Undergraduate Information Systems Education in the UK: Analysing the Curriculum Provision and Industry Needs

by

Angelos Stefanidis

A Doctoral Thesis submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of Loughborough University

January 2014

© Angelos Stefanidis 2014

ABSTRACT

In recent years there have been repeated calls for universities to better equip students with skills which are relevant to business and industry. The field of Information Systems (IS), along with the wider discipline of computing, has often been described as outdated, slow to adopt new technologies and unable to keep up with the fast pace of change of the 'real world'. Exacerbating the issue of academic relevance in relation to industry needs, universities around the world have experienced a growing disinterest in the study of IS and computing, resulting in worryingly low levels of new graduates who do not meet industry demands.

To understand the contentious relationship between academia and business in relation to IS, the research presented in this thesis investigates the current IS undergraduate provision in the UK and its alignment with the skill requirements of the IS industry. This is achieved through a two-stage approach of examining the position and expectations of each stakeholder, followed by the development of a method to facilitate the alignment of their inter-related needs.

As part of the first stage, the investigation into the academic stakeholder undertakes a holistic analysis of IS curriculum to quantify its content. This leads to the identification of original Career Tracks which specify the IS careers promoted by the curriculum. The second stage involves the investigation of the business stakeholder measuring the careers in demand and the skills that support them. The resulting findings from these investigations show that it is possible to determine the skills required by IS graduates in the UK to meet the demands of industry. This is achieved through the use of a newly developed IS Course Survey Framework that enables the configuration of IS courses to align to specific career tracks, thus mapping directly to the needs of industry as expressed through their job requirements and associated skills demand.

Keywords: IS Education, IS Curriculum Classification, IS Curriculum, IS Model Curriculum, Subject Benchmark Statement in Computing, IS 2010, IS Career Tracks

PUBLICATIONS

The following references are papers contained in this thesis which have been published or presented elsewhere. The papers were derived from work carried out as part of this thesis.

Stefanidis, A., Fitzgerald, G. and Counsell, S. (2013), IS curriculum career tracks: A UK study, *Education + Training*, Vol. 55 No. 3, pp. 220-233.

Stefanidis, A., Fitzgerald, G. and Counsell, S. (2012), A comprehensive survey of IS undergraduate degree courses in the UK, *International Journal of Information Management*, Vol. 32 No. 4, pp. 318-325.

Stefanidis, A., Fitzgerald, G. and Counsell, S. (2012), A comprehensive survey of IS undergraduate degree courses in the UK, *UKAIS International Conference 2012: Innovating Information Systems.* New College, Oxford.

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

Stefanidis, A. and Fitzgerald, G. (2010), Information Systems curricula in the UK: A survey of undergraduate courses (research-in-progress), *Italics*, Vol. 9 No. 1, pp. 87-99.

ACKNOWLEDGEMENTS

I owe a unique debt of gratitude to Prof Guy Fitzgerald for believing in my ability to complete this work. Thank you for your support and guidance.

Special thanks go to Dr Steve Counsell, Brunel University, for 'making me' sign up to do a PhD all those years ago. Thank you Steve for dismissing my excuses and apprehensions. You were right.

I am very grateful to my close circle of 'PhD friends': Bobi, Francois, Pat and Sunila. Pat deservedly got there first. It is now the turn of the remaining three!

I will always be indebted to my good friend and mentor Dr Nick Lambrou, who introduced me to academia, taught me to be inquisitive, supported me throughout my life, and keeps reminding me that I need to continue improving all aspects of my professional and personal life -in every possible way I can.

CERTIFICATE OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this thesis, that the original work is my own except as specified in acknowledgments or in footnotes, and that neither the thesis nor the original work contained therein has been submitted to this or any other institution for a degree.

Angelos Stefanidis
January 2014

LIST OF ABBREVIATIONS

AACSB	Association to Advance Collegiate Schools of Business
ABET	Accreditation Board for Engineering and Technology
ACM	Association for Computing Machinery
AIS	Association for Information Systems
AITP	Association of IT Professionals
BCS	British Computer Society
BoK	Body of Knowledge
CEng	Charted Engineer
CISP	Council of IS Professors
CITP	Charted IT Professional
CSci	Charted Scientist
DAMA	Data Administration Management Association
DF	Domain Fundamentals
DPMA	Data Processing Management Association
FKS	Foundational Knowledge and Skills
HESA	Higher Education Statistics Agency
IEEE	Institute of Electrical and Electronics Engineers
IEng	Incorporated Engineer
IFIP	International Federation for Information Processing
IRMA	Information Resources Management Association
IS 2002	Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems
IS 2010	Curriculum guidelines for undergraduate degree programs in Information Systems
IS'95	Guideline for Undergraduate IS Curriculum
IS'97	Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems
ISACA	Information Systems Audit and Control Association
ISCC '99	Information Systems-Centric Curriculum
ISSKS	IS Specific Knowledge and Skills
JACS	Joint Academic Coding of Subjects
MComp	Master's in Computing
NSS	National Student Survey
QAA	Quality Assurance Agency
SBSC	Subject Benchmark Statement in Computing
UCAS	Universities and Colleges Admissions Service
UKAIS	UK Academy for Information Systems

TABLE OF CONTENTS

ABSTRACT ii

PUBLICATIONS iii

ACKNOWLEDGEMENTS iv

CERTIFICATE OF ORIGINALITY v

LIST OF ABBREVIATIONS vi

LIST OF FIGURES xv

LIST OF TABLES xvii

1 Introduction 1

1.1 Introduction 1

1.2 Personal Motivations for Research 1

1.3 Emerging Research Gap 2

1.4 Research Aim 3

1.5 Research Objectives 4

1.6 Scope, Focus and Approach 4

1.7 Research Design 7

1.8 Research Contribution 7

1.9 Organisation of the Thesis 8

1.10 Summary 10

2 Information systems Education in Context 11

2.1 Introduction 11

2.2 The IS Field 11

2.3 The History of IS 15

2.3.1 The First Era from Mid-1960s to Mid-1970s 16

2.3.2 The Second Era from Mid-1970s to Mid-1980s 18

2.3.3 The Third Era from Mid-1980s to Late-1990s 20

2.3.4 The Fourth Era from Late-1990s to Today 21

2.3.5 History 'Lessons' about IS Education 22

2.4 The Crisis in IS *(Education?)*..... 23
2.5 IS Curriculum Development 26
2.6 IS Stakeholders 28
2.6.1 The Academic Stakeholder 31
2.6.2 The Employer Stakeholder..... 32
2.6.3 The Government Stakeholder 33
2.6.4 The Student/Alumni Stakeholder..... 33
2.6.5 The Accreditation/Professional Body Stakeholder..... 35
2.7 IS Education 37
2.8 Summary 40
3 Characteristics of Information Systems Education 42
3.1 Introduction..... 42
3.2 IS Education Characteristics 42
3.3 Demand for IS courses 43
3.3.1 IS Undergraduate Recruitment in the UK 45
3.3.2 IS Course Survey Enrolment Data 46
3.3.3 CISP Enrolment Data..... 48
3.4 IS Course Naming Conventions 50
3.4.1 Naming of IS Courses in the UK..... 50
3.4.2 Naming of IS Courses in the US..... 52
3.5 Entry-level Qualifications for IS Courses in the UK..... 52
3.6 Levels of Accreditation of IS Courses in the UK 55
3.7 IS Careers and Unistats Data..... 57
3.7.1 IS Career Keywords Found on Course Websites 58
3.7.2 Unistats Employment Data..... 60
3.7.3 Job Category of Graduates 61
3.7.4 Destination of Graduates 62
3.7.5 Job Type of Graduates..... 63
3.8 Summary 64

4 IS Model Curriculum Recommendations 65
4.1 Introduction 65
4.2 Mainstream Curricula Recommendations 65
4.2.1 Information Systems Model Curriculum - 1973 68
4.2.2 Report of the ACM Curriculum Committee on IS - 1981 69
4.2.3 Information Systems Curriculum Recommendations for the 80s - 1982 .. 70
4.2.4 Information Systems Model Curriculum – 1995 & 1997 71
4.2.5 IS 2002 73
4.2.6 IS 2010 75
(1) Characteristic 1: Beyond the Business School 77
(2) Characteristic 2: Revising Outcome Expectations 79
(3) High-level Capabilities 80
(4) Knowledge and Skills 81
4.2.7 Characteristic 3: Revising the Structure 83
4.2.8 Characteristic 4: Mobilising the Global IS Community 85
4.3 Other Model Curriculum Reports 85
4.3.1 Data Processing Management Association (DPMA) 86
4.3.2 ISACA Model Curricula 87
4.3.3 IRMA/DAMA Model Curriculum 2000 87
4.3.4 Information Systems-Centric Curriculum ISCC ’99 (ISCC ’99) 88
4.4 Curriculum Recommendations in the UK 89
4.4.1 IFIP/BCS Curriculum 89
4.4.2 UKAIS Scope of Domain of Study 89
4.4.3 QAA Subject Benchmark Statement in Computing (SBSC) 90
4.5 Body of Knowledge of IS 92
4.6 Summary 93
5 Research Approach 94
5.1 Introduction 94
5.2 IS Research 94
5.3 Emerging IS Education Research Gaps 95

5.3.1 IS Education Characteristics 95
5.3.2 IS Course Characteristics 96
5.3.3 IS Model Curriculum Recommendations 96
5.3.4 The Need for IS Curriculum and Graduate Job Surveys 97
5.3.5 IS Education Research – Stakeholder Perspectives 98
5.3.6 Using Surveys to Address the Research Objectives 98
5.4 Approaches for IS Education Research - Curriculum Surveys 99
5.4.1 Conducting IS Curriculum Surveys 99
5.4.2 Applying Direct Surveys to Curriculum Mappings 102
5.4.3 Factors Affecting Direct Curriculum Surveys 103
5.4.4 The Direct Survey - IS Curriculum in the UK 105
5.4.5 The Need for a Pilot Study 107
5.5 Approaches for IS Education Research - IS Job Skill Surveys 108
5.5.1 Identifying IS Graduate Skills 108
5.5.2 Data Collection Method: Survey (Paper Questionnaires) 111
5.5.3 Data Collection Method: Survey (Newspaper Ads) 114
5.5.4 Data Collection Method: Survey (Web) 116
5.5.5 Data Collection Method: Survey (Interviews) 119
5.5.6 Data Collection Method: Survey (Mixed Methods) 120
5.5.7 Selecting an Appropriate Data Collection Method 123
5.6 Content Analysis 128
5.7 The Content Analysis Survey - Graduate IS Job Ads in the UK 132
5.8 Summary 133
6 IS Curriculum Classification 135
6.1 Introduction 135
6.2 Surveying the IS Curriculum in the UK 135
6.3 Stages of the Curriculum Mapping Survey 136
6.4 Sourcing the Survey Data 136
6.5 Pilot Study Survey - Classifying the IS Curriculum 138

6.5.1 Pilot Study Survey: Course Selection Methodology 139
6.5.2 Pilot Study Survey: Data Collection Approach 141
6.5.3 Pilot Study Survey: Profile of Courses 142
6.5.4 Pilot Study Survey: Findings - Core Module Rankings 143
6.5.5 Pilot Study Survey: Findings - Option Module Rankings 145
6.5.6 Pilot Study Survey: Conclusions 147
6.6 QAA SBSC / IS 2002 Survey 148
6.6.1 QAA SBSC / IS 2002 Survey: Extended Course and Data Collection.... 150
6.6.2 QAA SBSC / IS 2002 Survey: Extending the classification methods 151
6.6.3 QAA SBSC Survey: Findings 152
6.6.4 IS 2002 Survey: Findings 155
6.6.5 QAA SBSC / IS 2002 Survey: Comparison 157
6.6.6 QAA SBSC / IS 2002 Survey: Observations 159
6.6.7 QAA SBSC / IS 2002 Survey: Limitations 161
6.7 IS 2010 Survey 161
6.7.1 IS 2010 Survey: Dataset Manipulations 162
6.7.2 IS 2010 Survey: Extending the Dataset 168
6.7.3 IS 2010 Survey: Course Survey Framework 169
6.7.4 IS 2010 Survey: Survey results 172
6.7.5 IS 2010 Survey: IS Specific Knowledge and Skills 174
6.7.6 IS 2010 Survey: Domain Fundamentals 175
6.7.7 IS 2010 Survey: Foundational Knowledge and Skills 177
6.7.8 IS 2010 Survey: Final Year Project 178
6.7.9 IS 2010 Survey: Observations 178
6.7.10 IS 2010 Survey: Limitations 180
6.8 Career Tracks in the IS Curriculum 181
6.8.1 Career Tracks: Categorising Job Skills 181
6.8.2 Career Tracks: Observations 183
6.8.3 Career Tracks: Limitations 185

6.9 Summary 185
7 IS Graduate Job Skills 187
7.1 Introduction 187
7.2 Surveying IS Jobs 187
7.2.1 Surveying IS Graduate Jobs in the UK 188
7.2.2 Surveying IS Graduate Job outside the UK 191
7.2.3 Content Analysis Software 193
7.2.4 Content Analysis Software Packages 194
7.3 Design of the Study 195
7.3.1 Search Parameters 196
7.3.2 Search Terms 198
7.3.3 Search Data 198
7.3.4 Dictionary Terms 200
7.3.5 Design Limitations 202
7.4 Analysis 205
7.4.1 Job Name 205
7.4.2 Industry 208
7.4.3 Location 209
7.4.4 Job Type, Experience, Career Level, Salary and Education 210
7.5 Popularity of Skills in IS Graduate Job Ads 213
7.6 Conclusions 217
8 Skills Alignment and Other Emerging Issues 218
8.2 Introduction 218
8.3 In Search of IS Curriculum and Job Alignment 218
8.3.1 IS Skills Alignment: Career Tracks vs. Job Titles 220
8.3.2 IS Skills Alignment: Module Skills vs. Job Skills 223
8.3.3 The Existence of Alignment 225
8.3.4 Aligning Careers and Skills 226
8.3.5 Emerging Alignment Issues 226

8.4 Emerging Issues from Academia 227
8.4.1 IS Identity Crisis 228
8.4.2 IS Course Demand 229
8.4.3 IS Entry Level Qualifications 229
8.4.4 IS Course Accreditation 230
8.4.5 IS Curriculum Observations 230
8.5 Emerging Issues from Business and Industry 232
8.5.1 Outsourcing of Jobs 233
8.5.2 Dotcom Burst 233
8.6 Summary 234
9 Conclusions 235
9.1 Introduction 235
9.2 Research Findings 235
9.2.1 The Undergraduate IS Curriculum in the UK 235
9.2.2 The IS Graduate Market in the UK 236
9.2.3 Skills Alignment 236
9.3 Reflections on the Research Approach 237
9.4 Reflections on the Survey Findings 237
9.5 Reflections on the Skills Alignment 238
9.6 Demonstrating the Research Aim 238
9.7 Contribution of the Research 239
9.7.1 Scope of the IS academic provision in the UK 239
9.7.2 Measure the IS curriculum provision in the UK 240
9.7.3 Develop a Course Survey Framework 240
9.7.4 Identify curriculum career tracks 241
9.7.5 Analyse employer-driven IS graduate skills requirements 241
9.7.6 Compare academic with business skills 241
9.7.7 Determine a method for aligning the identified skills gap 242
9.8 Reflections on the Contributions 242

9.8.1 Practical Implications for IS Academics 243
9.9 Future Work 243
9.9.1 Stakeholder: Employers 243
9.9.2 Stakeholder: Academics 244
9.9.3 Stakeholder: Students 246
9.9.4 Stakeholder: Professional Bodies / Accreditation 247
9.10 Conclusions 247
BIBLIOGRAPHY 248
APPENDIX A 263
APPENDIX B 269

LIST OF FIGURES

FIGURE 1.1. THE SCOPE, FOCUS AND APPROACH. 5

FIGURE 2.1. DIFFERENTIATING IS FROM OTHER IT-RELATED DISCIPLINES. 12

FIGURE 2.2. REPRESENTATION OF DISCIPLINARY GROUPS WITHIN THE FIELD OF IT. 13

FIGURE 2.3. FACTORS INFLUENCING THE DEVELOPMENT OF THE IS CURRICULUM. 27

FIGURE 2.4. STAKEHOLDERS IN RELATION TO IS TEACHING. 29

FIGURE 2.5. IS STAKEHOLDERS IN HE FOR IS. 30

FIGURE 3.1. US DEGREES AWARDED IN IS AND CS. 44

FIGURE 3.2. IS AND COMPUTING ENROLMENT DATA FOR THE UK. 47

FIGURE 3.3. IS ENROLMENT DATA FOR THE UK. 48

FIGURE 3.4. COMBINED IS ENROLMENT DATA FOR THE UK. 50

FIGURE 3.5. IS UNDERGRADUATE DEGREE COURSE TITLES IN THE UK. 51

FIGURE 3.6. PROMINENT UK UNIVERSITY GROUP AFFILIATIONS. 54

FIGURE 3.7. ENTRY LEVEL QUALIFICATION POINTS (A-LEVELS) BY GROUP. 55

FIGURE 3.8. IS COURSE ACCREDITATION BY UNIVERSITY AFFILIATION GROUP. 56

FIGURE 3.9. IS CAREER KEYWORDS. 59

FIGURE 3.10. IS JOB DATA BY UNIVERSITY AFFILIATION GROUP. 61

FIGURE 3.11. IS STUDENT DESTINATION DATA BY UNIVERSITY AFFILIATION GROUP. 62

FIGURE 3.12. IS JOB TYPE DATA BY UNIVERSITY AFFILIATION GROUP. 63

FIGURE 4.1. IS 2002 REPRESENTATIVE COURSE SEQUENCE 74

FIGURE 4.2. THE STRUCTURE OF IS 2010 MODEL CURRICULUM. 76

FIGURE 4.3. DEMONSTRATION OF CLOSE LINKAGE BETWEEN INFORMATION SYSTEMS AND BUSINESS IN IS 2002 78

FIGURE 4.4. REVISED EXIT CHARACTERISTICS. 79

FIGURE 4.5. OVERALL STRUCTURE OF THE BASIC CONCEPTS 80

FIGURE 4.6. OVERALL STRUCTURE OF THE BASIC CONCEPTS AND IS 2010 CORE COURSES.. 83

FIGURE 6.1. PILOT STUDY SURVEY. 139

FIGURE 6.2. FIRST STAGE MAPPING. 149

FIGURE 6.3. SECOND STAGE MAPPING. 162

FIGURE 6.4. IS COURSE INFORMATION COLLECTED FOR EACH INSTITUTION. 163

FIGURE 6.5. A SAMPLE OF THE CONTENT AND FORMAT OF COURSE DATA. 164

FIGURE 6.6. CAPTURING THE RELATIVE CONTRIBUTION EACH MODULE MAKES. 165

FIGURE 6.7. CAPTURING THE INDIVIDUAL MODULE SCORES PER YEAR OF STUDY. 165

FIGURE 6.8. CALCULATING THE RELATIVE SCORES OF MODULES IN RELATION TO CAREER TRACKS. 167

FIGURE 6.9. CAREER TRACK SCORES FOR A COURSE BASED ON WEIGHTINGS. 168

FIGURE 6.10. COURSE SURVEY FRAMEWORK (RIGHT) BASED ON IS 2010 BASIC CONCEPTS (LEFT). 170

FIGURE 6.11. BREAKDOWN OF MODULE DATA ACCORDING TO IS AND NON-IS GROUPINGS. 173

FIGURE 7.1. DISTRIBUTION OF JOB ADS ACROSS THE UK. 210

FIGURE 7.2. CLUSTER ANALYSIS OF IS JOB SKILLS. 215

LIST OF TABLES

TABLE 2.1. CITATION ANALYSIS OF IS EDUCATION. 39

TABLE 2.2. IS EDUCATION AND RESEARCH CLASSIFICATION. 39

TABLE 3.1. IS ENROLMENT DATA FOR THE UK 49

TABLE 3.2. ENTRY LEVEL POINTS BREAKDOWN. 53

TABLE 3.3. TYPE OF ACCREDITATION PER UNIVERSITY AFFILIATION GROUP. 57

TABLE 4.1. CURRENT CURRICULUM RECOMMENDATION REPORTS BY ACM. 66

TABLE 4.2. IS CURRICULUM RECOMMENDATIONS REPORT HISTORY (ACM). 68

TABLE 5.1. PAPER QUESTIONNAIRE SURVEYS 112

TABLE 5.2. NEWSPAPER AD SURVEYS 114

TABLE 5.3. WEB SURVEYS 116

TABLE 5.4. NEWSPAPER AD SURVEYS 119

TABLE 5.5. MIXED SURVEYS. 121

TABLE 6.1. LIST OF UNIVERSITIES INCLUDED IN THE PILOT STUDY SURVEY. 138

TABLE 6.2. MODES OF IS COURSES SELECTED. 141

TABLE 6.3. MODES OF IS COURSES SELECTED. 142

TABLE 6.4. QAA BOK CLASSIFICATION OF TOTAL NUMBER OF CORE MODULES IN ALL COURSES 144

TABLE 6.5. CORE MODULE POPULARITY RANKING BASED ON THE QAA IS BOK CLASSIFICATION 145

TABLE 6.6. QAA BOK CLASSIFICATION OF TOTAL NUMBER OF OPTION MODULES IN ALL COURSES 146

TABLE 6.7. OPTION MODULE POPULARITY RANKING BASED ON THE QAA IS BOK CLASSIFICATION. 147

TABLE 6.8. SUBJECTS MAKING UP THE UNCLASSIFIED CATEGORY. 151

TABLE 6.9. OVERALL MODULE DATA AND BREAKDOWN. 153

TABLE 6.10. QAA SBSC OVERALL DATA CLASSIFICATION 153

TABLE 6.11. QAA SBSC CLASSIFICATION BREAKDOWN WITH MODULE RATIOS 154

TABLE 6.12. QAA SBSC CLASSIFICATION METHOD PERCENTAGE BREAKDOWN OF UNCLASSIFIED MODULES 155

TABLE 6.13. IS 2002 OVERALL DATA CLASSIFICATION 156

TABLE 6.14. IS 2002 CLASSIFICATION BREAKDOWN WITH MODULE RATIOS. 156

TABLE 6.15. IS 2002 CLASSIFICATION METHOD PERCENTAGE BREAKDOWN OF UNCLASSIFIED MODULES 157

TABLE 6.16. UK UNIVERSITIES OFFERING IS COURSES SHOWN BY AFFILIATION. 168

TABLE 6.17. CORE/OPTION MODULE BREAKDOWN ACROSS ALL UNIVERSITIES. 169

TABLE 6.18. CORE/OPTION MODULE CONTRIBUTING TO CORE/OPTION IS 2010 SUBJECTS 171

TABLE 6.19. CORE MODULES MAPPING TO CORE IS 2010 SUBJECTS 174

TABLE 6.20. IS DEGREE COURSE CORE & OPTION MODULE RANKINGS (EXCLUDING PROJECT & NON-IS) 175

TABLE 6.21. BUSINESS – DOMAIN FUNDAMENTALS (COMBINED CORE & OPTION). 176

TABLE 6.22. COMPUTING - DOMAIN FUNDAMENTALS (COMBINED CORE & OPTION) 177

TABLE 6.23. DOMAIN FUNDAMENTALS (COMBINED CORE & OPTION). 177

TABLE 6.24. FOUNDATIONAL KNOWLEDGE AND SKILLS 178

TABLE 6.25. FINAL YEAR PROJECT 178

TABLE 6.26. CAREER TRACK RANKINGS. 182

TABLE 6.27. CAREER TRACKS MEASURED BY MODULE COVERAGE. 183

TABLE 6.28. CAREER TRACK CORRELATION WITH HIGHEST AND LOWEST SCORES HIGHLIGHTED. 184

TABLE 7.1. SKILLS DERIVED FROM UK JOB ADS IN 2001. 189

TABLE 7.2. SKILLS DERIVED FROM UK JOB ADS IN 2001. 195

TABLE 7.3. KEYWORD DICTIONARY DEVELOPED FOR QDA MINER. 201

TABLE 7.4. RANKING OF JOB NAME. 207

TABLE 7.5. RANKING OF INDUSTRY. 209

TABLE 7.6. RANKING OF JOB TYPE. 211

TABLE 7.7. RANKING OF CAREER LEVEL. 211

TABLE 7.8. RANKING OF EXPERIENCE. 212

TABLE 7.9. OVERALL POPULARITY OF IS JOB SKILLS 214

TABLE 8.1. CORRELATION BETWEEN CAREER TRACK NAMES AND JOB NAMES. 221

TABLE 8.2. SKILLS ALIGNMENT: DIRECT COMPARISON OF CURRICULUM CAREERS WITH INDUSTRY JOBS. 222

TABLE 8.3. SKILLS ALIGNMENT: INDIRECT COMPARISON OF IS CURRICULUM AND INDUSTRY SKILLS. 224

1 INTRODUCTION

1.1 Introduction

Formal research in Information Systems (IS) education has not been as popular as research in other aspects of the discipline, which enjoy lively debates at academic conferences and robust arguments presented in published journal papers. Yet IS 'education' is something that permeates the professional lives of all IS academics who engage in teaching and wider scholarly activities. Aspects of IS education are present in the Learning and Teaching approaches academics employ to ensure the highest impact of their teaching on their students. They are also present in the IS professional ethos that academics try to instil into their graduates. Similarly, additional aspects of IS can be found in the interactions between academics and industry as part of continuous efforts to ascertain the relevance and alignment of the skills required for the successful development of future IS professionals.

1.2 Personal Motivations for Research

The basic motivation behind the work presented in this thesis was the curiosity to provide answers to seemingly simple questions about what should or could be taught to UK undergraduate students undertaking a degree in IS, and why. Such questions would often emerge as part of a casual reflective process about teaching various IS topics to students, along with discussions with academic colleagues from different institutions. Questions such as "should we teach more systems analysis?" or "what is the best programming environment for first year students?" prompted the urge for an initial investigation.

At the same time, professional bodies, along with business and industry, would often raise the issue of an inadequate level of preparation offered by universities to computing and IS graduates who consequently lacked the appropriate skills required for the commercial world. IS educators would defend their position by explaining that offering rigorous, relevant and well-rounded academic pedagogy should be the main aim of IS education which can only be achieved by going well beyond teaching students purely 'vocational' skills. However, the case made by IS employers about operating in an unforgiving global economy was strong. They argued that business competitiveness would suffer unless IS graduates were capable of 'hitting the ground running', which is interpreted as entry-level employees having the right IS skills for the right job without the need of additional training. Bearing in mind that graduate

employability prospects are increasingly becoming one of the most decisive factors for students and their families when examining the relative merits of undertaking any degree course, it is not surprising that the views of employers are taken very seriously. As a result of these tensions, in addition to questions regarding the curriculum, further questions were raised about what would be the 'right' skills to give to students and how should such knowledge and skills be imparted successfully.

The backdrop to the emergence of these questions was characterised by significant changes to tertiary education and the field of computing and IS. For over ten years, from the start of the 21st century, the Higher Education (HE) sector in the UK underwent a number of significant changes. During this period successive governments made concerted efforts to expand HE by making it more accessible to students whose demographic profile would normally suggest limited access opportunities. At the same time, changes to funding models meant that students and their families would have to bear the increasing costs of university education with reduced support from the state. Evidence from the Universities and Colleges Admissions Service (UCAS) and universities across the UK showed a steady decrease in the number of students with an interest in the sciences, computing and IS (Stowell and Probert, 2012). Similar trends were also documented in other countries, including the US and Australia (Koch *et al.*, 2010, Wilson and Avison, 2007).

In parallel to the changes permeating the academic world, a number of changes of noticeable magnitude were also taking place in the professional world of IS. The burst of the dot com bubble in early 2000 (Panko, 2008) and the growth of outsourcing of IS 'functions', such as application development and technical support (Hirschheim and Newman, 2010), combined with a somewhat unclear identity of IS as a field of study, seemed to contribute to a growing unattractiveness of the IS profession.

1.3 Emerging Research Gap

Attempts to find answers to what were predominantly issues resulting from personal and professional curiosity about IS, led to the realisation that information about the scope and content of IS academic provision in the UK was very sparse. Equally, finding conclusive information about the industry's proclaimed skills gap was also problematic given the lack of clear data about graduate IS jobs and their associated skills.

As one of the prominent aspects of IS education, IS curriculum development is seen as a challenging process which aims to balance the provision of academic pedagogy and technical skills, while trying to keep up with continuous technological advancements (Hatzakis *et al.*, 2007). The fast-paced evolutionary cycle of change in the IS world often renders academia unable to cope with either technological or business practice transformations. While there is

an expectation that IS graduates possess sufficient skills to make their transition into graduate employment as seamless as possible, the reality is often different (Lee *et al.*, 2002). Perceived gaps both in terms of 'soft' and 'hard' graduate skills are difficult to measure precisely; evidence over time has indicated the existence of such gaps (Tang *et al.*, 2000, Litecky *et al.*, 2004). The consensus on how to best design IS curricula relevant to industry and future professionals suggests the need to involve those stakeholders with an inherent interest in the outcome (Petrova and Claxton, 2005).

The gap in the provision of relevant skills is seen by many in the academic and business worlds of IS as a plausible explanation for the decreasing numbers of IS undergraduate students and graduate IS professionals respectively (Granger *et al.*, 2007). The largely inconclusive attempts made by academic researchers hoping to isolate the exact reasons for this phenomenon, have highlighted issues ranging from the discipline's immaturity to a lack of meaningful cooperation between academia and industry. Among the possible explanations offered, a number of researchers, have argued that ageing IS undergraduate curricula are partly to blame for the demise of the discipline (Hirschheim and Klein, 2003).

1.4 Research Aim

Changes in both higher education and the world of business and industry are altering the traditional relationship between the academic and professional worlds. The rising cost of higher education is making prospective students very conscious of the range of employment opportunities and salaries they will be able to command as professionals. Prolonged international financial difficulties are also making business and industry much more selective in their recruitment efforts. At the same time, rapid technological advancements and business practices are constantly changing the skills necessary for a successful career in the field of IS. Despite the continuing evolution of IS degree courses across the UK higher education sector, the relationship between academia and business remains contentious due to the inadequate alignment between industry expectations and academic provision.

It is the aim of this research to provide a potential solution that addresses these issues by showing that:

It is possible to align industrial IS careers to current academic IS provision in the UK by conducting a comprehensive analysis of both the current undergraduate IS curriculum provision relevant to specific identified professional career tracks, and the skill requirements of IS employers. Such analysis will facilitate communication between industry and academia with regard to determining appropriate required skills for IS graduates.

To expedite the achievement of this aim, surveys investigating each stakeholder will be conducted to explore their positions. The first such survey will determine the IS course provision in universities and analyse the skills and careers promoted by the curriculum. The second survey will examine the job market and the associated skills required by business. A

comparison of the results will show how the supply and demand of graduate IS skills can be more appropriately regulated.

1.5 Research Objectives

Derived from the research aim are a series of measurable research objectives that explicitly identify the activities that need to be successfully undertaken in order for the research to be successful:

- Determine the scope of the IS academic provision in the UK.
- Conduct a comprehensive analysis of the current IS curriculum provision in the UK.
- Develop a Course Mapping Framework to ensure the process of IS curriculum mapping can be accurately carried out and repeated.
- Objectively identify the career tracks promoted by current undergraduate provision.
- Analyse skills requirements for IS graduates, as stated by employers (as evidenced in the advertising of graduate Information Systems jobs).
- Compare and contrast the skills required by employers and those developed through the implemented curricula (career tracks vs. careers).
- Determine candidate method for explicitly managing the identified skills gap by aligning curriculum skills to match industry needs.

1.6 Scope, Focus and Approach

The essence of what lies at the heart of this emerging research gap is the relationship between the IS academic and business stakeholders in relation to their perspectives about graduate skills. Understanding the relationship and finding synergies that can strengthen it requires prior understanding of the positions of both stakeholders. Thus, even though the ultimate goal of this research is to align industrial IS careers and skills to the current academic IS provision in the UK, much of the research undertaken is devoted to understanding each stakeholders' requirements by conducting a series of surveys that establish their positions. The nature of this research is therefore primarily investigative, seeking to explore the relationship between the two key IS stakeholders, identifying areas of commonality and difference, in order to gain a fuller understanding of the skills required of IS graduates.

A conceptual representation of the research undertaken is captured in Figure 1.1. The clustering of the components of the diagram reflect the scope, focus and approach of the work presented in this thesis. Defining the scope of the research is realised by determining the key **stakeholders** whose perspective is critical to the shaping of the nature of the investigations

which follow. Congruently, the approach for the investigations is directed by the two distinct but highly complementary **surveys.** The surveys scrutinise the IS curriculum and IS job skills which correspond to the underpinning position of each stakeholder. The focus of the research shapes the overall **research findings** of the work. By focusing on a series of quantifiable curriculum and job skills findings, and the unique correlation between them, it is possible to make recommendations about the better alignment of the often contentious views of the two key IS stakeholders.

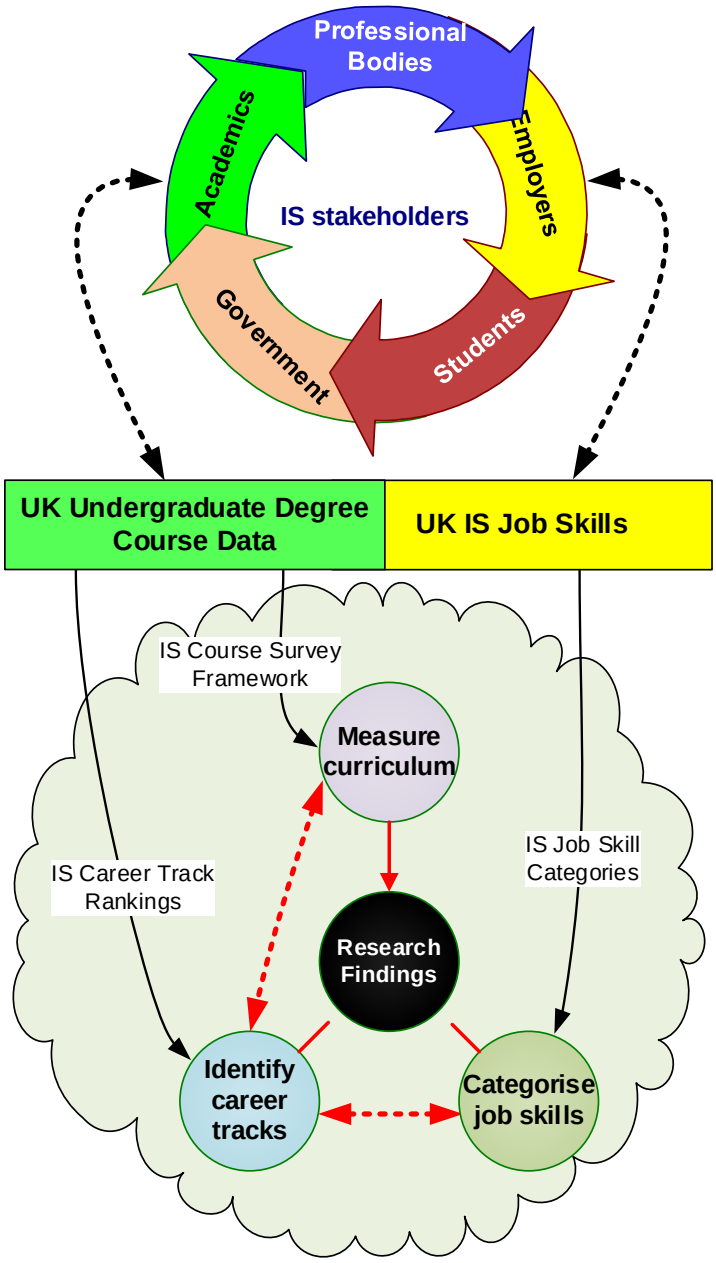


Figure 1.1. The scope, focus and approach.

Stakeholders

Much of the limited research in IS education has often taken the approach of investigating the perspective of one or more IS stakeholders in order to frame a particular problem and suggest improvements (Lightfoot, 1999, Snoke *et al.*, 2002, Latham, 2001, Pierson *et al.*, 2008). This approach has also been adopted for the purposes of this research which considers both IS undergraduate curriculum (academic stakeholder) and IS graduate skills (employer stakeholder) in order to investigate the relationship between these two primary stakeholders. Most researchers in this area, including the aforementioned, agree on the existence of five main IS stakeholders, as shown in Figure 1.1, whose views are important for the growth of the field. A discussion about their respective roles follows in Chapter 2. The basis of the decision to focus the investigation on only two key stakeholders for the purposes of this research was determined by the narrow focus required to gain a deep understanding of their respective positions.

Surveys

The use of surveys as a research tool investigating IS curricula and job skills has been well established over the last twenty years (Kung *et al.*, 2006, Trauth *et al.*, 1993). Although the majority of the surveys undertaken during this time, predominately in the US, have focused on investigating the position of a specific stakeholder, the driving force behind most surveys has invariably been the potential alignment of the differing stakeholder positions (Todd *et al.*, 1995). An increasing number of surveys enhance traditional information eliciting approaches about skills or curricula by utilising IS curriculum recommendation reports (Bell *et al.*, 2013). In doing so, the results can be both categorised and benchmarked against widely accepted 'standards', making comparative evaluations more robust. The IS course survey in this thesis makes extensive use of such standards, and offers additional insights into their practicality and applicability within the UK academic IS context of undergraduate degrees. Similarly, the job skill survey utilises a proven analysis tool which supports the correlation of data groupings.

Research Findings

Conclusive research findings capable of making a meaningful contribution to the area of study should be characterised by a research approach which has a clear focus within a field of investigation. The careful application of the complementary research tools used in this work should ensure robust findings open to scrutiny and validation. Each of the three research findings depicted in the bottom half of Figure 1.1, offer unique individual contributions to the academic and professional world of IS in the UK. More importantly though, by combining the results of these findings it becomes possible to contrast the views of the stakeholders and identify ways to enhance the IS curriculum in a way which can support the employability of future IS professionals.

