, they do indicate their willingness as a concern. This could suggest that if lecturing staff do not agree or see the merits of certification integration into the undergraduate computing curriculum, they may resist any change relating to this initiative.

Training preferences for both HoDs and lecturing were self-study texts, onsite and offsite training, as identified in section 5.4.2.2. HoDs seemed to be more in favour of Computer Based Training (CBT), Special Interest Groups (SIGS) and online classes than lecturing staff. This could be because HoDs would not have to manage the added expense, and timetabling issues in order to send lecturing staff away on training courses. As noted in section 2.4.3, time, money and resourcing are major issues in any instance of organisational change and integrating IT industry certification into the undergraduate computing curriculum is no different. As seen in section 5.4.2.1, some respondents' noted that it would be hard to manage the changing skills and resources required for delivering certification but suggest that greater efforts should be made to manage this properly. Some respondents suggest that blame lies with management and they should be willing to "spend money" to update hardware, software, training and resources.

It is evident from the above that in order to integrate IT industry certification into the undergraduate computing curriculum there would be additional requirements for training and resources in a number of areas and there are major concerns from both groups of respondents (HoDs and lecturing staff) in relation to this. Following an in-depth analysis of the findings in section 5.4.2, proposition two was accepted which indicated that lecturing staff would require additional training for certification integration. Further analysis as seen in section 5.4.3 shows that proposition three was rejected as the results indicate that overall, current support systems, resources, and existing courses could not accommodate certification integration. Therefore the findings suggest that Irish IoTs currently do not have the capability to properly integrate IT industry certification into their undergraduate computing curricula.

6.2.2 Research Question Two

Research Question 2:

To what extent are work practices within Irish IoTs mature enough to manage the integration of IT industry certification into the undergraduate computing curricula?

As seen in section 5.4.1, lecturing staff showed strong support for the use of PowerPoint slides and to lesser extent custom written handouts for delivering course material. As discussed in section 2.2.5, IT industry certification requires material to be delivered with a rigid adherence to guidelines set by the certifying bodies to ensure that all the material is covered and delivered accordingly. A possible shift in the methods of course delivery may be required by lecturing staff to effectively deliver IT industry certification within the undergraduate computing curriculum.

As seen in section 5.4.1, it is clear from the data that some lecturing staff believe that lectures to be structured to some degree and one third of the respondents believe that course syllabus should be rigidly adhered to. This is compatible with certification training given that certifications have fixed objectives that need to be met in order to obtain the designation. Over 60% of respondents also considered the use of problem cases and scenarios and Problem Based Learning (PBL) as effective modes of class delivery. 50% of lecturing staff also considered the use of Personal Computers to be beneficial in the classroom. As discussed in section 2.2.6, candidates are usually required to use PCs for training and exam purposes and providers often use problem cases and scenarios and PBL as a method of certification delivery. These methods and practices are all important for delivering IT industry certification. Should Irish IoTs consider integrating IT industry certification into the undergraduate curriculum some movement would be required in order to accommodate these changes in course delivery.

From the data it is evident that over two thirds (68.1%) of the lecturing staff respondents indicated that they use structured type exams (questions with sub questions) on a regular basis as their method of testing. Also 63.7% of respondents indicated that they use written exams for exam administration. These methods do not correspond to the manner in which IT industry certification are tested and administered. Certifications often use some form of computer-based MCQ's to test candidates and exams are usually administered over the Internet. It is clear from these results lecturing staffs' methods of testing and administration of exams would require some elements of change if certification integration took place in Irish IoTs.

As noted in section 5.4.2 some lecturing staff indicated that they would be comfortable with delivering IT industry certifications in a number of their current subject areas including networking, programming and database. There could be many reasons for this in that these specific areas are practical in nature and industry developments often require the current curriculum to be modified to reflect these changes. Therefore the requirement for lecturing staff to keep their skills current and up-to-date may give them an added advantage of being comfortable with delivering IT industry certification. Lecturing staff may also be familiar with and follow industry developments so much so that they are exposed to the latest and current technologies and possibly relevant certifications that are available and attempt to incorporate elements of them into their existing courses. It could also mean that the majority of the respondents who answered this question only lectured in those areas.

HoDs and lecturing staff indicated preference for modes of integration that would enable students to obtain certification or credit upon completion of the course. Both respondents tended to dislike integration methods where no form of certificate or reward was given to students. This could suggest that the respondents' prefer something in return for their efforts of integrating certification into their subjects. It may also suggest that it certification integration may not be worthwhile if the students do not receive certification upon completion of the additional coursework.

It is evident from the above that in order to integrate IT industry certification into the undergraduate computing curriculum, changes would be required of lecturing staff current work practices to accommodate effective delivery of certification training and testing. Following an in-depth analysis of the findings in section 5.4.1, proposition one was accepted which indicated that lecturing staff would be required to change their current teaching styles in order to effectively deliver IT industry certification into the undergraduate computing curriculum.. Further analysis as seen in section 5.4.5 show that proposition five was accepted as the results indicate that there was some conflict of interest between the both groups of respondents in relation to certification integration. There is mixed and spurious evidence for this research question, and although many respondents demonstrated a willingness and maturity to participate, this was not universal. Therefore the findings suggest that Irish IoTs currently do not have the maturity to integrate IT industry certification into their undergraduate computing curriculum.

6.2.3 Research Question Three

Research Question 3:

What are the wider implications of integrating IT industry certification into the undergraduate computing curricula in Irish IoTs?

In answering question 3, an investigation of the impact of certification integration on students' competencies and skills and the reputation of the IoTs was required.

The findings show that there was a significant difference in opinion between HoDs and lecturing staff in relation to the current skills of IT graduates. As highlighted in section 5.4.4.1, HoDs broadly agreed that graduates currently have all the skills necessary for industry, while lecturing staff did not. This could suggest that lecturing staff, who are at the forefront of producing quality IT graduates, are more in tune with industry requirements therefore providing an honest and frank opinion regarding the current graduates' competencies and skills.

The findings show that HoDs and lecturing staff indicated that certification integration would have a positive effect on students' practical skills, problem-solving skills, analytical and critical skills. However both groups thought that it could have a negative impact on student's communication and creativity skills. This suggests that the practical elements of IT industry certification would help students with technical competencies. However, they would not assist with the softer skills of interpersonal and creativity skills as these competencies require practice and experience. Teaching how to do is not the same as teaching what to think.

As highlighted in section 5.4.4.1, HoDs and lecturing staff also indicated that certification integration could have positive affect in the discipline areas of database, programming, web and multimedia, project management and IT fundamentals. Again this highlights affinity with such applied subjects of IT industry certification. It may also suggest that certification integration could work well with entry level computing subjects that deal with, for example IT fundamentals, where the existing course would not require much modification to align itself with specific IT industry certifications. Similarly, the respondents thought that networking, communications, systems analysis and design would also be positively affected by IT industry certification. Interestingly project management was also highlighted as an area where certification integration could have a positive effect. This could be due to the abundance of commercial exposure that project management certifications are been given at present.

As identified in section 5.4.4.1, both respondent groups indicated that certification integration could help assess competencies in knowledge and understanding, application to practice, and professional conduct (to a lesser extent). This may be because all these competencies can be taught and learned to some degree. The respondents did not agree that certification could help in the areas of leadership, management, supervision and interpersonal skills. This might suggest respondents believe that only through learning, practice and experience they can achieve these competencies. Time and experience is essential for individuals to become competent in these areas.

In general the findings show that there is some support for integrating IT industry certification into Irish IoTs. As seen in section 5.4.4.2, both groups of respondents indicated that it would help student competencies and skills, student employability and increase the reputation of Irish IoTs. However some respondents disagree with integrating IT industry certifications, highlighting that incorporating specific vendor technologies into the undergraduate computing curriculum will only serve to add control to multinational companies.

There is also seemingly some belief that certification integration will ultimately undermine the core value of IT higher education and in turn it will be of little benefit to the institute or student. Some respondents fear that certification will "shift the focus from the [current] syllabi" and suggest that this is not desirable. Although some respondents see the merits of certification integration there is still a concern that "training should not supplant education". Some suggest that IT industry certification is good for "vocational requirements" but nevertheless question its place at degree level. Some believe that training is an essential part of IT education and combining IT industry certification and existing curriculum together would help improve existing course material.

There are also mixed opinions amongst the respondents in relation to the efficacy of certification integration in attracting potential students to study in IoT. Some are not convinced of the effectiveness of this and suggest that in reality students are unwilling to take on extra work. However, others believe that students might embrace the idea of gaining a peripheral qualification that is recognised by industry, during their time in college. As seen in section 5.4.4.2, the findings indicate that in general respondents' believe that integrating IT industry certification into the undergraduate computing curriculum will likely raise the profile of IoTs, attract more students, increase IoT reputation and strengthen links and relevance to industry.