1.7 Research Design

The nature of this research has strong practical implications. Its exploratory significance is underpinned by the investigation of the relationship between two of the IS stakeholders with regard to their perspectives on skills. Successfully investigating this relationship is predicated on conducting a series of empirical studies with results systematically organised based on data obtained from content analysis surveys.

The two different types of surveys used share many similarities, the most significant being the use of the same unobtrusive content analysis method of collecting data from web sources. Content analysis is an approach which examines content such as text or images in an organised way (Weber, 1990). Even though they are methodologically similar, the approach that drives the survey which investigates the IS curriculum is more complex than the job advertisement (job ad) survey. This is because the former is based on a newly devised Curriculum Mapping Framework while the latter is based on past studies that were conducted outside the UK.

1.8 Research Contribution

The main body of this thesis discusses how each of the research objectives stated earlier is attained. In doing so, it becomes possible to show that the process of mapping the IS curriculum successfully enables the articulation of the skills which are embedded into it. Additionally, it also shows that the careful analysis of the graduate job requirements specified by IS employers is capable of identifying the set of graduate skills which are in demand by industry. By juxtaposing these two emerging skillsets, the relative lack of alignment between them can be compared, thus enabling academics to identify the precise adjustments needed to the IS curriculum so that it can become more accurate in cultivating the appropriate skills.

The exploratory nature of this work and the contributions it makes to the field are best presented as a series of findings which are mapped to the two main stakeholders. Each finding is derived directly from a corresponding research objective, providing an articulation of the goals which needed to be met in order to deem each objective successfully met.

The findings of this thesis are presented in relation to each of the two stakeholders below:

Academic stakeholder

- Scope of the IS academic provision in the UK: investigate the size and type of the IS undergraduate degree provision in the UK and ascertain its entry level qualification levels, degree naming convention, levels of professional body accreditation, recruitment levels, first destination statistics and associated skills/careers.

- Measure the IS curriculum provision in the UK: determine the popularity (ranking) of modules and, by implication, subject categories that make up the entire range of IS courses. Analyse the findings according to core/options modes, modules that make up the core of the IS discipline, modules that are derived from hierarchical disciplines, and modules that are predominantly skills orientated.
- Develop a Course Survey Framework: create a reusable, hierarchical and domain-independent course mapping framework that can be used to both map existing IS courses but also direct the design of new ones.
- Identify curriculum career tracks: determine the career tracks promoted by the IS curriculum by measuring the thematic contributions made by the combination of different modules that make up a degree course.

Business Stakeholder

- Analyse employer-driven IS graduate skills requirements: classify IS jobs skills by analysing job advertisements which target fresh university graduates.

(Combined) Academic & Business Stakeholder

- Compare academic with business skills: contrast the skills sought by employers embedded into advertised graduate positions and those developed through the implemented curricula.
- Determine a method for aligning the identified skills gap: devise ways to regulate the IS curriculum so that it matches industry requirements without sacrificing academic pedagogy.

1.9 Organisation of the Thesis

The remainder of this thesis is organised as follows:

Chapter 2 – Before work can proceed in the direction stated in the research aim, it is necessary to contextualise the relevant issues that affect IS education in relation to its stakeholders. This chapter considers the issues that underpin this research. The discussion initially focuses on the emergence of IS as an applied field of study. It then examines the challenges of the field as part of a brief historical overview which highlights important IS education developments over the years. These developments are examined further in an effort to understand the difficulties affecting the alignment of the IS curriculum with industry needs, by adopting a stakeholder approach.

Chapter 3 – As an extension to the discussion of the previous chapter, this chapter investigates the issues affecting the IS undergraduate degree provision in the UK, with the aim of establishing the magnitude of the recruitment problem that is contributing to the decreasing availability of qualified IS graduates. Supplementing this discussion, data about entry level qualifications, course accreditation, course naming conventions and career data originating from universities is also examined in order to contextualise the wider issues.

Chapter 4 – Prior to the survey about the IS curriculum, its classification, the development of the Curriculum Mapping Framework and Career Track analysis, it is important to consider the research regarding the development of IS curricula through model curricula recommendations that serve as the basis for the subsequent curriculum survey.

Chapter 5 – Discusses the research approach that underpins the two different survey types needed to meet the curriculum and job ad analysis objectives. Initially, the discussion focuses on past curriculum surveys and the adoption of a particular research approach appropriate for the UK specific survey presented in Chapter 6. Following this initial discussion, a second literature review examines the methods used to conduct employment skill surveys, leading to the discussion about the chosen method used for the UK graduate job ad survey presented in Chapter 7.

Chapter 6 – Presents an original IS curriculum survey which offers a comprehensive view of the undergraduate course provision in the UK. This holistic mapping of the curriculum gives rise to the development of the Course Survey Framework, providing a robust method for repeating similar surveys in the future which would enable a longitudinal view on the evolution of the IS curriculum. The quantification of the curriculum gives rise to a further important element of the work in this chapter, seen in the development of Career Tracks which offer a previously absent view of the IS curriculum in relation to the professional careers it promotes.

Chapter 7 – Focus is placed on employer requirements by classifying IS graduate jobs skills through the analysis of job advertisements targeting IS university graduates. In addition to skills, the study also considers a number of supplementary findings in relation to job titles, industries the jobs belong to, expected salaries, qualification and work experience levels of graduates. These findings constitute an important step in the effort to understand the level of correlation between academic knowledge and skills imparted to IS students, and the graduate skills that are in demand by the IS industry.

Chapter 8 – Emphasis is placed on the research findings emerging from the comparison of skills found in the IS curriculum and the graduate job skills sought by employers, and a consideration of the level of alignment which exists between the two sets of skills. A further discussion considers the practical approach that can be taken to improve alignment in cases where either new IS courses are designed or existing ones are updated. The remainder of the

chapter considers a number of emerging issues from the perspectives of the academic and employer stakeholders.

Chapter 9 – Presents a reflective overview of the key aspects of the research and its contribution, expressed in relation to the original research aim and objectives. Subsequently, the chapter discusses the potential for future development of the work.

1.10 Summary

This chapter began by explaining the need for this research which originated through a personal motivation to better understand aspects if IS education that affect the teaching of undergraduates students and their successful transition to the professional world of IS. Subsequently, it discussed the scope of the research and its particular focus, supported by the overall research aim and objectives that underpin it. The design of the research and its contributions along with a brief outline of the remainder of the report provide the closing aspects of the chapter.

2 INFORMATION SYSTEMS EDUCATION IN CONTEXT

2.1 Introduction

This chapter considers the wider field of IS and the issues that underpin this research. The discussion initially focuses on the emergence of IS as an applied field of study aiming to facilitate the use of fast-evolving technology within organisations. Part of the discussion looks at the challenging development of IS over the past five decades in relation to its philosophical positioning alongside the wider fields of computing and business, its research identity, relationship with technology, and the development of its educational identity. The focus then moves specifically to IS education by examining the perspectives of its different stakeholders, in an effort to identify the difficulties affecting the alignment of the IS curriculum with industry needs. The chapter concludes by considering the contribution made by research into IS education, setting the scene for the following chapter which examines the specific characteristics of IS education.

2.2 The IS Field

Discussions about whether IS constitutes a field or a discipline (Fitzgerald, 2003, Davis, 2006), whether it is of any relevance to business and industry (Carr, 2003), or whether it can act as a reference discipline to other disciplines (Baskerville and Myers, 2002), have been ongoing for a number of years. Many of these discussions examine the notion of IS being a legitimate 'field' of study with its own Body of Knowledge (BoK) (Agresti, 2008, Alter, 2012) and clearly defined contextual research parameters (King and Lyytinen, 2004). If such legitimacy can be demonstrated, IS could occupy a well-defined space alongside the wider fields of computing and business whose interconnection, some researchers argue, caused its inception over 50 years ago (Hirschheim and Klein, 2012). Many of the philosophical discussions about the origins, purpose and evolution of IS consider its positioning within academia and industry in relation to the characteristics that it exhibits through the research in which it engages and the curriculum it utilises. Broadly speaking, IS as a field of study concerns itself with the way in which information is facilitated by technology to support business functions (Avgerou *et al.*, 1999).

Despite some consensus on the background of IS, providing a definition that enjoys a similar consensus remains as elusive today as the time when Latham (2001) noted the lack of

a widely accepted definition over 10 years ago. Representing both the academic and practitioner community of IS in the UK, the UK Academy for Information Systems (UKAIS) defines IS in the following way (UKAIS, 1999):

> *Information systems are the means by which people and organisations, utilising technologies, gather, process, store, use and disseminate information.*

UKAIS' definition acknowledges the role of technology in organisations and society. The emphasis is not on technology itself but the way in which technology can be utilised to support business and the wider society. The advent of IS supported by technology can be traced back to the early 1960s when the use of computers began to have an impact on business processes, which, until that point, were predominantly manual (Hirschheim and Klein, 2012). IS, of course, did exist long before the introduction of technological interventions but such considerations presently serve only historical discussions (Avison and Elliot, 2006). UKAIS' 1999 definition may not reflect some of the new research directions the discipline of IS has taken since. It does, however, implicitly support the Australian Computer Society (ACS) view (Figure 1.2) that IS has an applied nature that deals with people (business & society) and as such, it can stand separately from other peripheral disciplines.

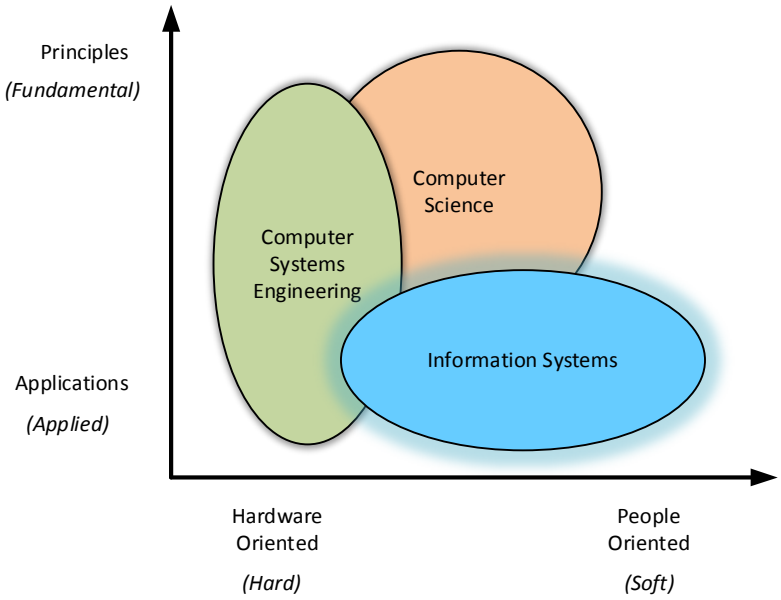


Figure 2.1. Differentiating IS from other IT-related disciplines (Avison and Elliot, 2006).

A more recent description of IS and its relationship with other disciplines was provided by Stowell and Probert (2012) who conducted a survey and analysis of the discipline on behalf of the Council of IS Professors (CISP) in the UK:

> *Information Systems focuses on the socio-technical aspects of IT-supported Information Systems development and implementation. In the commercial sphere the preferred term for such specialism is Information Technology (IT). Understood in this way, neither IS*

or IT should be confused with the (albeit closely related) academic discipline of Computer Science (CS). This potential confusion of mnemonics implies that the profile of IS (as a discipline) needs to be raised.

Although not a definition per se, CISP's view of IS as focusing on the socio-technical aspects of IT does not differ greatly from UKAIS' earlier definition. This is not surprising given the overlap in perspective of both organisations which probably have shared membership. Other perspectives of what constitutes IS can be seen in relation to the way the field is perceived by different schools of thought. Avgerou *et al.* (1999) makes a case for the way the European perspective of IS differs from that of the US, as evidenced in the way in which the discipline is organised both academically and in terms of its research. Even within Europe, the authors point out, the emphasis on different aspects of IS gives rise to different streams of thought, such as the socio-technical and humanistic perspective, and the drive for business excellence through technological innovation.

A further perspective of defining the field of IS which adopts a practical stance, explains its position in relation to other related areas while acknowledging the difficulties in differentiating between them (Kennan *et al.*, 2009). Figure 2.2 depicts another one of ACS' representations of IS as a field made up of broad subjects, some of which overlap with Computer Science (CS) and Business.

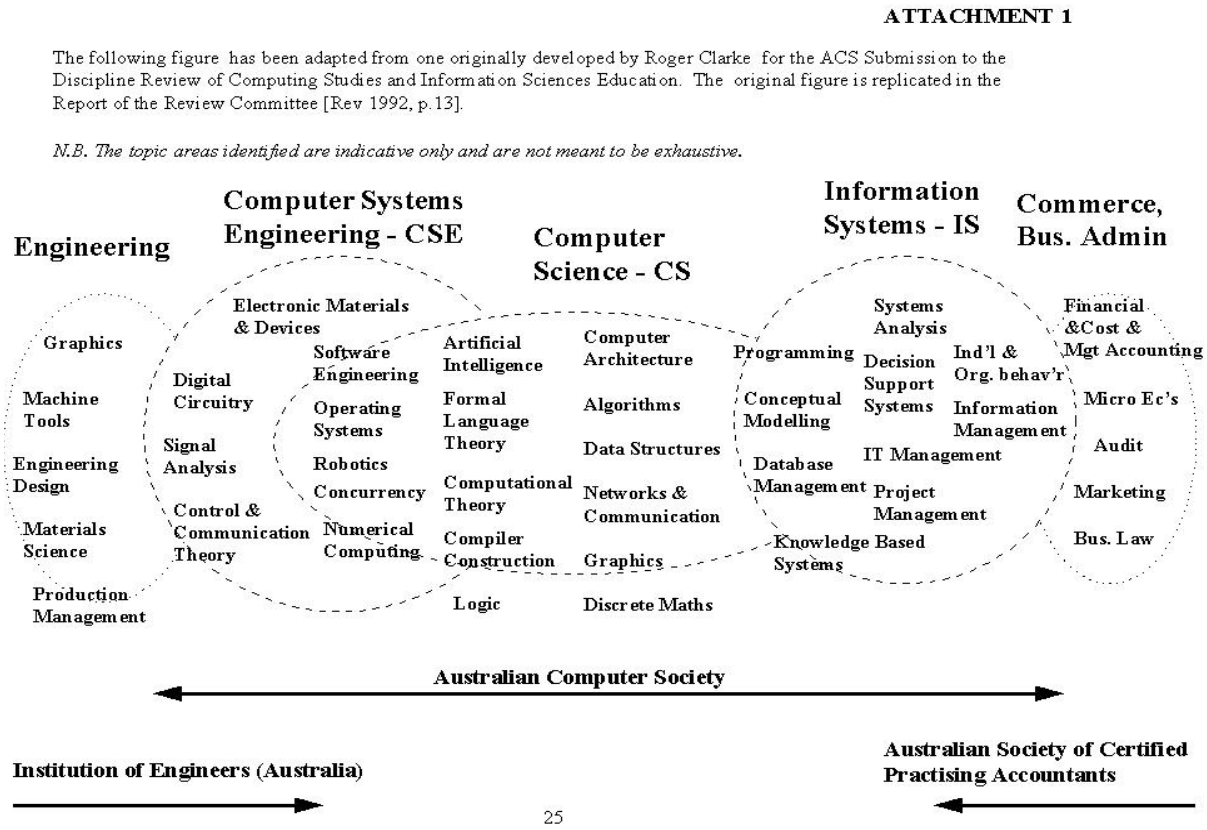


Figure 2.2. Representation of disciplinary groups within the field of IT (Kennan *et al.*, 2009).

The case for IS' differentiation from its related disciplines as demonstrated by ACS is also supported by Avison and Elliot (2006) who argue that by focusing on the application of technology as opposed to the technology itself, IS acquires a distinct nature which deals with the relationship between people and organisations, and the way technology facilitates it. This, they explain, makes IS 'applied' in relation to 'soft' issues (Figure 2.1). A similar perspective of IS in relation to its value is shared by Davis (2006) who considers it as an integral part of organisations. According to this author, IS' function is seen as serving the specific purpose of facilitating the delivery of information and communication to the organisation by utilising technology. To enable such function, IS needs to be developed and managed in a way that reflects its functional purpose which is of vital importance to the organisation it serves.

As part of an earlier effort to 'separate' IS from Computer Science (CS) and Software Engineering (SE), the authors of *IS'95: Guideline for Undergraduate IS Curriculum* argued that although SE and IS could be seen to cover the same domain, they possess significant differences (Couger *et al.*, 1995):

> *The context of information systems is an organization and its systems. The context of computer science is algorithms and system software. In computer science, the emphasis is on the "systematic study of the algorithmic process—the theory, analysis, design, efficiency, implementation, and application—that describes and transforms information. The context of software engineering tends to be large-scale software systems of the type found in command and control systems, military systems, communications systems, and large inter- organizational systems.*

Delving further into the past to a time when IS was still in its infancy, the earliest model curriculum work by the Association for Computing Machinery (ACM) (Atchison *et al.*, 1968) positioned CS as the main academic subject of the time, with three major divisions: Information Structure and Processes, Information Processing Systems, and Methodologies. An analysis of the subjects that made up each of the three divisions shows strong ties to both software and hardware. An illuminating perspective of the wider field is captured by the following comments by Atchison *et al.* (1968) who contemplates the role of different disciplines:

> *No attempt has been made to include within this classification system all the subject areas which make use of computer techniques, such as chemistry and economics; indeed, to list these would require inclusion of a major portion of the typical university catalog. Furthermore, the sociological, economic, and educational implications of developments in computer science are not discussed in this report. These issues are undoubtedly important, but they are not the exclusive nor even the major responsibility of computer science. Indeed, other departments such as philosophy and sociology should be urged to cooperate with computer scientists in the development of courses or seminars covering these topics, and computer science students should be encouraged to take these courses.*

An alternative approach to understanding the IS field is offered by Gou and Tatnall (2006) who consider it from three different perspectives: reflective, discipline-based and academic.

Specifically, the authors try to ascertain the scope of the field and the curriculum that should define it by deliberating three related questions. The first question examines the importance of IS to organisations; the second considers the use of technology to meet challenges facing organisations; the third reverses the previous issue by asking how organisations can be changed to take better advantage of technology. These questions are not new. Previous researchers have examined them, although not necessarily as three inter-related questions. As a possible answer to the first question, Topi *et al.* (2010) argue that IS continues to play a critical role in every organisation which goes beyond the simple facilitation of mundane business processes that require computerisation in order to be expedited. In fact, they claim, that the importance of IS has grown beyond the operational and tactical levels responsible for ensuring the operational health of a business, to becoming both a strategic determinant and a strategic enabler. Considerations about the second question are found in the work of many researchers who accept the importance of technology to business as a given, and argue for the need to equip the workforce with the necessary skills in order to maximise the benefits of IS which is seen as a business-enabling technology (Simon *et al.*, 2007, Litecky *et al.*, 2010). Others, such as Davis *et al.* (2010), postulate that the success of business relies on its ability to embrace and adopt new technologies whose cycle of development is becoming shorter. Finally, the third question which presents technology as a 'given' to organisations striving to be successful, finds support in Hirschheim and Newman (2010) who view the need for organisations to be adaptive and flexible as being crucial, because of the inevitable changes they have to face which often originate from technological advancements.

As part of a detailed investigation into the various definitions regarding IS and whether IS constitutes a discipline, Latham (2001) noted a wide range of similar but also varying views which suggest a certain amount of ambiguity within the field. Additional explorations of the identity and legitimacy of IS as a standalone discipline have also added to this sense of ambiguity (Teo and Srivastava, 2007, Klein and Hirschheim, 2008, King and Lyytinen, 2004, Bacon and Fitzgerald, 2001). A discussion on the field's uncertainty and its subsequent manifestation into a 'crisis' still affecting IS follows in section 2.4. By highlighting some of the issues causing the IS crisis, it becomes possible to contextualise many of the reasons that motivated this research. Before such discussion can take place however, it is necessary to briefly consider the development of IS by adopting a historical overview of the field, through which the emergent issues causing considerable concern can be traced.

2.3 The History of IS

Examining the foundation and subsequent development of the field of IS offers an informative way of understanding its identity and key aspects around curriculum development, research, stakeholder participation, relationship with business and industry, and future

direction. Some of these issues form the basis for the research presented in this thesis, and as such, they merit careful consideration both from a contemporary and historical perspective. An examination of the literature regarding the history of IS finds two overlapping perspectives. The first one examines the birth and growth of IS in the US and its propagation to the rest of world. The second traces the history of the discipline through its evolution in Australia as a leading force during the early stages of the developments of IS, in parallel to those of the US and later on in the UK and Europe. A UK-based historical perspective appears to be less well documented, nevertheless, it offers an important viewpoint for this study which focuses on matters relating to IS education, specifically pertaining to the UK.

The majority of researchers place the emergence of IS in the 1960s when the gradual differentiation from CS and other disciplines began to take place in the US (Clarke, 2006, Avgerou *et al.*, 1999, Lange, 2005, Hirschheim and Klein, 2012). The mid-1960s is also considered the starting point of IS in Australia (Clarke, 2006), while Stowell and Probert (2012) place the formalisation of IS as a standalone field in the UK ten years later, in the mid-1970s. In arguably one of the most comprehensive reviews, Hirschheim and Klein (2012) consider the historical evolution of IS as a series of eras which capture the multi-faceted developments of the field at approximately ten year intervals from the mid-1960s to the present day. As part of each era, the authors present IS advancements in technology, research themes, research methodologies, education and infrastructure (supporting organisations). This approach of deconstructing significant IS milestones from an Australian standpoint and placing them within specific timeframes is also used by Clarke (2006). The short historical review of IS in the UK by Stowell and Probert (2012) follows a similar pattern. This same pattern will be used as the basis for the short review in this section which borrows its headings from Hirschheim and Klein (2012), in order to highlight significant milestones that have influenced the direction of this research. Of particular interest are the educational developments due to their direct relevance to this research.

2.3.1 The First Era from Mid-1960s to Mid-1970s

This early stage in the evolution of IS was characterised by the emergence of computing in the previous decade as a technological innovation with potential application to the world of business and industry. One of the changes which simplified but also enhanced the growing attractiveness of computing to business was the progression from punch cards to mini computer terminals before the introduction of the Personal Computer (Tatnall and Burgess, 2009). Within organisations, data processing functions gained prominence and spread across departments, taking advantage of automation that offered significant competitive advantages (Hirschheim and Klein, 2012). The initial drive to facilitate management functions in organisations through the utilisation of technology, positioned the emerging discipline of IS in

the US at the heart of organisational management which led to the popularity of Management Information Systems (MIS) as a term characterising it. As the same time, the focus in Europe was on human behaviour in relation to the emerging technology and its application (Clarke, 2006).

Technology

Mainframes were the prominent computing technology which penetrated large organisations at an increasing rate. Their presence gave rise to parallel development in hardware and software technologies, which in turn sparked the establishment of some of the large technology conglomerates of today (Hirschheim and Klein, 2012). At the same time, the computerisation of government departments in Australia established the subsequent need for staff training and further software development (Tatnall and Burgess, 2009).

Research Directions

In its earliest stages, IS research was characterised by a plethora of approaches which shaped the field in ways which can still be seen today. The different schools of thought emerged in various academic institutions, pursuing ways to establish, but also advance, the identity of the field through the development of technical and social perspectives which examined the relationship between humans, technology and organisations. Inevitably, the field lacked a clear identity which prompted many researchers to consider its standing in relation to external influences affecting it. Numerous contributions about the positioning and purpose of IS as fielded were made during this time, often giving rise to some predictable disagreements (Hirschheim and Klein, 2012).

Education

Educational developments in IS, even at this early stage of the field, are of significant importance to this thesis. Some of the earliest developments in Australia saw the establishment of training courses to provide skills that would enable the use of the new technology within organisations. At the same time, Accounting departments at a handful of universities incorporated the first IS topics in their curricula, a pattern that gradually spread to many more institutions. Degree courses in Australian universities followed soon after, with CS establishing a clear lead over IS in terms of course provision (Clarke, 2006, Tatnall and Burgess, 2009).

Matching the Australian developments, the first IS academic courses appeared in the UK around the same time. The scope of IS in the UK was probably wider than other parts of the world, as a result of IS initiatives reaching out to both business and the public sector (Stowell and Probert, 2012). The expansion of IS academic programmes in the US highlighted a clear difference between the much better established CS as a field of study and the emerging IS that lacked direction in the way in which management and computing subjects should be put

together. This prompted the Association for Computing Machinery (ACM) to develop the first set of curriculum guidelines for IS courses (Teichroew, 1971, Couger, 1973). Coinciding with the efforts of the ACM, work in the Europe and the UK saw the development of similar guidelines as part of efforts supported by The International Federation for Information Processing (IFIP) and the British Computer Society (BCS) (Hirschheim and Klein, 2012).

A detailed examination of this early, but also subsequent, IS curriculum recommendations aimed at supporting academics in their curriculum development efforts is presented in Chapter 3, as it underpins the basis of a significant aspect of this research, part of which investigates the IS undergraduate curriculum provision in the UK.

Infrastructure

Professional societies, such as the ACM and the Data Processing Management Association (DPMA), along with the IFIP Technical Committee 8 and various others entities that have since ceased to exist, became involved with IS at the early stage of its inception. Their contribution has been important. Generally, they provided 'direction' through the development of IS curriculum recommendations, but more importantly, they often acted as a catalyst to important developments in the field by being a platform for research and collaboration (Hirschheim and Klein, 2012). The formation of ACS in 1966, much like similar organisations in the US, was the result of the growth in computing. ACS' support of IS has been significant for the development of the field in Australia and beyond (Clarke, 2006).

2.3.2 The Second Era from Mid-1970s to Mid-1980s

The second developmental stage of IS saw a significant increase in the acquisition and use of computers in organisations. Cheaper processing power meant increased opportunities for data and transactional processing. The adoption of technology, however, lacked clear strategy, often leading to discrepancies across different departments within the same organisation (Hirschheim and Klein, 2012). Academically, changes were being introduced that reflected the growing popularity of IS, while an increasing number of professional and research outlets provided opportunities to disseminate the advancements of the field (Clarke, 2006).

Technology

Technological changes during this period were characterised by the expansion of personal computing and the move from mainframes to smaller but powerful systems servicing the needs of corporate departments. The result of this change provoked the introduction of organisational changes that would utilise the benefits of the new computing architectures. Undoubtedly, these new systems could only be of value if they were supported by the right software and a parallel expansion in application development of software packages took place (Hirschheim and Klein, 2012).

Research Directions

During this era IS researchers became more aware of the lack of appropriate IS research methods. For many, this issue was linked to the efforts to define IS and differentiate it from other disciplines. Discussions about methodological approaches deepened, and the focus of research was placed on development, operations but also participative design within the socio-technical systems context (Hirschheim and Klein, 2012).

Education

Alongside the efforts to define the research dimensions of the field, work on IS curricula and wider educational contexts was also taking place. The IS academic community in Australia was gaining legitimisation through the creation of prominent IS professorial posts and research that was leading to PhDs in IS. However, further investigation of the field was needed to ascertain its identity. The paucity of an Australian IS BoK showed a lack of maturity at a time when ACM and DPMA were rolling out curriculum recommendations primarily for 'internal' consumption in the US (Clarke, 2006). The growth of the field in the UK was reflected in the explosion of 'conversion courses' in Polytechnics, aiming to up-skill non-technical professionals in IS. This rise in demand was caused by changes in industry which began to accept that IS had the ability to transform business structurally, going well beyond the simple automation of business functions encountered earlier (Stowell and Probert, 2012).

In the US, work on curriculum recommendations continued to increase with publications from both the ACM (Nunamaker *et al.*, 1982, Nunamaker, 1981) and the DPMA (Adams and Athey, 1982). Similar to the arguments emanating from academics working on ACM's model curriculum, academics and practitioners driving DPMA's efforts argued strongly the case for IS gaining its own identity. The publication of the DPMA model in 1982 explained the role of Computer Information Systems (CIS) as a distinct discipline with different characteristics to Computer Engineering (CE) and CS. The authors described CIS programmes as capable of producing graduates with technical skills relevant to computer systems, but also knowledgeable about their application within a business environment.

In Europe, work on the latest version of the IFIP/BCS curriculum (Buckingham *et al.*, 1987) which was going to replace the earlier version that had been developed 10 years earlier (Brittan, 1974) was progressing well but its publication was not due for a few more years. Scandinavian countries, in the meantime, were expanding their curriculum research work.

Infrastructure

Prominent journals and conferences being established predominantly in the US signalled the leading position of North American academics in the international IS arena. At the same time, professional organisations such as the Association for Information Systems (AIS) signified the growing international dimension of the field (Clarke, 2006).

2.3.3 The Third Era from Mid-1980s to Late-1990s

Decentralisation of computing power through the use of personal computing and bespoke software, gave rise to problems of compartmentalisation and disassociation of functions within organisations. Mix and match hardware and software made its way into business causing issues of incompatibility (Hirschheim and Klein, 2012). Large, mainly unsuccessful, IS projects made the headlines, highlighting the disjointed ways of systems thinking in relation to building systems. Such failures were not the exclusive domain of IS; technology was as much to blame as people (Stowell and Probert, 2012).

Technology

Expansion of the internet and the early steps in the development and proliferation of the web, were the key technological themes of this period. Portable devices, networks and inter-connectivity were at the forefront of technological advancements. Varied, but often also improved, methods of customer-technology interactions gave rise to a significant transformation of the traditional business model that used to describe the old way of doing business through direct contact (Hirschheim and Klein, 2012).

Research Directions

Research in IS was scrutinised further with researchers focusing on the improvement of methodologies and approaches. New topics, such as outsourcing and productivity increase, that reflected the prevailing needs of industry became prominent. Outsourcing became a near-permanent feature of many businesses which sought ways to resolve many of their IT/IS problems from the previous era by 'exporting' them to other countries (Stowell and Probert, 2012).

Education

The focus of curriculum development remained strong throughout this time. The publication of *IFIP/BCS IS Curriculum: a basis for course design* highlighted a growing issue in the field that continues to pose problems even today: the need to improve the IS curriculum in order to achieve skills alignment with industry. The work by Buckingham *et al.* (1987) carried explicit statements on the need to educate the professionals of tomorrow to meet business needs through designing a curriculum that was capable of accommodating the different needs of students from varying backgrounds. In a similar way, the last version of DPMA's curriculum (Myers, 1991) before it joined forces with ACM, sought to introduce flexibility in the recommendations to address the changing needs of organisations. Subsequent joint efforts by the two organisations focused on designing programmes which would support the critical role of IS professionals, operating in increasingly competitive global settings (Longenecker Jr *et al.*, 1994). As part of one of the defining IS curriculum recommendations IS'95 (Couger *et al.*, 1995), the community driving ACM's latest work set out to make a clear distinction between

IS, CS and SE by particularising the distinctive characteristics of IS as the bridge between technology and business.

In parallel to the curriculum development activities, a growing body of work was trying to address the ever increasing calls from industry on the lack of skills alignment between academia and the business world. Prominent IS researchers carried out surveys and investigations whose findings consistently pointed to a disconnect between the skills promoted by the IS curriculum and those needed by industry (Igbaria *et al.*, 1991, Trauth *et al.*, 1993, Lee *et al.*, 1995, Todd *et al.*, 1995). The technological advancements coupled with continuous business transformations had created a skills vacuum that was self-perpetuating. Modern professionals needed new skills but also the ability to acquire ways of 'learning how to learn' (Cheney *et al.*, 1989).

Infrastructure

Repeating some of the developments of the previous decade, this decade saw the launch of more IS journals both in the US and Europe. International IS conferences were also gaining strength, as were new professional organisations with a clear IS focus (Hirschheim and Klein, 2012).

2.3.4 The Fourth Era from Late-1990s to Today

Currently more than ever before, changes in technology are having a profound effect on business and the wider society. Ubiquitous computing is forcing companies to continuously adjust their strategies and become particularly agile in their approach to innovation and differentiation. The boom and bust of world economy alongside that of the dotcom boom and bust continues to inject uncertainty into the world of commerce and academia. By comparison, the turmoil of the previous eras appears today to have been a rather stable state of affairs (Stowell and Probert, 2012, Hirschheim and Klein, 2012).

Technology

The age of the internet changed all aspects of life. Technology was no longer supporting education, commerce, communication and social interactions, but it was driving them. Work in the wider field of IT, but also in virtually every other field, was determined by interactions with technology. Data became the new priceless commodity and its trade a lucrative new business.

Research Directions

Research methods and research directions continued to grow, influenced by the impact of technology on the different IS stakeholders. A noteworthy part of IS research became esoteric in its attempt to justify the existence of IS as a field or discipline. What was seen by some as a growing maturity of the field as a result of philosophical theorising about the nature and value of IS, gradually developed into an existential crisis. The publication of an article by

Carr (2003) whose premise was based on 'dismissing the lessening strategic value of IT', triggered a wave of research publications investigating what was broken and what needed to be fixed in IS. Some of this research is discussed in the next section due to its direct relevance to this work.

Education

Curriculum recommendations continued to be a strong feature of IS education along with efforts to address the skills gap that became prominent in the previous era. The publication of IS 2002 (Gorgone *et al.*, 2002) was seen as a catalyst for change by many North American institutions which were trying to address the growing problem of diminishing student numbers by looking for ways to update the IS curriculum. Interest in CS/IT/IS dropped significantly in the early years following the dotcom bust. Many in the academic community saw this phenomenon as adding weight to the discussion about the crisis of IS, with some pessimists forecasting the amalgamation of IS into another academic field (Bakshi, 2007). Apart from diminishing student numbers, the IS crisis was fuelled by the increasing inability of business to recruit adequately skilled IS/IT young professionals (Prabhakar *et al.*, 2005). Attempts to bridge the skills gap prompted the ACM and AIS to develop another edition of the IS curriculum recommendations, known as IS 2010 (Topi *et al.*, 2010). The new recommendations sought to introduce flexibility in course design to facilitate additional focus on the design of programmes that would address the skills needed by industry. The skills issue characterising the difficult relationship between the IS academic world and industry has not been confined to the US. The UK, Europe and Australia have also been affected, as are other part of the world (Stowell and Probert, 2012, Debuse and Lawley, 2009). Course accreditation was seen as one of the ways institutions could use to legitimise their curricula but much more work was needed to address the problem of adequate workforce preparation (Hilton and Lo, 2007).

Infrastructure

Professional societies, such as the AIS, continued to grow with the formation of new specialist interest and student engagement groups. Similarly, specialist journals such as *MISQ Executive*, and regional conferences were created to cater for aspects of IS that were otherwise under-represented (Hirschheim and Klein, 2012). Accreditation bodies, too, continued to be more active, taking advantage of the willingness by many institutions to develop closer links with the industry that argued it was not being supported adequately as a result of outdated curricula and non-relevant research (Reichgelt and Gayle, 2007).

2.3.5 History 'Lessons' about IS Education

The brief historical overview of the field has shown that IS education has undergone a challenging development over the last fifty years. In some sense, IS education was almost a by-product of the development of an emergent area of knowledge that was struggling to

position itself amongst better established disciplines. Computing developed as a field with an applied and theoretical research foundation earlier than IS. Its fortune was tied to the fast evolving computing technology, while drawing on mathematics and engineering for its research base. IS, however, struggled to form an early identity because it was trying to serve this notion of 'technology in use' which itself was only beginning to emerge as a result of technological interventions in organisations (Davis, 2006).

The applied nature of IS underpins its essence but also explains some of its constraints. As a discipline, IS focuses on the integration of technological solutions that meet the needs of organisations. By implication, IS education needs to blend together knowledge about socio-economic issues, organisational issues, application of technology, and software solutions (Shackelford *et al.*, 2006). The synthesis of such wide ranging knowledge areas presents its own difficulties as it involves a disparate set of skills. Its application, though, is even more challenging since the business environments to which it is relevant, are constantly evolving (Topi *et al.*, 2007). Arguably, this is why IS education appears to always 'play catch up', faulted for being unable to meet the industry demands which are constantly changing.

Admittedly, IS does not appear to be the only field that is in the firing line of stakeholders about its inability to meet industry demands or its lack of skills alignment with business. Education in IT, SE and CS are also criticised for their own skills shortcomings (Riihijarvi and Iivari, 2008, Lunt *et al.*, 2010, Nagarajan and Edwards, 2009, Surakka, 2005a). IS, however, appears more 'exposed' because of its role as the facilitator for business which places it at the heart of people in organisations and their often conflicting views.

The last two eras of IS education saw many calls, backed by academic and practitioner research publications, for improving its alignment with industry needs. As Latham (2000) surmised, IS graduates need to be multi-skilled; they need to have both technical and organisational competencies. Designing IS programmes that meet this challenge requires a clear understanding of what IS education offers and what business need. And this, effectively, is the research aim pursued in this thesis.

2.4 The Crisis in IS *(Education?)*

Attempts to establish IS as a bona fide discipline over the past fifty years have led to frequent discussions about its identity, contribution and legitimacy. Inward looking and reflective philosophical debates expressed through research are common to fledgling fields, resulting from an instinctive need to define their identity. According to Sidorova and Harden (2012) and Neufeld *et al.* (2007), apart from the more recent crisis which appeared at the beginning of the fourth era of development of the IS field, similar debates took place as far back as the 1970s.

At the centre of the most recent debate about the identity of IS stood its research. One of the earliest concerns contended that the diversity which had defined IS since its inception was growing and, as such, was becoming problematic by suppressing a dominant paradigm which would enable it to reduce its reliance on the disciplines that underpinned its foundation (Benbasat and Weber, 1996). Another discussion focused on the argument that IS researchers were under pressure to produce very rigorous research that would give scientific legitimacy to the discipline, at the expense of relevance that would serve its applied nature (Benbasat and Zmud, 1999). As expected, the rigour vs. relevance argument generated clusters of researchers taking opposing sides (Lyytinen, 1999). A further dimension to the crisis debate that made it quite prominent, can be seen in Benbasat and Zmud (2003) who claimed that the identity of the IS discipline was becoming ambiguous due to the wide diversity of research output that restricted the development of a representative core theory. Many researchers responded to the challenge of proposing research directions that would develop a core and help the discipline overcome its confusion. Of the eighteen such responses noted by Agarwal and Lucas Jr (2005) there was an relatively equal split between the school of thought that suggested IS was in crisis and needed urgent action, and that which disagreed and expressed its concern about the possible stifling of research diversity.

Philosophically evaluating any young applied discipline by questioning its origins, direction and contributions can have a positive effect, as suggested by King and Lyytinen (2006):

> *It is an understatement to say that there is no closure on what the IS field should be and how it should come to be that. However, there is more agreement on fundamental points than might first meet the eye. A quarter-century of discussion regarding the character, evolution and history of the field has been educational for the field.*

But while these essential debates about research and identity were taking place, the world of IS/IT was changing quite radically following the dotcom bust and the diminishing number of students pursuing IS courses. The subtle point about the absence of IS education from the crisis debate was made by Sidorova and Harden (2012) who noted:

> *Interestingly, all three debates have focused primarily on the IS research. While references to teaching and curriculum were made as a part of the rigor vs. relevance debate, teaching and textbooks were considered as a means of dissemination of academic research (Straub and Ang, 2008). Furthermore, the teaching and the curriculum in the IS field were assumed to be influenced by the IS discipline academic identity, rather than shaping such identity.*

Even though the reflective debate about the IS research paradigm was preoccupying a large number of the research community, a growing group of IS academics focused on IS education was becoming acutely aware of another 'crisis' that had the potential to seriously damage the discipline by making its members obsolete due to the shrinking of IS academic

departments across many universities (Granger *et al.*, 2007). The phenomenon of decreasing IS student numbers caused concern to academia worldwide (Aken and Michalisin, 2007, Foster, 2005, Plice and Reinig, 2007). Falling enrolment numbers, not only in IS but the wider computing field, were documented in various countries, including the US (George *et al.*, 2004), Australia (Wilson and Avison, 2007) and the UK (White and Irons, 2007, Stowell and Probert, 2012). The potential causes of the decline were investigated by researchers who have highlighted the burst of the dotcom bubble, the impact of outsourcing, and the inappropriateness of the IS curriculum, as some of the possible reasons for the downward trend in IS student applications (Kung *et al.*, 2006, Walstrom *et al.*, 2008, Hirschheim, 2007, Outlay and Krishnan, 2010).

Predictably, a dimension to the problem of declining interest in IS degree courses was attributed to the ongoing arguments about the state of the IS discipline and its perceived crisis (Benbasat and Zmud, 2003, Hirschheim, 2007, Hirschheim and Klein, 2003). The array of issues which was analysed earlier, ranged from the lack of a clear identity of IS to the type of research undertaken that undermined the IS academic-practitioner relationship. This particular school of thought considered the unclear state of the IS field as partly responsible for the decline in student numbers. The argument in this case related to a lack of understanding of the needs of the modern IS profession, exacerbated by an IS curriculum that lacked relevance and no longer reflected the characteristics of the evolving IS professional who was expected to operate in a dynamic business world (Granger *et al.*, 2007, McGann *et al.*, 2007).

Since curriculum relevance was viewed as a possible explanation for the falling application numbers phenomenon, the amount of research investigating it grew. A significant amount of work aiming to address this issue concentrated on the likely relationship between outdated IS curricula and the diminishing numbers of IS student applicants (Gill and Hu, 1999, Hirschheim and Klein, 2003, Impagliazzo *et al.*, 2007, Lightfoot, 1999, Walstrom *et al.*, 2008, Zhang, 2007, Wilson and Avison, 2007). Complementing this work, academics from around the world highlighted ways of improving existing IS curricula by ensuring that, while academic pedagogy was maintained to the highest standard, contemporary undergraduate programmes were injected with an appropriate amount of transferable or subject specific skills, thus increasing the recruitment opportunities of graduates seeking employment (Plice and Reinig, 2009, Hirschheim, 2007).

Further plausible explanations about the decline in student numbers were based on arguments about diminishing employment opportunities for IS graduates (Panko, 2008, Riemenschneider *et al.*, 2009). Undoubtedly, technology-based disciplines affected by rapid innovation and change are particularly susceptible to the organic ICT job market which is driven by technology trends (Yen *et al.*, 2001). Skills for such jobs change rapidly, as do job

titles and specialisations in emerging technologies (Benamati *et al.*, 2010, Lynch and Fisher, 2007, Debuse and Lawley, 2009). Jobs, however, do not necessarily disappear instantly; often they change or simply shift elsewhere (Beulen, 2010). So, can this complex problem of shifting employment trends in the wider field of IT explain why students are turning their back on IS? A study by Hirschheim and Newman (2010) appears to conclude that it cannot. The authors contest that while there are conditions such as offshoring, the burst of the dotcom bubble and a wider economic recession that affected student recruitment, it is not the direct impact of these conditions that is harming recruitment but the erroneous perception about the lack of jobs they create among potential IS students. Their argument about the existence of distorted student employability perceptions becomes particularly strong when considering that it is potentially the only reasonable determinant which helps to explain the paradoxical imbalance between the growing business demand for fresh IS graduates and the falling supply of new university applicants of IS. Examining the issue of demand for IS graduates, work by Koch *et al.* (2010), Davis *et al.* (2005), Litecky *et al.* (2010), Prabhakar *et al.* (2005), Scott *et al.* (2009) clearly demonstrates that the IT industry has been recovering for a number of years, and has become anxious to find well-qualified graduates. At the same time, the supply of new IS applicants remains either stagnant (Stowell and Probert, 2012) or continues to fall (Walstrom *et al.*, 2008, Firth *et al.*, 2008, Scott *et al.*, 2009).

The need to ascertain the likely relationship between outdated IS curricula and the diminishing numbers of IS student applicants has been well documented. Similarly, it is also evident that there is a need to improve existing IS curricula by ensuring that while academic pedagogy is maintained to the highest standard, contemporary undergraduate programmes are injected with an appropriate amount of transferable and subject specific skills, thus increasing the recruitment opportunities of graduates seeking employment (Gill and Hu, 1999, Lightfoot, 1999, Impagliazzo *et al.*, 2007, Walstrom *et al.*, 2008). This research aims to support this premise by investigating both the IS curricula and business skills.

2.5 IS Curriculum Development

Past research investigated the complexity of IS curriculum development by examining different stakeholder perspectives that placed varying degrees of emphasis on academic pedagogy and skills (Zwieg *et al.*, 2006, Yen *et al.*, 2001, Tuson, 2008). Broad consensus has been difficult to achieve because of the disparate views stakeholders often have about the long term objectives of the IS curriculum (Figure 2.3). A common method of assessing IS curriculum relevance compares existing skills embedded into the curriculum with those revealed by surveying IS practitioners and employers (Tang *et al.*, 2000, Lee *et al.*, 1995, Cappel, 2001, Wickramasinghe and Perera, 2010).

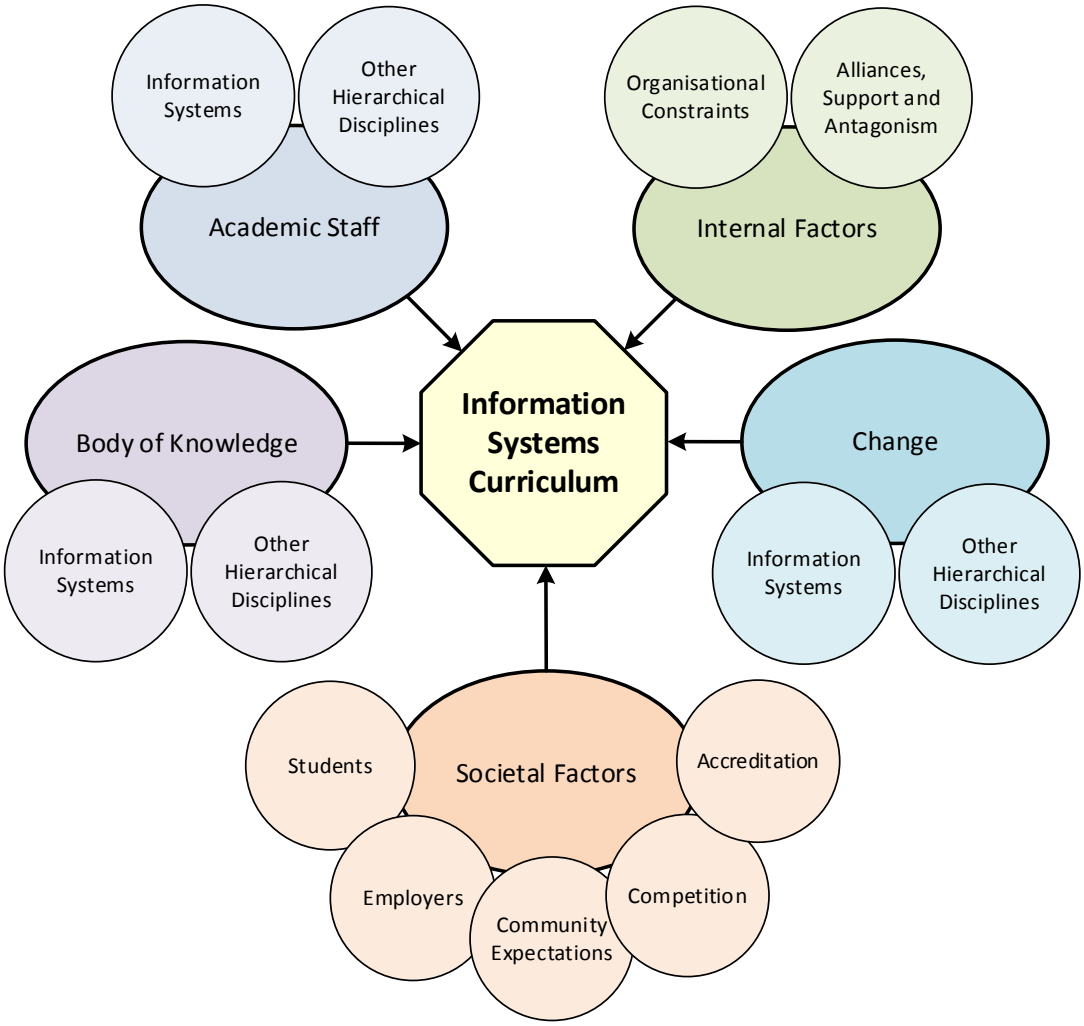


Figure 2.3. Factors influencing the development of the IS curriculum (Tatnall and Burgess, 2009).

Additionally, academics assess the relevance of IS curricula by evaluating them against 'standards' put forward by professional organisations, such as the ACM and AIS, which periodically publish new model curricula (Kung *et al.*, 2006, Dwyer and Knapp, 2004). Likewise, researchers explore IS curriculum relevance by examining the views of students and professionals. Martz and Cata (2008) observed one such case of divergent perceptions of professionals and students regarding the types of skills that were considered most relevant by each group. The survey demonstrated that while students believed technical 'hard' skills to be of higher significance, IS professionals considered 'soft' transferable skills to be more important. Analogous investigations into IS alumni views reinforce the importance of injecting relevant skills into the IS curriculum as a necessary precondition to a successful future career in IS (Plice and Reinig, 2009, Tesch *et al.*, 2003, Nagarajan and Edwards, 2009).

Despite the numerous suggestions, establishing whether or how the curriculum of a discipline as diverse as IS would benefit from updating in terms of making it more attractive to prospective students, is a complex issue. The ambiguous and uncertain identity that IS finds

itself in, raises fundamental questions about its academic, research and professional standing. As a result, IS researchers often questioned whether their field was indeed a discipline, and the direction it should take in the future (George *et al.*, 2004, Fitzgerald, 2003, Neufeld *et al.*, 2007). While these existentialist arguments about the core of IS continued, research on updating IS curricula to make it more attractive focused on covering three inter-related areas that map to particular stakeholders: relevant IS skills (business), value of accreditation of IS courses (professional bodies) and IS curriculum modernity (academia). Examples of such work highlighted the importance of matching industry expectation of graduate skills to the skills embedded into undergraduate courses in IS (Nelson *et al.*, 2007, Snoke, 2007, Xiang *et al.*, 2004). At the same time, Challa *et al.* (2005), Reichgelt and Gayle (2007) considered the merits of accreditation and the quality assurance benefits it offers to IS curricula, while Granger *et al.* (2007) argued for the need to overhaul IS curricula in order to rekindle student interest.

Developing sound arguments, specifically about the UK state of the IS education and curriculum development that stem from convincing research, is hampered by the lack of comprehensive data concerning the curriculum, and the number and types of courses that currently exist. Thus, before any discussion can take place about the state of the IS discipline in the UK, its future academic development or the development of closer ties between industry and academia, it is essential to know what the starting point is.

2.6 IS Stakeholders

As part of a detailed analysis of the IS curriculum development process, Lightfoot (1999) identified four stakeholder groups whose input influence the curriculum in different ways (academics; employers; government; students). First, academics focus on enabling students with the ability to understand and learn new concepts, synthesise ideas and become critical thinkers. Such a perspective gives academics a long term view of IS curriculum development that has a strong pedagogical orientation (Yen *et al.*, 2003). Second, industry, as the natural recipient of IS graduates, looks at the IS curriculum through the skills and qualities that business needs to grow and evolve. There are two broad categories of such skills: 'soft' skills which aid the development of well-rounded professionals with high-level conceptual qualities; 'hard' or technical skills which enable graduates to organically grow into new jobs with minimum training (Bailey and Mitchell, 2006). Consequently, the perspective that business adopts in relation to IS curriculum development tends to be short to medium term. Third, governments through their manifestations as research funding or quality assurance bodies try to ensure that public money is spent commensurate with public expectations about education and their own political priorities. It is therefore reasonable to assume that such a perspective tends to be both tactical and short to medium term (Decter, 2009). Fourth, students are the passive recipients of the prevailing IS curriculum, with limited influence in the way it can be

changed during their study period; they enjoy a degree of freedom in choosing option subjects and therefore to specialise in a particular aspect of IS. While the students' perspective is slowly becoming more long term as they try to anticipate changes in the employment market to justify their investment in higher education (Scott *et al.*, 2009), it still remains relatively short term. This is because students are mostly passive observers to the technological changes in the IS field and the changes in practice of the wider business world. A further perspective that is less prominent at the time of Lightfoot's research relates to the professional accreditation bodies. Lightfoot (1999) argues that different perspectives of stakeholders do not co-exist harmoniously, thus making the design of IS degree courses challenging. As a solution, Lightfoot suggested that the balance of influence should shift to academics, since they are the stakeholder group with the long term perspective on the IS curriculum development process.

More recently Sidorova and Harden (2012) argued that by aligning IS research with the curriculum and practitioners it is possible for academics to strengthen the identity of the IS discipline. The authors also considered the IS discipline teaching identity which, they argued, is based on complex negotiations between different stakeholders (Figure 2.4).

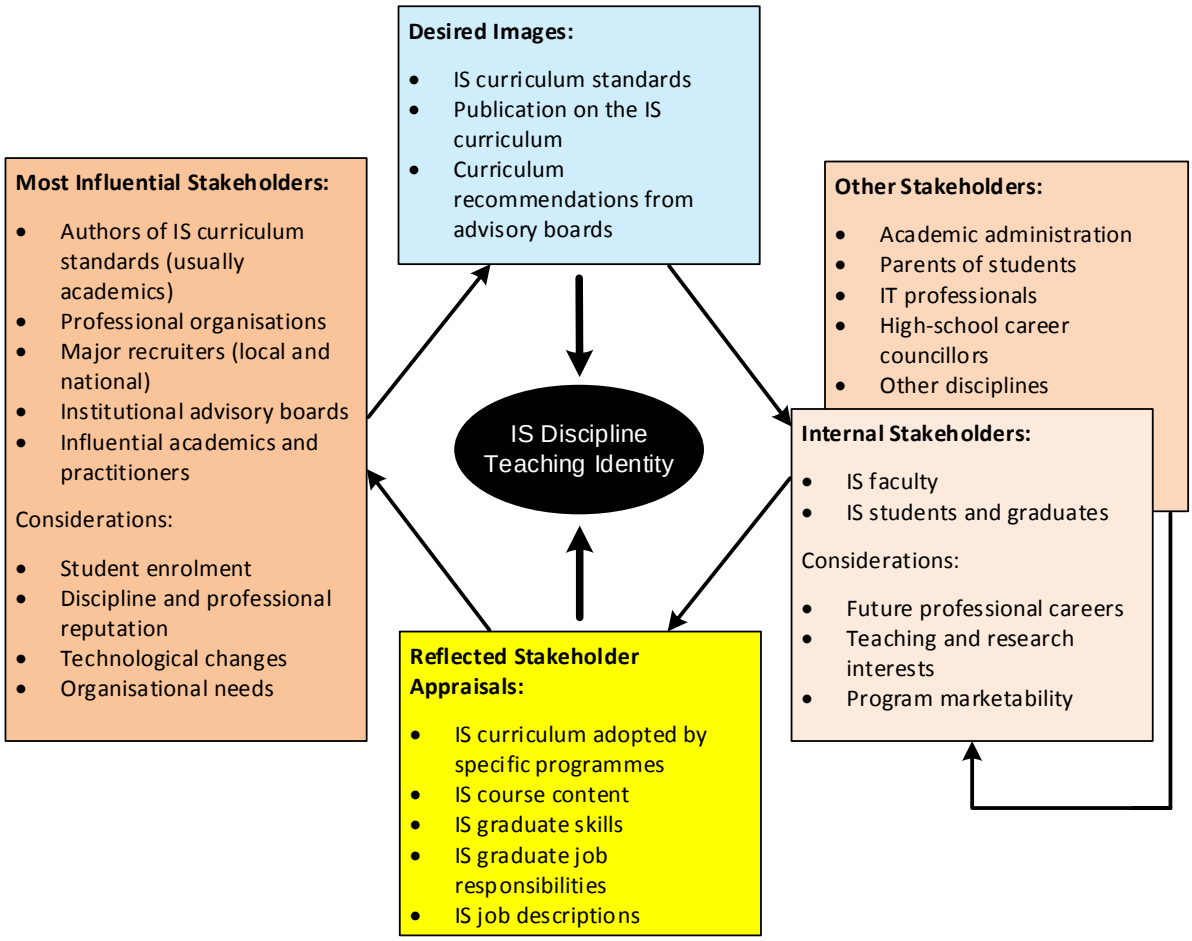


Figure 2.4. Stakeholders in relation to IS teaching (Sidorova and Harden, 2012).

A stakeholder approach examining the emergence of IS education specifically in the UK is found in Latham (2001) whose work on determining the relevant knowledge and skills of IS graduates focused primarily on academics, employers and students/graduates. The stakeholder views of professional bodies and the government were also considered, but they were deemed to be of lesser importance to the study. The author argued that the five stakeholders influencing the discipline (Figure 2.5) are both providers and beneficiaries of IS, and as such their collective input into a broad study of IS education is necessary.

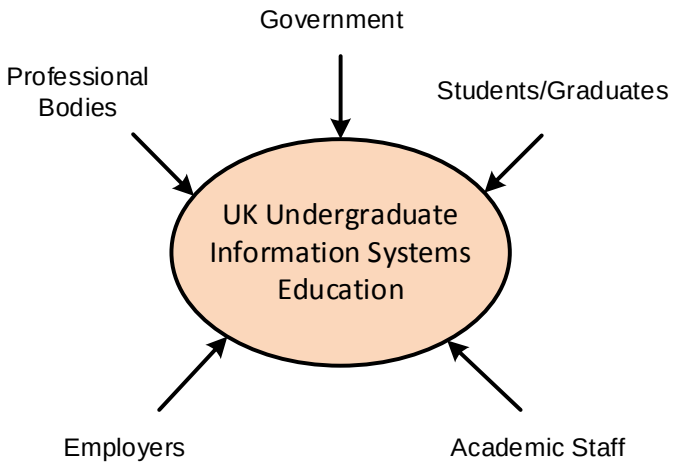


Figure 2.5. IS stakeholders in HE for IS (Latham, 2001).

The scope of Latham's research was unavoidably broader than the scope of the research presented in this thesis which primarily concentrates on a detailed analysis of two of the five stakeholders. Latham investigated the need to introduce changes in IS education in light of the significant changes in the field during its first 3 eras of expansion. The historical context for the investigation was defined by the rapid growth in the provision of IS courses across UK universities, and an explosion of IS professional positions in industry during the dotcom boom years. By adopting a broad research scope, the author was able to consider four key aspects of IS education through a series of survey investigations (Latham, 2001). The first issue examined IS as a new field in relation to its theoretical core and applied contributions in order to determine its maturity. This would determine whether IS could be seen as discipline, capable of differentiating its research, curriculum and practitioners from other computing disciplines. As part of the second issue, Latham reviewed teaching and learning in HE. The aim of this objective was to ascertain the contribution of teaching quality in relation to preparing students effectively for professional careers in industry. As part of the third issue, focus was placed on teaching and learning in IS. Specifically, the investigation focused on the existence of a skills gap between academia and industry by surveying the views of both academics and practitioners, and examining if an IS core curriculum would be of value. The final issue involved

the analysis of the role of the IS professional as a product of undergraduate IS education in HE, and a 'commodity' of an expanding industry with rapidly changing needs (Latham, 2001).

Various elements of the research presented in Latham's work provide valuable input in the design of the surveys undertaken as part of this thesis. Additionally, certain thematically equivalent investigations of that early work offer comparable findings that provide a rare historical dimension to the evolution of IS education in the UK. As a result, chapters in the concluding part of this thesis will carry a more detailed analysis of these findings and their contribution to this research. The discussion that follows in the next section about the main individual stakeholder groups as they are described in Figure 2.5 and to some extend Figure 2.4, considers their overall positions, along with their perspective of IS and the influence they exert to the field.

2.6.1 The Academic Stakeholder

IS academics are predominantly concerned with IS research and teaching. The former shapes the direction of the field by considering both its applied and theoretical dimensions, often giving rise to arguments about balancing focus between them. The latter considers the curriculum development, teaching methods, and skills in relation to their relevance to industry.

Interest in this issue of IS curriculum modernity remained strong during the last decade mainly because of the reduction in numbers of fresh IS university applicants. Research in the area of IS student enrolments echoed the earlier expressed need for updating IS curricula (Panko, 2008, Foster, 2005, Hirschheim, 2007). At the same time, the body of work promoting the importance of possessing the right skills to succeed in the changing IS job market, continued to grow (Prabhakar *et al.*, 2005, Tuson, 2008). In a recent article Benamati *et al.* (2010) carried out a survey to measure the level of IS curricula alignment with industry needs, and examine the amount of change in the curriculum over a period of three years by reviewing a sample of IS courses in US universities. The authors concluded that while progress was being made, more work to address the problems of low student recruitment and insufficient graduate skills was necessary.

The work by Benamati *et al.* (2010) reaffirms the usefulness of IS course surveys through content analysis, but the position of this thesis is that measuring curriculum alignment with industry requires a more comprehensive understanding of three key issues: Firstly, the IS curriculum content needs to be comprehensively surveyed in terms of clearly quantifiable and broad criteria. Secondly, the surveyed IS curriculum content needs to be analysed in relation to the career tracks it promotes by examining the types of specialisations it offers through its optional modules. Thirdly, there is a need for a review of the skills required by IS graduates

who have followed the aforementioned IS curriculum in relation to industry requirements, expressed through graduate jobs skills.

2.6.2 The Employer Stakeholder

As part of the development of a key stakeholder action plan to avert the IS crisis, Hirschheim and Newman (2010) examined the role of business and industry as a key contributor to the debate about improving the field's fortunes. The perspective held by business in relation to IS, but also other applied disciplines, relates to the ability to recruit employees with as many relevant skills as possible, in order to minimise their training needs. As such, business stands apart from academics whose perspective invariably focuses on the educational and pedagogical needs of students that goes beyond skills (Lightfoot, 1999). Further examination of business as a critical IS stakeholder in relation to academics shows an additional advantage the former holds over the latter. Since academics are charged with the responsibility of producing well qualified graduates, business can be seen as 'customers' of the 'product' which they 'buy' when they recruit a graduate. Therefore, business can 'shop around' for better graduates, while expressing their requirements for 'improvements' in the 'product' (Lightfoot, 1999).

Undoubtedly, it is in the interest of business for academia to continue to attract capable students and educate them to the highest standard. When the balance between the demand of business for graduates and the supply of students to universities is disturbed, business stands to lose as dearly as academia but with a relative time lag. This is why the wider IT industry has been concerned about diminishing student numbers in key subject areas, resulting in various initiatives of corrective action. There is clear evidence that the size of the undergraduate IS student population in the UK appears to be unhealthy (Stowell and Probert, 2012), while globally, the picture is even more disheartening (Scott *et al.*, 2009). Such trends are very discouraging for business whose demand for skilled workers continues to grow (e-skills, 2012).

Business in the UK and elsewhere recurrently calls for an additional number of IS graduates equipped with more relevant skills (Zwieg *et al.*, 2006). Yet there is often insufficient evidence about what these skills should be or how they need to be updated to keep up with industry developments (Prabhakar *et al.*, 2005, Todd *et al.*, 1995). Therefore, as a stakeholder, business has a crucial role to play in helping academia understand the requirements business have and the ways they can be supported. As such, they are one of the two key stakeholders of this research.

2.6.3 The Government Stakeholder

The role of government, apart from providing funding and determining policy, can be seen as a facilitator between all the other major stakeholders. Government influence largely depends on the HE system of a country. In the UK, and most of mainland Europe, public funding, either in the form of student fee grants or research funding allocations, enables governments to exert significant influence at policy level. Recent changes in funding models in the form of student fees are bound to at least partially change this status quo. One of the roles of government is to encourage universities and business to work closely together though the creation of initiatives promoting skills and training, such as Knowledge Transfer Projects (KTPs). Additionally, funding sources, either at national or regional level, affect the way universities operate and the type of research they undertake (Decter, 2009).

In addition to UK funding councils which distribute money, determine policy, fund research and implement a regulatory framework for HE institutions, government also plays a significant role in the quality assurance and enhancement of HE. Furthermore, the government cultivates close relationships with industry bodies and representatives, professional and accreditation bodies, and acts as a facilitator between international partners.

While the role of the government as a stakeholder is strategically important, it has limited bearing on the practical objectives of this study which focuses on issues of a much lower level of granularity than those normally addressed by governments.

2.6.4 The Student/Alumni Stakeholder

The influence students exert on HE in the UK is growing as a result of the gradual commercialisation of the sector with the introduction and subsequent increase in student fees. Universities are engaging with students in many more ways than before, both internally within their own institutions as part of quality enhancements efforts, but also at national level where students take part in surveys such as the *National Student Survey* (NSS) and the *Destination of Leavers from Higher Education* (DLHE). Data collected from students for these surveys contributes to university league table scores which are playing an increasing role in the sector, with both national and international ramifications.

Specifically within the field of IS, the prominence of students as important stakeholders has grown primarily for two reasons. Firstly, the enrolment crisis that has plagued the wider field of computing but also IS, has prompted researchers to consider the views of students carefully in an attempt to understand their unwillingness to follow a path with seemingly good career prospects (Hirschheim, 2007). Secondly, the interest of industry in students has grown as a result of its inability to attract sufficient numbers of adequately skilled graduates (Benamati *et al.*, 2010). As a result, a significant aspect of the research regarding IS students

and alumni focuses on the views of these two groups in relation to the IS curriculum and the skills necessary for employment.

Research that explores the reasons fuelling the IS enrolment crisis primarily involves surveys that attempt to capture existing students' views on their reasons for choosing to study IS. Surveys, such as the one carried out by Zhang (2007) consider issues regarding the interest students have in the discipline itself, the availability of graduate jobs and career progression, the perception of academic difficulty associated with studying IS, and the influence exerted by peers, friends and family in choosing IS as a field of study. Naturally, some of these issues have a bigger influence on prospective students than other, but providing large scale quantifiable results to determine it can be very challenging. In the case of Scott *et al.* (2009) the emphasis was placed on capturing qualitative responses from students participating in focus groups. The findings of the investigation analysing the reasons that encourage students to choose IS, pointed to the scope of IS jobs as the main determining factor. According to the students of the study, opportunities to travel as part of the job, developing social interaction networks but also the perceived availability of jobs were all important factors in their decision making process. But how informed are student choices, which sometimes rely on peer pressure or advice from parents and friends who may not understand IS well? According to Berry *et al.* (2006) who carried out a brief study, the answer is not very much. Their work showed that often students getting ready to choose a degree and subsequent career do not have enough exposure to their prospective field to make an informed choice.

Choosing to dismiss such findings as inconclusive may be warranted up to a point but a more significant issue still remains: do students understand what it means to study IS? Given the identity crises affecting the field since its early days, it is difficult to see how a student can make an informed choice about studying a field that is unclear about its own identity. Courte and Bishop-Clark (2009) extended this argument by conducting a student survey to determine if students are in a position to differentiate between the different 'flavours' of computing (viz. CE, CS, IS, IT and SE). Based on the finding of the survey the majority of prospective students could not understand the differences among the disciplines. More worryingly, the survey also showed that even students who were studying one of the computing disciplines at the time were also often unable to explain the differences.

Although it is a reasonable first step to ensure that students are fully appreciative of their choices before they commit to a field of study, Akbulut and Looney (2007) made the valid point about the need to also ensure that students pursuing their studies in this area must be rewarded with a positive learning experience that offers intellectual challenges and inspires them to develop strong professional careers. Attaining such goals, however, may be difficult

when the perceptions of students (the professionals of tomorrow) are different to the professionals of today. In a study about the comparability of such perceptions, Martz and Cata (2008) discovered a relatively wide discrepancy between the two groups in relation to issues such as outsourcing, skills and the difference between computing disciplines. Confirming the need for further work with students, Woratschek (2010) offered the following remark about a recent UK study:

> *The findings of this study confirm that students currently studying a computer-related discipline in the UK seem to have limited knowledge of the fields of computing and/or the career opportunities in these fields. Also needed is some work in breaking down the stereotypes students have regarding the computing fields especially in regard to the areas of programming and mathematics and how they relate to the discipline.*

The standing of alumni as a separate stakeholder is relatively weak. Most of the research involving IS stakeholders considers their views from the standpoint of junior IS professionals with the implied benefit of being able to combine together their views about recent academic and business experiences. Examples of such work can be seen in Tesch *et al.* (2003) who carried out an analysis of IS skills through a repeated survey targeting the views of recent IS graduates. Similar work that considers the alignment of skills between industry and academia appears in Plice and Reinig (2007) who also examine the views of recent graduates. Following this research theme, work by Wilkerson (2012), Chrysler and van Auken (2002) take the same approach in their efforts to understand the alignment of skills.

The careful consideration of the views of students can offer significant advantages to the improvement of aspects of IS education, such as learning and teaching in IS, curriculum development, enrolments, skills, and the perception of IS outside business and academia. This has been shown repeatedly in the research examples discussed briefly above, but also as part of the work carried out by Latham (2001). Nevertheless, the value of such perspective is limited in this study as it does not support its objectives directly.

2.6.5 The Accreditation/Professional Body Stakeholder

Professional body course accreditation in computing but also specifically in IS has grown in popularity during the last twenty years (Gorgone, 2006). Accreditation is recognised as an important method of enhancing the academic quality of programmes (Hilton and Lo, 2007). Students often perceive accreditation as a bridge that connects the world of academia with the professional world they wish to become part of. They see accredited courses as being more relevant to the needs of industry as a result of a professional endorsement which should ensure the existence of the necessary skills within what otherwise could be overtly theoretical programmes of study. At the same time, employers considering graduate recruitment have the added reassurance that students graduating from accredited programmes possess a minimum

set of skills and a level of practical competence that meets industry standards. Such indirect endorsement of quality benefits the reputation of academic institutions which are perceived by students to offer higher than normal employability opportunities (Lidtke *et al.*, 2002).

Broadly speaking, the process of accreditation involves the development of standards by industry professionals which need to be embedded within courses. The attainment of the accreditation kite mark from a professional or accreditation body is not the only part in the process. In fact, it is aspect of a quality assurance and enhancement cycle that necessitates the close collaboration between students, academics and professionals (Lidtke and Yaverbaum, 2003).

Maturing accreditation schemes are often seen to provide additional intangible benefits to both industry and academia through the development of collaboration practices that broker healthy communication between two of the stakeholders whose relationship is often seen as strained. In capturing the implicit value of IS accreditation, Topi (2009) states:

> *Accreditation has a number of benefits: it (a) forces programs to go through important self-reflection processes in preparation for their visits and in responding to the evaluators' comments; (b) provides programs with general guidance and specific change requirements; (c) encourages sharing of best practices; (d) provides programs with external validation regarding their quality that can be used in communication with various stakeholder groups; and (e) provides external input regarding necessary resource levels (and, therefore, gives departments leverage in their discussions with school and university level administration).*

Course accrediting bodies are not always synonymous with professional societies, at least in the US where the largest and most popular professional bodies reside. Both the ACM, with its wider computing remit, but also AIS with its distinct focus on IS, do not offer course accreditations. Instead, they aim to promote higher education, research and practice standards in the disciplines they represent, by engaging with all the relevant stakeholders. As part of their services, they support the academic and business communities through the development of IS curriculum recommendations. (Note that a discussion about curriculum recommendations follows in Chapter 4). Similarly, the *Association of Information Technology Professionals* (AITP), which has previously contributed to the development of IS model curricula (Gorgone *et al.*, 2002), strive to support the professionals of the field to maximise their potential through education and training opportunities. IS course accreditation in the US is primarily provided by the *Association to Advance Collegiate Schools of Business* (AACSB) and the *Accreditation Board for Engineering and Technology* (ABET). The former organisation has a wide scope which covers a number of business discipline specialisations, while the later focuses on engineering and technology, including IS (Hilton and Lo, 2007). Alternative accreditation 'standards' do exist, but they are not sufficiently specific to the needs of IS (Dumond and Johnson, 2013).

In the UK, British Computer Society (BCS) and the Academy for Information Systems (UKAIS) have been and continue to be the two largest professional body organisations representing the interests of IS, as first noted by Latham (2001) over ten years ago. *BCS, The Charted Institute for IT*, was established in 1957 and has been operating under a Royal Charter for nearly 30 years. Its aim is to support and promote standards and facilitate the creation of knowledge, expertise and professionalism. As part of its services, BCS provides HE accreditation alongside other types of training and accreditation services but does not consider the academic provision of IS separately. UKAIS was established in 1995 as a leading IS professional organisation by UK academics. It aims is to promote IS teaching and research though an annual IS conference that has been growing in standing over the years (Latham, 2001).

Undoubtedly, the contribution of professional and accreditation bodies to the development of the IS field is significant. As a stakeholder, they can enhance the development of the IS curriculum and support the skills alignment between industry and academia (Mills *et al.*, 2008). Despite the importance to the field, the scope of this research does not include professional or accreditation body input apart from measuring the level of IS course accreditation as an indicative parameter that supports the building of the IS education profile in the UK. The contribution of this stakeholder can only be utilised once the dimensions of the IS curriculum and business skills have been determined.

2.7 IS Education

IS education does not appear to be a term that enjoys a formal definition, although it is often used to describe various conventional aspects of education pertaining to IS. An example of its use as a loosely descriptive term with generic meaning attributed to it, is found in Avison (2008) in the preface of a book that presents a collection of IS related papers published under the auspices of IFIP:

> *Our first group of three papers have been categorized as IS education, though the papers can be seen also as covering the discipline of information systems as a whole as they discuss the links between teaching, research, and practice.*

In the first of the papers published in the aforementioned book, Riihijarvi and Iivari (2008) discuss aspects of education in relation to IT. Specifically, the authors consider the practical relevance of IT education at university level by examining its value to skills needed by IT experts. Such research is frequently mirrored by academics and practitioners who focus specifically on the relationship between IS curricula and *skills* (Benbasat *et al.*, 1980, Trauth *et al.*, 1993, Lee *et al.*, 2002, Plice and Reinig, 2007, Benamati *et al.*, 2010). Since the acquisition of skills relies on some form of study that entails a syllabus, research on *curricula* forms another area of interest for researchers who can be deemed to do work relating to IS

education. In addition to the curriculum recommendations promoted by various professional organisations, research into the development and maintenance of IS curricula is not uncommon; a selection of good examples can be found in Bryant (2003), Lightfoot (1999), Tatnall and Burgess (2009), Noll and Wilkins (2002), Gill and Hu (1999). IS course *accreditation* forms an extension to the relationship between curriculum and skills (Topi, 2009). As discussed earlier, the primary purpose of IS accreditation is to ensure that courses meet minimum standards of quality and consistency (Hilton and Lo, 2007, MacKinnon and Han, 2008, Lidtke and Yaverbaum, 2003, Dumond and Johnson, 2013). As such, the accreditation of IS courses by various professional bodies forms another aspect of what some researchers refer to as IS education (Topi, 2009, Bell *et al.*, 2013, Gorgone, 2006, McAleer and Szakas, 2009). Based on the above, IS education could be perceived either as those aspects of the field that relate to teaching and to some degree research, or an amalgamation of teaching and research in relation to practice.

Much of the research in IS education that focuses on *skills*, *curricula*, and *accreditation* appears to be published in 'non-mainstream' IS research outlets. A citation-based analysis of papers that summarise and profile the research published by some of the most highly regarded journals and conferences within IS, paints a disappointing picture (Table 2.1). The actual number of IS education papers published in nine academic journals that appear in the top ten of the majority of journal ranking lists is down to double digit figures. Unfortunately, data from three conferences with significant international appeal does not improve the disappointing figures.

Undoubtedly, the statistics populating Table 2.1 are not entirely accurate. The methods of calculating citations are neither perfect in their application nor universal in their use (Phelan, 1999, Cronin, 2001, Garfield, 1979). Likewise, the scope of study varies between different authors as do the years of review. For example, in one of the largest studies of its kind Neufeld *et al.* (2007) reported on citation data from 6,466 articles during a period of 30 years. Yet, the results were based on the analysis of abstracts and keywords alone. At the same time, Avison *et al.* (2008) who dealt with a significantly smaller pool of papers and employed a similar set of classifying categories based on the categories by Barki *et al.* (1993), reported a relatively large number of papers in IS education but combined "education" and "research" in the same category.