Comments provided by HoDs and lecturing staff indicated that integrating IT industry certification into the undergraduate computing curriculum would not necessarily posit an

IoT at the cutting edge of IT education. Many respondents indicated that caution should be taken in relation to certification integration as its adoption in higher education could lead to vendors dictating what and how to teach in the computing curriculum. This potentially could have a negative impact of the rigour of IT education where students are taught skills that can be built upon over a lifetime and not just what is current. Some respondents suggested that efforts would be better focused on research; "research within the institute will drive knowledge creation and generate the intellectual capital needed to keep us at the cutting edge".

One key finding from this study is that many of the respondents empathised with a need for change. Some believe that certification integration could achieve the change required. Alternatively, others suggest that promoting critical thinking, using sophisticated and complex competencies frameworks to inform the IT curriculum, conducting more research might be some examples of how change could occur. It is evident that there is a strong emphasis for change within the computing curricula of Irish IoTs but it should not at the expense of the existing programmes, with one respondent suggesting that the "core programmes cannot be compromised" and that certification integration would only be appropriate in some instances. One respondent commented that "...there is a third school of thought that welcomes change, welcomes updating course material and teaching methodologies, but are very wary of IT certifications from specific vendors/industries dictating what should be more generic syllabus content".

As seen in section 5.4.4, proposition four was accepted, indicating that the overall wider implications for integrating IT industry certification into the undergraduate computing curriculum would possibly help improve students' competencies and skill and, to some extent, raise the profile and reputation of Irish IoTs. However promoting areas such as research and critical thinking skills could also have the same effect and a number of respondents would prefer efforts to focus on these instead. Overall certification is considered a proper function of Irish IoTs and is considered a welcome change to some degree. However, it should not be implemented to the detriment of the existing curriculum and the core values of higher education.

6.3 Research Limitations

The following critique details a number of factors that are thought to have impinged upon this research project.

This research was only concerned with Irish Institutes of Technology (IoTs). Whilst IoTs make up a large sector of higher education in Ireland, the sample is not representative of all Universities or other types of Higher Educational Institutes in Ireland. However, the historically applied and vocational nature of the IoT sector implied that the IoTs would be most amenable for incorporating certification programmes.

The domain of this research was found to be inherently complex, as illustrated in section 3.2.2 and it also had to be completed within a reasonable timeframe. Therefore the study was scoped to investigate the perspectives of two key stakeholders only (HoDs and lecturing staff), in relation to five issues identified in the theoretical framework. Given more time additional stakeholders, for example, industry representatives, funding agencies and students could have been included in this study. Also those issues identified in the framework as being beyond the scope of this research could have been addressed. However, a singular study can only achieve a focused and narrow objective. Additional time might also have enabled face-to-face interviews to be carried out in order to corroborate the findings of this study. Given the richness of the qualitative and free text data collected in section, this may have resulted in a richer perspective and interpretation. However, the methodology followed is nonetheless deemed appropriate.

This study obtained copious amounts of quantitative and rich qualitative data, and its voluminous nature rendered it is impossible to ensure all data was addressed equally. Some areas, identified in section 3.3, as being beyond the scope of this study, were sometimes raised and touched on by the comments provided by respondents. Every effort was made to separate issues that were considered irrelevant to this study. However the nature of this complex human centred system made it virtually impossible to completely isolate the issues deemed necessary for this study from those that were not.

6.4 Conclusions and Further Research

Overall the research findings suggest that IoTs sector does not currently have the capability or maturity to integrate IT industry certification into the undergraduate computing curricula. However the benefits identified by this research suggest that it could be a worthwhile initiative.

This study presents several areas worthy of further research. One area possible of further research could be to expand the study to consider how the findings would transfer to the University sector. This could enable a comparative study, which would identify the differences and similarities between two types of HEIs in relation to integrating IT industry certifications into tertiary education in Ireland. Another possibility for further research would be to conduct a study through action research in an Irish IoT, to witness first hand the change process of integrating IT industry certification into the computing curriculum. This would give further insight into the real world the key stakeholders affected by this change. Other areas that were identified as part of this complex human centred system as noted in section 3.2.2, that were beyond the scope of this study, would also need to be considered if certification integration was to take place. Investigating these elements would require further investigation.

6.5 Closing Remarks

This study has provided a valuable insight into the two key stakeholder's perspectives (HoD and lecturing staff) in relation to integrating IT industry certification into the undergraduate computing curricula in Irish IoTs. As very little research has been conducted in the area of IT certifications in general, the findings of this original study are deemed a significant contribution to the wider literature. The findings may also inform wider studies relating to certification and educational change.

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APPENDIX A

STUDENT QUESTIONNAIRE

SECTION 1 PERSONAL DETAILS

Name: ______________________________ (optional) Age: 16-20 ☐ 21-25 ☐ 26-30 ☐

Gender: Male ☐ Female ☐ 31-40 ☐ 41-50 ☐ 51+ ☐

Contact No: __________________________ (optional) e-mail ___________________________ (optional)

Course: ____________________________________ Course Mode: Full-time ☐ Part-time ☐

Industry Experience: Total _____________ (years) IT related _________________ (years)

SECTION 2 AWARENESS OF IT INDUSTRY CERTIFICATION

2.1 Are you familiar with IT industry certification?

not at all 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *very aware*

2.2 For the following certifications, please indicate those you are familiar with. Also, please provide the vendor/provider name, the programme title and the discipline (if known).

Familiar		Acronym	Vendor/Provider	Title	Discipline
Y ☐	N ☐	A+			
Y ☐	N ☐	MCSE			
Y ☐	N ☐	CCNA			
Y ☐	N ☐	RHCE			
Y ☐	N ☐	CCNP			
Y ☐	N ☐	PMP			
Y ☐	N ☐	CCP			
Y ☐	N ☐	CNA			

SECTION 3 VALUE OF IT INDUSTRY CERTIFICATION

3.1 Would you consider certification advantageous in helping IT graduates find employment?

no advantage 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *major advantage*

3.2 To what extent would certification help provide additional employment skills?

not at all 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *major extent*

3.3 Skills obtained by certifications are more practical in nature than those in academic programmes.

strongly disagree 1 2 ☐ 3 ☐ 4 ☐ 5 ☐ ☐ *strongly agree*

SECTION 4 SUPPORT OF INDUSTRY CERTIFICATION

4.1 List the certifications you have completed (if any): ________________________________

____

4.2 Would you consider obtaining certifications post graduation?

not at all 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *major extent*

If so, what type of certification: ____

4.3 Certification is a viable alternative to a degree for new IT Industry professionals.

strongly disagree 1 2 ☐ 3 ☐ 4 ☐ 5 ☐ ☐ *strongly agree*

SECTION 5 INTEGRATION OF INDUSTRY CERTIFICATION

5.1 Undergraduate degree programmes should resemble modules offered by industry certification (no industry certification is obtained).

strongly disagree 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *strongly agree*

5.2 Undergraduate degree programmes should contain modules offered by industry certification (industry certification obtained on module completion).

strongly disagree 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *strongly agree*

5.3 Academic credit should be given for industry certificates already held by undergraduates (e.g. module exemptions on a degree programme).

strongly disagree 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *strongly agree*

5.4 Certification and undergraduate studies should remain separate.

strongly disagree 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ *strongly agree*

Please provide any additional comments (optional): ______________________________

____

____

Overall would you be in favour of integrating IT industry certification into undergraduate degree programmes in Irish Institutes of Technology? Yes No ☐ ☐

APPENDIX B

FOCUS GROUP QUESTIONS

QUESTIONS FOR FOCUS GROUP

Q1. Are you familiar with IT industry certification?

Prompt:
- Different types of certification and their providers
- Has anybody been/or would like to become certified, if so, reasons why?

Q2. Do you think that industry certification could "fit" into IT programmes in Irish Institutes of Technology (IoTs)?

Prompt:
- Vocational nature of IoTs
- Would IoTs be seen as a trade school?
- Do you consider it to be a separate function altogether?

Q3 How would industry certification be integrated effectively into IoTs?

Prompt: Standalone or integrated into exiting modules
- Undergraduate degree programmes should resemble modules offered by industry certification (no industry certification is obtained)
- Undergraduate degree programmes should contain modules offered by industry certification (industry certification obtained on module completion)
- Academic credit should be given for industry certificates already held by undergraduates (e.g. module exemptions on a degree programme)
- Certification and undergraduate studies should remain separate

Q4. Have you issues or concerns with integrating industry certifications into IT programmes in Irish IoTs?