Author	Journal / Conference Reviewed	Review Years	Information Systems Education (ISE)				
			ISE Rank	ISE Papers	Total Papers	ISE Paper %	Notes
(Avison *et al.*, 2008)	ISJ	91 - 08	3/9	36	275	13.1%	Combined (education + research)
(Claver *et al.*, 2000)	I&M, MISQ	81 - 97	-	0	1,124	0%	
(Dwivedi and Kuljis, 2008)	EJIS	97 - 07	23/33	4	620	0.6%	Rank : joint 21st
(Dwivedi and Mustafee, 2010)	JEIM	99 - 08	-	0	381	0%	Keywords
(Dwivedi *et al.*, 2008)	ISF	99 - 08	-	0	307	0%	
(Gable, 2008)	ACIS	90 - 07	5/- *	- *	- *	5%	*Incomplete data
(Galliers and Whitley, 2007)	ECIS	93 - 02	-	0	1,292	0%	ISE might be embedded in 'social'; 14%
(Lee *et al.*, 1997)	ISR, JMIS, CACM, MISQ	91 - 95	-	0	143	0%	
(Mustafee, 2011)	EJIS, MISQ	95 - 08	-	0	726	0%	Keywords
(Neufeld *et al.*, 2007)	MISQ, ISR, JMIS, DS, IEEE Trans on SE, DSS, I&M	73 - 04	9/10	92	*6,466	**2%	*Citations & abstracts; **Number of articles containing a term from this category, divided by the total number of articles.
(Palvia *et al.*, 2007)	I&M	98 - 05	31/33	2	737	0.27%	
(Pervan and Shanks, 2006)	[Opinions sought]	2005	-	0	24*	0%	Survey of researchers *opinions
(Pouloudi *et al.*, 2012)	MCIS	06 - 10	19/29	7	359	1.9%	Rank: joint 11th

ISR	Information Systems Research	**EJIS**	European Journal of Information Systems
JMIS	Journal of Management Information Systems	**ISF**	Information Systems Frontiers
CACM	Communications of the ACM	**JEIM**	Journal of Enterprise Information Management
MISQ	MIS Quarterly	**ECIS**	European Conference of Information Systems
I&M	Information & Management	**MCIS**	Mediterranean Conference on Information Systems
ISJ	Information Systems Journal	**ACIS**	Australian Conference on Information Systems

Table 2.1. Citation analysis of IS education.

The analyses presented in these papers used a variety of methodologies, most of which stem from the work of Barki *et al.* (1993) who established a foundational classification scheme for IS, by cataloguing and grouping the frequency of keywords present in a large volume of IS articles. The authors described the importance of the classification as (Barki *et al.*, 1993):

> *First, it defines the field of IS in some detail. Second, it provides a common vocabulary. Third, it provides a tool with which the evolution of research can be studied. The second function served by the scheme is especially important in a rapidly changing domain such as IS. The lack of a common vocabulary among researchers is a problem that cannot be solved by computerized search systems.*

The authors propose that IS education is delineated into categories:

IA	IS EDUCATION AND RESEARCH
IA01	IS Curriculum
IA02	Computer Literacy
IA03	Computer Science Education
IA04	Certification

Table 2.2. IS Education and research classification (Barki *et al.*, 1993).

Although *skills* are not mentioned explicitly in any of the categories, they match closely (IA02) *Computer Literacy*, while (IA01) *IS Curriculum* and (IA04) *Certification* offer a clear mapping to *curricula* and *accreditation*.

Irrespective of the precise accuracy of the data, it remains clear that a significant number of prominent IS research outlets either choose not publish research papers in IS education due to their editorial scope or attract a negligible number of IS education research papers as a result of limited interest from potential authors (Claver *et al.*, 2000, Mustafee, 2011, Dwivedi and Mustafee, 2010). Beyond these outlets, the most noticeable cluster of activity in the area of IS education is found in the US as part of the *Education Special Interest Group* (EDSIG) of the *Association of Information Technology Professionals* (AITP). The group, which has been organising the *Information Systems Education Conference* (ISECON) since 1982 and the *Conference on Information Systems Applied Research* (CONISAR) since 2008, publishes three peer-reviewed journals that specialise in IS skills, curriculum, pedagogy and accreditation.

In the UK, apart from the work carried out by UKAIS which has been supporting recent initiatives by CISP to understand developments in the IS discipline (Stowell and Probert, 2012), there is no conclusive evidence to show extensive research into IS education. By contrast, the IS community in Australia has been more active in this area. An analysis of the *Australian Conference of Information Systems* (ACIS) by Gable (2008) revealed that IS education took up 5% of papers published between 1990 and 2005. The same author reports that various pockets of IS education activity in universities across the different states of Australia.

2.8 Summary

This chapter has considered the emergence of IS and its attempts to establish itself as an applied discipline with a strong research and teaching identity. Through a historical review of the past five decades, the discussion exposed the issues affecting IS education, highlighting the organisational and technological advancements that often caused tension between IS and its stakeholders. Additionally, the historical review demonstrated the efforts made by the academic community to position the field and legitimise its identity among a number of other emerging fields.

In order to contextualise the issues affecting IS, and in particular those driving this research, a stakeholder approach was adopted. As each stakeholder was analysed, changing requirements emerged, leading to contentious relationships among them which caused some to question the identity, purpose and future of IS. Academia and business are shown to be at

odds over the necessary skills that would enable IS graduates to function optimally as future IS professionals.

The investigation of the uneasy relationship between academia and industry forms the basis for this research. The chapters that follow will carefully examine the academic curriculum and the skills sought by industry, which underpin the research aim of this thesis to align industrial IS careers to the current academic IS provision in the UK. Before this is achieved, the next chapter will focus on quantifiable characteristics of IS education which show how the issues highlighted earlier in this chapter, manifest into practical problems that threaten the future of the field.

3 CHARACTERISTICS OF INFORMATION SYSTEMS EDUCATION

3.1 Introduction

As discussed in the previous chapter, the philosophical crisis in the IS field coupled with a turbulent external environment, have caused considerable difficulties for both academia and industry. Universities and industry have experienced difficulties recruiting adequately qualified students and graduate professionals respectively, leading to additional tensions between two of the most prominent stakeholders of IS.

Although previous attempts have been made to measure the scale of the problems affecting IS education, none has considered the UK market in a holistic way. Hence, this chapter investigates the issues affecting the academic provision of IS at UK universities in an attempt to establish the magnitude of the recruitment problem that is contributing to the decreasing availability of qualified IS graduates. The discussion about recruitment is supplemented with findings about entry level qualifications, course accreditation, course naming conventions and career data.

3.2 IS Education Characteristics

Aiming to build a comprehensive view of the IS curriculum, this section focuses on a series of outlying issues that provide context to the curriculum mapping exercise which is discussed later in this thesis. Specifically, the discussion here considers the following five key topics:

- IS degree course recruitment trends utilising two separate analyses.
- Entry level qualifications that govern and determine IS recruitment across all UK institutions.
- IS degree course naming conventions that illustrates the way the UK academy chooses to advertise its portfolio of courses to prospective students.
- Course-based career data that supplements IS course descriptions.
- Levels of course accreditation that indicate the degree to which professional bodies and universities are working together to enhance IS courses.

By analysing these peripheral, but nevertheless essential, aspects of the IS curriculum it becomes possible to better understand some of the earlier discussions regarding the state of

the IS discipline, its perceived crisis which is causing uneasiness in the world of academia and the need for all the relevant IS stakeholders to work together to minimise the uncertainty regarding the IS field in the UK and beyond.

Each of the five topics presented below features comprehensive numerical information, providing a relatively easy way to appreciate the UK-based indicators. Where necessary and relevant, data from credible international sources is also included, enabling comparisons with UK-based data that forms the basis of the surveys discussed in chapters 6 and 7, thus building a more comprehensive picture about the issues in question.

3.3 Demand for IS courses

Accurate international enrolment statistics are difficult to obtain and compare, as the very few countries that publish data in this area use different methods for collecting and recording statistical information, as well as defining what constitutes an IS course and by implication an IS student. It is, nevertheless, important to gain an appreciation of the magnitude of the downturn in recruitment by briefly considering some key international indicators. Such understanding will provide a contextual framework for the discussion that follows in the next section about IS recruitment data in the UK.

Combined IS and Computer Science degrees reported by Koch *et al.* (2010) for the wider US market (Figure 3.1) show a continuous drop in student numbers since the peak in 2003. Granger *et al.* (2007) reported that IS enrolment numbers have been declining since their peak in 1990s. In one case study of an IS department in the US, McGann *et al.* (2007) described a 56% drop in IS enrolment numbers occurring within a two-year period from 2001 to 2003. Similarly, an analysis of enrolment data by Panko (2008) at another US institution showed a sustained decline in numbers from 2001 onwards. Likewise, research by Scott *et al.* (2009) acknowledged the significant reduction in IS numbers and attempted to explain the reasons behind the phenomenon, while Firth *et al.* (2008) referred to an enrolment “crisis” which has reduced IS students numbers by 50% since 2002. Many of these reported findings about falling numbers across US institutions coincide with references to reports from official US employment agencies that project future increases in the numbers of IT professionals sought by business and industry (Walstrom *et al.*, 2008, Lifer *et al.*, 2009, Simon *et al.*, 2007, Kung *et al.*, 2006). This offers further evidence about the existence of the imbalance between the diminishing supply of IS students and the growing demand for IS professionals.

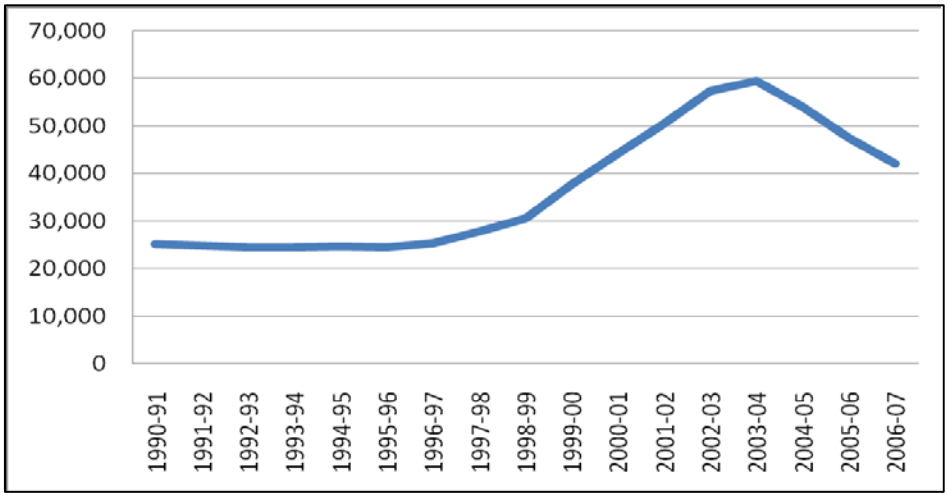


Figure 3.1. US degrees awarded in IS and CS (Koch *et al.*, 2010).

Although Koch *et al.* (2010) did not offer a breakdown for the IS and Computer Science numbers plotted in Figure 2.6, it is worth noting that the number of graduates remained virtually unchanged between 1990 and 1997. A similar, noticeable increase from 1997 until after the dotcom bubble burst in 2002 can also be observed in the UK admissions data which is reviewed in the next section. The UK data suggests that the peak in the US occurs a year before the UK, although the margin of relative increase between the two years is very small. Furthermore, at its peak, IS and Computer Science recruitment in the US stood at nearly 60,000 undergraduate students which is approximately double the peak IS recruitment number of 34,010 of the UK.

Evidence about IS student recruitment from Australia paints a similarly disappointing picture to that of the US. In a paper discussing the IS crisis from an Australian perspective, Wilson and Avison (2007) noted that the number of student applications and university offers for IT fell consistently from 2001 to 2006. The authors proceeded to present an array of data about the state of New South Wales where the overall combined IS and ICT student application number fell by 39.2% in 6 years. More worryingly they claimed that (Wilson and Avison, 2007):

> *Some academics have estimated that in 2005 there were more students enrolled in the 3rd year of IS/ICT degrees than in the 1st and 2nd years combined.*

As part of a detailed study about the IS discipline in Australia Gable (2008) mentioned:

> *Since the 'dotcom implosion' of about 2000, enrolments in IS courses have decreased substantially.*

In a further indicative comment, Gable (2008) stated:

> *The recent reduced student enrolments led to changes in the organisational location of IS groups in many universities, reduced staffing and rationalisation of the ICT curriculum. In some IS groups, these changes were used strategically to strengthen the position of IS*

> *in comparison with related disciplines. Reduced student enrolments appeared not to have impacted on the quality of Australian IS research.*

Observations about IS enrolments in Australian universities were also confirmed by the Australian government in a report on country-wide university recruitment trends by the *Department of Education, Employment and Workplace Relations* DEEWR (2008):

> *The decline was most dramatic in the early 2000s, but the rate of decline has since shown signs of slowing down and perhaps is levelling off. Between 2001 and 2005, there was a 53.5% drop in the number of applicants who had information technology as a first preference, with the number of applicants down from 12,056 in 2001 to 6,810 in 2005. Since then, there has only been a decline of 11.4% between 2006 and 2008.*

Outside Australia and the US, a more encouraging outlook is found in Ching-Chang and Ting-Peng (2007) who claim that IS enrolments in Taiwan have only seen a small decline, with top-ranking universities continuing to attract healthy number of students. In another study Tan and Taizan (2007) reported similar findings about Singapore. They explain that although demand for IT graduates has been affected, IS has maintained healthier numbers across the country's small number of universities. While these are encouraging findings both countries in this case have relatively small IS communities with minimal impact on overall global numbers.

3.3.1 IS Undergraduate Recruitment in the UK

The discussion about US recruitment data regarding the paradoxical mismatch between IS graduate demand and IS student supply, whereby supply fails to follow demand (Benamati *et al.*, 2010, Prabhakar *et al.*, 2005), appears to hold true for the UK as well. Capturing the UK's future employment growth in the technology sector, e-skills (2012) reported as part of their *Technology Insights 2012* survey that the number for IT & Telecoms professionals has been growing year-on-year since 2009. An analysis of the most sought after positions as expressed by recruiters in 2011 showed a clear need for graduates with skills in systems development, project management, and business and database analysis e-skills (2012):

> [...] *employment in the IT professional workforce is expected to grow at 1.62% per annum, over the 2011-2020 period - nearly twice as fast as the predicted growth rate for UK workers as a whole.*

Further analysis of the IS/IT employment market in the UK by Stowell and Probert (2012), reached the same conclusion:

> *There are, and will continue to be, ample opportunities for both graduates and postgraduates of IS programmes to gain employment within the IS/IT sector in the UK - and within all sectors that make extensive use of IS/IT within their organisations, i.e. most sectors of employment in the UK. This suggests that IS should be understood to be strategically important for the UK economy. However, at present, it is also vulnerable. It is vulnerable at undergraduate level owing to the low interest in the discipline from potential students, and it will be vulnerable at the postgraduate level from 2015 onwards,*

as the full impact of higher undergraduate student fees begins to impact on the UK postgraduate market more generally.

While demand in the UK for well-qualified graduates remains evidently positive, student demand for IS degree courses has been moving in the opposite direction. UK data from two complementary studies examining IS recruitment figures between 2002 and 2011 suggest that, at best, IS courses are unable to generate significant interest in students contemplating their future careers.

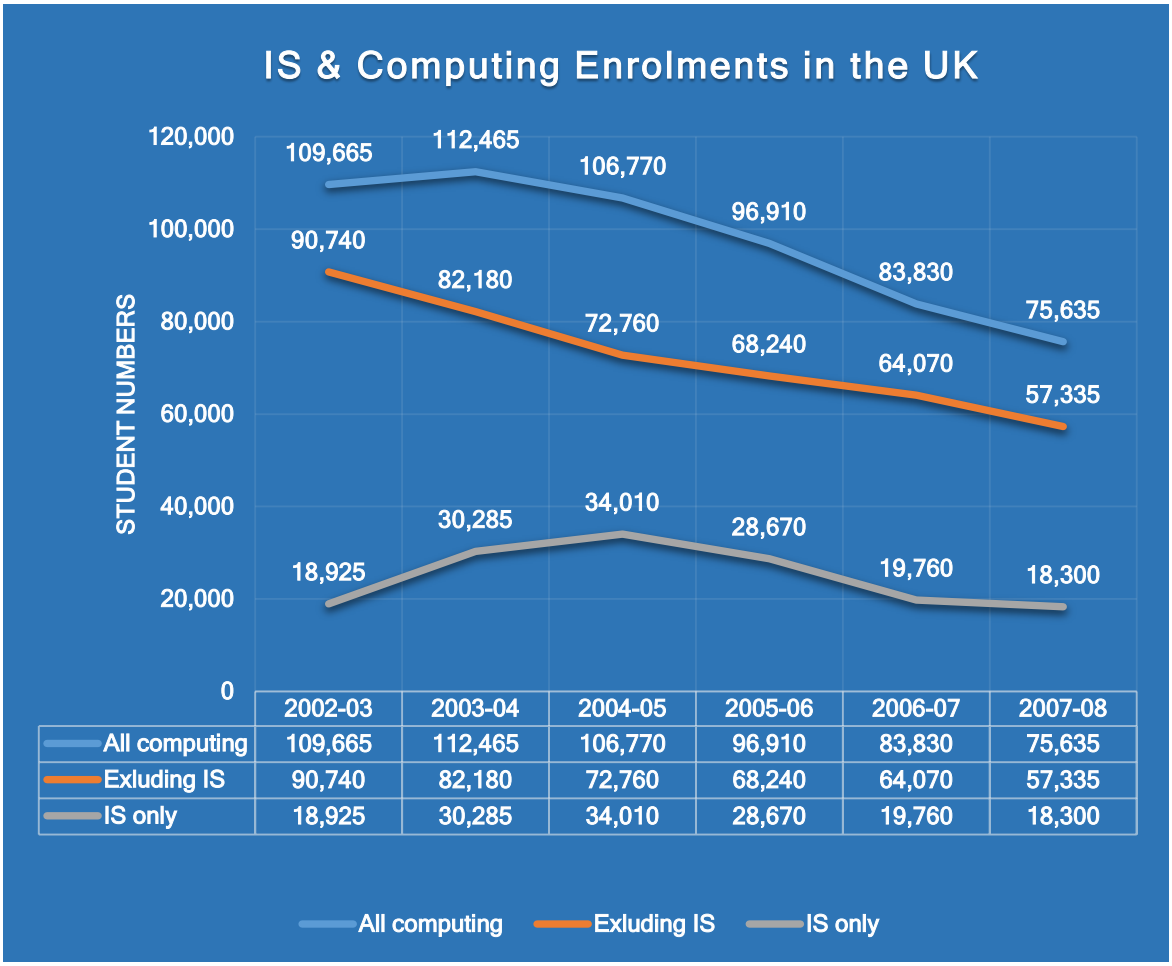
The initial study of enrolment data is part of the wider IS course degree survey discussed in Chapter 6. IS enrolment data was collected from the *Higher Education Statistics Agency* (HESA), with the aim of enhancing overall understanding of the IS course provision in the UK. The data analysis examined IS and computing recruitment statistics from immediately after the dotcom implosion in 2002 until 2007 when changes were made to the way data was recorded by HESA. The second study of enrolment data reviewed the recently published survey by Stowell and Probert (2012) which examined both undergraduate and postgraduate IS recruitment in the UK by analysing data published by HESA between 2006 and 2011. Relevant data from both studies was combined to provide a holistic view of IS recruitment in the UK.

3.3.2 IS Course Survey Enrolment Data

HESA reports annually on UK university student numbers. Its data collection and reporting on HE statistics forms the official data source for many agencies that publish HE related information, including Unistats, which is discussed later in this chapter. One of HESA's publications known as Students and Qualifiers Data Tables offers a breakdown of UK student numbers by level of study, mode of study, subject of study, domicile and gender (HESA, 2010). HESA uses Computer Science as a term to describe the discipline made up of a number of subjects: *Broadly-based Programmes within Computer Science*, *Computer Science* [the subject of], *Information Systems*, *Software Engineering*, *Artificial Intelligence* and *Others in Computing Sciences*. Statistical data is provided for the entire field as well as the individual subject areas, such as *Information Systems*. To avoid any naming confusion subsequent references to computing will refer to the discipline as described by the above subjects, and *Computer Science* will refer to one of the subjects of the computing discipline.

As part of the first set of enrolment figures, examining IS student data between the academic years of 2002-03 and 2007-08 reveals some interesting trends (Figure 3.2). The growth in student IS numbers peaked in 2004-05, around three years after the burst of the dotcom bubble which is often referred to as the catalyst for the drop in *Information Systems* and wider computing student applications. Specifically, the numbers grew nearly two-fold from 18,925 in 2002-03 to 34,010 by 2004-05, reflecting the cumulative effect of large student

intakes during earlier years. By the end of this period, the large intakes of the late 1990s and early 2000s reached graduation which, coupled with falling new recruitment, caused a sharp fall in the following years. During the 2007-08 academic year student numbers dropped to levels slightly below those of 2002-03 leaving the majority of universities exposed after the investment of resources into what were once very popular IS courses.



	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
All computing	109,665	112,465	106,770	96,910	83,830	75,635
Exluding IS	90,740	82,180	72,760	68,240	64,070	57,335
IS only	18,925	30,285	34,010	28,670	19,760	18,300

Figure 3.2. IS and computing enrolment data for the UK.

Student numbers for the entire computing discipline during the same period of 2002-03 to 2007-08 have followed a different trend. While the *Information Systems* managed to maintain its original student population despite significant fluctuations, the computing discipline as a whole, which peaked in 2003-04, maintained a constant drop shedding numbers continuously up to 2007-08. During the 2003-04 academic year computing student numbers stood at an all-time high of 112,465. By 2007-08 the number had fallen to 75,636, a cumulative drop of 33%. A closer inspection reveals that contrary to *Information Systems* gaining numbers in the years following the aftermath of the dotcom bubble burst until 2004-05, the rest of computing (shown as Excluding IS in Figure 3.2) suffered immediate and sustained losses. Examining further the graphs in Figure 3.2 shows that the increase in overall computing numbers from 2002-03 to 2003-04 is the direct result of growing *Information Systems*

recruitment alone, at a time when *Computer Science* and *Software Engineering,* which are the two main disciplines part of the category labelled Excluding IS, were losing around 9% of students annually. The disparity between Computing and IS student numbers can also be expressed in terms of the percentage of students studying IS between 2002-3 and 2007-8 in relation to the rest of the Computing discipline. While computing shed over 35,000 undergraduate students in five years, *Information Systems* managed to retain its 2002 student base which resulted in a substantial increase in the overall student share within the wider computing field from 17.3% to 24.2%. The findings suggest that *Information Systems* courses fared better than *Computer Science* and *Software Engineering* which suffered the biggest losses. Despite such 'success', however, the problem of student supply not meeting graduate demand still remains unresolved.

3.3.3 CISP Enrolment Data

The second set of enrolment figures are drawn from the work carried out by Stowell and Probert (2012) on behalf of CISP. As part of their report, the authors examined both undergraduate and postgraduate enrolment data over a period of five years, up to 2011 which was the last year for which HESA had published enrolment data at the time of the publication of the report. Figure 3.3 depicts a diagrammatical amalgamation of the undergraduate enrolment data from the CISP report.

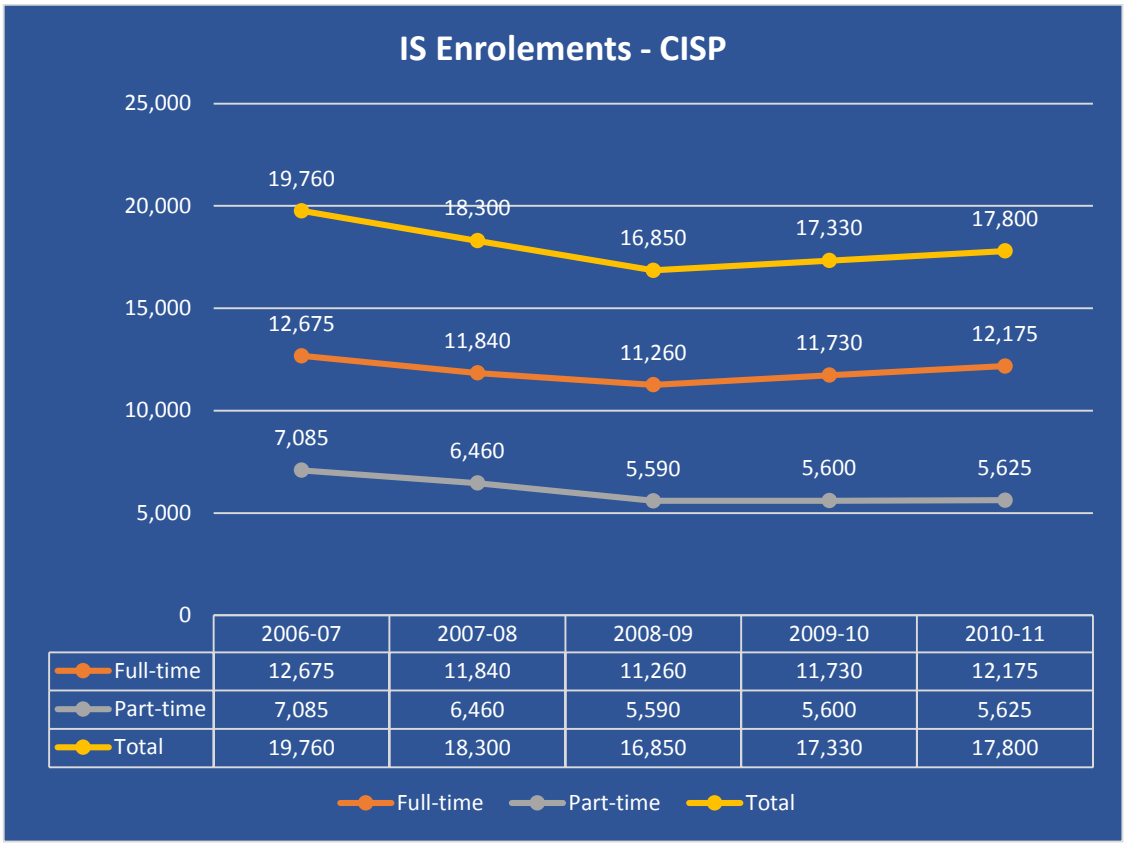


Figure 3.3. IS enrolment data for the UK (Stowell and Probert, 2012).

Recruitment based on the combined full-time and part-time undergraduate IS numbers from 2006 to 2011 appears to be declining with some losses during 2007-09 and subsequent smaller gains since then. Overall, IS student numbers in 2011 stood at 90.1% of what they were in 2006. This is an unwelcome finding that clearly goes against the increase in demand for more graduates. The shift in numbers, causing the overall negative picture, is the result of substantial reductions in part-time IS numbers as indicated in Table 3.1. It is encouraging, however, to notice that the 2010-11 figures show an increase in both full-time and part-time students, albeit a small one.

	2006-07	2007-08	2008-09	2009-10	2010-11
Full time	12,675	11,840	11,260	11,730	12,175
FT annual % change		**-7%**	**-5%**	**4%**	**4%**
Part time	7,085	6,460	5,590	5,600	5,625
PT annual % change		**-9%**	**-13%**	**0%**	**0%**
Total	19,760	18,300	16,850	17,330	17,800
% change annually		**-7%**	**-8%**	**3%**	**3%**

Table 3.1. IS enrolment data for the UK. Adopted from (Stowell and Probert, 2012) with partial data.

Noting their observations for the data in Table 3.1 and Figure 3.3 Stowell and Probert (2012) explained:

> *Whilst postgraduate numbers are relatively healthy, undergraduate numbers are not strong. There are two main concerns; First, undergraduate numbers have shown little growth during the five-year period – unlike many other subjects in HE [footnote deliberately omitted]. Second, postgraduate numbers may struggle to maintain these levels as the impact of the rise in undergraduate fees in England begins to influence UK postgraduate student numbers; probably from 2015 onwards. This possibility is acknowledged by HEFCE.*

Combining the data from both data analyses sets provides an extended graphical representation of the recruitment trend in IS in the UK from 2002 to 2011 (Figure 3.4).

While acknowledging HESA's various methodological tweaks in capturing and reporting data over the years, it is worth noting that by 2010-11 the number of students taking up an IS undergraduate degree stands at just over 50% of what it was in 2004-05; and only 94.1% of 2002-03.

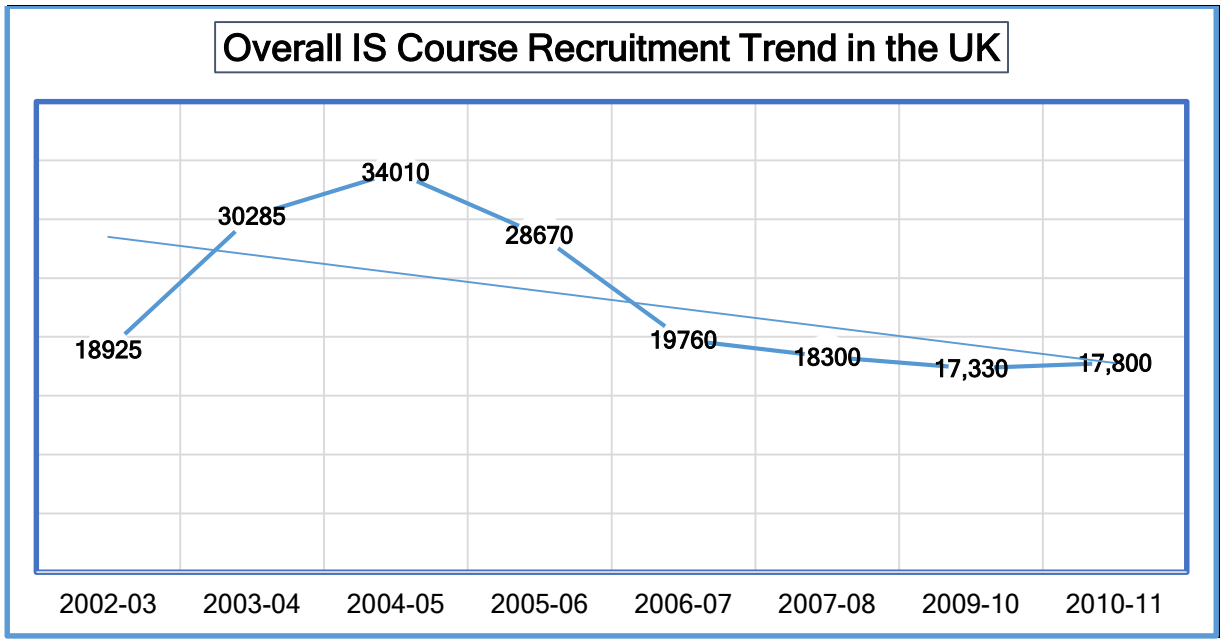


Figure 3.4. Combined IS enrolment data for the UK.

3.4 IS Course Naming Conventions

Understanding the title names used to describe IS undergraduate courses provides a further insight into the views held by the academic community about the field of IS, its relationship with other hierarchical disciplines and the influence of major technological advancements. The variation in IS course names has, as expected, increased over the years with the expansion in the provision of IS courses which can often appear as specialisations within the wider field.

The naming of university courses is not an exact science, especially for a dynamic discipline such as IS. Naming IS courses is a balance mostly between a reflection of the content of a course, the prevailing terminology adopted by the IT industry and some marketing thrown into the mix to make them sound 'cool'. Given the close association between technology and IS, technology-savvy students of IS are bound to be influenced by the course names they encounter. For a loosely defined discipline such as IS which inherits many of its subjects from a variety of computing and business topics, it is difficult to provide a name that accurately encompasses all its different elements (Gorgone *et al.*, 2002):

> *Information Systems as a field of academic study exists under a variety of different names. The different labels reflect historical development of the field, different ideas about how to characterize it, and different emphases when programs were begun.*

3.4.1 Naming of IS Courses in the UK

Most of the 228 IS courses on offer in the UK during the 2010 academic year, the identification of which is discussed later in Chapter 6, bear titles that suggest a clear focus on IS. A title such as "BSc Information Systems" which has the highest frequency of occurrence

among the 228 courses examined and presented in Figure 3.5 is arguably the most descriptive. Interestingly, many of those 44 (19%) courses with this title carry name qualifiers in an attempt to give prospective students a better impression of what they encompass. Titles such as "BSc Business Information Systems" (15%) or even "BSc Business Information Technology" (11%) offer less of an indication that they are attributed to IS courses. "BSc Computing (with qualifier)" (7%) is possibly one of the least descriptive titles and more likely to be misconstrued as a computing course title. The majority of courses were classified as BSc courses with only 5 listed as BA and a further 2 as BA/BSc. Seven courses classified as MComp were included in the study since they were listed by UCAS as undergraduate degrees despite their 4-year duration which leads to a Master of Computing qualification. The category shown as Various was populated by 38 course titles which feature permutations of a few key names such as Computer Information Systems and Information and Communication Technology.

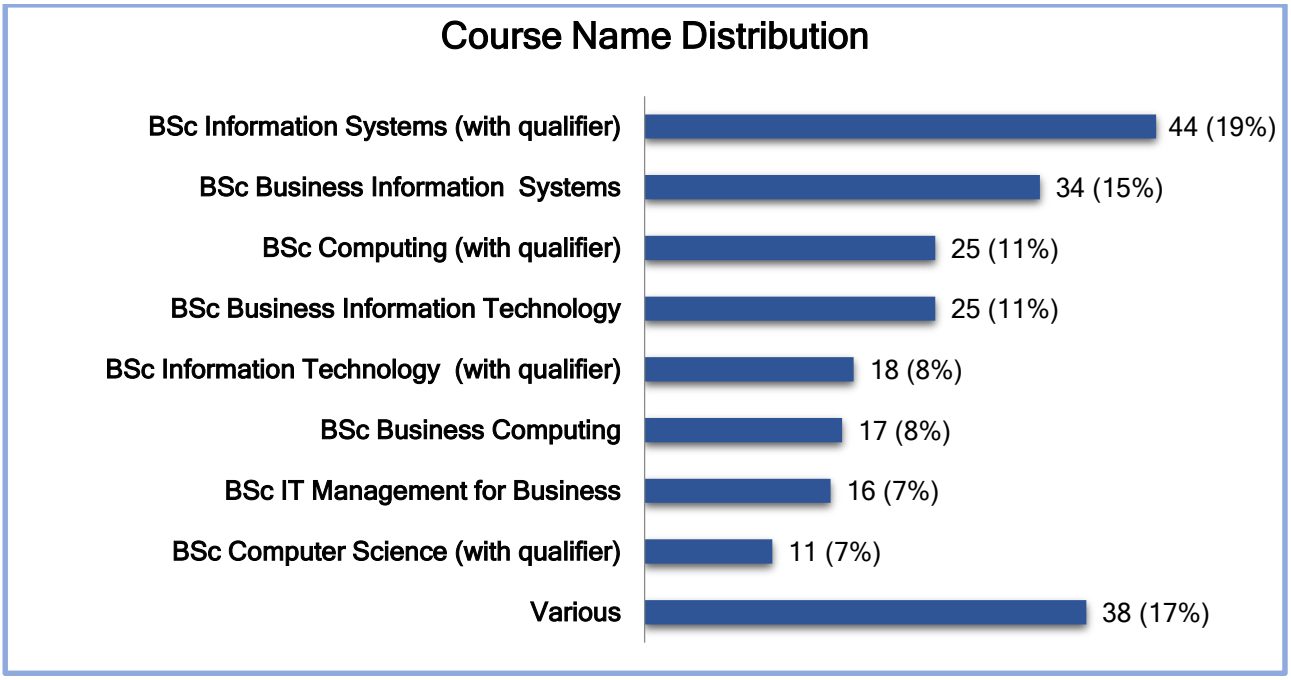


Figure 3.5. IS undergraduate degree course titles in the UK.

Closer examination of the data reveals that sometimes courses with visibly different titles, such as BSc Information Systems and BSc Business Computing, have closely matched contents. The majority of courses feature the term "business" either in the title name itself or the qualifier of the title. As such, there might be an expectation that most of the 228 courses reside in business departments, schools or faculties. Despite the frequency of "business", 203 (89%) of courses belong to computing and the remaining 25 (11%) to business departments. This is in contrast to the situation in the US where the majority of contemporary IS courses, or MIS as they tend to be known, reside in business schools (Pierson et al. 2008). A small number of courses were collaborations between computing and business departments but in all such

cases one department was featured as the lead department, most likely for administrative reasons.

3.4.2 Naming of IS Courses in the US

In one of the earliest attempts to analyse the names of IS courses in the US, Nunamaker (1981) surveyed 124 IS courses surveyed between 1977 and 1979. The findings show 37 different titles, with the most frequent one being "Management Information Systems", present in 27 out 124 courses (18.9%). The second most popular title was "Information Systems" with 14.5% frequency. The lack of conclusive subsequent IS title surveys until the publication of the work of Pierson *et al.* (2008) makes it difficult to determine the evolution of course nomenclature, however, in their IS'95 and IS 2002 reports Couger *et al.* (1995), Gorgone *et al.* (2002) respectively, list the two aforementioned titles as being popular many years after Nunamaker's original survey. By 1995, "Business Information Systems" and "Information Science" course titles were also part of the list of popular names of IS courses, and continued to be so well beyond 2002.

A much more conclusive study in the use of IS title names in the US was carried out by Pierson *et al.* (2008). Their work, which is a reference point for IS 2010 (Topi *et al.*, 2010), examined the names found in AACSB accredited IS courses. The study concluded that by 2007 the majority of IS courses (40.5%) were named "Management Information Systems", with a further 20.6% names "Information Systems". In third place with 18% was "Computer Information Systems", a title which is completely absent from UK courses.

3.5 Entry-level Qualifications for IS Courses in the UK

Apart from the impact that course titles have on attracting prospective students, the reputation, location and quality of facilities of institutions are also seen as important selling points. A further parameter is the entry requirement or entry level qualification, often expressed as the UCAS Tariff which universities utilise to express course entry requirements. Entry to UK universities for undergraduate study is controlled by UCAS. Through its UCAS Tariff system, the organisation supports universities and candidate students by attributing points to qualifications, effectively setting minimum targets for entry for each course (http://www.ucas.ac.uk/students/ucas_tariff/how). A common way of expressing entry-level requirements is through A-Level score points. The proliferation of different UK-specific and international qualifications over the years resulted in a tariff-based system that calculates the equivalency of scores between dissimilar qualifications. Recently, UCAS acknowledged the need to overhaul the tariff-based system, which is over ten years old, to address the challenge of measuring the evolving national and international entry level qualifications in a more meaningful way (http://www.ucas.ac.uk/documents/tariff/review.pdf).

Course entry requirements stipulate the minimum level of achievement in specific A-Level or A-Level equivalent points. Universities offering IS courses accept a variety of qualifications such as A-Levels, Scottish Qualifications, International Baccalaureate, Irish Leaving Certificate, Access Qualifications, BTEC Higher National Diploma, BTEC National Diploma, Advanced Diploma or Cambridge Pre-U. A range of international qualifications are also considered to enable EU and overseas students to gain places. The analysis of the entry level points needed for the 225 courses of this study (3 of the courses feature no formal UCAS Tariff) revealed an average of 246 points (two A grade A-Levels are worth 240 points which is equivalent to 3 C grade A-Levels with a median value of 240 (Table 3.2); for a comprehensive list see: http://www.ucas.com/students/ucas_tariff/). A significant number of courses express minimum as well as preferred achievements. For instance, a course entry requirement may specify as a minimum 240 points which is equivalent to two A grade A-Levels, yet the preferred option would be 3 A-Levels with a total of 240 points or more. Similar constraints are expressed by most courses in terms of additional achievements in GCSE English Language and/or Mathematics. The highest tariff score of 340 points was found in 12 courses (5%), almost 3 times higher than the lowest score of 120 points which was set by 2 courses (1%). More than half (55%) of the courses examined require a minimum of 240 points or more.

A-Level Points	Number of courses	%
120	2	1%
150	4	2%
160	22	10%
180	10	4%
200	24	11%
220	17	8%
240	39	17%
260	33	15%
280	24	11%
300	12	5%
320	26	12%
340	12	5%
Total:	**225***	**100%***

Table 3.2. Entry level points breakdown.

The examination of entry-level requirements for each of the 228 courses was carried out by cross-referencing the information published on individual university websites against the data published by UCAS. To enhance the appreciation of entry-level differences between institutions, participating universities were grouped according to their affiliations. The number of courses offered by each group and their respective descriptions are shown in Figure 3.6.

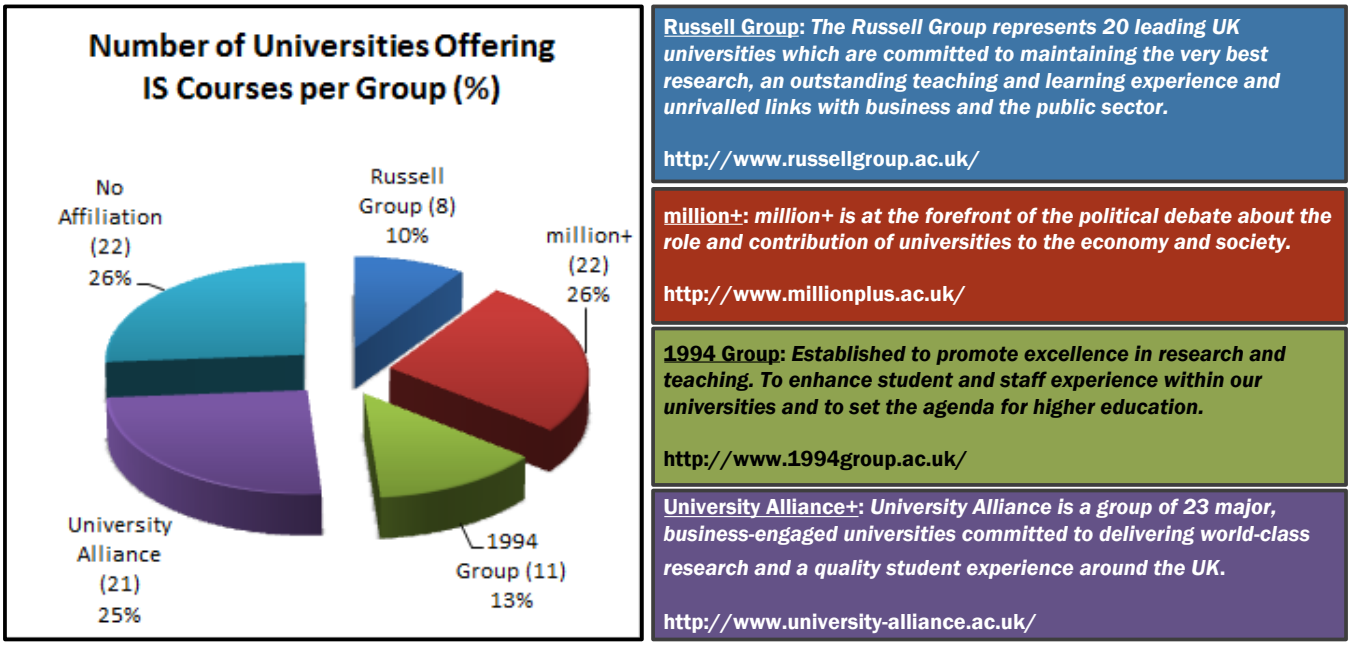


Figure 3.6. Prominent UK university group affiliations.

Of the total 228 courses, eight Russell Group universities offer 22 courses, twenty-two million+ universities offer 60 courses, eleven 1994 Group universities offer 29 courses, twenty-one University Alliance universities offer 53 courses, with the remaining sixty-four courses being offered by 22 universities with No Affiliation.

Differential comparison of university groups in terms of course entry requirements shows significant variations (Figure 3.7). Russell Group universities, which contribute only 10% of the overall number of IS courses, set their minimum entry 20 points higher than the highest tariff set by million+ institutions that offer 26% of IS courses. A further noticeable difference exists between one institution within the No Affiliation group that requires a mere 120 points (equivalent to one A grade A-Level) and the minimum set by Russell Group institutions that expect at least 280 points (equivalent to BBC A-Levels). While it is beyond the scope of this study to carry out comparisons between different institutions and the admissions standards they apply, it begs the question how similar or dissimilar two IS courses can be when the entry requirements for one are more than twice as high as another.

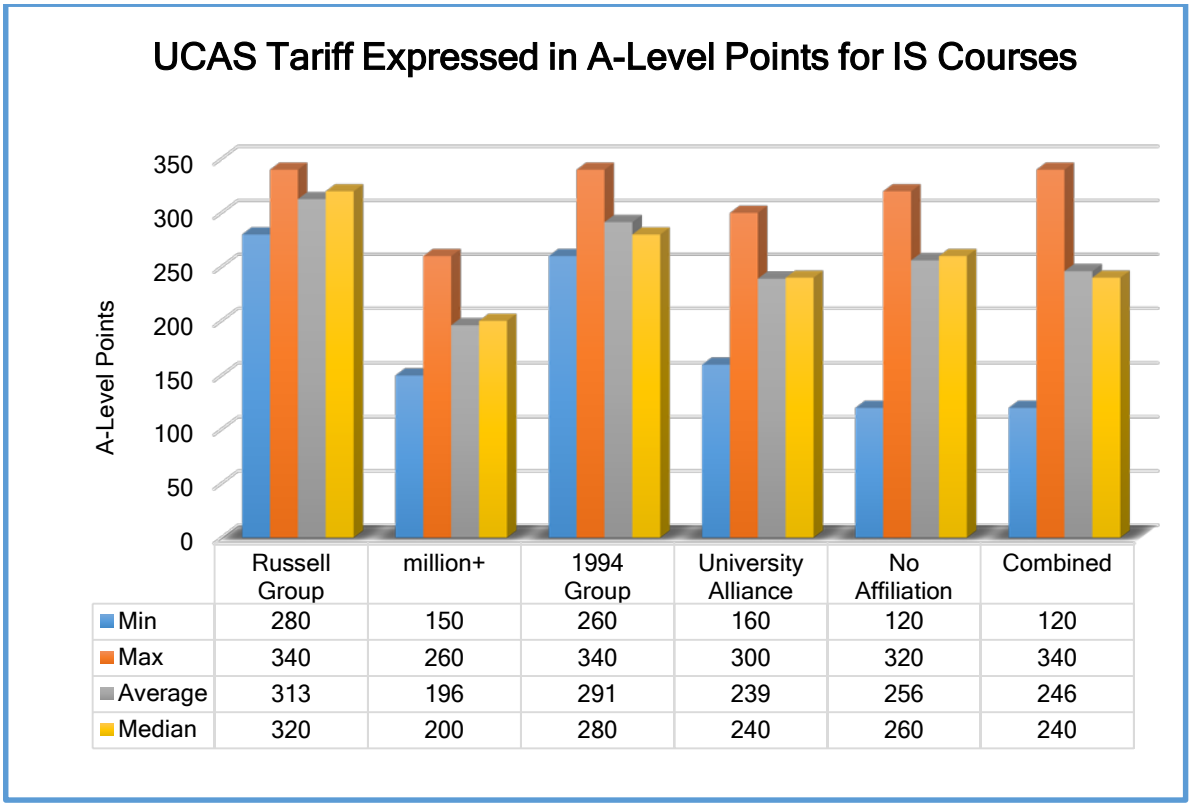


Figure 3.7. Entry level qualification points (A-Levels) by group.

3.6 Levels of Accreditation of IS Courses in the UK

Reviewing the level of accreditation of courses was carried out as part of an effort to provide a comprehensive overview of those elements of the undergraduate provision that characterise IS education. The data in this section, as was the case with the section on IS course naming conventions, does not lend itself to drawing comparisons between institutions or ascertaining the level of quality of different courses. It simply offers an indication of how popular undergraduate course accreditation was at the time when the IS course survey was carried out. The temptation to review the levels of IS course accreditation in the US and Australia was resisted as it would offer no basis for meaningful comparisons given the differences in the accreditation processes.

As discussed earlier, course accreditation is becoming increasingly associated with improving academic quality standards and employability opportunities (Lidtke and Yaverbaum, 2003). According to Lidtke *et al.* (2002) accreditation benefits a wide range of stakeholders, including, students and their parents, employers and the public. Lunt *et al.* (2010) summarised the essence of accreditation in the following manner:

> *Accreditation is essentially a quality assurance mechanism for higher education. Accreditation assures that a program or school meets a set of independently specified quality criteria.*

The accreditation of IS courses in the UK is not extensive. BCS is the main professional body offering HE accreditation in the ICT field, along with the Institution of Engineering and Technology (IET) that offers academic accreditation to mostly engineering programmes (http://www.theiet.org/academics/accreditation/). As part of its mission, BCS strives to work with HE institutions on the development of professional standards within educational qualifications - both undergraduate and postgraduate. Unlike AACSB and ABET in the US, BCS does not consider the accreditation of schools or departments. Instead, it focuses on individual courses that fall under the umbrella of computing or IT, including IS (http://www.bcs.org/upload/pdf/criteria-appendix4.pdf). The accreditation process is based on ascertaining how well certain academic and professional requirements are delivered through the curriculum before a student successfully completing a qualifying course can register as a Chartered IT Professional (CITP) and/or Chartered or Incorporated Engineer (CEng/IEng) and/or a Chartered Scientist (CSci) (http://www.bcs.org/category/7065). In contrast, accreditation of IS programmes in the US focuses on the specific requirements of the discipline within the context of HE. Informative considerations about accreditations in the US can be found in Challa *et al.* (2005), Reichgelt and Gayle (2007) who offer a good discussion about the value and process of gaining IS accreditation, while Hilton and Lo (2007), Lending and Mathieu (2010) look for evidence of qualitative benefits of accreditation, as they urge IS programmes to become involved with the accreditation process. Moreover, Mills *et al.* (2008) provide a framework within which accreditation of IS courses can be facilitated to offer maximum benefits to all stakeholders involved.

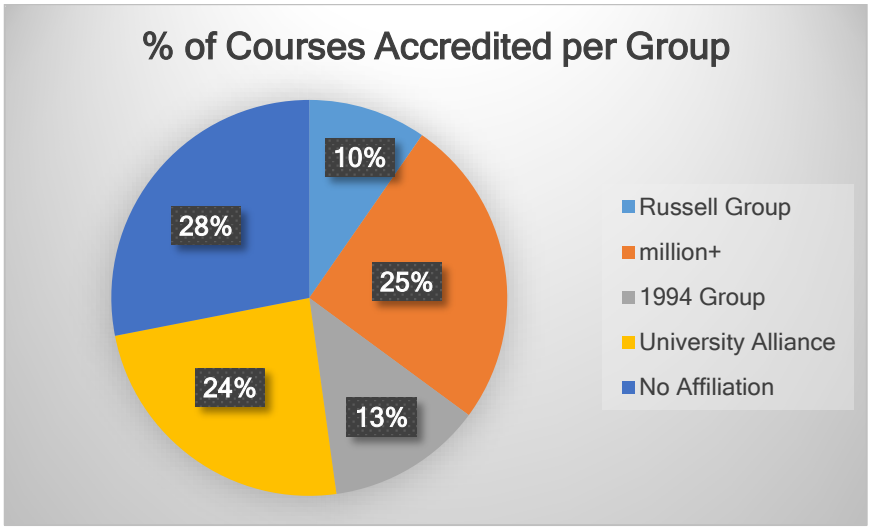


Figure 3.8. IS course accreditation by university affiliation group.

The number of IS courses with an active BCS accreditation status shows noticeable differences between the main university groups (Figure 3.8). With only 10% of BCS accredited courses, Russell Group universities take up last place, while universities with No Affiliation

have nearly three times as many accredited course. For a complete, quarterly updated, list of all BCS accredited UK university courses, see (http://wam.bcs.org/wam/coursesearch.aspx).

	Full CITP		CITP Further Learning Element		Partial CITP		Full CEng		Partial CEng		Full CSci		Partial CSci		Full IEng		Partial IEng	
Russell Group	11	50%	2	9%	0	0%	0	0%	3	14%	0	0%	2	9%	0	0%	0	0%
million+	14	24%	0	0%	0	0%	0	0%	7	12%	0	0%	6	10%	0	0%	0	0%
1994 Group	17	59%	2	7%	1	3%	2	7%	12	41%	2	7%	6	21%	0	0%	1	3%
University Alliance	8	15%	0	0%	0	0%	0	0%	5	9%	0	0%	0	0%	0	0%	2	4%
No Affiliation	7	11%	0	0%	1	2%	0	0%	9	14%	0	0%	4	4%	0	0%	0	0%

Table 3.3. Type of accreditation per university affiliation group.

Overall, seventy-six (33%) of the 228 IS courses are accredited by the BCS, holding different, often multiple, types of accreditations (Table 3.3). Unsurprisingly, the most frequent type of accreditation offered to IS courses is CITP while, as expected, no IS course leads to full IEng accreditation status. Often course accreditations have been subject to conditions, with the most common being to pass a specific module or the Final Year Project at the first attempt. Other conditions involved students taking a specific module, having to study at a particular campus (course franchising implications), passing without condonement, and providing a student pass list to the BCS for approval. Even though the value of IS course accreditation is well established (Kung *et al.*, 2006, Topi, 2009), it is difficult to ascertain any direct benefits which are specific to IS courses derived from the BCS accreditation process, since the accreditation focus is on the level or type of accreditation offered as opposed to the specific discipline of the course under examination.

3.7 IS Careers and Unistats Data

Gathering additional information about career data from university course websites contributes to the earlier stated effort of supporting a well-rounded profiling of the IS education provision across the UK. This category of data is present in all the university IS course webpages and predominantly involves indicative careers information designed to help prospective students match their career aspirations to those promoted by different courses. Most universities label this category as “Careers”, “Career prospects” or “Career opportunities”. The information available on these webpages appears in two different ways.

First, there are narrative descriptions of employment opportunities, showcasing examples of recent graduates who have secured jobs in different business sectors or with noticeable companies. Furthermore, there are often lists of jobs or job types which graduate students could pursue after completing their courses. Undoubtedly, this type of information is non-

standardised in terms of its quantity and quality but it does provide an insight into the way universities choose to promote the employability opportunities of the IS courses they offer. More often than not, the career opportunity descriptions in this area have a noticeable marketing look and feel to them, reflecting contemporary webpage authoring technologies.

Second, there is career and course employability data which is recorded by all universities and is made available through Unistats. As a government agency, Unistats describes itself as (http://unistats.direct.gov.uk/find-out-more/about-unistats/):

> [...] *the official site that allows you to search for and compare data and information on university and college courses from across the UK. The site draws together comparable information on those areas that students have identified as important in making decisions about what and where to study. The items that students thought were most useful have been included in a Key Information Set (KIS), which can be found on the Overview tab for each course*

Unistats data collection and reporting has become more detailed since 2010-11 when the original data was collected in this project. Currently, it is possible to review data specific to each IS course, as part of the following categories (http://unistats.direct.gov.uk/find-out-more/about-the-data/):

- Student satisfaction from the National Student Survey
- Student destinations on finishing their course from the Destinations of Leavers from Higher Education survey
- How the course is taught and study patterns
- How the course is assessed
- Course accreditation
- Course costs (such as tuition fees and accommodation)

At the time of conducting the data collection for this survey, the Unistats data was limited to fewer categories, organised by wider discipline-based groupings as opposed to individual courses. As a result, the data presented below reflects those limitations.

3.7.1 IS Career Keywords Found on Course Websites

This first subsection, discusses graduate careers that reflect the employment information that universities display and promote on their websites. Such data tends to be 'deduced' from destination statistics that university marketing departments collect. Although the information is highly indicative, it provides a clear picture of how universities choose to promote the employability of their courses, at least on their course web pages. The remaining four subsections provide more detailed data about employment opportunities and destination statistics which is captured by Unistats through the graduate student survey conducts every

year. Although the data of these surveys is less indicative, it is still inconclusive on the overall employability and career opportunities available to students. Nevertheless, it is important to consider this information and compare it with the elaborate results from the employer survey which are discussed in Chapter 7.

The initial part of the career keyword analysis focuses on the keywords listed within each careers section of the individual IS course websites. The lack of any clear model in gathering such data makes it necessary to record every keyword encountered. The keywords, which are either embedded into narrative descriptions of the employment opportunities offered by a given course or within generic descriptions about jobs in the field of IT, were collated for the purposes of measuring their frequency across all IS courses. As each of the 228 IS course websites were reviewed, it became quickly evident that the majority of course descriptions did not offer any specific keywords as an indication of future career. Data plotted in Figure 3.9 confirms that 59% of Russell Group, 37% of Million+, 61% of 1994 Group, 53% of University Alliance and 57% of No Affiliation universities display no career keywords (labelled as *None*).

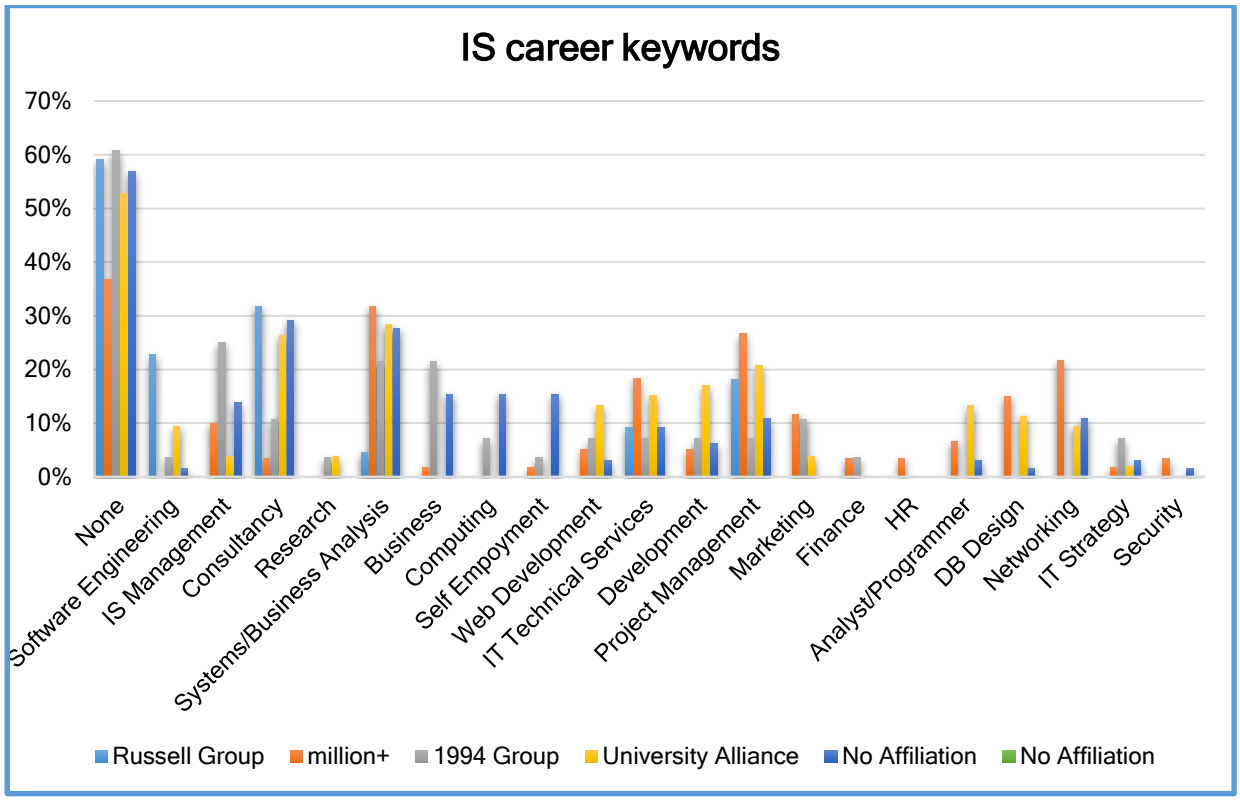


Figure 3.9. IS career keywords.

In cases where keywords were mentioned, the most popular with an average score of 23% across the five university groupings was *Systems and Business Analysis*. Interestingly, IS courses belonging to Russell Group universities feature this keyword in only 5% of their courses whereas the rest have a frequency that ranges between 21% and 32%. In contrast, the second most popular keyword, *Consultancy*, is featured in 32% of IS courses offered by

Russell Group universities, while only 3% and 11% of million+ and1994 Group universities respectively. *Project Management, IS Management* and *IT Technical Services* are the following three categories that present average frequency scores above 10%.

Conclusions derived from this data should be considered with caution. Although the data has been collected for all 228 courses of the 84 universities included in this survey, it is not conclusive. Universities do not appear to follow any specific reporting scheme that can be used as the basis of comparison or analysis. Instead, the data offers an indicative description of potential careers that their graduates could pursue.

3.7.2 Unistats Employment Data

The proliferation of statistical data on the HE sector in the UK has been growing fast in recent times. Agencies like Unistats, UCAS, HESA, Quality Assurance Agency (QAA), NSS, National Union of Students (NUS) and Higher Education Funding Council for England (HEFCE) plus the universities themselves, publish an increasing amount of information which is designed to promote transparency and openness. At the same time, university rankings presented as league tables provide a further, often highly criticised, view of university accomplishment, reputation and branding (Tapper and Filippakou, 2009, Wilkins and Huisman, 2012).

In the case of Unistats, the last few years have seen it grow into one of the most authoritative portals of information about official course data from universities and colleges in the UK. As part of the significant changes that have taken place since this survey was carried out, data supplied by HESA and reported by Unistats, has become more detailed than before. In the official document outlining the type of data and its reporting format, Unistats Data Guide v1.5 state that:

> *All data on the Unistats public site is grouped into subjects rather than against each course. This is due to the HESA data being collected for subject groupings, however the current data collection exercise is being undertaken at course level and therefore is expected to be displayed as such, at some point in the future.* [1]

The transition from grouping data by subject to course is a significant one, especially for prospective students who are interested in knowing exactly how well their subject of choice performs across different institutions. Similarly, employers, accreditation bodies and other stakeholders have access to detailed information which was unavailable only a few years ago. Whereas a few years earlier it was only possible to review employability statistics for the entire discipline of computer science (including IS), it is now possible to analyse the same data down

[1] The document is no longer available on the Unistats website as the methods of data collection and reporting have since changed.

to individual courses offered by any university across the UK. The lack of this level of information at the time of carrying out the survey presents a noticeable drawback. The reviewed 2010-11 Unistats data was collated under the *Computer Science* category, making it impossible to distinguish between conventional computing undergraduate courses and the 228 IS programmes that make up this study. Despite this limitation, there is still merit in considering the combined employment data as it is the only official data that exists for that period of time, drawn from the graduates themselves.

The overall *Employment Prospects* category, as defined by Unistats in 2010-11, uses data collected from the Destination of Leavers from Higher Education (DLHE) survey, which is carried out 6 months after students successfully complete their course. The survey produces data which is organised in three different categories:

- Percentage of students employed in graduate jobs.
- Further percentage breakdown of the above category identifying graduates who may be combining further studying with employment.
- Profession types of those graduates in employment.

The order of the groupings correspond to what Unistats label as *job category, destination* and *job type* respectively. Upon closer inspection, the *category* and *destination* groups show a certain amount of overlap since the latter offers a distinct breakdown of the former's data. Nevertheless, it is deemed necessary to present the data in its original form for all categories to avoiding any unwarranted distortion.

3.7.3 Job Category of Graduates

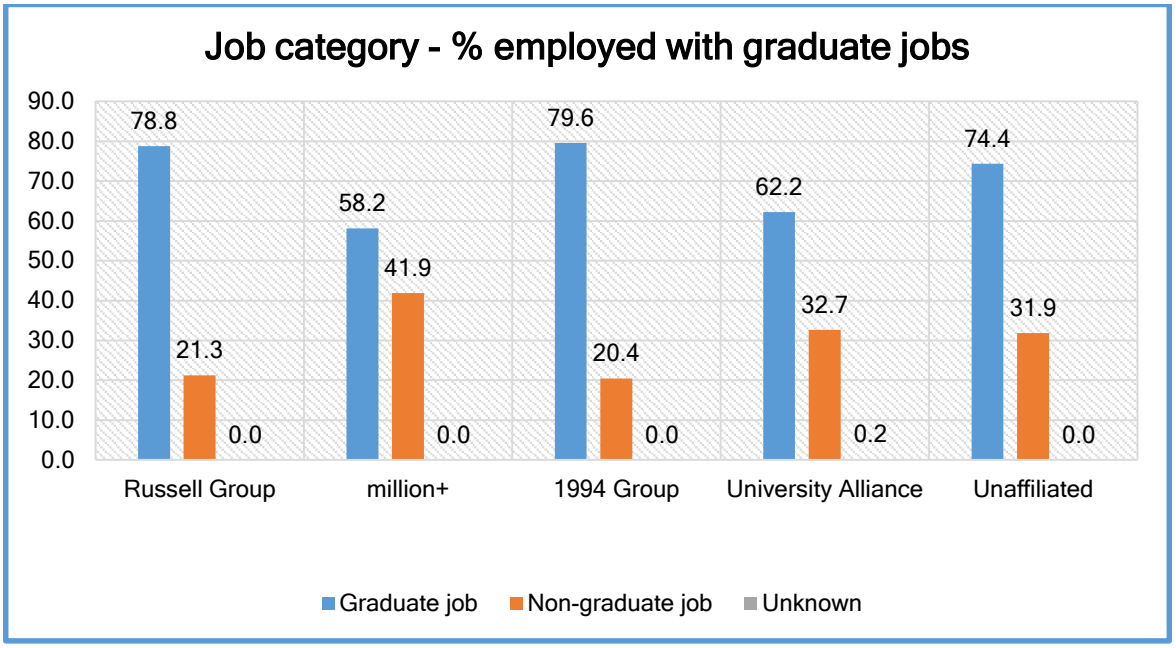


Figure 3.10. IS job data by university affiliation group.

Plotting the first group of *job category* data, shown in Figure 3.10, suggests significant differences between the different university groups. The percentage of graduates holding the highest number of graduate (79.6%) and the lowest non-graduate (20.4%) jobs is achieved by the 1994 Group of universities. By contrast, million+ graduates appear to perform significantly worse with only 58.2% managing to land a graduate position, while 41.9% work in positions deemed also to be shared by those without an undergraduate degree qualification. Unlike University Alliance and No Affiliation institutions, Russell Group university graduates score less than 1% on either side of the top-performing 1994 Group.

3.7.4 Destination of Graduates

The second group of data shows the *destination* of graduates in terms of work, further study or a combination of the two. Effectively, the data in this group offers a breakdown of the information presented in Table 3.11, by drilling down into the employment data to show the distribution of graduates across different activities.

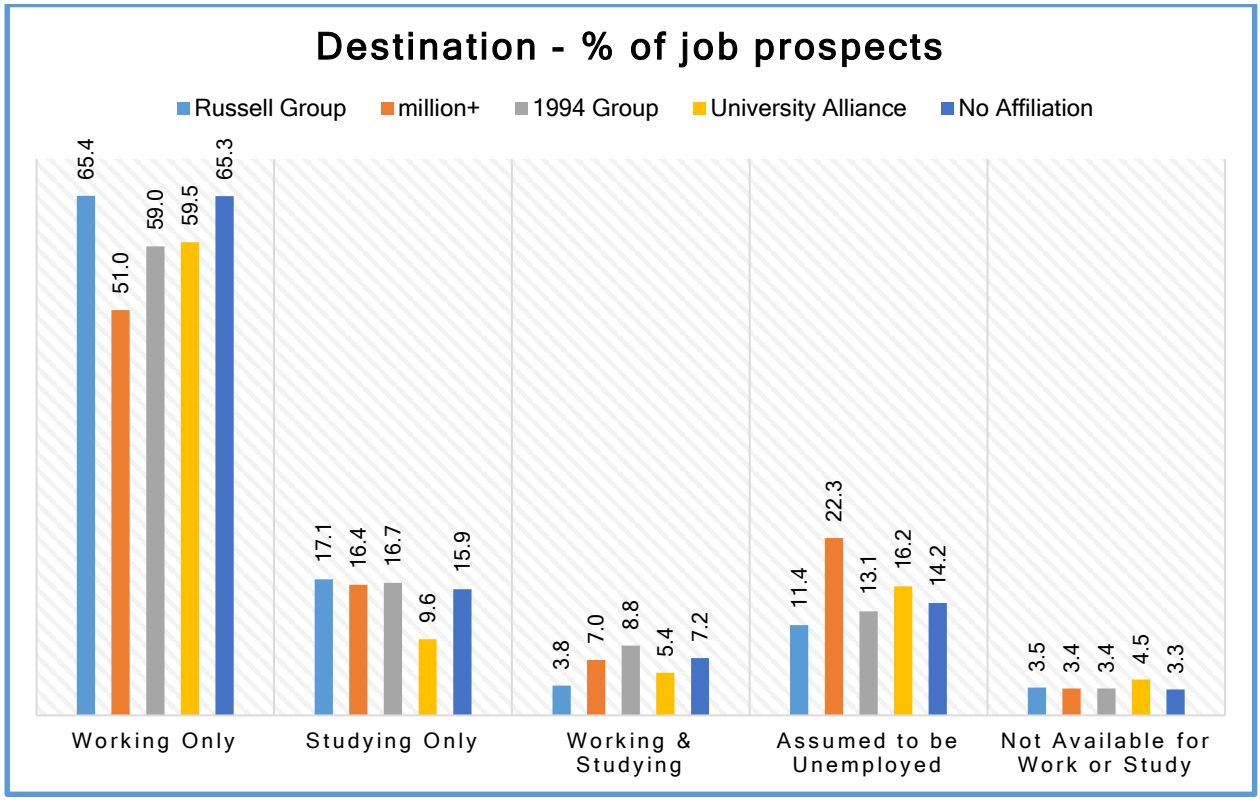


Figure 3.11. IS student destination data by university affiliation group.

Drawing definitive conclusions derived from the data in Table 3.11 about which university group performs better would be ill-advised as the categories in this case allow for limited qualitative or achievement-like interpretations. Russell Group universities are leading the pack with marginally higher data than the rest in most of the categories, while also having the lowest score in the unemployed category. The biggest discrepancies are seen in the Working Only,

Studying Only and Assumed to be Unemployed categories where million+, University Alliance and Russell Group university groups respectively show noticeable scoring differences than the rest.

Despite the obvious numerical differences which often tend to indicate performance or ranking, the data in this case cannot be qualified in a way that categories such as Assumed to be Unemployed and Not Available for Work or Study are not the result of unavailability of data, as opposed to precise measurements of graduate unemployment. Equally, the Working Only and Working and Studying scores of Russell Group and No Affiliation universities offer no indication of the reasons behind employment opportunities. In fact, it may well be that graduates 'ended up' in those categories not due to lack of employment opportunities but by choice.

3.7.5 Job Type of Graduates

The final Unistats group of career data is designed to capture the top ten jobs that graduates landed six months after graduation, although it is often the case where the overall number of jobs is below or above this threshold. Job types are not random, instead they follow the Standard Occupational Classification (SOC) code which is supplied by HESA (http://www.hesa.ac.uk/content/view/2521).

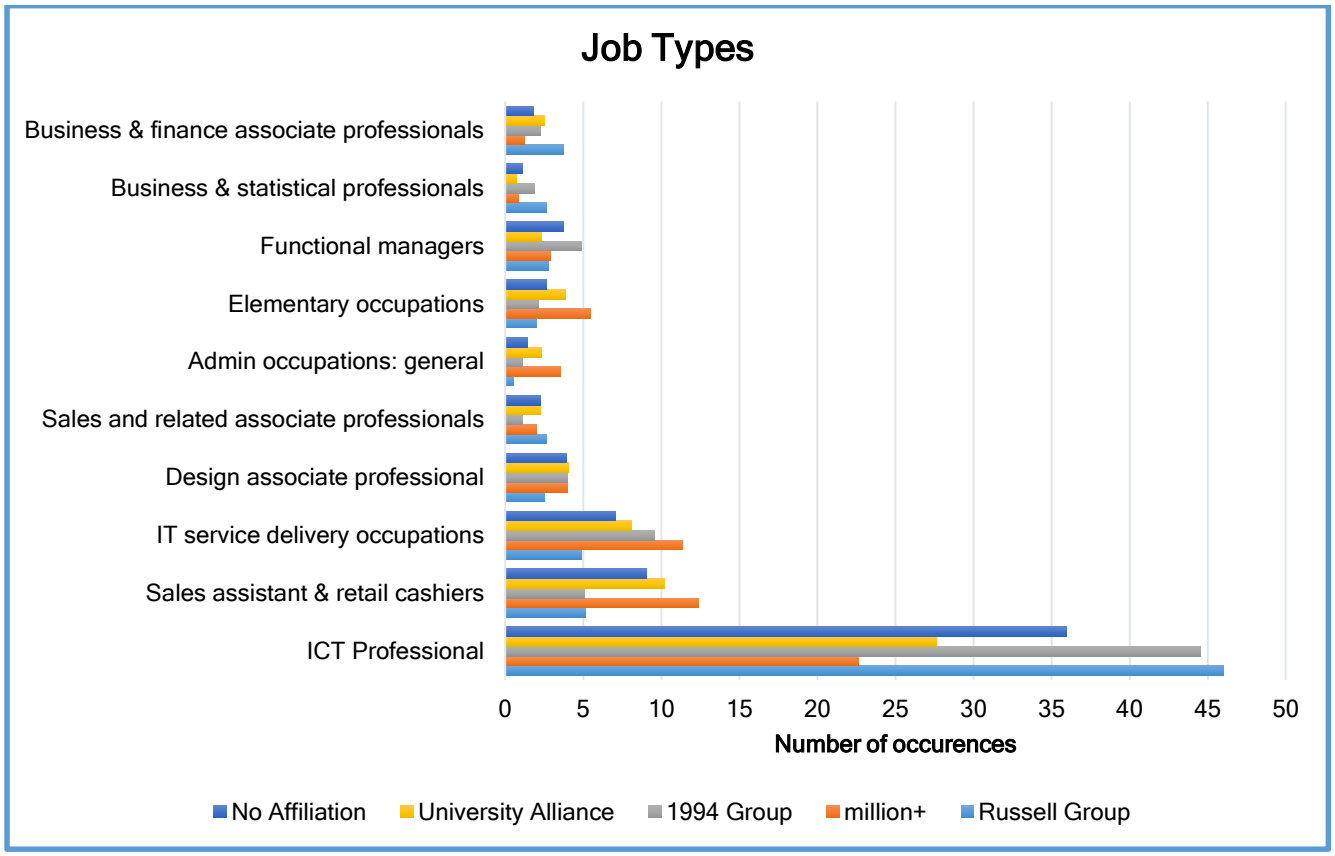


Figure 3.12. IS job type data by university affiliation group.

There are 37 jobs types in total listed for the 228 IS courses surveyed. The majority of job type occurrences are very low, making their presence in the final table statistical insignificant. Figure 3.12 shows the ten most commonly occurring job types.

3.8 Summary

The discussion in this chapter focused on a number of important topics that characterise undergraduate course provision in the UK, as part of the wider review of IS education. Understanding these topics highlighted further the importance of this research which aims to align industrial IS careers to current academic IS provision in the UK, and thus help restore confidence in both the academic and professional worlds of IS.

The issues of diminishing IS student recruitment numbers, levels of course accreditation, course naming conventions and career data which were examined in this chapter, provide a much needed context for IS education, necessary for understanding the scale of the problems faced by academia and industry. If the findings shown are to be accepted, hard questions need to be asked about the reasons for dwindling IS student numbers and the possible link to curriculum relevance. Equally, the low course accreditation levels suggest that professional bodies could have a significant role to play in supporting universities to raise the employability aspect of their courses.

Having established the need for the research presented in this thesis, the next chapter considers the development of IS curricula by examining IS model curricula recommendations that have emerged in the past forty years. The use of IS curriculum recommendations forms the basis of the surveys that underpin the subsequent curriculum classification exercises.