Prompt: Change in work practices
- Resources
- Training (retrain existing staff or employ new staff)
- Course rework/preparation

Q5. Some 83% of students in WIT would be in favour of integrating industry certification into IT programmes in Irish Institutes of Technology. Discuss.

Q6. Are there any other issues or concerns relating to industry certification and its integration into Irish IoTs that you would like to discuss?

APPENDIX C

LIST OF PARTICIPATING IOTS

PARTICIPATING IOTS

Athlone AIT
Blanchardstown ITB
Carlow ITC
Cork CIT
Dundalk DKIT
Dunlaoighre Institute of Art, Design and Technology IADT
Galway-Mayo GMIT
Limerick LIT
Letterkenny LYIT
Sligo ITS
Waterford WIT
Tallaght IOT
Tralee ITT

APPENDIX D

CERTINT-IE PROJECT: REQUEST FOR COOPERATION

Subject: CERTINT-IE Project: Request for Cooperation.

Dear XXXX,

My name is Lucy White and I am currently undertaking a research masters in Waterford Institute of Technology. The topic for my research is investigating the integration of IT industry certifications into Irish Institute of Technology's. The focus of this study will be from the computing Heads of Department (HoDs) and lecturing staff perspectives.

The success of this study relies heavily on staff participation; therefore I would really appreciate your assistance with this. I have compiled two online questionnaires that I will be sending out to all Institute of Technology's in the coming week. The first questionnaire is designed for HoDs only and I would be very grateful if you could personally respond and complete this questionnaire. An additional email will be sent shortly afterwards which will contain the second questionnaire designed for lecturing staff only. Again I would very much appreciate if you could forward this email to a sufficient number of staff in your department and encourage them to take part.

Neither questionnaire should take longer than 15-20 minutes to complete. I am hoping to get all the results back in a two week time period from the date the questionnaires are sent. An executive summary of the findings will be compiled towards the end of the study and this will be available to all participants.

In order to achieve a fair and representative perspective it is vital that as many people as possible take part in this study. Therefore I would be extremely grateful for your valuable cooperation.

In summary, could you please:

- Personally complete the HoD online questionnaire
- Forward my subsequent email regarding the Lecturer online questionnaire to all computing staff in your department, and encourage them to participate

Should you have any queries in relation to this research project please do not hesitate in contacting me.

Kind regards,
Lucy White

APPENDIX E

EMAIL - CONTAINING HOD QUESTIONNAIRE

Subject: CERTINT-IE Project: Heads of Department (HoDs) Questionnaire.

Dear XXXX,

Following on from our phone conversation this morning, I have included the link to the HoDs questionnaire below. This questionnaire is to be filled out by you only. I will send an email shortly with a link to the Lecturing staff questionnaire. You are not required to fill out the lecturing staff questionnaire. However this will have to be forwarded to all your lecturing staff in the computing department. I would be very grateful if you could encourage them to fill it out.

I have also attached a confidentiality statement for your consideration.

I would like to thank you again in advance as I really do appreciate your assistance with this research project.

Heads of Department (HoDs) Questionnaire:

http://www.surveymonkey.com/s.asp?u=172173255770

If you have any questions or queries, please do not hesitate in contacting me.

Kind regards,
Lucy White

APPENDIX F

HODS QUESTIONNAIRE

Copy of Integrating IT Industry Certification into Irish Institutes of Technology's (IoTs)

Introduction

ISOL Research Centre & Waterford Institute of Technology

An Online Survey to Investigate the Integration of IT Industry Certification into Undergraduate Degree Programs in Irish Institutes of Technology's (IoTs) from the perspectives of the Key Stakeholders: Heads of Departments (HoDs) and Lecturing Staff

• This survey should not take more than 15-20 minutes of your time.

• Please answer the following questions by either ticking the appropriate option or entering information into the space provided.

• Questions marked with an asterisk are mandatory.

• All information you provide will be kept strictly confidential and will only be used for the purpose of this academic research study.

• Please answer as many questions as possible.

• I thank you in advance for your participation.

• PLEASE NOTE THIS SURVEY IS TO BE COMPLETED BY HEADS OF DEPARTMENT (HoDs) ONLY.

Section A: Industry Certification Awareness

Question 1

From memory only, please indicate your level of awareness for each of the following IT industry certifications.

Note:

• Never heard of = unrecognised
• Heard of only = recognise acronym only
• Recognise = recognise acronym and possibly the vendor/provider
• Somewhat familiar = recognise acronym, vendor/provider and discipline
• Familiar = identify acronym, vendor/provider and the certification discipline
• Very familiar = have a good understanding of the certification, vendor/provider, certification discipline and possibly have exposure to the certification

	Never heard of (1)	Heard of Only (2)	Recognise (3)	Somewhat familiar (4)	Familiar (5)	Very Familiar (6)
IBM CDA						
SCJP						
CCNE						
CNE						
CIW						
MCP						
MCAD						
A+						
OCP DBA						
RHCE						
CCP						
Project+						
Network+						
PMP						

Section A: Cont.

Question 2

Have you ever obtained an IT industry certification?

- Yes
- No

Section B: Effects of Certification Integration

Question 3

“Integrating IT industry certifications into the undergraduate curriculum will mean vendors will dictate what and how we teach, potentially affecting the quality of our courses” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section B: Cont.

Question 4

Integrating IT industry certification into the undergraduate curriculum in Irish IoTs would have various effects on lecturing staff. Please indicate on a scale of 1 to 5 your level of concern with each of the following issues.

	No concern at all (1)	(2)	(3)	(4)	Major concern (5)
Time (updating knowledge and skills)					
Development of new course material					
Flexibility (integrating certification into existing courses)					
Teaching Style					
Learning Style					
Resources (physical resources, ie classrooms, hardware and software)					

Section B: Cont.

Question 5

"Integrating IT industry certifications at undergraduate level will disrupt our current way of teaching and our traditional courses will suffer" A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section C: Training Requirements for Lecturers

Question 6

How effective do you think Computer Based Training (CBT) would be in helping to deliver a certification programme (e.g. Cisco Academy)?

- Not at all effective (1)
- (2)
- (3)
- (4)
- Very effective (5)

Section C: Cont.

Question 7

Please indicate on a scale of 1 to 5 your preference regarding modes of certification training for lecturing staff.

	Very much dislike (1)	(2)	(3)	(4)	Very much like (5)
Special Interest Groups (SIGs) and Peer learning					
Offsite (boot camps, workshops)					
Self-study texts, workbook and videos					
Computer Based Training (CBT)					
Onsite (with expert external facilitators)					
Online Classes					

Section C: Cont.

Question 8

In the space below, please enter any additional comments in relation to lecturer training requirements and IT industry certification.

Section D: Certification Integration

Question 9

Do you think that IT industry certifications could be easily integrated into your IoT?

Not at all (1)	(2)	(3)	(4)	Major extent (5)

Please explain your reasons.

Section D: Cont.

Question 10

Please indicate on a scale of 1 to 5 your concern about the management of the following certification integration issues.

	No concern at all (1)	(2)	(3)	(4)	Major concern (5)
Lecturing staff's willingness					
Budget availability					
Support systems adaptability					
Physical resources					
Timetable flexibility					
Lecturing staff's ableness					

Section D: Cont.

Question 11

Do you think that learning outcomes would alter with the integration of IT industry certification into the undergraduate curriculum?

- Not at all (1)
- (2)
- (3)
- (4)
- Major extent (5)

Please explain your answer.

Section D: Cont.

Question 12

Has your Institute ever investigated the integration of IT industry certification into the undergraduate curriculum?

- Yes
- No
- Don't know

If yes, please give a brief explanation.

Section E: Modes of Integration

Question 13

Please indicate on a scale of 1 to 5 your preference for each of the following modes of integration for IT industry certifications:

	Very much dislike (1)	(2)	(3)	(4)	Very much like (5)
Undergraduate degree programmes should contain modules which also lead directly to industry certification (industry certification obtained as part of module completion)					
Undergraduate degree programmes should resemble modules offered by industry certification (no industry certification is obtained)					
Accreditation of Prior Experiential Learning (APEL)! Academic credit should be given for industry certificates already held by undergraduates (e.g. module exemptions on a degree programme)					
Certifications offered as separate mode by the institute (e.g. optional night courses)					

Section E: Cont.

Question 14

Are IT industry certifications offered to your students in any mode, for example evening courses?

- Yes
- No
- Don't know

If yes, please give a brief description of the certifications offered.

Section F: Resources

Question 15

For each of the following resources, please indicate what you feel your Institute would require if IT industry certification were integrated into the undergraduate curriculum.

	Not required at all (1)	(2)	(3)	(4)	Very much required (5)
Additional hardware					
Time to train (e.g. training days)					
New employees					
Staff training					
Vendor course material					
External trainers for staff					
Dedicated classrooms/labs					
Additional software					

Section F: Cont.

Question 16

“IT industry certifications are moving targets, and are frequently changing. The Computing Department would not be able to manage the changing skills and resources required for delivering IT industry certification in the undergraduate curriculum. It's not easy keeping up with industry developments!” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section G: Student Competencies

Question 17

Please indicate on a scale of 1 to 5 how negatively or positively you would feel the integration of IT industry certifications would in general impact the following student competencies. (Please do not focus on individual certifications).

	Impact negatively (1)	(2)	(3)	(4)	Impact positively (5)
Flexibility and Adaptability					
Initiative					
Communication skills					
Creativity					
Critical thinking skills					
Analytical skills					
Problem solving skills					
Practical skills					

Section G: Cont.

Question 18

Please indicate on a scale of 1 to 5 how integrating IT industry certification into Irish IoTs could negatively or positively affect the following:

	Negatively affect (1)	(2)	(3)	(4)	Positively affect (5)
Student skills					
Student employability					
Reputation of your Institute					

Section G: Cont.

Question 19

For each of the following areas, please indicate on a scale of 1 to 5, whether you agree or disagree that IT industry certifications could help achieve such competence.

	Strongly disagree (1)	(2)	(3)	(4)	Strongly agree (5)
Professional					
IT Fundamentals					
Web and Multimedia					
Systems Analysis and Design					
Database					
Networking and Communications					
Project Management					
Programming					

Section G: Cont.

Question 20

Outlined below are five roles and responsibilities that have been identified in assessing competence and commitment. Please indicate on a scale of 1 to 5, whether you agree or disagree that IT industry certification could help achieve such competence.

	Strongly disagree (1)	(2)	(3)	(4)	Strongly agree (5)
Knowledge and Understanding					
Application to Practice					
Leadership/Management/Supervision					
Interpersonal Skill					
Professional Conduct					

Section G: Cont.

Question 21

Do you think that IT graduates currently have ALL the necessary skills required by industry upon leaving your IoT?

Not at all (1) (2) (3) (4) Major extent (5)

Section H: Reputation of IoT

Question 22

"If the Institute offered students a means to obtain certain certifications during their time in college, more students would be attracted to study in that institute" A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

Strongly disagree (1) Disagree (2) Undecided (3) Agree (4) Strongly agree (5)

Any additional comments?

Section H: Cont.

Question 23

“Institutes that offer IT industry certifications at undergraduate level are at the cutting edge of IT Education” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

Strongly disagree (1) | Disagree (2) | Undecided (3) | Agree (4) | Strongly agree (5)

Any additional comments?

Section H: Cont.

Question 24

“Integrating IT industry certification into Irish IoTs is not what we are about. That is a trade school function. We are educators and not trainers” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

Strongly disagree (1) | Disagree (2) | Undecided (3) | Agree (4) | Strongly agree (5)

Any additional comments?

Section H: Cont.

Question 25

“There is no need to integrate IT industry certification into the curriculum. Our existing approach has worked for us in the past!” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

Strongly disagree (1) | Disagree (2) | Undecided (3) | Agree (4) | Strongly agree (5)

Any additional comments?

Section I: Summary of Basic Position

Question 26

Would you consider IT industry certification as a proper function of IoTs?

Not at all (1) | (2) | (3) | (4) | Major extent (5)

Question 27

Would you be in favour of integrating IT industry certifications into Irish IoTs?

Not at all (1) | (2) | (3) | (4) | Major extent (5)

Question 28

Finally, please provide any additional comments or opinions relating to IT industry certification and its integration into the undergraduate curriculum in Irish IoTs.

Section J: Demographics

Current Position in IoT

Head of Department (HoD) | Lecturer

Institute of Technology (IoT)

Gender

Age

<30 | 31-40 | 41-50 | 51-60 | 60+

Years of IT experience

Higher Education (excluding undergraduate study)

Industry

Level of Education

For the purpose of this study and the accuracy of the results, I would very much appreciate it if you could give suitable contact details (e.g. Name, email address and/or telephone number) in the event that I need to contact you regarding your response. If you need to contact me directly regarding this survey, my name is Lucy White and I can be contacted at lbwhite@wit.ie or alternatively on 086 1619481.

Personal details

Name

E-mail address

Phone No

APPENDIX G

CONFIDENTIALITY STATEMENT

CONFIDENTIALITY STATEMENT

- The data collected for this study will be held and used in strictest confidence.
- Only the researcher and her supervisor will have access to the full data for the sole purposes of conducting this research project and disseminating the findings.
- During data analysis, the advice of a statistician from the WIT faculty may be sought. However, in such cases, the data will be anonymous, and the individual participants and the Institutes involved will not be uniquely identifiable by the statistician.
- Electronic copies of the data will be securely stored on a password-protected computer in appropriate statistical, database and spreadsheet formats. Any backups will be similarly protected.
- The data collected will be appropriately analysed and disseminated by way of thesis, presentations, and articles.
- Any dissemination will endeavour to ensure that individual people or Institutes cannot be uniquely identified.
- The full data will be held for the duration of the research project. Afterwards, any uniquely identifying data concerning individuals or Institutes will be permanently destroyed within 6 months.

APPENDIX H

EMAIL – CONTAINING LECTURING STAFF QUESTIONNAIRE

Subject: CERTINT-IE Project: Lecturing Staff Questionnaire.

This survey is to be completed by Lecturing Staff only.
Please click on the link below to view and complete the Lecturing Staff Questionnaire.

http://www.surveymonkey.com/s.asp?u=888113255645

Lucy White

APPENDIX I

LECTURING STAFF QUESTIONNAIRE

Integrating IT Industry Certification into Irish Institutes of Technology's (IoTs)

Introduction

ISOL Research Centre & Waterford Institute of Technology

An Online Survey to Investigate the Integration of IT Industry Certification into Undergraduate Degree Programs in Irish Institutes of Technology's (IoTs) from the perspectives of the Key Stakeholders: Heads of Departments (HoDs) and Lecturing Staff

• This survey should not take more than 15-20 minutes of your time.

• Please answer the following questions by either ticking the appropriate option or entering information into the space provided.

• Questions marked with an asterisk are mandatory.

• All information you provide will be kept strictly confidential and will only be used for the purpose of this academic research study.

• Please answer as many questions as possible.

• I thank you in advance for your participation.

• PLEASE NOTE THIS SURVEY IS TO BE COMPLETED BY LECTURING STAFF ONLY.

Section A: Industry Certification Awareness

Question 1

From memory only, please indicate your level of awareness for each of the following IT industry certifications.

Note:

• Never heard of = unrecognised
• Heard of only = recognise acronym only
• Recognise = recognise acronym and possibly the vendor / provider
• Somewhat familiar = recognise acronym, vendor / provider and discipline
• Familiar = identify acronym, vendor / provider and the certification discipline
• Very familiar = have a good understanding of the certification, vendor / provider, certification discipline and possibly have exposure to the certification

	Never heard of (1)	Heard of Only (2)	Recognise (3)	Somewhat familiar (4)	Familiar (5)	Very Familiar (6)
IBM CDA						
Network+						
OCP DBA						
PMP						
CCP						
CIW						
RHCE						
SCJP						
Project+						
CNE						
MCP						
CCNE						
MCAD						
A+						

Integrating IT Industry Certification into Irish Institutes of Technology's (IoTs)

Section A: Cont.

Question 2

Have you ever obtained an IT industry certification?

- Yes
- No

Section B: Current Teaching Styles

Question 3

Have you ever obtained any formal teacher training qualification (e.g. Higher diploma in education)?

- Yes
- No

Section B: Cont.

Question 4

Please indicate on a scale of 1 to 5 how often you use the following materials in the classroom?

	Use rarely (1)	(2)	(3)	(4)	Use regularly (5)
Powerpoint slides					
Acetates					
Internet based (direct students to websites)					
Custom written handouts					
Prescribed textbooks					
Photocopied handouts (journal articles, newspaper clippings..)					

Section B: Cont.

Question 5a

In your opinion how structured do you think lectures should be?

Note:

Flexible = lectures are spontaneous
Well structured = lectures follow a predefined plan

- Flexible (1)
- (2)
- (3)
- (4)
- Well structured (5)

Question 5b

In your opinion should course syllabus be used rigidly or as a guide?

- Use rigidly (1)
- (2)
- (3)
- (4)
- Use as guide (5)

Question 5c

Do you think student participation is important in the classroom?

- Not at all important (1)
- (2)
- (3)
- (4)
- Very important (5)

Question 5d

Do you use problem cases and scenarios in your lectures?

- Never use (1)
- (2)
- (3)
- (4)
- Always use (5)

Section C: Learning Styles

Question 6a

Do you think Problem Based Learning (PBL) is effective in the classroom environment?