4 IS MODEL CURRICULUM RECOMMENDATIONS

4.1 Introduction

The discussion in the previous two chapters about IS education highlighted some of the difficulties facing the stakeholders of the field, and the need to explore further the challenging relationship between academia and industry. As a relatively young academic and professional field, IS appears to have been unable to date to fully satisfy its critics on the value of the contribution it can make to the worlds of business and academia. The preceding discussion on the perceived crisis in IS and the often conflicting views of its stakeholders, made a strong case for understanding the educational aspects of the field which are expected to challenge new students, support fast-evolving business by producing well-trained graduates, and inspire a restless academic community looking to push the boundaries of its research agenda.

As an earlier stated premise of this research, measuring the IS curriculum in the UK is a necessary step towards understanding IS education and supporting a healthy debate about the inclusion of strong pedagogical and practical elements in a curriculum that is expected to produce well-qualified graduates. This chapter offers a broad understanding of the curriculum recommendation models that form the basis of the survey which underpins the UK-based curriculum mapping survey in Chapter 6. The discussion combines a brief historical overview that captures the evolution of these models, along with a detailed analysis of those that are key to this research, namely IS 2002, IS 2010 and QAA Subject Benchmark Statement in Computing (SBSC).

The rest of this chapter is organised in the following way. Initially, mainstream curricula recommendations emanating from ACM are presented. Next, there is a brief discussion of a small number of less popular or discontinued models. Work originating from the UK is finally discussed before the chapter concludes with an overview of the IS BoK and the way in which model curricula have been contributing to it.

4.2 Mainstream Curricula Recommendations

Professional organisations in the US have a long history in developing curriculum recommendations for IS, computing and other related disciplines within the wider field of IT. A common goal of these organisations, such as the ACM, AIS, the AITP, and the Institute of Electrical and Electronics Engineers (IEEE) Computer Society, is to provide a wide range of

services to professionals and the academic community, including curricula recommendations, holding repositories of relevant published data, organising conferences, publishing academic and professional journals, encouraging professional development efforts through continuing education or professional programmes, and providing support for pursuing employment opportunities. As one of the most prolific organisations in the area of curriculum recommendations, ACM has been very active with in its efforts to support the academic and professional communities, which begun with the publication of a set of curriculum recommendations for computing. Over the last forty years, ACM expanded its efforts beyond this initial publication, by considering the curriculum needs of other disciplines within the wider field of IT.

The development of the curriculum recommendation reports is normally driven by 'task forces' which comprise of academic and professional experts of a given field. Each report takes years to develop before its final version is ratified by the relevant education and professional committees. In cases where the development cycle becomes lengthier that originally envisaged, interim reports are released. Currently, there are seven discipline-specific reports that cover the specialisations listed in Table 4.1.

Curriculum Recommendation Publications	Level
Software Engineering 2004	Undergraduate
Computer Engineering 2004	Undergraduate
Computing Curricula 2005	Undergraduate
MSIS 2006 - Information Systems	Postgraduate
Information Technology 2008	Undergraduate
Graduate Software Engineering 2009	Postgraduate
Information Systems 2010	Undergraduate

Table 4.1. Current curriculum recommendation reports by ACM.

ACM's efforts to develop curricula recommendations have resulted in collaborating with similar organisations, such as the Data Processing Management Association (DPMA) and AIS, in order to reach a wider audience (ACM, 2013):

> *In the decades since the 1960s, ACM, along with leading professional and scientific computing societies, has endeavored to tailor curriculum recommendations to the rapidly changing landscape of computer technology. As the computing field continues to evolve, and new computing-related disciplines emerge, existing curriculum reports will be updated, and additional reports for new computing disciplines will be drafted.*

One of the earliest publications by ACM is attributed to Computer Science. *Curriculum 68: Recommendations for Academic Programs in Computer Science: a Report of the ACM Curriculum Committee on Computer Science* (Atchison *et al.*, 1968), paved the way for many

subsequent curriculum recommendation reports and established ACM as one of the main professional associations whose contribution would have global impact. A subsequent major revision of the CS curriculum saw ACM join forces with IEEE Computer Science, resulting in the publication of *Computing Curricula 1991* (Tucker, 1991). A major revision of this work followed ten years later with the publication of *Computing Curricula 2001, Computer Science* (Engel and Roberts, 2001). In order to keep abreast of the rapid changes in the field of computing, an interim revision of the 2001 report was published seven years later, entitled *Computer Science Curriculum 2008: An Interim Revision of CS 2001* (Cassel *et al.*, 2008). At the time of writing, a new ACM and IEEE Computer Science joint task force was working on producing *Computing Curricula 2013* (Sahami *et al.*, 2011).

Apart from computing which, as was shown previously, 'arrived' before the other disciplines of the IT field, interest in the development of MIS curricula was not far behind. The first concerted effort of noticeable scale to address IS curriculum issues was made in 1971, as part of a position paper by the ACM *Curriculum Committee on Computer Education and Management*. In this paper, the committee made a strong case about the need to support MIS and 'separate' it from computing because of its distinct emerging characteristics (Teichroew, 1971):

> *The need for an analytic approach to information systems is acute, and has wider implications than simply making computer use more efficient. In a situation where technology is changing rapidly, demand for qualified personnel exceeds supply, and confusion exists concerning the economics of applications, a codification of principles would provide a necessary background for policy formulation. In the broader context of general social questions, many of the arguments over whether computers have liberating or dehumanizing social effects could be carried on much more rationally if the underlying nature of information systems were better understood.*

The work of the committee took place during the first era of IS as discussed earlier in the brief historical overview of the field. During that period, the proliferation of IS programmes in the US, Australia and Europe was strong, with businesses striving to make use of the new technologies which were automating many of the traditional transactional functions. The early position paper by Teichroew (1971) set the scene for the numerous IS curriculum reports that followed over the years. Table 4.2 captures the main publications, along with an indicative contribution they made to IS curriculum development, and the purpose they served at the time of their publication. The remainder of this section provides an overview of each curriculum recommendations report listed in Table 4.2.

Year	Curriculum Events	Purpose	Contribution
1973	Curriculum Recommendations for Undergraduate Programs in Information Systems (Couger, 1973)	Define IS research; relationship between IS and Computing; support IS organisations	11 topics in sequence over 4 years
1981	Educational Programs in Information Systems: a Report of the ACM Curriculum Committee on Information Systems (Nunamaker, 1981)	Summarise available courses; set minimal criteria of courses	First robust survey of academic institutions offering Information Systems degree programmes
1982	Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs (Nunamaker *et al.*, 1982)	Recommendations for improving computer education for management	'Technology' and 'Process' themes by 8 recommended topics
1995	Information Systems ' 95 Curriculum Model - A Collaborative Effort (Gorgone *et al.*, 1994b)	IS curriculum recommendations	Skills and knowledge of IS; IS graduate abilities; IS body of Knowledge; 10 topics in sequence
1997	IS'97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems (Davis *et al.*, 1996)	IS curriculum recommendations	Skills and knowledge of IS; IS graduate abilities; IS body of Knowledge; 10 topics in sequence and 1 pre-requisite
2002	IS 2002 Model Curriculum and Guidelines for Undergraduate Programs of Information Systems (Gorgone *et al.*, 2002)	IS curriculum recommendations reflecting the advent of the internet and professional accreditation	Small updates on IS'97
2010	IS 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems (Topi *et al.*, 2010)	IS curriculum recommendations reflecting multi-domain environment and focusing on career track specialisations	Core and options topics; career tracks; domains

Table 4.2. IS curriculum recommendations report history (ACM).

4.2.1 Information Systems Model Curriculum - 1973

The first curriculum model to receive noticeable attention by the wider IS community was IS '97 (Davis *et al.*, 1996). IS '97 and its subsequent edition, IS 2002, were the result of collaborative efforts between ACM, AIS, and DPMA. The popularity of IS '97, however, was not entirely based on innovative ideas about the IS curriculum, but also on the culmination of twenty-five years of earlier work that had begun in 1973 with the publication of the first set of guidelines known as *Curriculum Recommendations for Undergraduate Programs in Information Systems* (Couger, 1973). The motivation behind this early curriculum report was explained by Teichroew (1971), who identified four issues that continue to remain relevant today:

> *(1) Crystallize thinking about programs and courses, particularly management programs in business schools and elsewhere. (2) Define research areas for business schools, computer science departments, and industry. (3) Show the interrelationships between administrative information systems and other areas of computer application. (4) Aid organizations in their planning for staffing and education of information processing departments.*

The position paper published by the committee headed by Teichroew (1971), concluded that resolving these issues could best be carried out by putting forward a set of curriculum recommendations that addressed both academic and industry needs specific to IS, in order to complement, but also determine the knowledge, abilities and experience needed by graduates. By determining the output qualifications of graduates through the analysis of the field as represented by the organisations seeking IS professionals, Couger (1973) who published the final report following on from the original position paper, 'reverse-engineered' eleven topics suitable for four-year degree courses. The recommended topics were much more descriptive than similar publications that have followed since. The sequence of delivery of those topics was laid out in diagrammatic format, along with a schedule of delivery and implementation guidelines. Topics were organised in a way that provided either an *organisational concentration* or a *technological concentration*, thus allowing the development of specialisations according to the underlying academic orientation of the particular department delivering the course (Couger, 1973).

Certain elements of this early report became part of the format of subsequent publications: course (topic) outlines, pre-requisite qualifications needed by students, output qualifications expressed as knowledge and skills, and methods of integration of the curriculum in relation to its hierarchical domains. Much to their credit, the authors of this early report were very aware of the need to reach out to the wider academic and professional communities in order to not only maximise the impact of their efforts but also receive valuable feedback. This particular collaborative trend continued with all the subsequent publications, as noted in the discussion of the most recent curriculum report which utilised Web 2.0 technologies (Topi, 2010).

4.2.2 Report of the ACM Curriculum Committee on IS - 1981

Education Programs in Information Systems (Nunamaker, 1981) was a report on the status of IS at the beginning of a new decade, as opposed to a set of model curriculum recommendations. The essence of the report was based on the analysis of the results of a survey designed to classify the provision of IS degree courses across the US, a similar focus to what part of this research aims to achieve in the UK. The survey targeted over two-hundred AACSB accredited business schools, academics from CS departments across the country, and ACM members. Similar to the innovative approach of the previous report that influenced future publications, this one inspired numerous subsequent surveys that focused on comparisons between accredited programmes and curriculum recommendations (Lifer *et al.*, 2009, Williams and Pomykalski, 2006), reviews on the relationship between IS and skills (Kim *et al.*, 2006, Plice and Reinig, 2007), and attempts to understand the relationship between accreditation and curriculum development (Pierson *et al.*, 2008, Challa *et al.*, 2005).

Following a historical review of IS up to that point in time, the report considered the prevailing curriculum requirements. It also gave an insight into the naming conventions used to describe IS degree programmes, as noted in the section 3.4.1. Perhaps most importantly, it offered a strong justification for the need to continue developing IS, along with a set of definitions that captured the view of the field at the time (Nunamaker, 1981):

> *The term "information system" has come to refer to a computer-based system for providing information to members of an enterprise. The term "management information system" indicates a major emphasis in information systems. The IS discipline provides the analytical framework and the methodology to analyze, design, implement, and manage complex information/decision systems. An IS is defined as "a set of personnel, computer hardware, software packages, computer programs, data files, communication systems, decision models, organizational procedures and practices, so structured and assembled as to ensure data quality, transmission, processing, and storage in accordance with a given performance criterion to assist decision-making."*

4.2.3 Information Systems Curriculum Recommendations for the 80s - 1982

The publication in 1982 of *Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs* (Nunamaker *et al.*, 1982), signified the first major update of the curriculum recommendations of nine years earlier. Its final version was heavily influenced by the report on the IS curriculum published in the previous year. In essence, the editors of this publication reviewed the advances of the field over the years by examining organisational and technological developments, and adjusted the curriculum recommendations in a way that reflected the knowledge and skills IS graduates would be expected to possess in the 80's. Predictably, the structure of the curriculum changed to incorporate thematic groupings of topics that differentiate ICT from Information Systems Process. Revised topics such as *Data Management (IS4)* became central to the technology theme of the recommended curriculum, as did *Information Analysis (IS5) and Systems Design (IS8)* for the process theme. Although there was a distinct lack of specific pre-requite or background knowledge expectations, the authors of the report acknowledged the need for students to possess some experience in programming and quantitative/mathematical knowledge. The curriculum report identified ten topics which encompassed the field of IS but only eight of those were deemed appropriate for undergraduate study. The remaining two topics, *Modelling and Decision Systems (IS7)* and *MIS Policy (IS9)*, were judged to be highly specialised areas of knowledge, best suited for postgraduate students (Nunamaker *et al.*, 1982). This provided the motivation to develop additional recommendations for Master's and MBA programmes in IS, complementing the recommendations for degree courses. As noted in the discussion earlier regarding one of the first surveys of IS courses (Nunamaker, 1981), by this time AACSB had become prominent in both the academic and professional sphere of IS through its provision of certification and accreditation services. The inclusion of AACSB in

the curriculum recommendations of 1982 laid the foundations for formalising the role of accreditation bodies in this area.

4.2.4 Information Systems Model Curriculum – 1995 & 1997

The result of collaborative efforts between ACM, AIS and DPMA which lasted approximately two years from late 1992, brought about the publication of *IS'95: Guidelines for Undergraduate IS Curriculum* (Couger *et al.*, 1995). Efforts to develop this latest version of IS curriculum recommendations became systematic and more wide-spread than previously. Hundreds of IS professionals from industry participated in the review process by offering comments on various drafts, thus shaping the final report in a way that reflected the latest developments in business and industry. In an early status report which was about the task force's progress, Gorgone *et al.* (1994a) explained the multi-faceted approach needed to establish IS as a stand-alone discipline, independent from, but loosely coupled with, other disciplines. The same position was repeated in another publication aiming to promote the collaborative work of the task force that involved different professional bodies working together (Gorgone *et al.*, 1994b):

> *There are other curricula related issues that are being addressed in the report, such as: The definition of IS field, essential differences between IS, CS, and SE, and the number of courses required for an information systems major including IS Core and IS Electives.*

Specifically in relation to curriculum recommendations, IS'95 proposed ten topics, packaged together in a way that determined a sequential delivery which satisfied pre-requisite relationships. In line with the wider developments taking place in the professional field of IS, the topics that made up IS'95 focused on foundational issues and theory, knowledge and understanding of business, appreciation of emerging technologies, and skills enhancements regarding systems development and deployment. As expected, the aforementioned topics mapped closely to the newly revised BoK which was designed to capture the necessary knowledge for IS. The IS'95 BoK appeared in the report for the purposes of contextualising the content of the recommended topics, but also showcased a new set of desirable curriculum attributes that would enhance the skillset of IS graduates. Recommendations regarding prior knowledge were much more detailed in this version of the curriculum report than any previous ones. Personal computing skills, alongside an appreciation of general organisational issues became important new areas of knowledge of IS, and thus found a place in the curriculum report. Both these topics would facilitate the successful completion of an IS degree by providing adequate coverage of the prevailing technological and organisational advancements of that time. In addition to topic descriptions, the report also made recommendations as to the level of resources necessary to deliver this ambitious set of recommended topics.

Technological innovations that captured the imagination of students growing up with easy access to computing became part of the recommended equipment for the modern classroom.

IS'95 was an ambitious effort that included two distinct improvements over previous publications: refining the content and design of topics by attempting to better integrate technical and organisational concepts, and balancing the curriculum in terms of ethical and professional issues that were gaining prominence. At the same time, the task force recognised the need to utilise internet technologies such as email, to facilitate faster and better communication with the all relevant stakeholders which were contributing to the report.

With the previous version only two years earlier, the publication of *IS'97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems* (Davis *et al.*, 1996) gave the impression that IS'95 was an interim report as opposed to a 'final product'. Topi *et al.* (2010) confirmed this notion in a brief historical overview of ACM's curriculum development efforts:

> *IS '97 experienced a wide degree of success. It became the initial basis for IS accreditation. Yet, the document was prepared largely in 1995, and was modified to keep it up-to-date until its publication in 1997.*

The interim nature of IS'95 was further reinforced by Gorgone *et al.* (1994a) and Couger *et al.* (1995) who reflected on the development process of IS'95 by explaining how the two organisations, ACM and DPMA, had made significant efforts to overcome their differences in order to unite the academic and professional IS communities which, up to that point, were subjected to two separate curriculum recommendation documents. In effect, IS'97 was the publication with which the two organisations concluded their efforts to unify the development of IS curricula recommendations.

While the principles underpinning IS'97 remained essentially in line with the those of IS'95, a small number of changes did appear, which were the natural outcome of the ongoing work undertaken by the various subcommittees tasked with designing a modern set of recommendations. One such change was the design and introduction of a pre-requite topic which implied prior knowledge of basic productivity software such as word processing and spreadsheets (Davis *et al.*, 1996). At the same time, the sequence of topics was changed for IS'97 to enable more flexibility by grouping subjects together as opposed to prescribing them in a piece-meal way. Topics were organised in five different areas. Each area reflected a thematic categorisation of the various elements that made up IS'97's updated BoK: Information Systems Fundamentals, Information Systems Theory and Practice, Information Technology, Information Systems Development, and Information Systems Deployment and Management processes.

4.2.5 IS 2002

The publication of *IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems* (Gorgone *et al.*, 2002) was the culmination of efforts to carry out a relatively small revision of IS'97 by incorporating some important changes in the field of IS during the previous five years, namely the advent of the internet and the increasing amount of student IT literacy. According to the authors of IS 2002, the main principles behind the development of IS'97 were still valid, and thus the scope for changes was limited (Gorgone *et al.*, 2002):

> *Survey research conducted by the co-chairs indicates that there is still a wide agreement of practitioners and academicians as to the relevance of the spiral approach, the exit objectives, and most of the detailed learning objectives, but there was a clear need to update the model curriculum because of rapid contextual and technological change.*

Like its predecessor, IS 2002 continued to offer curriculum recommendations mainly for the benefit of North American institutions, despite claims by the task force that they were providing an international dimension to the curriculum. IS 2002 aimed to offer a flexible structure that academic institutions could adopt to fit to their local settings, while ensuring sufficient subject diversity to enable IS graduates gain relevant professional skills (Gorgone *et al.*, 2002). Even though IS 2002 evolved from small changes to IS'97, it soon attracted significant attention from academia in North America and became the preferred method for many US researchers to measure, analyse or simply catalogue the provision of IS courses (Kung *et al.*, 2006, Lifer *et al.*, 2009). IS 2002 was also used for other purposes, for example, to address implementation issues relating to the development of better IS curricula (Albrecht *et al.*, 2009), measure the degree to which accredited IS courses match the recommendations of IS 2002 (Williams and Pomykalski, 2006), or analyse individual case studies that demonstrate the practical applications of IS 2002 (Dwyer and Knapp, 2004, Soe and Hwang, 2007). There was also limited evidence that IS 2002 has some degree of international appeal, as demonstrated by Mesaric and Dukic (2005), who used it to influence the development of IS curricula outside North America.

Not unlike the previous version of the curriculum recommendations, the appropriate delivery of IS 2002 was predicated on two sets of pre-requisite knowledge: familiarity with basic productivity tools, and general organisational knowledge that is complimented by good analytical and communication skills. Information Technology (knowledge about software, architecture, operating systems and hardware) was central to the IS 2002 curriculum, the outline of which depicted in Figure 4.1

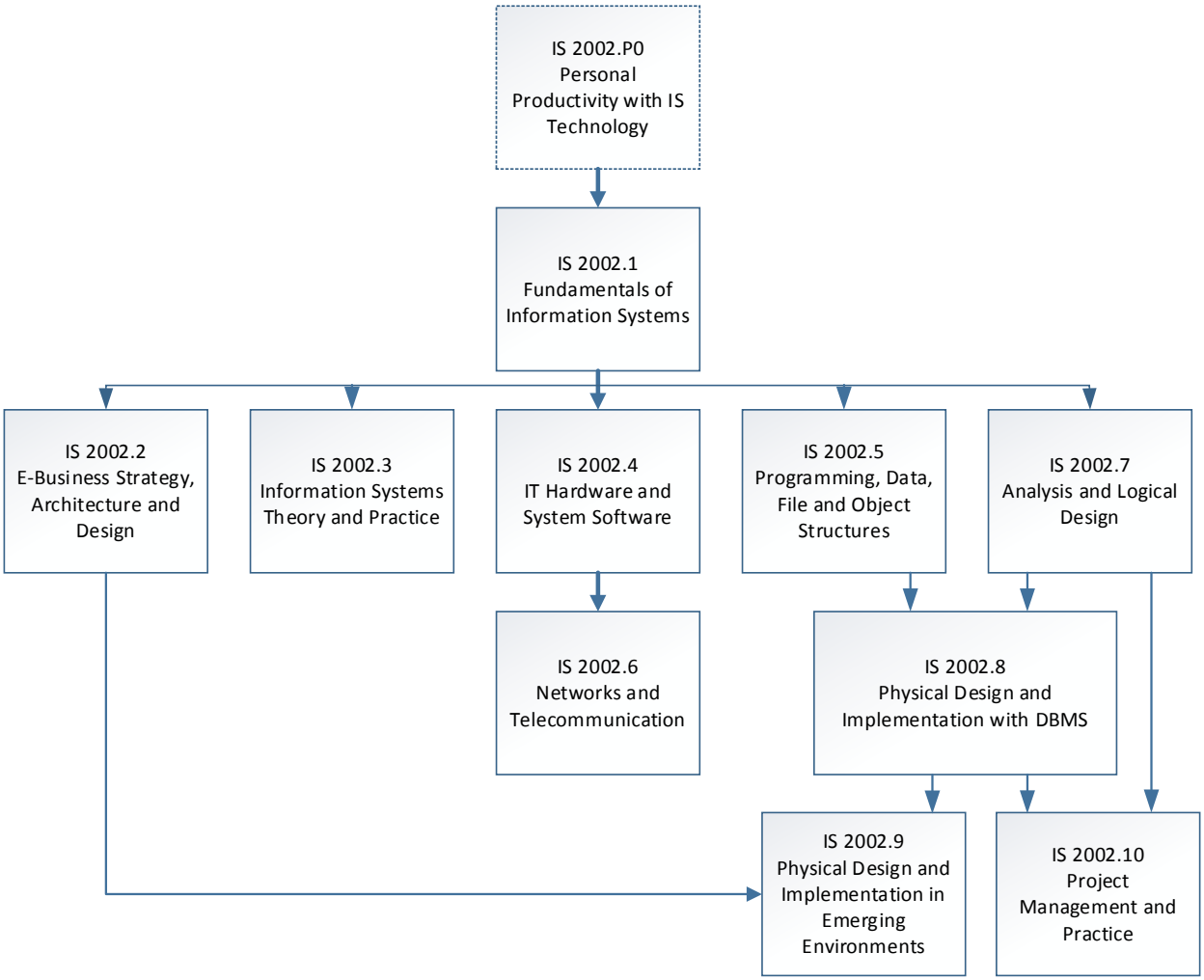


Figure 4.1. IS 2002 representative course sequence (Gorgone *et al.*, 2002).

The five main characteristics of IS 2002, although largely inherited from IS'97, distinguished it from previous reports. These characteristics shaped IS 2002 in a way that made it possible to support the efforts by curriculum developers across different institutions, who wanted to combine the new knowledge stemming from advancements in the IT field with modern delivery methods. The five characteristics were described in the following way (Gorgone *et al.*, 2002, Topi *et al.*, 2010):

- Given that the knowledge base that defines how the IS 2002 curriculum recommendations have evolved, the methodology used to develop it can be replicated as new changes are introduced.
- Topics that define the content of IS 2002 are presented in a functional way that allow course development to move away from a prescriptive approach whereby specific subjects need to be listed explicitly as separate modules or units.

- The BoK encapsulated within the recommended topics of IS 2002 can be delivered in an incremental and gradual way, thus allowing students to build on foundational knowledge before they apply themselves to mastering specialisations of the field.
- Learning outcomes of topics are realised through measurable competency achievements based on feedback and assessment.
- Programmes can benefit from a degree of customisation due to the flexible structure of the content that makes up each topic.

IS 2002 continued with the earlier practice of describing the resources necessary for the successful delivery of IS courses by discussing the minimum expectations for supporting teaching, computer labs and IT infrastructure, classrooms, and libraries.

4.2.6 IS 2010

Following the publication of IS 2002, the next curriculum report was published eight years later. IS 2010 was a joint collaborative effort between ACM and AIS, two of the largest professional associations representing the interests of the broader IT and IS communities. Although both organisations are perceived as being US-centric in terms of their membership and activities, in recent years they have made concerted efforts to embrace the wider international IS academic and professional communities. These ongoing internationalisation efforts are also reflected in IS 2010 which considers the delivery of IS courses outside North America.

IS 2010 introduced both structural changes to IS 2002 and a philosophical shift in the curriculum recommendation development process, while maintaining the essential guiding principles that influenced the design of previous versions. Featuring a flexible structure, the new model separated core and option subjects, thus making a clear distinction between what constitutes core IS knowledge and a number of specialisations that can exist alongside it (Topi *et al.*, 2010). The structure of IS 2010 (Figure 4.2) was essentially made up of three key components with varying significance: the 'Core IS Courses' (or core subjects as they will be referred to from now on to reduce ambiguity among similar terms) that define the IS discipline, 'Elective Courses' (or option subjects) which offer specialisations within the discipline, and 'Career Tracks' that act as focal points in terms of exit qualifications.

Structure of the IS Model Curriculum:Information Systems specific courses

Career Track:	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Core IS Courses:																	
Foundations of IS	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Enterprise Architecture	○	●	○	○	○	●	○	○	○	○	●	○	○	○	●	○	○
IS Strategy, Management and Acquisition	○	●	○	○	○	●	○	○	●	○	●	○	○	○	●	○	○
Data and Information Management	●	○	○	●	●	○	○	●	●	○	●	○	●	○	○	○	○
Systems Analysis & Design	●	●	●	○	○	○	●	○	○	○	○	○	○	○	●	●	●
IT Infrastructure	○	○	○	●	○	○	○	●	●	●	○	○	●	●	○	○	○
IT Project Management	●	○	○	○	○	●	○	○	○	○	●	○	○	○	●	●	●
Elective IS Courses:																	
Application Development	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●	●
Business Process Management		●	●			○	○	○		○	●				○		
Collaborative Computing						○								○			○
Data Mining / Business Intelligence		●		●	●	○	○	○	●		○	○	○	○	○		○
Enterprise Systems		●	●	○	○	○	●	●	○		●	●	○	○			
Human-Computer Interaction	●					○	○				○					●	
Information Search and Retrieval		○		○	●								○				●
IT Audit and Controls	○		●	○	○	○	○	●		●	○		○	○	○		○
IT Security and Risk Management	○			○	○	○	○	●	●	○	○		●	●	○		○
Knowledge Management		●		○		○	○			○							
Social Informatics													○		○		

A = Application Developer
B = Business Analyst
C = Business Process Analyst
D = Database Administrator
E = Database Analyst
F = e-Business Manager
G = ERP Specialist
H = Information Auditing and Compliance Specialist
I = IT Architect
J = IT Asset Manager
K = IT Consultant
L = IT Operations Manager
M = IT Security and Risk Manager
N = Network Administrator
O = Project Manager
P = User Interface Designer
Q = Web Content Manager

Key:

● = Significant Coverage

○ = Some Coverage

Blank Cell = Not Required

Figure 4.2. The structure of IS 2010 model curriculum (Topi *et al.*, 2010).

The motivations that led to the development of IS 2010 were multiple. Over a period of three years the authors of IS 2010 sought various opportunities to explain the changes in IS industry and academia which provided the context for developing the new recommendations. The first significant change since the publication of IS 2002 related to technological advancements. Ubiquitous computing and its associated web technologies had not only changed the technology itself as evidenced by the proliferation of cloud and mobile computing, but also the interaction of people with technology and the reshaping of their perceptions about it (Topi *et al.*, 2007). Globalisation and standardisation of service delivery was the second change that, despite the complexities involved, affected the way in which industry approached new innovative IS solutions (Topi *et al.*, 2008).

The development of IS 2010 was centred on four characteristics which influenced its authors' decision to part with the legacy of earlier work, thus ensuring that the aforementioned contextual changes affecting the IS industry and academia were addressed in the best possible way (Topi *et al.*, 2010):

> *This revision has four broad key characteristics that have shaped the outcome significantly. First, the curriculum reaches beyond the schools of business and management. Previous versions of the IS curriculum have been targeted to a typical North American business school. This model curriculum, however, is guided by the belief that even though business will likely continue to be the primary domain for Information Systems, the discipline provides expertise that is critically important for an increasing number of domains. Second, the outcome expectations of the curriculum have been very carefully re-evaluated and articulated, first in the form of high-level IS capabilities and then in three knowledge and skills categories: IS specific knowledge and skills, foundational knowledge and skills, and domain fundamentals. Third, the curriculum is structured so that it separates the core of the curriculum from electives with the intent of supporting the concept of career tracks. Finally, the design of this curriculum includes enough flexibility to allow its adoption in a variety of educational system contexts.*

The importance of these four characteristics is paramount to this research, an aspect of which, deals with the comprehensive mapping of the IS curriculum in the UK based on a newly developed reusable, hierarchical and domain-independent course mapping framework that was heavily influenced by IS 2010. Additionally, these characteristics support another aspect of this research which deals with determining the career tracks promoted by the IS curriculum. It is, therefore, essential to examine the defining characteristics that gave rise to IS 2010, as it the primary vehicle for successfully delivering a significant aspect of the work presented in this thesis.

(1) Characteristic 1: Beyond the Business School

To understand the transition from the rigid perspective of the business school being the centre of IS education to a more liberal position that embraces a multitude of domains, it is important to understand the exit characteristics of IS'97 and IS 2002. The majority of the studies that influenced the 'exit characteristics' of IS 2002 which in turn determined its underlying structure, pointed to the same conclusion: IS degree programmes should train students in the facilitation of technology to support business. Trauth *et al.* (1993) made this case by arguing the need to review the IS curriculum in order to enable business schools offering IS to better align the skills embedded into their courses with those deemed important by industry. Similarly, Todd *et al.* (1995) raised questions about the lack of clear understanding regarding the need for IS professionals to possess relevant business skills. Arguments by Nelson (1991) further reinforced the point that organisational knowledge for IS professionals is a key ingredient for their integration within the organisation that is trying to utilise IS to a gain competitive advantage. In discussing the findings of an entry-level IS jobs skills survey of employers, Cappel (2001) concluded that technical skills alone could be addressed by the IS curriculum but they were not sufficient to address the needs of evolving organisations. Cappel went on to argue that successful IS graduates must learn how to learn while gaining job experience at the same time. Studies like these, and others which are discussed in greater

detail later in this thesis, influenced the exit characteristics of IS 2002, best summarised by the following excerpt from Gorgone *et al.* (2002) and depicted in Figure 4.3:

> […] *high-level categorization of the exit characteristics that emphasizes the central role of Technology-Enabled Business Development at the intersection of the four major areas that were identified in the initial assumptions about the IS profession.*

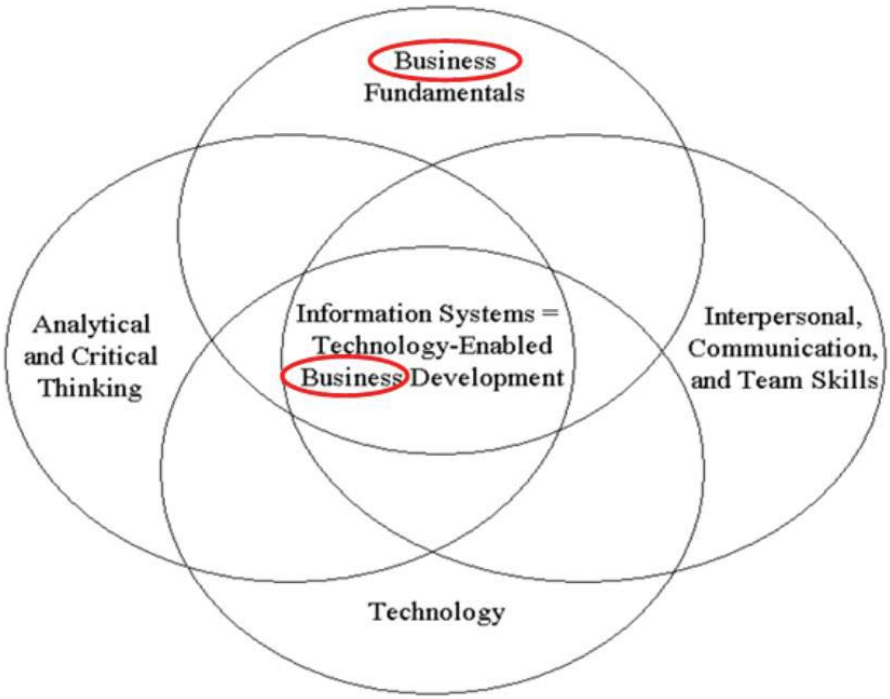


Figure 4.3. Demonstration of close linkage between Information Systems and business in IS 2002 (Topi *et al.*, 2010).

In spite of the strong arguments about IS' link with the business domain, IS 2010 recognised that aspects of the IS field were becoming part of many more domains beyond business (Topi *et al.*, 2010). Domains like healthcare, government and non-profit organisation were challenging the traditional view that IS simply focused on the use of technology within the business world, and as such, they deserved to be interfaced with and facilitated by a field that continues to grow. The modern IS professional was seen as a critical and analytical thinker who was able to synthesise complex solutions, while being capable of working across different organisational cultures. Consequently, such professional possessed a multitude of skills and aptitudes that built on the understanding necessary to operate in different organisational contexts across various domains. The IS 2010 guidelines stressed that the development or review of an IS degree programme educating such professionals should be carried out within a specific domain context. In doing so, the resulting degree course should reflect the needs of the business it tries to serve by producing well-rounded graduates to service it (Topi *et al.*, 2010). Figure 4.4 reflects the changes incorporated into IS 2010 that move it away from business to interchangeable domains.

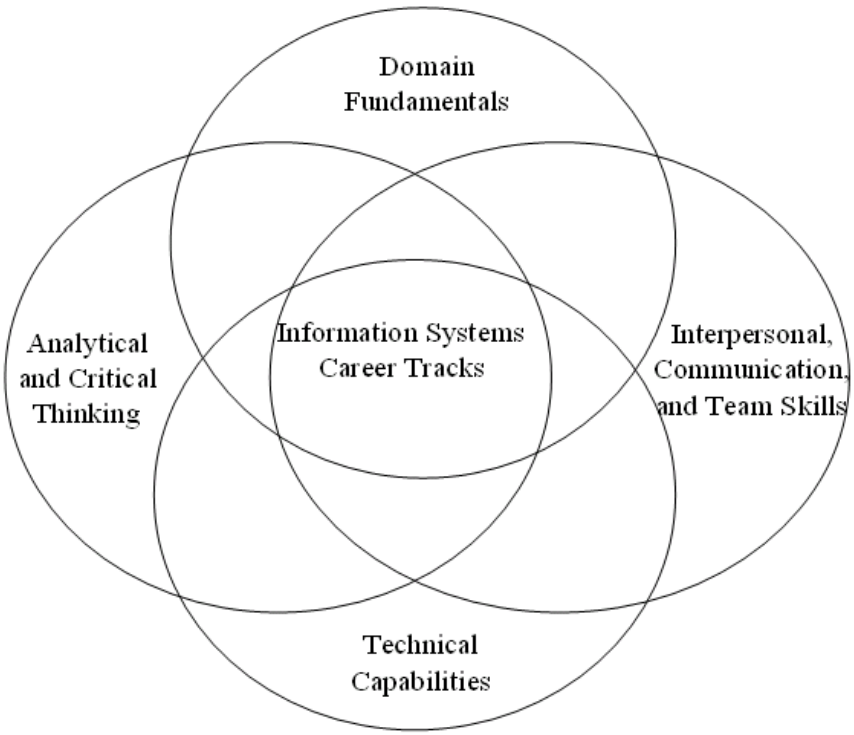


Figure 4.4. Revised exit characteristics (Topi *et al.*, 2007).

(2) Characteristic 2: Revising Outcome Expectations

A further criticism of IS 2002 that became a catalyst for change in IS 2010 related to the way in which the model defined its outcome expectations. IS 2002 offered a rather monolithic representation of recommended IS curriculum core topics that left little room for adaptation. Lifer *et al.* (2009), who contemplated the reasons for IS 2002 not being adopted by academia in a more comprehensive way despite the struggle to maintain up to date IS courses that were popular with students and endorsed by industry, reached the same conclusion. Similarly, the findings from a study by Williams and Pomykalski (2006) showed that a number of schools (in the US) offered only a small subset of IS 2002, thus depriving their students of important knowledge and skills that IS 2002 defines as critical because of its rigid structure. A few years later, the authors of IS 2010 confirmed this observation that many of the business schools offering IS programmes tended to follow a pattern of teaching that did not sit well with the structure of IS 2002 (Topi *et al.*, 2008):

> […] *if we consider a North American business school context, an undergraduate information systems degree typically consists of about 50 percent of general education content (much of which addresses the foundational knowledge and skills), 25-35 percent of domain foundations (that is, general business and a minor business specialization), and only 15-25 percent or 6–10 semester-long courses of content that specifically focuses on information systems knowledge and skills.*

Accepting this problematic pattern of delivery and the continuous socio-technical changes in organisations, IS 2010 redefined the overall structure of the curriculum model by focusing

on the *High-level Capabilities* needed by IS. These capabilities were mapped to knowledge and skills which were categorised as *IS Specific Knowledge and Skills* (ISSKS), *Foundational Knowledge and Skills* (FKS), and *Domain Fundamentals* (DM) (Figure 4.5). The synthesis of these three categories made it possible to devise a series of topics (curriculum) that address the high-level capabilities of the discipline while allowing variations between different domains.