Note: PBL is the use of complex, ill-structured problems that exist in real world situations to solve in the classroom. Students learn by solving problems.

- Not at all effective (1)
- (2)
- (3)
- (4)
- Very effective (5)

Question 6b

Do you think the use of personal computers by students would be beneficial in the classroom environment?

- Not at all beneficial (1)
- (2)
- (3)
- (4)
- Very beneficial (5)

Section D: Assessment

Question 7a

Please indicate on a scale of 1 to 5 how often you use the following methods of testing for Continuous Assessment (CA) only:

	Use rarely (1)	(2)	(3)	(4)	Use regularly (5)
Essay style exams					
Multiple choice exams					
Structured exams (questions with part A, B, C etc.)					

Question 7b

Please indicate on a scale of 1 to 5 how you administer those exams for Continuous Assessment (CA) only:

	Never use (1)	(2)	(3)	(4)	Always use (5)
Written exams					
Computer-based exams					

Section E: Effects of Certification Integration

Question 8

“Integrating IT industry certifications into the undergraduate curriculum will mean vendors will dictate what and how we teach, potentially affecting the quality of our courses” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

Strongly disagree (1) | Disagree (2) | Undecided (3) | Agree (4) | Strongly agree (5)

Any additional comments?

Section E: Cont.

Question 9

Integrating IT industry certification into the undergraduate curriculum in Irish IoTs would have various effects on lecturing staff. Please indicate on a scale of 1 to 5 your level of concern with each of the following issues.

	No concern at all (1)	(2)	(3)	(4)	Major concern (5)
Time (updating knowledge and skills)					
Development of new course material					
Flexibility (integrating certification into existing courses)					
Teaching Style					
Learning Style					
Resources (physical resources, ie classrooms, hardware and software)					

Section E: Cont.

Question 10

“People get rusty; we can’t help it! Lecturing staff would not be able to effectively deliver industry certifications at undergraduate level as most of us do not have the current and up-to-date expertise to do so” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section E: Cont.

Question 11

"Integrating IT industry certifications at undergraduate level will disrupt our current way of teaching and our traditional courses will suffer" A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section F: Training Requirements for Lecturers

Question 12a

How comfortable would you feel about delivering a certification programme if it were integrated into one of your existing subjects or modules?

- Not at all comfortable (1)
- (2)
- (3)
- (4)
- Very comfortable (5)

Question 12b

If you indicated 3 or more for question 12a, please give details of the certification you feel you could successfully deliver and the related discipline of the subject or module.

Certification:

Discipline:

Section F: Cont.

Question 13

In general, would you be concerned that your knowledge of various vendor technologies may not be current enough to deliver a certification programme?

- Not at all concerned (1)
- (2)
- (3)
- (4)
- Very concerned (5)

Section F: Cont.

Question 14

Would you benefit from additional training in order to deliver IT industry certifications at undergraduate level in Irish IoTs?

- Not at all (1)
- (2)
- (3)
- (4)
- Major extent (5)

Section F: Cont.

Question 15

How effective do you think Computer Based Training (CBT) would be in helping to deliver a certification programme (e.g. Cisco Academy)?

- Not at all effective (1)
- (2)
- (3)
- (4)
- Very effective (5)

Section F: Cont.

Question 16

Please indicate on a scale of 1 to 5 your preference regarding modes of certification training for lecturing staff.

	Very much dislike (1)	(2)	(3)	(4)	Very much like (5)
Onsite (with expert external facilitators)					
Online Classes					
Special Interest Groups (SIGs) and Peer learning					
Self-study texts, workbook and videos					
Offsite (boot camps, workshops)					
Computer Based Training (CBT)					

Section F: Cont.

Question 17

In the space below, please enter any additional comments in relation to lecturer training requirements and IT industry certification.

Section G: Certification Integration

Question 18

Do you think that learning outcomes would alter with the integration of IT industry certification into the undergraduate curriculum?

- Not at all (1)
- (2)
- (3)
- (4)
- Major extent (5)

Please explain your answer.

Section H: Modes of Integration

Question 19

Please indicate on a scale of 1 to 5 your preference for each of the following modes of integration for IT industry certifications:

	Very much dislike(1)	(2)	(3)	(4)	Very much like (5)
Certifications offered as separate mode by the institute (e.g. optional night courses)	☐	☐	☐	☐	☐
Undergraduate degree programmes should contain modules which also lead directly to industry certification (industry certification obtained as part of module completion)	☐	☐	☐	☐	☐
Undergraduate degree programmes should resemble modules offered by industry certification (no industry certification is obtained)	☐	☐	☐	☐	☐
Accreditation of Prior Experiential Learning (APEL)! Academic credit should be given for industry certificates already held by undergraduates (e.g. module exemptions on a degree programme)	☐	☐	☐	☐	☐

Section H: Resources

Question 20

“IT industry certifications are moving targets, and are frequently changing. The Computing Department would not be able to manage the changing skills and resources required for delivering IT industry certification in the undergraduate curriculum. It’s not easy keeping up with industry developments!” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

☐ Strongly disagree (1) ☐ Disagree (2) ☐ Undecided (3) ☐ Agree (4) ☐ Strongly agree (5)

Any additional comments?

Section I: Student Competencies

Question 21

Please indicate on a scale of 1 to 5 how negatively or positively you would feel the integration of IT industry certifications would in general impact the following student competencies. (Please do not focus on individual certifications).

	Impact negatively (1)	(2)	(3)	(4)	Impact positively
Creativity					
Practical skills					
Flexibility and Adaptability					
Analytical skills					
Problem solving skills					
Initiative					
Communication skills					
Critical thinking skills					

Section I: Cont.

Question 22

Please indicate on a scale of 1 to 5 how integrating IT industry certification into Irish IoTs could negatively or positively affect the following:

	Negatively affect (1)	(2)	(3)	(4)	Positively affect (5)
Reputation of your Institute					
Student employability					
Student skills					

Section I: Cont.

Question 23

For each of the following areas, please indicate on a scale of 1 to 5, whether you agree or disagree that IT industry certifications could help achieve such competence.

	Strongly disagree (1)	(2)	(3)	(4)	Strongly agree (5)
Systems Analysis and Design					
Networking and Communications					
Programming					
IT Fundamentals					
Professional					
Database					
Web and Multimedia					
Project Management					

Integrating IT Industry Certification into Irish Institutes of Technology's (IoTs)

Section I: Cont.

Question 24

Outlined below are five roles and responsibilities that have been identified in assessing competence and commitment. Please indicate on a scale of 1 to 5, whether you agree or disagree that IT industry certification could help achieve such competence.

	Strongly disagree (1)	(2)	(3)	(4)	Strongly agree (5)
Knowledge and Understanding					
Application to Practice					
Leadership/Management/Supervision					
Interpersonal Skill					
Professional Conduct					

Section I: Cont.

Question 25

Do you think that IT graduates currently have ALL the necessary skills required by industry upon leaving your IoT?

Not at all (1) | (2) | (3) | (4) | Major extent (5)

Section J: Reputation of IoT

Question 26

"If the Institute offered students a means to obtain certain certifications during their time in college, more students would be attracted to study in that institute" A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

Strongly disagree (1) | Disagree (2) | Undecided (3) | Agree (4) | Strongly agree (5)

Any additional comments?

Section J: Cont.

Question 27

“Institutes that offer IT industry certifications at undergraduate level are at the cutting edge of IT Education” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section J: Cont.

Question 28

“Integrating IT industry certification into Irish IoTs is not what we are about. That is a trade school function. We are educators and not trainers” A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section J: Cont.

Question 29

"There is no need to integrate IT industry certification into the curriculum. Our existing approach has worked for us in the past!" A N Other

Please indicate on a scale of 1 to 5 your opinion regarding this statement.

- Strongly disagree (1)
- Disagree (2)
- Undecided (3)
- Agree (4)
- Strongly agree (5)

Any additional comments?

Section K: Summary of Basic Position

Question 30

Would you consider IT industry certification as a proper function of IoTs?

- Not at all (1)
- (2)
- (3)
- (4)
- Major extent (5)

Question 31

Would you be in favour of integrating IT industry certifications into Irish IoTs?

- Not at all (1)
- (2)
- (3)
- (4)
- Major extent (5)

Question 32

Finally, please provide any additional comments or opinions relating to IT industry certification and its integration into the undergraduate curriculum in Irish IoTs.

Section L: Demographics

Current Position in IoT

- Head of Department (HoD)
- Lecturer

Please choose the subject area(s) you lecture in.

- Project
- Systems Analysis and Design
- Web and Multimedia
- IT Fundamentals
- Programming
- Database
- Management
- Distributed Systems
- Networking and Communications
- Artificial Intelligence
- Systems Architecture

Institute of Technology (IoT)

Gender

Age

- <30
- 31-40
- 41-50
- 51-60
- 60+

Years of IT experience

Higher Education (excluding undergraduate study)

Industry

Level of Education

For the purpose of this study and the accuracy of the results, I would very much appreciate it if you could give suitable contact details (e.g. Name, email address and/or telephone number) in the event that I need to contact you regarding your response. If you need to contact me directly regarding this survey, my name is Lucy White and I can be contacted at lbwhite@wit.ie or alternatively on 086 1619481.

Personal details

Integrating IT Industry Certification into Irish Institutes of Technology's (IoTs)

Name

E-mail address

Phone No

APPENDIX J

EMAIL – QUESTIONNAIRE REMINDER

Subject: CERTINT-IE Project: Reminder

Dear XXXX,

Following on from our conversations last week I would like to thank you for your participation with this study. The response so far has been excellent. I would be grateful however if you could make one last effort to encourage those computing staff that have not completed the questionnaire to do so as I am hoping to finalise all data for next Friday so I can begin the analysis. Again the success of this study depends heavily on the participation of as many lecturing staff as possible from all Irish Institutes of Technology. It is also worth mentioning that if the executive summary is going to be of any real interest to you, it should really reflect the positions of your own computing staff. Therefore it would be worthwhile to encourage further responses if possible from your department.

I really appreciate all your help.

Kind regards,
Lucy White

APPENDIX K

EMAIL – LETTER OF GRATITUDE

Subject: CERTINT-IE Project

Dear XXXX,

I would like to thank you and your department for all your assistance with my research project. Your support is greatly appreciated. On completion of the research I will contact you with the executive summary as promised. I hope that it will be of some interest to you.

Again thank you for your support.

Kind regards,
Lucy White

APPENDIX L

DATA – HOD

Head of Department (HoDs) Questionnaire Data

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
1	Likert	(1: Never hear of and 6: Very familiar)	12	PMP	7 58.3%	4 33.3%	-	-	-	1 8.3%	1.75	1.422
				Project	7 58.3%	4 33.3%	1 8.3%	-	-	-	1.50	.674
				CCNE	2 16.7%	1 8.3%	2 16.7%	2 16.7%	1 8.3%	4 33.3%	3.92	1.929
				Network+	3 25.0%	2 16.7%	-	1 8.3%	4 33.3%	2 16.7%	3.58	2.021
				OCP DBA	7 58.3%	1 8.3%	1 8.3%	1 8.3%	2 16.7%	-	2.17	1.642
				IBM CDA	6 50.0%	3 25.0%	3 25.0%	-	-	-	1.75	.866
				SCJP	7 58.3%	1 8.3%	-	2 16.7%	2 16.7%	-	2.25	1.712
				MCAD	5 41.7%	2 16.7%	1 8.3%	1 8.3%	2 16.7%	1 8.3%	2.67	1.875
				RHCE	9 75.0%	2 16.7%	-	1 8.3%	-	-	1.42	.900
				CNE	1 8.3%	3 25.0%	4 33.3%	1 8.3%	1 8.3%	2 16.7%	3.33	1.614
				A+	2 16.7%	3 25.0%	-	1 8.3%	4 33.3%	2 16.7%	3.67	1.923
				CCP	7 58.3%	2 16.7%	1 8.3%	-	1 8.3%	1 8.3%	2.08	1.730
				MCP	1 8.3%	1 8.3%	3 25.0%	2 16.7%	3 25.0%	2 16.7%	3.92	1.564

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				CIW	8 66.7%	3 25.0%	1 8.3%	-	-	-	1.42	.669
2	Yes/No	(1: Yes and 2: No)	12		4 33.3%	8 66.7%					1.67	.492
3	Likert	(1: Strongly disagree and 5: Strongly agree)	12		2 16.7%	5 41.7%	2 16.7%	2 16.7%	1 8.3%		2.58	1.240
4	Likert	(1: No concern at all and 2: Major concern	12	Time	-	2 16.7%	5 41.7%	3 25.0%	2 16.7%		3.42	.996
				Develop new course material	2 16.7%	3 25.0%	5 41.7%	2 16.7%	-		2.58	.996
				Flexibility	-	3 25.0%	4 33.3%	3 25.0%	2 16.7%		3.33	1.073
				Teaching style	2 16.7%	2 16.7%	6 50.0%	1 8.3%	1 8.3%		2.75	1.138
				Learning style	2 16.7%	2 16.7%	4 33.3%	3 25.0%	1 8.3%		2.92	1.240
				Resource	2 16.7%	1 8.3%	3 25.0%	4 33.3%	2 16.7%		3.25	1.357
5	Likert	(1: Strongly disagree and 5: Strongly agree)	12		2 16.7%	6 50.0%	3 25.0%	-	1 8.3%		2.33	1.073
6	Likert	(1: Not at all effective and 5: Very effective)	12		-	-	5 41.7%	4 33.3%	3 25.0%		3.83	.835
7	Likert	(1: Very much dislike and 5: very much like)	12	Self-study	-	2 16.7%	6 50.0%	2 16.7%	2 16.7%		3.33	.985
				Computer-based training	-	-	6 50.0%	4 33.3%	2 16.7%		3.67	.778
				Onsite	-	2 16.7%	3 25.0%	4 33.3%	3 25.0%		3.67	1.073

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				Offsite	-	3 25.0%	4 33.3%	3 25.0%	2 16.7%		3.33	1.073
				SIGs (Special Interest Groups)	-	-	4 33.3%	4 33.3%	4 33.3%		4.00	.853
				Online	-	-	4 33.3%	4 33.3%	4 33.3%		4.00	.853
8	Open-Ended											
9	Likert	(1: Not at all and 5: Major extent)	12		-	2 16.7%	5 41.7%	3 25.0%	2 16.7%		3.42	.996
10	Likert	(1: No concern at all and 2: Major concern	12	Budget	-	1 8.3%	3 25.0%	2 16.7%	6 50.0%		4.08	1.084
				Lecturing staff's ableness	2 16.7%	4 33.3%	5 41.7%	1 8.3%	-		2.42	.900
				Lecturing staff's willingness	-	3 25.0%	5 41.7%	3 25.0%	1 8.3%		3.17	.937
				Timetable flexibility	1 8.3%	2 16.7%	5 41.7%	2 16.7%	2 16.7%		3.17	1.193
				Support systems adaptability	-	3 25.0%	2 16.7%	4 33.3%	3 25.0%		3.58	1.165
				Physical resources	-	3 25.0%	3 25.0%	5 41.7%	1 8.3%		3.33	.985
11	Likert	(1: Not at all and 2: Major extent)	12		1 8.3%	2 16.7%	6 50.0%	2 16.7%	1 8.3%		3.00	1.044
12	Yes/No	(1: Yes and 2: No and 3: Don't know)	12		9 75.0%	2 16.7%	1 8.3%				1.33	.651
13	Likert	(1: Very much dislike and 5: very much like)	12	No certification obtained with degree	2 16.7%	5 41.7%	5 41.7%	-	-		2.25	.754

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				Certification obtained with degree	1 8.3%	1 8.3%	5 41.7%	3 25.0%	2 16.7%		3.33	1.155
				APEL (Accreditation of Prior Experiential Learning)	1 8.3%	-	5 41.7%	3 25.0%	3 25.0%		3.58	1.165
				Certification as a separate module	-	2 16.7%	2 16.7%	4 33.3%	4 33.3%		3.83	1.115
14	Yes/No	(1: Yes and 2: No and 3: Don't know)	12		10 83.3%	1 8.3%	1 8.3%				1.25	.622
15	Likert	(1: Not required at all and 5: Very much required)	12	Vendor course material	-	1 8.3%	1 8.3%	3 25.0%	7 58.3%		4.33	.985
				Staff training	-	-	-	4 33.3%	8 66.7%		4.67	.492
				Additional hardware	1 8.3%	4 33.3%	4 33.3%	1 8.3%	2 16.7%		2.92	1.240
				Additional software	-	-	5 41.7%	4 33.3%	3 25.0%		3.83	.835
				Dedicated classrooms/labs	1 8.3%	4 33.3%	2 16.7%	2 16.7%	3 25.0%		3.17	1.403
				Time to train	1 8.3%	-	3 25.0%	3 25.0%	5 41.7%		3.92	1.240
				External trainers	-	1 8.3%	3 25.0%	6 50.0%	2 16.7%		3.75	.866
				New employees	4 33.3%	4 33.3%	2 16.7%	2 16.7%	-		2.17	1.115
16	Likert	(1: Strongly disagree and 5: Strongly agree)	12		-	3 25.0%	6 50.0%	3 25.0%	-		3.00	.739
17	Likert	(1: Impact negatively and 5:	12	Critical thinking skills	-	4	5	2	1		3.00	.953