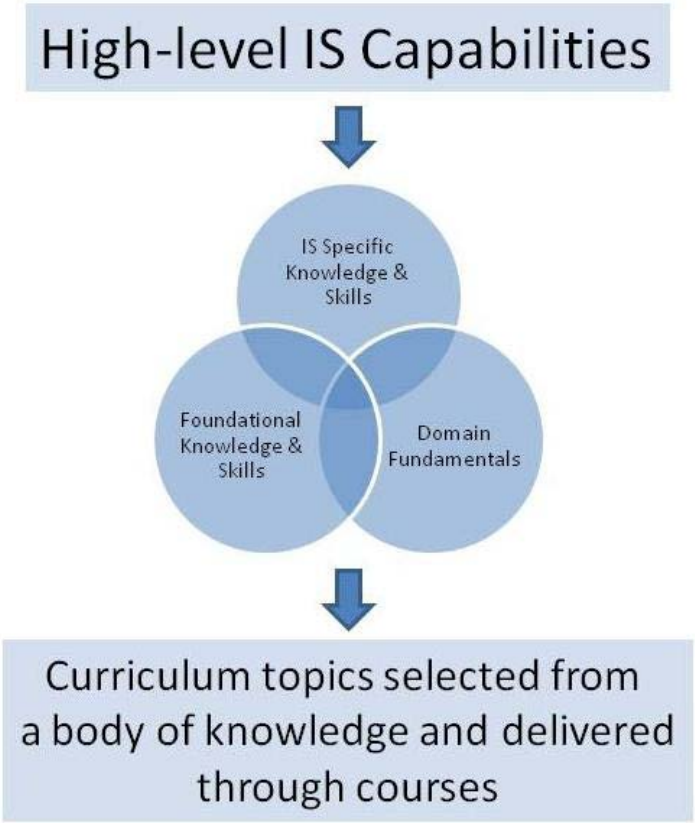


Figure 4.5. Overall structure of the basic concepts (Topi *et al.*, 2010).

(3) High-level Capabilities

The *High-level IS Capabilities* summarised below, offered a domain-neutral view of the contribution IS could make to varying professional settings by projecting a series of roles graduates of the field would be expected to undertake (Topi *et al.*, 2010):

- *Improving Organisational Processes* - IS graduates should understand the fundamental principles and concepts of organisations, devise and implement solutions, enhance their knowledge through the research techniques, and bring about innovative change.
- *Exploiting Opportunities Created by Technology Innovations* - graduates of IS should develop a clear ability that enables them to visualise and implement technological solutions that address specific organisational needs, within a given domain. Analysis, synthesis, conceptualisation, design, and

implementation capabilities should be part of the graduate's evolving expertise.

- *Understanding and Addressing Information Requirements* - requirements elicitation, analysis, and facilitation should be a core ability for IS graduates who will be tasked to take responsibility for the assessment of organisational needs as presented at the various organisational levels. Armed with the ability to utilise technology where necessary, these specialist graduates should provide a key infrastructure role in the hierarchy of an organisation.
- *Designing and Managing Enterprise Architecture* - taking as a reference IT management frameworks such as ITIL and COBIT, IS graduates must be capable of facilitating different organisational goals which are represented as enterprise architectures with a varying degree of interventions that necessitate high-level technological solutions.
- *Identifying and Evaluating Solutions and Sourcing Alternatives:* while there is a paramount need for IS graduates to be able to see 'the big picture' by excelling at conceptualising, there is an equal need for them to provide solutions to technological challenges that are specific to aspects of the organisation.
- *Securing Data and Infrastructure* - electronic security is a growing concern of organisations operating in a globalised environment. IS graduates are expected to possess sufficient relevant knowledge that can be applied by contributing to the implementation of corporate strategies design to protect the financial and corporate well-being of organisations.
- *Understanding, Managing and Controlling IT Risks* – risk is prevalent in any organisation that wishes to innovate. It is, therefore, important for IS graduates to be able to facilitate the management of risk without restricting innovative business transformations.

(4) Knowledge and Skills

As mentioned earlier, the new extensively revised IS 2010 guidelines were driven by the constantly evolving *High-level Capabilities* that employers require from the IS workforce. These capabilities were expressed as three distinct areas of knowledge and skills: ISSKS, DF, and FKS. In line with previous curriculum reports, the aim of IS 2010 was to facilitate curriculum development through the introduction of IS topics which promoted the transmission of these capabilities, without prescribing how to design courses which could have the opposite effect. The three areas of knowledge and skills were organised in the following way:

IS Specific Knowledge and Skills

ISSKS represent the core knowledge that makes up the IS discipline. While it may be possible to find elements of ISSKS in other disciplines, such elements would most likely be few and of an optional nature. Within IS, the significance of ISSKS is reflected in the type of modules that made it up and their frequency in the curriculum. Invariably, modules that relayed ISSKS should appear as core modules across the curriculum, although a smaller number of such modules could be offered as options to support further specialisations (Figure 4.2, Core IS 2010 Subjects). The following reflect the content of this category:

- Identifying and designing opportunities for IT-enabled organisational improvement
- Analysing trade-offs
- Designing and implementing information solutions
- Managing ongoing information technology operations

Foundational Knowledge and Skills

FKS are important components of knowledge for the IS discipline, but they are not necessarily unique to it. Modern professionals are expected to have analytical and critical thinking skills which sit well within the FKS category. Without such knowledge, IS graduates would be unable to meet many of the requirements defined earlier as part of the *High-level Capabilities* that are essential to organisations. The following reflect the content of this category:

- Leadership and collaboration
- Communication
- Negotiation
- Analytical and critical thinking, including creativity and ethical analysis
- Mathematical foundations

Domain Fundamentals

As part of the third category, DF would either reflect the business and computing reference disciplines that exert the highest influence on IS or other fields such as healthcare. The depth of coverage would depend upon the level of specialisation necessary. Topi *et al.* (2010) identified three main categories of knowledge for each domain:

- General models of domain
- Key specialisations within the domain
- Evaluation of performance within the domain

4.2.7 Characteristic 3: Revising the Structure

In a featured article presenting IS 2010 to the wider community, Topi (2010) drew attention to the new aspects that were introduced to the latest version of the model curriculum:

> […] *IS 2010 is significantly more flexible than its predecessors. It is the first IS model curriculum that separates core courses from electives, and it introduces the concept of career tracks, including a comprehensive set of examples. The core is relatively small (only seven courses), and it includes two new broad topics: Enterprise Architecture and IT Project Management. Programming/Application Development is not a required component of the core any more. The new curriculum structure can be used whether you have five or fifteen courses available for the IS major. We also believe that its applicability around the world in different national and regional contexts is significantly better than with the earlier IS model curricula.*

The driving force behind the decision to discard the monolithic structure of IS 2002 which was made up of ten subjects structured in a hierarchical arrangement with no inherent flexibility in terms of its application (Figure 4.1), was influenced by many authors who tried to apply IS 2002 with variable success (Dwyer and Knapp, 2004, Plice and Reinig, 2007, Lifer *et al.*, 2009, Kung *et al.*, 2006). At the same time, the task force developing IS 2010 seized the opportunity to open up the latest version of the curriculum recommendations to other existing or emerging disciplines that exhibited signs of strong affiliation with IS. Thus, the new structure of IS 2010 introduced core subjects, option subjects and career tracks which, effectively, determine specialisations.

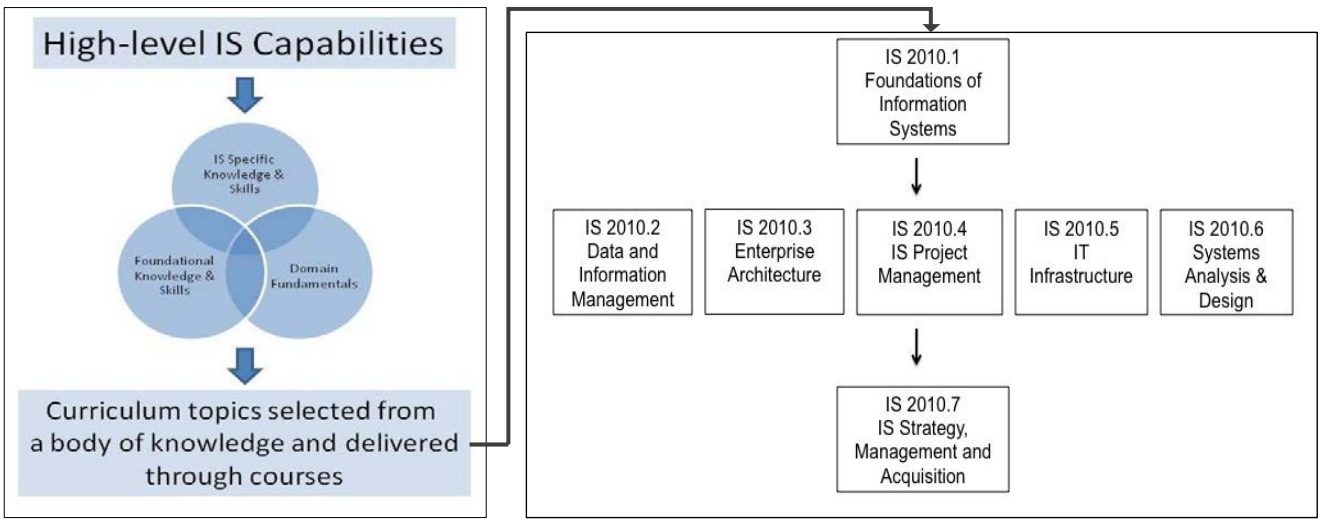


Figure 4.6. Overall structure of the basic concepts and IS 2010 core courses. Adapted from (Topi *et al.*, 2010) by merging two separate diagrams.

Core subjects determine ISSKS (Figure 4.6) by capturing the IS knowledge that characterises the discipline. The amount of suggested subject coverage ultimately rests with course development teams, a principal approach that previous versions of model curricula also supported. IS 2010 encourage course development teams to consider the local context within

which their course will be delivered. It also suggests variable amount of coverage for each of the seven compulsory core subjects within the curriculum depending on the local requirements of different courses. By suggesting 'significant' or 'some' coverage (Figure 4.2, Key) for each of the core subjects, the model highlights the emphasis each topic should receive in relation to the overall aims and objectives of the course. The authors of IS 2010 noted in their report four points regarding the changes introduced that merit a brief mention here (Topi *et al.*, 2010):

- *Status of application development in the curriculum* – programing or development has always occupied a central role in previous versions of the model curricula. For the first time, however, application development is removed from the list of core Information Systems subjects to enable what is described as a 'domain-neutral' approach. As an optional component, domains with limited reliance or use of programming, can minimise its inclusion, while 'traditional' IS programmes can introduce a variety of development modules, and thus, provide adequate coverage of the topic.
- *Inclusion of both enterprise architecture and IT infrastructure* – IS 2010 enterprise architecture and IT infrastructure appear as an amalgamation of two areas of expertise that are edging closer together due to an increasing amount of technological similarities.
- *Removal of personal productivity tools* – these topics have become obsolete as primary and secondary education covers such material extensively.
- *Sequencing* – IS 2010 is far less hierarchical than its predecessor, offering more flexibility to course developers struggling with determining the order of delivery of modules through the application or pre- and co-requisite decisions.

Beyond the inclusion of updated core topics, option subjects introduce a new, previously absent, dimension to the model. They offered an inherent course design flexibility which supports course developers in their attempts to design distinct IS courses with localised 'flavours'. Option subjects are meaningful when they are seen as part of the career tracks they support through the provision of specialist skills and knowledge. In essence, this approach offers course development teams a bottom-up as well as a top-to-bottom design approach. With the former, IS courses could be designed by setting the exit skills and knowledge as the underlying principle of a course, while the latter supports the design of courses based on the IS teaching and research strengths a particular department possesses.

Career tracks is a new feature of IS 2010 that reflects the increasing importance of the relationship between student employability and university education. As a notion, the use of career tracks to develop and update IS curricula is not new. Hwang and Soe (2010) examined over a hundred IS courses in the US identifying three times as many career tracks derived

from them. They argued that courses with clearly defined career tracks tended to be updated frequently, thus keeping abreast of the technological advancements of IT. More generally, the relationship between IS curriculum and careers continued to receive a lot of attention (Martz and Cata, 2008, Benamati *et al.*, 2010, Fang *et al.*, 2005). Despite the potential benefits of research in this area, little attention was given to the idea of examining IS curricula based on thematic specialisations often described as career tracks. In another such study, Downey *et al.* (2008) analysed the relationship between skills, the IS curriculum and newly qualified IS professionals. Their results highlighted the importance of developing varying course specialisations to cover a wider range of relevant skills. Similar findings emphasising the significance of career tracks were noted by (Noll and Wilkins, 2002, Lee *et al.*, 1995, Ehie, 2002).

4.2.8 Characteristic 4: Mobilising the Global IS Community

The IS 2010 task force recognised at an early stage that the success of the curriculum report would largely depend on its acceptance by the wider academic community. For this reason, the task force took the unusual step of utilising social networking technologies in order to engage the largest possible number of interested parties in the development process of the new curriculum recommendations (Topi, 2010).

Although the protagonists of this effort felt that there was great scope for future improvements that would lead to wider participation, their innovative ideas in this area are bound to be replicated by others engaging in similar efforts. Topi *et al.* (2010) summarised their approach in the following way:

> *Through the use of Web 2.0 technologies, we created a platform for discussion and harnessing the collective intelligence of the global IS community. The specific Web 2.0 platform selected was MediaWiki, an open source wiki platform originally written for Wikipedia. By using this Web-based platform, the task force believes that it can better engage the broader IS community to assist in developing and maintaining the curriculum. Despite its relative simplicity, ours appears to be a novel approach for developing curricula. It is our hope that the task force's work can help other academic disciplines find ways to improve their curriculum development processes.*

4.3 Other Model Curriculum Reports

Alongside the more popular model curriculum recommendations that were published by large professional organisations such as ACM and AIS, a number of less prominent or discontinued models have also appeared over the years. In a paper which attempted to compare different curricula Scime and Wania (2005) provided a list of eight such models. Closer inspection, however, revealed that not all of them fall within the realm of IS; for example, *Guidelines for Software Engineering Education v.1* (SEI) or *Computing Curricula 2001* (CC 2001), clearly address different fields. Three of the models merit a brief discussion as a means

of providing a well-rounded view of curriculum recommendations. Before they are presented, a discussion on the curriculum efforts made by DPMA takes place. As stated earlier, DPMA published 'competing' curriculum reports in parallel to ACM for a number of year before the two organisations joined forces in the mid-1990s.

4.3.1 Data Processing Management Association (DPMA)

The first set of DPMA's *Curriculum Guidelines for Undergraduate Programs in Computer Information Systems (CIS)* was published in 1981. The efforts of the organisation for this initiative were drawn together by combining input from academics, industry professionals and experts of the field. As part of an evolutionary development approach, the proposed curriculum guidelines were debated in various conferences and workshops in an effort to receive feedback on the proposals. Additional input was sought through questionnaire surveys administered to professionals (Adams and Athey, 1982).

From a historical standpoint, the publication of DPMA's initial curriculum report was published at a time when ACM were also engaging with the IS community as part of their efforts to update their own curriculum recommendations (Nunamaker, 1981, Nunamaker *et al.*, 1982). Inevitably, the two separate streams of model curricula publications caused a lot of confusion over the years in the IS community. This is best explained by a joint committee ACM/DPMA that initiated the first collaborative efforts between the two organisations (Werth *et al.*, 1995):

> *The curriculum work is the first collaborative effort between ACM and other professional societies associated with information systems education. The previous situation in which several different organizations had released proposed curriculum models was confusing to both academia and industry. The joint team has been in operation for the past year and is ready to present its work for comment.*

At the heart of the proposed recommendations lay a set of fifteen topics made up of seven core and eight elective subjects respectively. An additional set of eight business support topics were also included in the report, but only as guiding pre-requisite elements. The philosophical underpinning of what constituted an IS student, who could benefit from these recommendations, was described in the preface of the report by Adams and Athey (1982):

> *It is the culmination of over two years of effort in studying the academic preparation required by persons who will enter the field of information systems as business application programmer/analysts and who will grow professionally within normal career paths open to business computer specialists.*

By 1986, the second DPMA report was published (CIS '86), featuring updates which were aligned to the technological and business innovations of the previous five years. The third and last DPMA major curriculum report, known as IS '91, succeeded CIS '86 by introducing a raft

of changes with a noticeable change of no longer featuring 'Computer' in the title of the report. This latest iteration adopted a more descriptive approach that offered curriculum design flexibility by supporting the specific needs of different institutions (Myers, 1991). It promoted nine IS topics which showed a healthy hands-on approach, through the use of the latest technologies, programming language kits and CASE tools. Much like the realisations made by similar ACM curriculum development panels, the DPMA committee also realised the need to drop business supporting courses from the report, indirectly acknowledging the emerging relationship between different domains of knowledge and the core of IS.

4.3.2 ISACA Model Curricula

The formation of the *Information Systems Audit and Control Association* (ISACA) can be traced back to 1969. ISACA describes itself as global organisation that provides specialist knowledge and expertise in 160 countries (ISACA, 2012). Its effort to develop a standard for undergraduate and postgraduate curriculum models was driven by the desire to provide universities seeking to educate aspiring IS auditors with the right curriculum. The two models published initially were described in the following way (ISACA, 1998):

> *The purpose of the models is to propose IS auditing curricula at the undergraduate and graduate levels. The models are based on the needs and the expectations of the IS auditing profession and the prior research of academicians, practitioners, audit organizations, and professional societies. The model curricula are living documents and will be routinely updated by ISACF.* [Information Systems Audit and Control Foundation]

The impetus to review the early models had many similarities with that behind the revision of IS 2000 (Gorgone *et al.*, 2002), namely the rapid technological advancements and feedback from academia and industry (Lord, 2004). Similar pressures gave rise to a further update that followed eight years from the second edition of the curricula recommendations. This latest effort was described in the following way (ISACA, 2012):

> *In the information-based business environment, professionals who are technically competent in IS, or IS specialists who understand accounting, commerce and financial operations, are in great demand for IS audit careers. The IS specialist and the IS auditor must continually receive training to upgrade their knowledge, skills and abilities. Universities with the appropriate curriculum can generate employable candidates for the IS audit and control profession.*

Similar to IS 2010, the latest edition of the ISACA model utilised the concept of domains which encapsulated different topics. Each topic consisted of subtopics which make up the cumulative knowledge of a particular specialisation.

4.3.3 IRMA/DAMA Model Curriculum 2000

The IRMA/DAMA model curriculum was the collaborative effort of the *Information Resources Management Association* (IRMA) and the *Data Administration Management*

Association (DAMA). Their efforts date back to the mid-1990s when the initial attempt to draft the curriculum was made. Cohen (2000) explained:

> *This document details an international information resources management curriculum for a four-year undergraduate level program specifically designed to meet needs. The curriculum provides a model for individual universities to tailor to their particular needs. That is, the IRMA/DAMA Curriculum Model is a generic framework for universities to customize in light of their specific situations. This curriculum model prepares students to understand the concepts of information resources management and technologies, methods, and management procedures to collect, analyze and disseminate information throughout organizations in order to remain competitive in the global business world.*

IRMA/DAPA acknowledged that their curriculum was engineered to focus on information resource management which, they claimed, is a sub-set of IS. They argued that their 'closest rival', the IS'97 curriculum model, did not address the needs of information resource management due to its generic nature. It was for this reason that they encouraged academics to analyse their curricula requirements very carefully before committing to ACM's IS'97 (Cohen, 2000).

4.3.4 Information Systems-Centric Curriculum ISCC '99 (ISCC '99)

ISCC '99 was the result of a four-year effort to produce a set of recommendations that would equip students with the necessary skills to meet industry demands. The curriculum recommendations concentrated on training students to work on large, complex systems (Lidtke and Stokes, 1999). Designed as a set of thirteen topics, the recommended curriculum was offered as a sequence of topics that benefited from being ordered according to requirements of prior knowledge. Additionally, the task force behind this work recommended three quantitative pre-requisite topics, complimented by a further one that covered group work. The essence of ISCC '99 was captured by Lidtke and Stokes (1999):

> *ISCC 99 provides a conceptual foundation for graduates who wish to become involved as members of teams in the design and implementation of complex, enterprise information systems that meet the diverse and complete information requirements of today and tomorrow's industry. This approach emphasizes the systems view, which is introduced early in the curriculum, along with teaming and communications skill building through practice. The systems view is central to the courses in the middle years, as students learn to build and exercise systems components. In the final courses in ISCC 99 students participate in the design and simulation of enterprise wide information systems.*

The authors of ISCC '99 claimed that the early feedback from at least two institutions that implemented the curriculum was positive. However, it is difficult to cross-reference the validity of such claim as there is no further information offered in this regard, and further literature searches do not yield any additional conclusive evidence.

4.4 Curriculum Recommendations in the UK

The contribution of UK academic and professional bodies to the development of UK-specific IS curriculum recommendation reports is very limited. With the exception of the work published by IFIP/BCS, there is no other report available. Professional organisations in the UK and Europe have been known to provide advice for curriculum development but without the aid of a newly devised set of curriculum recommendations such as those published in the US (Finkelstein, 1993).

This subsection provides a brief overview of the IFIP/BCS report, before it considers the contributions made by UKAIS and the QAA's Computing SBS.

4.4.1 IFIP/BCS Curriculum

The *Information systems curriculum: a basis for course design* was an effort to provide an attractive and effective set of curriculum recommendations for aspiring young graduates at a time when the field of IS was still at its infancy (Buckingham, 1987). Work had begun in 1968 under the auspices of IFIP and culminated in 1974 with the publication of an initial report that adopted an international curriculum development outlook. Subsequent work on this original report continued in the UK with the support of BCS (Latham, 2001).

The IFIP/BCS curriculum was presented as three separate levels with detailed descriptions for all the modules at each level. The purpose of the levels was to separate the different aspects of the suggested general and specialist IS knowledge. They were described by Buckingham *et al.* (1987) as Level 1: Source Studies, Level 2: Major Contributory Studies and Level 3: Mainstream Studies. As part of the review of the IFIP/BCS curriculum Latham (2001) explained:

> [...] *level 1 being concerned with basic knowledge and skills, level 2 with material presented in greater detail and depth and level 3 focussing on the prime target of how to design, implement and manage Information Systems.*

In the concluding comments of the report Buckingham *et al.* (1987) provided the following statement that captured its essence:

> *Although compiled primarily for those who wish to follow a professional career in information system design, the curriculum can be adapted to meet the needs of others with different ends in view, e.g. a managerial appointment which involves some responsibility for the development of information systems in the organisation. The course developer is free to select what is most appropriate.*

4.4.2 UKAIS Scope of Domain of Study

Although not a curriculum recommendation report, the UKAIS IS definition and scope of domain of study is a rare contribution to the nature of IS education in the UK by a UK body.

UKAIS (1999) explained the position of the organisation in terms of the IS domain in the following way:

> *The domain involves the study of theories and practices related to the social and technological phenomena, which determine the development, use and effects of information systems in organisations and society.*

For each of the ten domain categories there were definitions and indicative topics. Despite the indicative topics, UKAIS did not present this information as IS curriculum recommendations or indicative IS syllabi. In an effort to examine the IFIP/BCS curriculum and the UKAIS scope of domain of study more closely Latham (2001) carried out a comparison of the two sets of statements and concluded the following:

> *From these suggested curricula it can be seen that the IFIP/BCS proposal is more prescriptive, but at the same time has a wider subject base. It includes 'engineering' aspects, with topics such as programming, mathematics, statistics and operational research techniques, but also emphasises the practical issues of modelling and communication. The UKAIS domain of study pays more attention to management issues.*

4.4.3 QAA Subject Benchmark Statement in Computing (SBSC)

The application of benchmarks as a means for HE academic institutions to self-evaluate, was first observed in North America in the early 1990s, followed by Australia and the UK before the turn of the century (Jackson, 2001). According to the same author, the proliferation of benchmarking in the UK was the result of three factors:

- Government policies forcing universities to become more efficient as a result of the introduction of measures that lead to university mass-education.
- An increase in the overall international and transnational competition among universities looking to promote and enhance their quality standing.
- A drive to make universities more cost-effective, and thus, optimise resources without drawing on additional funding.

The dual purpose of benchmarking was explained by Jackson (2001) as the means:

> *(1) to facilitate improvement – development – change; and (2) to satisfy expectations and requirements for professional accountability*

The role of overseeing quality standards in HE in the UK is the responsibility of the QAA. Part of its duties involve drafting Subject Benchmark Statements (SBS) for a wide range of different disciplines which reside within institutions across the UK. According to QAA (2007):

> *Subject benchmark statements (SBS) provide a means for the academic community to describe the nature and characteristics of programmes in a specific subject. They also represent general expectations about the standards for the award of qualifications at a*

> *given level and articulate the attributes and capabilities that those possessing such qualifications should be able to demonstrate.*

The purpose and intended use of benchmark statements are relatively wide, although it is commonly accepted that these statements are the driving force behind the quality assurance and enhancement processes employed by UK universities and a point of reference for HE providers engaging in course development. Apart from academics and industry, the purpose of benchmark statements also extends to students who are given the opportunity to review them in relation to courses offered by universities. This is best described by Williams (2005) who concluded:

> *In summary, the subject benchmarking process can be seen as an attempt to assure the higher education community itself and its stakeholders that after the rapid transition to mass higher education in the early 1990s there is still a real sense in which first degree graduates from one university are equivalent to those from any other university in the country.*

The SBS specific to computing (SBSC) was published by the QAA in 2001 and subsequently revised in 2007, in line with the QAA's commitment to periodic reviews. The statement provides a description of the nature of the computing discipline and its numerous sub-disciplines. It was developed by UK academics whose area of expertise spanned the breadth of the computing discipline. UK universities hoping to attain the highest level of quality are encouraged to design, review and evaluate their computing programmes by taking into account the expectations about standards set out by the SBS. Unlike curriculum recommendations, the SBSC does not make reference to any generic or specific syllabi. Instead, it endeavours to stimulate discussion among academics and other stakeholders about the nature of the discipline and the quality standards courses in a particular subject should strive to achieve (QAA, 2007).

For its most part the SBSC concerns itself with the nature and scope of computing, the abilities and skills students are expected to develop, the principles of course design that universities should consider as part of their computing course as well as the teaching, learning and assessment strategies that should be employed. In addition, it describes the BoK for computing and its sub-disciplines (QAA, 2007), including IS as:

> [...] *defining the scope of the broad area of computing. It is not intended to define curricula or syllabi, it is merely provided as a set of knowledge areas indicative of the technical areas within computing.*

The IS BoK captured in the SBSC report is made up of sixteen broad categories which, at the time of publication, encompassed the breadth and depth of the IS field in the UK. Because of its UK origin, the SBSC BoK was used to devise a mapping mechanism to survey

the UK undergraduate IS curriculum. The findings of this survey, along with a discussion about developing a framework that can be used to map IS courses, are presented in Chapter 6.

4.5 Body of Knowledge of IS

The development of a BoK for IS has been a problematic issue that continues to challenge researchers. In a paper exemplifying its value Iivari *et al.* (2004) postulated that IS, like many of the other applied disciplines, should have a BoK that provides a contextual framework within which the depth and breadth of the field can be defined. They accepted, however, that unlike some of the natural sciences, IS may not enjoy a systematic BoK due to its less technical and more behavioural nature. Hirschheim and Klein (2003) viewed the definition of an IS BoK as the means to developing a solution that would address at least part of the multi-faceted problems that plague the IS field. Research that was more professionally-orientated by Agresti (2008), acclaimed the value of creating a BoK for the IT profession whose development would benefit both the academic and professional world. Agresti's argument was based on the idea that well-rounded professions have clearly defined boundaries that encompass all their relevant knowledge. In this state, it becomes possible to develop academic programmes which have strong practical foundations, enact certification programmes which support and enhance the profession of the field, and support organisational improvements. Sharing a similar point of view Alter (2012) endorsed many of the arguments for developing an IS BoK made by Hirschheim and Klein (2003), Iivari *et al.* (2004) and proposed the development of a knowledge cube that could contain the concepts, principles, generalisations and empirical findings that make up the IS BoK. A similar approach for devising and containing the essence of an IS BoK was outlined by Benbasat and Zmud (1999):

> *Once a sizable body of literature exists regarding a phenomenon, it does become possible to synthesize this literature, e.g., as a state of the art review, to develop usable prescriptions. And, as this body of literature evolves, authors can place the insights gained from their specific studies within this broader body of knowledge to again produce useable prescriptions.*

One area within IS which offers clearly defined and regularly updated versions of the IS BoK is curriculum recommendation reports. IS 2010 defined the IS BoK according to four categories that were driven by the learning objectives of academic programmes: General Computing Knowledge Areas, IS Specific Knowledge Areas, Foundational Knowledge Areas, and Domain-specific Knowledge Areas (Topi *et al.*, 2010). These four areas were the result of the refinement of the three subject areas of major topics and subtopics that encapsulate the knowledge that made up IS 2002: Information Technology, Organisational and Management Concepts, and Theory and Development of Systems (Gorgone *et al.*, 2002). As expected, the majority of similar curriculum recommendation reports published over the years, featured various forms of IS BoK descriptions (Davis *et al.*, 1996, Couger *et al.*, 1995, Myers, 1991,

Adams and Athey, 1982, Buckingham, 1987). Despite the proliferations of such IS BoK descriptions, Hirschheim and Klein (2003) claimed that the challenge to devise a comprehensive IS BoK still remains unmet due to the limited, and mainly academic, standpoints adopted by curriculum recommendation publications. In support of this criticism, Iivari *et al.* (2004) asserted that the development of the BoK requires world-wide contributions from a range of IS stakeholders.

A further example of a BoK which offers practical implications for a specific profession can be seen in the work carried out by ACS. The purpose of its publication entitled *The ICT Profession of Body of Knowledge* (Hart and Graham, 2012) was to facilitate the appropriate design of academic programmes and their accreditation. This effort is comparable to the work carried out by various other similar organisations, such as the BCS, International Computer Driving License (ICDL) and others, highlighted by Agresti (2008).

4.6 Summary

This chapter discussed IS model curriculum recommendations which form the basis of one of the two research surveys undertaken and described in this thesis. Curriculum models emanating mostly from the US have a long history of incremental development that attempts to capture the core elements of IS which, as some advocate, should form the basis of any undergraduate curriculum. Invariably, the evolution of these models tried to address the prevailing needs of business and industry while reflecting the contributions made by a growing body of academic and practitioner researchers. Although these models serve a useful albeit predictable purpose which primarily supports the design of new and the maintenance of existing IS curricula, a number of researchers have used them to design, quantify, compare and analyse IS course content.

As stated in the introduction of this thesis one of the objectives of this work is to provide an original and comprehensive view of the overall IS undergraduate curriculum in the UK. This is carried out by undertaking a module classification exercise using classification methods originating from different curriculum recommendations. The discussions in this chapter on IS 2010, IS 2002 and the QAA SBSC provide the context for understanding the development of the curriculum surveys which follow.

5 RESEARCH APPROACH

5.1 Introduction

The earlier discussion in Chapter 2 on the development of IS over the last fifty years and its repeated crises, touched on the pluralism of research methods that has characterised the field since its early days. Following the initial historical overview which briefly considered the way research in which IS developed, a further discussion looked at citation analysis data regarding research publications in IS education in some of the most distinguished journals and conferences of the field. Despite the disappointing results regarding the popularity of IS education as a research topic, it is important to consider the earlier work as it has informed the research approach adopted in this study.

This chapter considers the IS education research approaches relevant to the two different types of studies found in this thesis viz. curriculum and job ad surveys. Initially, the discussion focuses on past curriculum surveys by examining the merits of different data collection methods used. This leads to a discussion on the adoption of a particular research approach, appropriate to the UK specific survey presented in Chapter 6. Following this initial discussion, a further background research investigation examines the methods used to conduct job ad surveys. The chapter concludes with an outline of the chosen job ad survey method used in this thesis, paving the way for the job ad survey discussion in Chapter 7.

5.2 IS Research

The historical overview of IS in Chapter 2 showed that the first era of IS was characterised by a lack of clear research methodologies and a limited range of research themes which mostly focused on the identity of the fledgling discipline (Hirschheim and Klein, 2012). Such a state of affairs was not surprising given the absence of core research activity and the limited numbers of researchers who could identify directly with IS. Research in the field began to gather momentum as a result of early interest in what was perceived to be an applied social science with an implicit interest in technology and its use (Avison and Elliot, 2006). The early IS researchers were, in effect, 'stepping out' of their IS reference disciplines, such as computing, management and sociology, to do work in a field that lacked a clear identity but offered opportunities for innovative applied work. In doing so, the early IS research outputs were characterised by the approaches and methods of the reference domains that were

helping IS form as an independent field. It took over 20 years before Barki *et al.* (1993) offered the first concrete declaration of an IS research classification scheme (discussed in Chapter 3) that provided a description of IS and the research areas that would develop it further (Avison and Elliot, 2006). Apart from providing context and direction, this was a clear sign that IS research was becoming more focused. The continued growth in the pluralism of research approaches in the field gave rise to a mixture of theories, philosophical perspectives, research paradigms, methods and topics.

As the number of high quality research outlets began to grow, IS research aligned to different paradigms became prominent. Positivist IS research saw propositions and hypotheses being tested, along with models based on quantifiable data that stood the test of careful scrutiny. At the same time, interpretive research focused on non-deterministic perspectives about cultural phenomena which became an increasingly important part of the field (Chen and Hirschheim, 2004, Orlikowski and Baroudi, 1991). With the development of new research directions the methods used to conduct research grew. Case studies, surveys, experiments, action research, grounded theory and others were used to observe, study, analyse and influence the phenomena preoccupying the field of IS (Palvia *et al.*, 2007, Dwivedi and Kuljis, 2008). Many theories and theoretical constructs supported the tens of research topics which emerged as the level of research maturity in the field continued to grow (Avison *et al.*, 2008). In the backdrop of these significant developments, research approaches specifically in IS education remained fairly unchanged, arguably due to the limited attention given to this area of IS.

5.3 Emerging IS Education Research Gaps

While the research culture and practice underpinning IS has grown significantly during the four eras of development, a vacuum appears to exist in relation to research into the educational aspects of the field. This section briefly captures the key massages emanating from the background IS education research presented earlier in this thesis.

5.3.1 IS Education Characteristics

A growing number of researchers in the IS community have been arguing that the discipline is undergoing a crisis (Benbasat and Zmud, 1999, Klein and Hirschheim, 2008, King and Lyytinen, 2004, Bacon and Fitzgerald, 2001). They have identified a multitude of issues ranging from the lack of clear identity of IS to the type of research undertaken, and the IS academic-practitioner relationship. Although examining such issues may be viewed as a sign of maturity for a discipline that has only been around for a relatively small number of years, it has become increasingly evident that the driving force behind this exercise is not just an

attempt for philosophical reflection but a pragmatic need to understand the future direction of the field.

5.3.2 IS Course Characteristics

For the most part of the past ten years academia and industry have been reporting decreasing numbers of IS undergraduate students and IS graduate professionals respectively. The largely inconclusive attempts made by academic researchers hoping to isolate the exact reasons for this phenomenon, have highlighted issues ranging from the field's immaturity to a lack of meaningful cooperation between academia and industry. Among the possible explanations offered, a number of researchers, mainly in the US, have argued that ageing IS undergraduate curricula are partly to blame for the demise of the discipline (Hirschheim and Klein, 2003, Hirschheim, 2007).

In addition to disappointing student recruitment trends both in the UK and overseas, further investigation into key characteristics of the IS undergraduate degree provision in the UK raises additional questions which merit further exploration. First, entry-level requirements vary significantly between IS courses, as shown by the analysis of the entry requirements set by universities. While the average of 246 UCAS tariff points is equivalent to just over 3 grade 'C' A-Levels, the range of entry qualifications stretches from 120 to 340 tariff points, exposing a significantly wide gap in relation to pre-degree acquired knowledge and skills. Second, analysis conducted regarding the course title naming conventions used by the 85 UK universities offering the 228 IS degrees show significant naming variations. The most popular course name is BSc Information Systems, a title which often carries a qualifier in brackets denoting a particular specialisation. However, a significant number of courses bear titles that are not sufficiently unambiguous, making the distinction between a conventional computing and an IS degree difficult. 'Business' is the keyword with the highest frequency of use in all the titles and their qualifiers even though 89% of all IS courses are placed within computing departments. Third, the scale of professional accreditation of IS courses by BCS in the UK is limited to a third of the degrees surveyed. While there are many benefits derived from professional bodies accrediting academic programmes, the standards set by BCS are focused on important issues outside the immediate scope of the discipline of IS, thus making it difficult to ascertain the specific benefits the accreditation process offers to IS courses beyond those afforded to individuals gaining accreditation status.

5.3.3 IS Model Curriculum Recommendations

The review of the relevant literature regarding curriculum recommendation reports for the purpose of classifying the IS curriculum, confirms their successful practical application in a variety of settings. IS 2002, in particular, is shown to offer a robust framework for measuring

the provision of courses regardless of the underlying nature for the survey which can range from course comparisons to curriculum skills analysis or accreditation compliance (Kung et al., 2006, Lifer et al., 2009, Dwyer and Knapp, 2004).

While IS curriculum recommendations provide a useful structure which enables the quantification of the curriculum, they inevitably affect the categorisation of the findings which are structured based on the prevailing topics that make up the model curriculum. Therefore, it is important to understand the limitations of any given model curriculum report, so that the analysis and subsequent interpretation of the survey data based on it considers any bias introduced by it. For example, during the discussion of IS 2002, it was shown that it suffers from various structural deficiencies, such as being designed with the North American IS market and having a rigid, inflexible structure of 10 topics that appear in near sequence (Topi *et al.*, 2010, Gorgone *et al*, 2002). Hence, it is important to understand that any UK-based survey using IS 2002 as its basis would have to reflect these shortcomings. With this in mind, the driving force behind the design of the survey to measure the IS undergraduate curriculum across the UK presented in this thesis, not only needs to be comprehensive by mapping all aspects of the curriculum, but also consider the limitations of a given mapping structure and how they can be mitigated.