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
		impact positively)				33.3%	41.7%	16.7%	8.3%			
				Practical skills	-	1 8.3%	1 8.3%	4 33.3%	6 50.0%		4.25	.965
				Problem solving skills	-	3 25.0%	4 33.3%	4 33.3%	1 8.3%		3.25	.965
				Analytical skills	-	4 33.3%	2 16.7%	5 41.7%	1 8.3%		3.25	1.055
				Communication skills	1 8.3%	3 25.0%	5 41.7%	2 16.7%	1 8.3%		2.92	1.084
				Creativity	1 8.3%	4 33.3%	5 41.7%	2 16.7%	-		2.67	.888
				Initiative	-	4 33.3%	5 41.7%	3 25.0%	-		2.92	.793
				Flexibility and adaptability	-	3 25.0%	6 50.0%	3 25.0%	-		3.00	.739
18	Likert	(1: Negatively affect and 5: Positively affect)	12	Institute's reputation	-	-	2 16.7%	7 58.3%	3 25.0%		4.08	.669
				Students employability	-	-	1 8.3%	8 66.7%	3 25.0%		4.17	.577
				Student skills	-	1 8.3%	3 25.0%	6 50.0%	2 16.7%		3.75	.866
19	Likert	(1: Strongly disagree and 5: Strongly agree)	12	Professional	2 16.7%	-	8 66.7%	2 16.7%	-		2.83	.937
				Database	-	-	5 41.7%	6 50.0%	1 8.3%		3.67	.651
				Programming	-	1 8.3%	6 50.0%	4 33.3%	1 8.3%		3.42	.793
				Networking and	-	-	2	8	2		4.00	.603

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				communications			16.7%	66.7%	16.7%			
				Systems analysis and design	-	1 8.3%	8 66.7%	3 25.0%	-		3.17	.577
				Web and Multimedia	-	2 16.7%	5 41.7%	5 41.7%	-		3.25	.754
				Project Management	-	1 8.3%	6 50.0%	5 41.7%	-		3.33	.651
				IT fundamentals	1 8.3%	-	6 50.0%	4 33.3%	1 8.3%		3.33	.985
20	Likert	(1: Strongly disagree and 5: Strongly agree)	12	Knowledge and understanding	-	-	4 33.3%	7 58.3%	1 8.3%		3.75	.622
				Application to practice	-	-	4 33.3%	6 50.0%	2 16.7%		3.83	.718
				Leadership/ management/ supervision	2 16.7%	3 25.0%	6 50.0%	-	1 8.3%		2.58	1.084
				Interpersonal skills	2 16.7%	4 33.3%	5 41.7%	-	1 8.3%		2.50	1.087
				Professional conduct	-	4 33.3%	3 25.0%	4 33.3%	1 8.3%		3.17	1.030
21	Likert	(1: Not at all and 2: Major extent)	12		1 8.3%	1 8.3%	3 25.0%	4 33.3%	3 25.0%		3.58	1.240
22	Likert	(1: Strongly disagree and 5: Strongly agree)	12		-	1 8.3%	6 50.0%	3 25.0%	2 16.7%		3.50	.905
23	Likert	(1: Strongly disagree and 5: Strongly agree)	12		-	4 33.3%	6 50.0%	1 8.3%	1 8.3%		2.92	.900
24	Likert	(1: Strongly disagree and 5: Strongly agree)	12		2 16.7%	7 58.3%	2 16.7%	-	1 8.3%		2.25	1.055

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
25	Likert	(1: Strongly disagree and 5: Strongly agree)	12		2 16.7%	5 41.7%	4 33.3%	-	1 8.3%		2.42	1.084
26	Likert	(1: Not at all and 5: Major extent)	12		-	1 8.3%	5 41.7%	3 25.0%	3 25.0%		3.67	.985
27	Likert	(1: Not at all and 5: Major extent)	12		1 8.3%	-	5 41.7%	3 25.0%	3 25.0%		3.58	1.165

APPENDIX M

DATA – LECTURING STAFF

Lecturing Staff Questionnaire Data

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
1	Likert	(1: Never hear of and 6: Very familiar)	73	PMP	67 91.8%	2 2.7%	1 1.4%	2 2.7%	-	1 1.4%	1.21	.799
				Project	59 80.8%	9 12.3%	2 2.7%	2 2.7%	1 1.4%	-	1.32	.780
				CCNE	39 53.4%	9 12.3%	5 6.8%	6 8.2%	7 9.6%	7 9.6%	2.37	1.799
				Network+	50 68.5%	9 12.3%	6 8.2%	1 1.4%	4 5.5%	3 4.1%	1.75	1.392
				OCP DBA	62 83.8%	5 6.8%	1 1.4%	1 1.4%	4 5.5%	1 1.4%	1.42	1.135
				IBM CDA	58 79.5%	7 9.6%	4 5.5%	4 5.5%	-	-	1.37	.825
				SCJP	62 84.9%	5 6.8%	2 2.7%	1 1.4%	1 1.4%	2 2.7%	1.36	1.046
				MCAD	47 64.4%	10 13.7%	4 5.5%	5 6.8%	6 8.2%	1 1.4%	1.85	1.392
				RHCE	65 89.0%	3 4.1%	1 1.4%	1 1.4%	2 2.7%	1 1.4%	1.29	.964
				CNE	47 64.4%	6 8.2%	8 11.0%	5 6.8%	4 5.5%	3 4.1%	1.93	1.484
				A+	42 57.5%	7 9.6%	5 6.8%	5 6.8%	7 9.6%	7 9.6%	2.30	1.808
				CCP	50 68.5%	7 9.6%	7 9.6%	5 6.8%	3 4.1%	1 1.4%	1.73	1.261
				MCP	43 58.9%	3 4.1%	4 5.5%	8 11.0%	7 9.6%	8 11.0%	2.41	1.892

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				CIW	64 87.7%	4 5.5%	2 2.7%	2 2.7%	-	1 1.4%	1.26	.834
2	Yes/No	(1: Yes and 2: No)	74		17 23.6%	55 66.7%					1.76	.428
3	Yes/No	(1: Yes and 2: No)	71		19 26.8%	52 73.2%					1.73	.446
4	Likert	(1: Use rarely and 5: Use regularly)	69	Acetates	47 68.1%	8 11.6%	9 13.0%	1 1.4%	4 5.8%		1.65	1.135
				PowerPoint slides	10 14.5%	5 7.2%	6 8.7%	2 2.9%	46 66.7%		4.00	1.543
				Prescribed textbooks	16 23.2%	16 23.2%	13 18.8%	16 23.2%	8 11.6%		2.77	1.352
				Photocopied handouts	18 26.1%	11 15.9%	20 29.9%	8 11.6%	12 17.4%		2.78	1.413
				Custom written handouts	17 24.6%	7 10.1%	4 5.8%	7 10.1%	34 49.3%		3.49	1.720
				Internet based	7 10.1%	7 10.1%	16 23.2%	16 23.2%	23 33.3%		3.59	1.321
5a	Likert	(1: Flexible and 5: Well structured)	69		-	5 7.2%	19 27.5%	29 42.0%	16 23.2%		3.81	.879
5b	Likert	(1:Use rigidly and 5: Use as guide)	69		3 4.3%	18 26.1%	22 31.9%	15 21.7%	11 15.9%		3.19	1.128
5c	Likert	(1: Not at all important and 5: Very important)	69		-	1 1.4%	6 8.7%	10 14.5%	52 75.4%		4.64	.707
5d	Likert	(1: Never use and 5: Always use)	69		2 2.9%	7 10.1%	16 23.2%	34 49.3%	10 14.5%		3.62	.956
6a	Likert	(1: Not at all effective and 5: Very effective)	69		1 1.4%	3 4.3%	22 31.9%	29 42.0%	14 20.3%		3.75	.881
6b	Likert	(1: Not at all	69		3	12	19	21	14		3.45	1.132

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
		beneficial and 5: Very beneficial)			4.3%	17.4%	27.5%	30.4%	20.3%			
7a	Likert	(1: Use rarely and 5: Use regularly)	69	Multiple choice exams	31 44.9%	10 14.4%	14 20.3%	8 11.6%	6 8.7%		2.25	1.366
				Essay	35 50.7%	9 13.0%	8 11.6%	6 8.7%	11 15.9%		2.26	1.540
				Structured exams	7 10.1%	6 8.7%	9 13.0%	6 8.7%	41 59.4%		3.99	1.419
7b	Likert	(1: Never use and 5: Always use)	69	Written exams	4 5.8%	10 14.5%	11 15.9%	15 21.7%	29 42.0%		3.80	1.290
				Computer-based exams	20 29.0%	8 11.6%	13 18.8%	16 23.2%	12 17.4%		2.88	1.491
8	Likert	(1: Strongly disagree and 5: Strongly agree)	69		3 4.3%	12 17.4%	15 21.7%	33 47.8%	6 8.7%		3.39	1.018
9	Likert	(1: No concern at all and 5: Major concern)	67	Time	11 16.4%	14 20.9%	9 13.4%	11 16.4%	22 32.8&		3.28	1.516
				Develop new course material	11 16.4%	9 13.4%	17 25.4%	17 25.4%	13 19.4%		3.18	1.348
				Flexibility	9 13.4%	8 11.9%	15 22.4%	19 28.4%	16 23.9%		3.37	1.335
				Teaching style	13 19.4%	15 22.4%	16 23.9%	14 20.9%	9 13.4%		2.87	1.325
				Learning style	10 14.9%	16 23.9%	14 20.9%	18 26.9%	9 13.4%		3.00	1.291
				Resource	12 17.9%	11 16.4%	11 16.4%	15 22.4%	18 26.9%		3.24	1.468
10	Likert	(1: Strongly disagree and 5: Strongly agree)	67		10 14.9%	19 28.4%	13 19.4%	19 28.4%	6 9.0%		2.88	1.237
11	Likert	(1: Strongly disagree and 5:	67		5	24	18	15	5		2.87	1.086

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
		Strongly agree)			7.5%	35.8%	26.9%	22.4%	7.5%			
12a	Likert	(1: Not at all comfortable and 5: Very comfortable)	66		9 13.6%	16 24.2%	19 28.8%	10 15.2%	12 18.2%		3.00	1.301
12b	Open-Ended											
13	Likert	(1: Not at all concerned and 5: very concerned)	66		13 19.7%	9 13.6%	17 25.8%	18 27.3%	9 13.6%		3.02	1.330
14	Likert	(1: Not at all and 5: Major extent)	66		7 10.6%	4 6.1%	10 15.2%	18 27.3%	27 40.9%		3.82	1.323
15	Likert	(1: Not at all effective and 5: very effective)	64		4 6.3%	6 9.4%	25 39.1%	19 29.7%	10 15.6%		3.39	1.063
16	Likert	(1: Very much dislike and 5: Very much like)	63	Self-study	8 12.7%	15 23.8%	20 31.7%	13 20.6%	7 11.1		2.94	1.190
				Computer-based training	9 14.3%	12 19.0%	25 39.7%	11 17.5%	6 9.5%		2.89	1.152
				Onsite	6 9.5%	5 7.9%	10 15.9%	23 36.5%	19 30.2%		3.70	1.253
				Offsite	5 7.9%	11 17.5%	21 33.3%	16 25.4%	10 15.9%		3.24	1.160
				SIGs (Special Interest Groups)	8 12.7%	16 25.4%	16 25.4%	19 30.2%	4 6.3%		2.92	1.154
				Online	10 15.9%	16 25.4%	18 28.6%	13 20.6%	6 9.5%		2.83	1.212
17	Open-Ended											
18	Likert	(1: Not at all and 5: Major extent)	60		2 3.3%	7 11.7%	19 31.7%	22 36.7%	10 16.7%		3.52	1.017
19	Likert	(1: Very much dislike and 5: very much like)	58	No certification obtained with degree	15 25.9%	20 34.5%	10 17.2%	11 19.0%	2 3.4%		2.40	1.169

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				Certification obtained with degree	6 10.3%	8 13.8%	11 19.0%	24 41.4%	9 15.5%		3.38	1.211
				APEL (Accreditation of Prior Experiential Learning)	5 8.6%	5 8.6%	18 31.0%	20 34.5%	10 17.2%		3.43	1.141
				Certification as a separate module	4 6.9%	8 13.8%	16 27.6%	19 32.8%	11 19.0%		3.43	1.156
20	Likert	(1: Strongly disagree and 5: Strongly agree)	58		6 10.3%	12 20.7%	19 32.8%	16 27.6%	5 8.6%		3.03	1.123
21	Likert	(1: Impact negatively and 5: impact positively)	56	Critical thinking skills	8 14.3%	9 16.1%	22 39.3%	14 25.0%	3 5.4%		2.91	1.100
				Practical skills	-	3 5.4%	13 23.2%	20 35.7%	20 35.7%		4.02	.904
				Problem solving skills	6 10.7%	4 7.1%	22 39.3%	19 33.9%	5 8.9%		3.23	1.079
				Analytical skills	4 7.1%	8 14.3%	22 39.3%	15 26.8%	7 12.5%		3.23	1.079
				Communication skills	9 16.1%	2 3.6%	33 58.9%	9 16.1%	3 5.4%		2.91	1.032
				Creativity	10 17.9%	12 21.4%	22 39.3%	9 16.1%	3 5.4%		2.70	1.111
				Initiative	7 12.5%	3 5.4%	24 42.9%	17 30.4%	5 8.9%		3.18	1.097
				Flexibility and adaptability	9 16.1%	7 12.5%	27 48.2%	11 19.6%	2 3.6%		2.82	1.046
22	Likert	(1: Negatively affect and 5: Positively affect)	56	Institute's reputation	4 7.1%	1 1.8%	10 17.9%	23 41.1%	18 32.1%		3.89	1.107
				Students employability	2 3.6%	2 3.6%	3 5.4%	21 37.5%	28 50.0%		4.27	.981

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
				Student skills	2 3.6%	4 7.1%	14 25.0%	22 39.3%	14 25.0%		3.75	1.031
23	Likert	(1: Strongly disagree and 5: Strongly agree)	56	Professional	3 5.4%	7 12.5%	24 42.9%	14 25.0%	8 14.3%		3.30	1.043
				Database	2 3.6%	4 7.1%	23 41.1%	17 30.4%	10 17.9%		3.52	.991
				Programming	3 5.4%	8 14.3%	15 26.8%	19 33.9%	11 19.6%		3.48	1.128
				Networking and communications	3 5.4%	4 7.1%	15 26.8%	18 32.1%	16 28.6%		3.71	1.124
				Systems analysis and design	5 8.9%	8 14.3%	24 42.9%	11 19.6%	8 14.3%		3.16	1.125
				Web and Multimedia	3 5.4%	7 12.5%	18 32.1%	18 32.1%	10 17.9%		3.45	1.094
				Project Management	4 7.1%	7 12.5%	21 37.5%	15 26.8%	9 16.1%		3.32	1.114
				IT fundamentals	4 7.1%	9 16.1%	17 30.4%	17 30.4%	9 16.1%		3.32	1.146
24	Likert	(1: Strongly disagree and 5: Strongly agree)	53	Knowledge and understanding	3 5.7%	6 11.3%	17 32.1%	16 30.2%	11 20.8%		3.49	1.120
				Application to practice	1 1.9%	3 5.7%	11 20.8%	22 41.5%	16 30.2%		3.92	.958
				Leadership/ management/ supervision	9 17.0%	12 22.6%	22 41.5%	8 15.1%	2 3.8%		2.66	1.055
				Interpersonal skills	9 17.0%	14 26.4%	20 37.7%	8 15.1%	2 3.8%		2.62	1.060
				Professional conduct	5 9.4%	13 24.5%	20 37.7%	12 22.6%	3 5.7%		2.91	1.043

No.	Type	Values	N		1	2	3	4	5	6	Mean	Std. Dev.
25	Likert	(1: Not at all and 5: Major extent)	52		13 25.0%	11 21.2%	18 34.6%	9 17.3%	1 1.9%		2.50	1.111
26	Likert	(1: Strongly disagree and 5: Strongly agree)	52		1 1.9%	3 5.8%	15 28.8%	22 42.3%	11 21.2%		3.75	.926
27	Likert	(1: Strongly disagree and 5: Strongly agree)	51		6 11.8%	11 21.6%	19 37.3%	11 21.6%	4 7.8%		2.92	1.111
28	Likert	(1: Strongly disagree and 5: Strongly agree)	51		2 3.9%	21 41.2%	10 19.6%	14 27.5%	4 7.8%		2.94	1.085
29	Likert	(1: Strongly disagree and 5: Strongly agree)	51		3 5.9%	26 51.0%	15 29.4%	7 13.7%	-		2.51	.809
30	Likert	(1: Not at all and 5: Major extent)	51		2 3.9%	10 19.6%	22 43.1%	16 31.4%	1 2.0%		3.08	.868
31	Likert	(1: Not at all and 5: Major extent)	51		2 3.9%	7 13.7%	14 27.5%	23 45.1%	5 9.8%		3.43	.985
32	Open-Ended											