5.3.4 The Need for IS Curriculum and Graduate Job Surveys

The background research presented in the previous three chapters has highlighted a number of significant gaps in the understanding of the IS academic provision in the UK, the characteristics which support it and the philosophical perspectives of the field that underpin it.

Given the importance of these issues it becomes necessary to gain a detailed understanding of the IS curriculum by performing a comprehensive categorisation of its parts, thus providing a basis for further research. Such work should focus on the distribution of modules according to year of study and the relationship between core and option modules. Additional analysis should derive the skills courses promote through their career tracks. With such findings in place, a job ad survey would identify the skills employers require from new IS graduates, and examine how well the career tracks promoted by IS courses match the needs of industry. Furthermore, issues relating to employability, transferable skills, and the characteristics of the IS employment market would yield important insights into the debate about skills alignment.

The next step in addressing the aforementioned research gaps is presented in the remainder sections of this chapter which investigate the relevant research approaches capable of supporting empirical survey studies regarding the mapping of the IS curriculum and identification of graduate job skills.

5.3.5 IS Education Research – Stakeholder Perspectives

The detailed discussion of the differing, and often conflicting, perspectives of the five main IS stakeholders in Chapter 2, highlighted the wide scope of investigation approaches available to researchers undertaking research in IS education. In the case of Latham (2001), a multi-stakeholder perspective was necessary in order to examine five key aspects of IS education through a series of independent but complimentary surveys. By combining the views of academics, employers, professional bodies, government and students, Latham synthesised a complex picture which captured the IS knowledge and skills requirements of IS graduates in the UK, their professional standing and the methods which underpinned their education. While this type of pluralistic approach which combines multiple stakeholders can be very effective for broad investigations, it is not necessarily appropriate for work which needs to be narrowly focused.

The decision to concentrate specifically on the academic and business stakeholders as part of this thesis, was driven by the overarching research aim which sets out to align industrial IS careers to current academic IS provision in the UK by conducting a comprehensive analysis of both the current undergraduate IS curriculum provision relevant to specific identified professional career tracks, and the skill requirements of IS employers. Incorporating the views of any other stakeholder in this case would detract from the carefully balanced exercise of juxtaposing the views of the academics and employers who act as the supplier and beneficiary of skills promoted by the IS curriculum respectively.

It is envisaged that the findings of the work presented in this thesis will offer the basis for further research which could introduce additional stakeholder perspectives, leading to more pluralistic perspectives on IS education.

5.3.6 Using Surveys to Address the Research Objectives

By establishing the clear need to focus specifically on the academic and employer stakeholder in order to support the overall aim of this research, it becomes necessary to determine the methodological approach by which the research aim will be materialised as outlined by its corresponding research objectives. Each of the research objectives stated in Chapter 1, either refers directly to investigating a large sets of data or deriving relationships from possible correlations between data sets. In each case, the implied data collection, investigation and analysis infers a comprehensive and holistic approach which relies on the entire census of samples. Specifically, the mapping of the IS undergraduate curriculum is designed to include the entire UK provision by incorporating every IS course offered in the UK. Equally, the job ad analysis of IS graduate skills aims to include the entire sample of data available within a statistically valid data collection period. Each of these approaches require all-inclusive data collection methods, typically found in surveys.

Latham (2001) argues that, from a methodological standpoint, the aim of surveys is to collect and analyse substantial amounts of data. Surveys can take different different forms, the majority of which are discussed in the subsequent sections of this chapter. Specifically, content analysis appears particularly well suited for the purposes of this study for two main reasons:

- The collection of the data requires an unobtrusive approach given its existence as part of online sources.
- The nature of 'carrying out a census' requires maximum comprehensiveness of the data collection process.

The review of alternative methodological approaches (Case Study, Action Research, Ethnography, Grounded Theory, Laboratory Experiments, Fieldwork or Mathematical Modelling), all of which are discussed in Latham (2001), do not offer the means of meeting the objectives of this research. In fact, no other method is capable of acting as a reasonable candidate alongside content analysis, capable of challenging its applicability as the most appropriate survey method for this research.

5.4 Approaches for IS Education Research - Curriculum Surveys

This section considers the background research relating to curriculum surveys. Studies in this area are empirical, either utilising conventional survey methods to collect relevant data, or direct survey approaches that make use of available material which exists online or in printed format. The review of some of the important work in this area is necessary to ensure that the most appropriate curriculum survey method is adopted for this research. The studies examined employ traditional data gathering methods such as questionnaires (Riihijarvi and Iivari, 2008), direct survey methods (Kung *et al.*, 2006), or sometimes a mixture of more than one method (Bell *et al.*, 2013). Despite their small differences, each method has an important role to play in ensuring that the objectives of a given study a met successfully.

5.4.1 Conducting IS Curriculum Surveys

The use of unobtrusive survey methods to gather and analyse information about the evolution of courses has a relatively long history in the IS field, dating back to the early days of its birth. The reasons that continue to fuel, even today, the need for measuring, mapping and classifying the IS curriculum stem from the tempestuous history of the field which, since its early days, has had to justify its existence and establish its legitimacy. As the discussion in Chapter 2 showed, the identify crises of the field have caused many researchers to scrutinise the positioning of IS within the wider field of computing by examining its research and curriculum (Hirschheim and Klein, 2012, Avison and Elliot, 2006). Many of the discussions

have been shaped by the role different stakeholders play in the field and the influence they exert on it. Their views not only affect the way the IS curriculum has evolved but also the way young people entering the world of IS transition from academia to industry. Given the importance of the curriculum to the identity of IS, the 'esoteric' crises about its philosophical positioning (Benbasat and Weber, 1996, Benbasat and Zmud, 2003), and the 'applied' crisis caused by inadequate levels of student and also professional recruitment (Hirschheim, 2007, Wilson and Avison, 2007), it is understandable why researchers study the IS curriculum from a number of different stakeholder perspectives. As Sidorova and Harden (2012) explained, the IS discipline is partly defined by its curriculum as represented by two key stakeholders:

> *Internal stakeholders (IS faculty, students and graduates) are the most likely to identify with the IS discipline, as represented through the IS curriculum, and they reflect the IS teaching images projected by the influential stakeholder by developing program-specific curricula, preparing course syllabi, and in the case of students, selecting major and registering for courses and thus expressing their preference for certain curriculum. The IS teaching identity as represented in the internal stakeholder appraisals is likely to reflect their concerns for future professional careers, in case of IS students, and teaching interests and research interests, as well as the marketability of their programs, for the IS faculty.*

One of the earliest IS curriculum surveys took place between 1977 and 1979. It used a descriptive analysis approach to gather information about the provision of IS courses in the US and the professional careers open to graduates (Nunamaker, 1981). The purpose of the study was mainly exploratory as opposed to trying to address a specific issue regarding the field. Nunamaker surveyed university catalogues and brochures, obtained through pre-internet era means, such as writing information request letters and placing calls to request materials. This type of data gathering, as explained earlier, constituted one of the earlier forms of direct surveys which deals with examining relevant aspects of information found in printed materials.

The proliferation and increased popularity of model curriculum recommendations in the 1990s, along with the wide availability of detailed curriculum information on the web, caused renewed interest in the study of the IS curriculum. At the same time, content analysis software and more traditional statistical analysis packages were becoming more widespread, causing a significant reduction in the effort needed to process large quantities of curriculum data. In one such study which unusually focused on postgraduate IS courses, Gorgone *et al.* (2001) considered the status of Master's degree programmes in the US by examining the commonality of topics covered and their adherence to IS'97. The absence of a comprehensive postgraduate model curriculum at the time, explains the reason behind the authors' decision to use IS'97 which had been designed to cover the undergraduate curriculum. Noticeable research, which made use of the postgraduate curriculum recommendations which were published five years later by ACM and AIS, *MSIS 2006: model curriculum and guidelines for*

graduate degree programs in information systems Gorgone *et al.* (2006), utilised a direct survey approach of gathering course data from university websites (Yang, 2012):

> *To collect data on IS master's programs in the United States and their required courses, I directly surveyed the websites of those institutions offering master's degrees in IS. This method facilitates systematic collection and standard coding of data, thus providing an inclusive view of existing IS master's programs in the United States (Kung et al., 2006).*

Yang's findings were based on a survey of 273 universities in the US offering postgraduate courses in IS. They showed that the majority of the programmes demonstrated close adherence to MSIS 2006. In another case examining undergraduate courses, Anthony (2003) gathered and analysed data from US university websites for a study in computing education that aimed to distinguish between the different disciplines within the computing field and the academic programmes that define it. More specific direct surveys on the IS curriculum followed after the publication of IS 2002. Some of these studies relied on the IS 2002 curriculum recommendations to examine the level of alignment of IS courses to the model, thus, measuring the popularity of subjects available to undergraduate students (Dwyer and Knapp, 2004, Williams and Pomykalski, 2006, Lifer *et al.*, 2009). Similar empirical research methods were also used to conduct IS curriculum surveys that examined the correlation between graduate level skills and the skills expectations by industry (Prabhakar *et al.*, 2005, Litecky *et al.*, 2004, Nelson *et al.*, 2007). For the majority of these studies, as is the case with (Pierson *et al.*, 2008, Apigian and Gambill, 2010), data was collected from relevant websites to ensure the most up-to-date information is used.

The curriculum surveys which were carried out in the 2000s coincided with a noticeable rise in the accreditation of IS courses by AACSB and ABET (Lidtke and Yaverbaum, 2003, Hilton and Lo, 2007). As a result, researchers looking to accurately identify IS course samples for their studies, often chose to include courses which were listed as accredited by the aforementioned organisations. Many of these researchers were influenced by the early work of Maier and Gambill (1996) who set out to profile the IS curriculum of 108 accredited courses. Adopting the same direct survey approach, the authors of that work showed that the rapid technological changes in IT necessitate the frequent revision of the IS curriculum if it is to remain relevant to the needs of industry. Assuming a similar reasoning about the importance of the relevance of the IS curriculum, Lifer *et al.* (2009) used a direct survey method to study over 400 accredited IS courses by examining their adherence to the IS 2002 curriculum recommendations. By accurately mapping the reviewed curriculum to IS 2002, the authors strove to support the debate about curriculum modernisation and the skills alignment with industry requirements. With similar objectives, Apigian and Gambill (2010) conducted a comparable survey which analysed the IS provision from 240 US universities. Although this study did not exclusively include accredited courses, it had the same overall aim of supporting

the debate about curriculum and skills relevance at a time when IS student enrolments were falling. In order to improve the accuracy of their analysis, the authors of that study chose to use the draft IS 2010 curriculum recommendations (known as IS 2009 at the time) as the basis for their analysis. More recently, one of the first studies to make use of the latest curriculum recommendations, IS 2010, is found in the work of Bell *et al.* (2013) who examined 127 AACSB accredited IS courses in an attempt to evaluate how well the IS 2010 recommendations have been adopted by programmes in the US.

Kung *et al.* (2006) encapsulated all of the important characteristics found in IS curriculum survey studies discussed so far. Methodologically, this study clearly demonstrated the value and validity of direct survey as a method capable of accurately collecting secondary data that exists in printed or online format. At the same time, it showed the importance of using an appropriate data sample selection method (in this case partly using AACSB accredited courses) in order to ensure the reliability and validity of the data set. Finally, it used one of the model curriculum recommendations (IS 2002) as a framework for structuring and analysing the data, and presenting the overall results. While the actual findings from Kung *et al.* (2006) and the other US-based studies have no direct relevance to the research aim of this thesis, which focuses on the UK, it is evidently clear that direct survey methodology offers a valid approach for carrying out IS curriculum surveys. Based on this conclusion, the UK curriculum surveys presented in the next chapter adopt the same methodological principles discussed in this section.

5.4.2 Applying Direct Surveys to Curriculum Mappings

Curriculum mappings using direct survey approaches are not synonymous with the conventional meaning of content analysis, although sometimes the terms are used interchangeably. Early curriculum surveys relied on the acquisition of relevant data through traditional survey techniques such as questionnaires and interviews. Maier and Gambill (1996) provide one of the earliest curriculum survey examples which involved the distribution of questionnaires. Only a few years later, Gill and Hu (1999) carried out a similar study aiming to understand the changes in the IS curriculum over a period of study. Their method was also based on a survey questionnaire which was administered to a relatively large number of IS academics.

The expansion of the web saw the publication of extensive course information on university websites. As a result the web, as a new communication medium, shifted the data collection research methods away from obtrusive questionnaires that necessitated interaction with humans, to unobtrusive collection and data parsing processes which often benefited from software tools that performed data coding. Pierson *et al.* (2008) explained their direct survey method, which underpinned a comparative study of approximately 900 institutions offering IS

courses, as a survey of university websites to collect relevant data. In a similar way, Lifer *et al.* (2009) made a case for online course surveys by arguing that web sources contained more accurate information than printed catalogues which are updated infrequently. Apigian and Gambill (2010) utilised exactly the same web-based data collection approach, as did Kung *et al.* (2006) who explained its value in the following way:

> *We used a direct survey of undergraduate IS programs in the United States to collect data on IS curricula. The advantage of a direct survey is that it focuses on a specific program of interest (i.e., undergraduate), allows collection of data in a systematic way, and facilitates standard quantification of data. Hence, this methodology provides a comprehensive view of the current undergraduate IS programs in the United States.*

They elaborated their approach further (Kung *et al.*, 2006):

> *Using published university catalogs from these schools, we examined the core curricula of the 232 undergraduate IS programs to analyze program core requirements (i.e., courses that are required by all graduates of the major).*

Two further cases of direct survey of IS curriculum characteristics are found in Soe and Hwang (2007), Hwang and Soe (2010) who carried out two complimentary surveys into the proliferation of career tracks in the design of IS courses. In each case the authors investigated course content available on university websites. White (2004) discussed the content of business information modules which were part of accredited library and information studies programme, as part of an investigation which involved surveying 48 programmes. The methodological approach used by White was very similar to those described earlier: most content was obtained from webpages, with some unavailable material acquired through staff requests via email. In another study, Stone *et al.* (2006) investigated the role of ethics in the business curriculum by performing two related studies. The first considered data gathered from websites, while the second analysed the content of text books. In a final example, Bell *et al.* (2013) investigated the adoption of IS 2010 by undergraduate degree programmes in order to ascertain their compliance with the new guidelines. Their investigation was supported by two supplementary surveys. In the first instance, the authors used a direct survey to collect data directly from programme catalogues available on university websites. The second survey necessitated additional data which was acquired though telephone interviews. Although rare nowadays, data collection methods such as the latter, or a survey distributed via email (Ryker *et al.*, 2008), still exist as supplementary means of obtaining course data that is not available online.

5.4.3 Factors Affecting Direct Curriculum Surveys

The majority of the curriculum survey research reviewed in the previous section exhibits three main characteristics that describe the way it is structured: study design, data collection and results. In most cases, the first two characteristics appear under the heading of 'method',

'methodology' or some other synonymous categorisation (Lifer *et al.*, 2009, Kung *et al.*, 2006, Apigian and Gambill, 2010). From a methodological standpoint, the validity of a study of this type can be ascertained by examining the variables, sampling and coding scheme used.

Variables

Selecting the appropriate variables, which theoretically determine the outcome of a study as a result of recording information about data items which can be contextually different, is predetermined by the type of course under review. The welcome restriction imposed by variables significantly reduces the margin of error in the design of such studies. This can be explained by considering the work of Gill and Hu (1999) whose questionnaire featured 120 questions, covering areas about the institution which was being surveyed and the courses it offered. Their approach can be characterised as analytical, as it was trying to determine descriptive information about courses, modules and the teaching software tools used to deliver the curriculum. As such, there are no predictions, generalisations, hypotheses or complex extrapolations about relationships between the data. Instead, the scope of the analysis is determined by the level of granularity of the questions used, and the results are primarily determined by univariate of bivariate analysis. Information derived from questionnaires of this type is no different to the information that is extracted from the course catalogues available on university websites. A typical direct curriculum survey, such as the one carried out by Kung *et al.* (2006), is governed by the pre-existing information that is available online, effectively making the scope of such study identical to the previous one. A small variation to this conventional approach can be seen in Bell *et al.* (2013) with the introduction of variables which calculated scores based on the occurrence of certain modules categories within courses. Even this small variation, however, does not constitute a departure from the standard approach of measuring the curriculum to determine what it offers.

Sampling

In addition to variables which are crucial for determining what information is to be recorded and analysed, sampling is another important aspect that can influence the overall findings of a study by determining the number and type of courses which make it up. In most cases, the size of the sample is constrained by the objectives of the study. The type of sample used, such as AACBS accredited courses or courses offered by universities in a particular geographical area, characterises the scope of the study, and by implication, the significance of its findings. As an example, Dwyer and Knapp (2004) used a sample of one, as part of a case study about the IS curriculum in a single institution. At the same time, Maier and Gambill (1996), Pierson *et al.* (2008) examined hundreds of IS courses which were qualified as AACBS accredited, while excluding everything else. In another example, Kung *et al.* (2006) sampled general four-year long IS courses found across the US without taking into account their

accreditation status. Ultimately, the size of the sample determines the amount of generalisability of the results, while the type affects data homogeneity.

Coding Scheme

Whereas variables determine the data units being recorded and samples frame the scope of the direct survey data, coding schemes characterise the nature of surveys. Coding schemes can range from simple to detailed. An example of a simple coding scheme can be seen in the work carried out by Nunamaker (1981). In this survey, the author measured the provision of IS courses (mixture of accredited and non-accredited courses), and analysed their names. Similarly, Maier and Gambill (1996) carried out a relatively simple study by coding the modules offered by the AACBS accredited universities surveyed, and ranked them to demonstrate their popularity. In both these cases the information recorded as part of the variables used is of limited depth, since it did not contain details such as the structure of modules, credit weighting or any software tools used in the curriculum. Lack of such detail does not negate the value of the work of either of the aforementioned authors. Their work simply offers a narrower perspective of the curriculum. A more detailed coding scheme was used by Gill and Hu (1999) who not only considered the type of data seen in previous studies, but also elaborated on specific aspects of courses, offering findings with significantly more depth. Specifically, Gill and Hu (1999), in addition to deconstructing the nature of the courses under examination, analysed the popularity of software tools used to teach programming, while also considering the different operating systems used in the IS syllabi. It is, therefore, apparent that the increase in the amount and depth of data extracted is directly related to the depth of the coding scheme used. Studies by Lifer *et al.* (2009), Apigian and Gambill (2010), Bell *et al.* (2013) can be seen as having an even more detailed coding scheme by utilising the structures of curriculum recommendations to contextualise their findings. In the case of Lifer *et al.* (2009), data collected from different type of accredited IS courses was mapped to the structure of IS 2002, thus showing the adoption levels of IS 2002, and by implication the level of compliance with its recommendations. More importantly, coding schemes which enable the data of direct course survey findings to be mapped to model curricula, increase the contextualisation and validity of the findings. 'Context' and 'validity' in this case does not mean that curriculum recommendation models should be accepted as the definitive blueprints for designing IS courses. Instead, they can be seen as providing a well-recognised and well-defined structure, which despite its shortcomings, enhances the accuracy of curriculum mappings by providing a reference point of comparison.

5.4.4 The Direct Survey - IS Curriculum in the UK

The main aim of the curriculum survey used to underpin this thesis is to map all aspects of the IS undergraduate provision in the UK. In order to qualify the somewhat abstract notion

of 'mapping all aspects of the curriculum' and explain how such relatively abstract aim can be realised, three incremental objectives have been devised:

- Catalogue the provision of all IS programmes across the UK by deriving information on the total number of IS courses on offer by universities belonging to different affiliation groups, their modules, sizes, modes of delivery, year of offer, thematic origin that denotes the discipline from which modules are derived, and the popularity of each subject.
- Develop a framework that depicts the overall IS course provision but also provides the means for mapping individual or groups of IS courses, now and in the future.
- Devise a method to measure the career tracks promoted by the IS curriculum and quantify their popularity.

Variables

Choosing the appropriate variables for this study is ultimately determined by curriculum information which needs to be captured in order to support the development of the framework and career tracks. The comprehensiveness of the analysis of the curriculum stipulates the recording of a much more detailed array of variables, capturing all aspects of the courses under investigation, but also taking into account the ways in which the contribution of each subject can be weighted with regard to its frequency.

Sampling

Determining the sample of the survey poses no particular difficulty given the nature of the study which is designed to cover the entire IS academic provision in the UK. To ensure the inclusion of every possible institution prior to conducting any data gathering, data from UCAS and Unistats was cross referenced to compile a definitive list of universities across the UK. An identical approach was used to determine a complete list of institutions in the Greater London area, necessary for the development of the pilot study which precedes the main survey. Ensuring that all IS courses were included in the study was achieved by consulting the UCAS course listings to verify the status of all legitimate IS courses as being available for recruitment. A detailed discussion on this particular process and the overall sampling approach, exists in the early part of the survey discussion in Chapter 6.

Coding

The coding scheme envisaged for this survey relies on a number of different curriculum recommendation guideline models. Both IS 2002 and 2010 are used for reasons explained in Chapter 6 as part of the detailed discussion about the execution of the survey. Additionally,

the coding scheme is supplemented by the development of a new classification method that utilised UK specific IS subject guidelines in the form of the QAA IS BoK.

Beyond the Survey – Framework and Career Tracks

Addressing the three aforementioned survey objectives requires a multi-faceted coding scheme. Apart from mapping the constitution of the curriculum in a simplistic way by counting the occurrence of topics, it is also important to devise a descriptive model that enables the quantification of every aspect of the curriculum, including subjects which are borrowed from outside the field of IS. The refinement of the method should give rise to a Course Survey Framework that supports any attempt to replicate the findings of the study, but also conduct similar studies in the future to track changes in the evolution of the curriculum. Equally, the framework should be able to support the analysis of a single existing course, and act as a guide to designing new or redesigning existing IS courses.

Measuring the career tracks promoted by the IS curriculum in the UK needs to be based on the overall outputs of the Course Survey Framework. By having a detailed analysis of the curriculum that is weighted according to the contribution each subject makes to it, careers tracks can be calculated based of the combination of weightings of subjects which contribute to a particular career track. As more career tracks are added or removed, the framework will be adjusted accordingly to reflect the new subjects and their weightings.

5.4.5 The Need for a Pilot Study

It is evident from the literature review regarding curriculum mapping surveys that the scope of this proposed UK study exceeds any similar work which has been carried out in the past, both in terms of range and level of detail. A closer examination of the survey objectives found in the previous section suggests that the first objective reflects many of the similar survey efforts undertaken in the past outside the UK but on a smaller scale. In the case of the last two, it is clear that both objectives point to development of artefacts which will be based on the survey but not be part of it in a literal sense. The requirement to undertake such detailed curriculum survey and develop these artefacts, as explained earlier, stems from the overall research aim of this work to align the IS curriculum with IS careers. Thus, it is imperative to determine the career tracks promoted by the curriculum before any comparisons can be made.

Given the complexity of a curriculum mapping survey whose level of comprehensiveness has not been encountered in the literature previously, it was deemed necessary to perform an initial pilot study to trial the key design features of the main survey. Following a successful outcome, the pilot would be extended across all institution in the UK, providing a much more conclusive picture of what the IS professionals of tomorrow will be taught today. Academics should be able to design new or review existing courses by taking into account the emerging

national provision of IS courses. At the same time, industry as the main recipients of IS graduates, should gain a better understanding of the knowledge and skills newly qualified graduates will bring into the world of business. Students and their families should get a clearer understanding of the breadth of subjects that will be available to them.

5.5 Approaches for IS Education Research - IS Job Skill Surveys

Similar to the previous section which considered the background research relevant to the first of the two surveys in this thesis, this section examines the background research which describes the different approaches used for surveying IS job skills. Forming the second survey of the thesis, IS job skill surveys share a number of characteristics with IS course surveys. While some types of job surveys follow traditional data gathering methods, such as interviews and questionnaires, unobtrusive data collection is also an important technique that has been used successfully as part of many studies. Given, however, the variety of different data gathering techniques, it is important to review them carefully before the most appropriate one can be selected.

5.5.1 Identifying IS Graduate Skills

Understanding the evolving nature of jobs in the IS field is a complex matter. Employers and professional bodies maintain strong arguments about the changing landscape of skill requirements in the highly competitive business arena where technological innovation is often synonymous to competitive advantage (Gallivan *et al.*, 2004, Hickson, 2000, Nelson *et al.*, 2007). In response to such views, academics have carried out numerous studies in an attempt to ascertain the skills relevant to business. The majority of the studies are empirical, and rely on interpreting the needs of business and industry by decoding information that is either gathered through traditional surveys (questionnaires and interviews) or by reviewing published information such as job advertisements in newspapers and the web. Often, research published in this area tries to interpret findings pertaining to skills for graduates by examining them in relation to the academic curriculum, thus, linking curriculum relevance to employability skills (Lynch and Fisher, 2007, Riihijarvi and Iivari, 2008, Tuson, 2008, Nagarajan and Edwards, 2009). The case for curriculum relevance and the importance of skills in the curriculum was made convincingly in the development of IS 2010. As one of the imperatives driving the need to update the model curriculum, Topi *et al.* (2010) carefully considered the issue of curriculum relevance which they highlighted as a key issue for academics, industry and the future development of the field. Their case is underpinned by the perpetual advancements in technology and business which, as they see them, necessitate frequent reviews of the IS curriculum to ensure it remains relevant to the needs of relevant stakeholders.

Considerations regarding curriculum relevance are not new. Forty ago when the field of IS was still in its infancy, academics and professionals were facing the same challenge of developing courses that could address the needs of business and industry (Couger, 1973). Two decades later, in one of the seminal papers in this area Trauth *et al.* (1993), probed the same issue by asking:

> *Are colleges and universities responding fast enough to the business and technology changes that have redefined the role of information systems in today's organizations? Are we providing the right type of education for future information systems (IS) professionals?*

Pursuing a similar line of enquiry Lee *et al.* (1995) argued the need for better alignment between industry and academia through curriculum relevance. More recently, Granger *et al.* (2007) reiterated the importance of re-evaluating IS curricula to attract more students to the discipline, while Bullen *et al.* (2007), Zwieg *et al.* (2006) noted the importance of rethinking curriculum and training development efforts. An initial review of the relatively large body of research which focuses on the analysis of graduate jobs skills, gives rise to a series of emerging groupings of sources of data that map to the earlier mentioned stakeholders. A good summary of these themes was offered by Wilkerson (2012) who organised the findings of a review of thirty-six academic job ad papers according to *students*, *alumni*, *employers*, *employees*, *educators* (academics) or *analyses of job ads* originating from printed or online material. In a similar effort to taxonomise the sources of data of job ads, Chia-An and Shih (2005) separated their review of relevant papers in key academic journals based on studies relating to *industry surveys*, *faculty and student surveys*, and *job advertisement studies*. At the same time Litecky *et al.* (2004) categorised job skills research in IS as *normative*, *traditional empirical*¸ *unobtrusive empirical*, and *opinion based* (*practitioners*). They described their classification methods in the following way:

> *Herein, normative studies are characteristically aimed at producing authoritative pronouncements on IS career development and are generally issued under the aegis of academic and professional societies. Traditional empirical studies are usually directed toward describing what exists in IS job skills and career development. Traditional empirical studies contrast with normative studies in their emphasis on academic rigor and in their suggested implications from the findings; these studies do not issue pronouncements with the authoritative force of the normative studies. Unobtrusive empirical studies are similarly concerned with describing what exists in IS job skills and career development and use unobtrusive methods of data collection. The unobtrusive studies mainly use data gathered from position ads. Other approaches characteristically use less formal research methods and many of these are practitioner-oriented.*

As expected, all of these approaches aim to gather relevant data from the group of IS stakeholders discussed in Chapter 2. The majority of the studies featured in Chia-An and Shih (2005), Wilkerson (2012) focused on a single stakeholder. Some ambiguity in mapping groups to stakeholders results from the varying naming conventions used by authors who are

influenced by the prevailing terminology at the time of carrying out their work, but also their particular focus. For example, Lee *et al.* (1995) referred to *IS managers, user managers,* and *Information Systems consultants* as different stakeholder groups, while Todd *et al.* (1995) name their groups as *Programmers, Analysts* and *Managers.* At the same time, Gallivan *et al.* (2004) considered *IT Professionals* as their target group although it is unclear if their category is a superset of one of the previous categories as the name implies.

In addition to considering the perspective of different IS stakeholders, research in job ad surveys is further characterised by the particular methods used to carry out each study. Surveys take many forms, ranging from traditional paper-based questionnaires to automated content analysis of web-based data. Traditional surveys examine the views of respondents by eliciting answers to carefully crafted questions. Bullen *et al.* (2007) offered an example of a two-stage survey, traditional and web-based, used as part of a project examining current and future IT workforce trends. As part of a similar but smaller scale project, Janicki *et al.* (2004) carried out an employer survey to review job skills and the implications industry expectations have on the IS curriculum. Zhang (2007) demonstrated the use of surveys by analysing data from students in an effort to understand their intentions to follow IS degree courses. Further examples of employer and student surveys are present in Cappel (2001), Akbulut and Looney (2007) respectively. Interviews generally offer a narrower scope than surveys but allow more focused and in-depth enquiries provoking qualitative responses. Zwieg *et al.* (2006) interviewed senior IT executives to identify skill requirements and changes in the workforce trends, while Scott *et al.* (2009) conducted a series of focus groups with students to understand their motivation for electing to study IS. Similarly, Tan and Taizan (2007) targeted scholars through interviews to ascertain the level of maturity of IS in Singapore. Delphi studies support the distilling of views within the same group due to their iterative approach that involves summarising the results from each round of surveys before another set of questions is administered. Snoke (2007) demonstrated the value of such an approach in an Australian study that examined the skills employers require from graduates studying IS courses. Content analysis, either for the purpose of analysing job ads to catalogue graduate skills in demand (Kennan *et al.*, 2009, Todd *et al.*, 1995, Prabhakar *et al.*, 2005, Litecky *et al.*, 2010) or for surveying IS curricula (White, 2004, Kung *et al.*, 2006, Hwang and Soe, 2010, Anandarajan and Lippert, 2006), is thus a well-established research approach in this area.

Following this brief overview of the literature which outlined the breadth of the work available in this area, a more in-depth analysis of graduate job skills is carried out below to determine the different data collection methods used, the way the analyses were carried out, and the stakeholders involved. A more thorough examination of the different approaches will provide a good basis for selecting an appropriate method to analyse job skills for the purposes of this research. The data presented in each section is organised in a table which shows the

contribution made by each stakeholder category. This approach is similar to the way Wilkerson (2012) organised findings derived from an analogous study. The tables feature listings of relevant research publications and the stakeholders involved in each case. Certain categories in the tables are deliberately disaggregated: employers, managers and recruiters, for instance, refer to the same Employers stakeholder but appear as separate entries to reflect the categories found in the original work and the different perspectives a single stakeholder may adopt.

5.5.2 Data Collection Method: Survey (Paper Questionnaires)

One of the earliest attempts to analyse IS and IT skills that are perceived to be useful by business and industry was carried out by (Benbasat *et al.*, 1980) using a questionnaire. The authors of this work influenced numerous researchers who subsequently utilised the same data collection method (Table 5.1) in their efforts to understand the skills in demand. From a methodological standpoint, Benbasat *et al.* (1980) utilised a well-crafted postal questionnaire which aimed to gather information about the perceptions of managers and systems analysts regarding the types of skills that are necessary in organisations at different levels of maturity of development. They considered skill categories borrowed from earlier studies in an attempt to ascertain the importance of those skills in organisations which have reached different levels of maturity, as determined by a list of 'maturity characteristics'. As is the case with many subsequent studies, the findings led to recommendations about the IS curriculum (Benbasat *et al.*, 1980):

> *The objective of this study is to examine the skills deemed useful to information systems managers and systems analysts in information systems (IS) environments of different levels of maturity, and based upon the results, make recommendations for IS curriculum.*

Similarly, the work of Leitheiser (1992) which was published twelve years later used a survey questionnaire to obtain the views of IS managers regarding the skills expected to be present in systems developers and technical specialists. A year earlier, Igbaria *et al.* (1991) used a hypotheses testing approach, similar to Benbasat *et al.* (1980), to explore multi-faceted relationships that stem from a combination of innate and acquired characteristics. Their conclusions pointed to the existence of career orientation predispositions by IS employees, and a relationship between job satisfaction and job settings.

Author	Discipline	Data Collection Method: Survey (Paper Questionnaire)							
		Employees	Employers	Alumni	Students	Academics	Managers	Recruiters	Other
(Aasheim *et al.*, 2009b)	IT								
(Azevedo *et al.*, 2012)	Bus	⊙	⊙						
(Benbasat *et al.*, 1980)	IS						⊙		⊙
(Cappel, 2001)	IS		●						
(Chrysler and van Auken, 2002)	IS			●					
(Davis and Woodward, 2006)	IS	●							
(Davis, 2003)	IS	●							
(Downey *et al.*, 2008)	IS	●							
(Fang *et al.*, 2005)	IS							●	
(Fang, 2004)	IS				●				
(Igbaria *et al.*, 1991)	IT	●							
(Janicki *et al.*, 2004)	IT						⊙	⊙	
(Kaarst-Brown and Guzman, 2005)	IT			●					
(Kim *et al.*, 2006)	IS	●							
(Lee and Fang, 2008)	IS				⊙			⊙	
(Lee and Mirchandani, 2010)	IT/IS						●		
(Lee *et al.*, 2002)	IS	⊙				⊙			
(Leitheiser, 1992)	IS						●		
(Martz and Cata, 2008)	IS	⊙			⊙				
(Noll and Wilkins, 2002)	IS						●		
(Plice and Reinig, 2007)	IS			●					
(Plice and Reinig, 2009)	IS			●					
(Snoke, 2007)	IS					●			
(Wu *et al.*, 2006)	IS	●							
(Yen *et al.*, 2001)	IS	●							
(Zhao, 2002)	IT						⊙	⊙	
(Zwieg *et al.*, 2006)	IT						●		
Totals	**27**	**10**	**2**	**4**	**3**	**2**	**7**	**4**	**1**

Table 5.1. Paper questionnaire surveys (● - single participant involved; ⊙ - two or more participants involved).

A third of the twenty-seven paper-based questionnaire studies, which are predominately IS specific, target Employees, while the second most popular category involves Managers. The composition of participants in the Employees group range from a handful of organisations in a particular geographical area (Downey *et al.*, 2008) to graduates from a particular institution of employment (Davis, 2003). Studies focusing on the opinions of Managers, such as in the

case of Lee and Mirchandani (2010), showed similar characteristics to the Employees group. Noll and Wilkins (2002) who also considered the views of Managers concluded that there was a need to re-focus the curriculum, so that it can be aligned with the continuously diversifying nature of IS jobs, by analysing the data from 380 questionnaires distributed to local companies. Data from a smaller number of companies targeted by Leitheiser (1992) similarly pointed to a need for universities to constantly update their curricula.

In addition to the remaining categories which are less popular, a number of papers studied the views of two groups combined which are either complimentary (Azevedo *et al.*, 2012) or represent different stakeholders (Martz and Cata, 2008). In the case of the former, the authors considered the views of employers and employees across four European countries. Their purpose was to devise a framework that measured the competencies of business graduates. To do so, they administered 900 questionnaires to a range of companies. The study by the latter, approached the issue of skills differently by measuring the perceptions of students and employees about a range of issues, including outsourcing, the differences between the IS and CS fields, and the value of real-world experiences in degree courses.

The majority of the work involving paper questionnaires groups the limitations of the approach in two ways. First, there are issues affecting the scope of a given study which is likely to involve the distribution of a relatively small number of questionnaires due to the impracticalities associated with surveys; for example, targeting small groups of either students in universities (Fang, 2004), university alumni (Chrysler and van Auken, 2002) or organisations (Downey *et al.*, 2008). Second, there are issues relating to the well-documented problems with questionnaires which are described by Latham (2001):

- Sampling-related problems include issues regarding bias in responses, selecting representative samples from different stakeholder categories, and self-selections where follow up questionnaires are sent to participants who have responded earlier.
- Data-related problems which restrict any ability to explore complex data which may have direct relevance to the issues in hand.
- Wrongly interpreted questions due to the differing perceptions of the participants.
- Low response rates affecting the validity of the data due to an inability to correlate a sufficiently large sample of opinions.

Despite such problems, paper-based questionnaires offer a good way of collecting and synthesising the views of different groups by collecting rich data. Their use in the past has

been extensive owing to the popularity of survey questionnaire as a method, but also the extensive research into ways of mitigating the shortcomings of approach.

5.5.3 Data Collection Method: Survey (Newspaper Ads)

The research method used for the analysis of job skills found in advertising differs considerably from that used for questionnaires. Jobs recorded in newspaper ads offer a 'static' snapshot of the job market at the time of publication. As shown in Table 5.2 below, the ads invariably originated from employers who seek to recruit workers with the appropriate skill set that matches their requirements. While there is value in looking at the job market at a specific point in time, most researchers utilising this research method carried out longitudinal studies of the job market in an attempt to highlight trends in the evolution of skills.

Author	Discipline	Data Collection Method: Survey (Newspaper Ad)							
		Employees	Employers	Alumni	Students	Academics	Managers	Recruiters	Other
(Athey and Plotnicki, 1998)	IT		●						
(Fernandez-Sanz, 2010)	IT		●						
(Gallivan *et al.*, 2004)	IT		●						
(Maier *et al.*, 2002)	IT/IS		●						
(Surakka, 2005a)	IT (SW)		●						
(Todd *et al.*, 1995)	IS		●						
Totals	**6**	-	5	-	-	-	-	-	-

Table 5.2. Newspaper ad surveys (● - single participant involved).

A good example of such effort is found in Todd *et al.* (1995) whose early work influenced subsequent researchers. Their study examined the development of skills requirements over a period of 20 years from 1970 to 1990 by focusing on three specific job types: programmers, systems analysts and IS managers. In a similar manner, Maier *et al.* (2002) considered the variable demand of a series of technical skills over a period of time at equal intervals, while Athey and Plotnicki (1998) reviewed analogous skills during a shorter period of time but in a wider geographical area. With the exception of Todd *et al.* (1995) who concentrated on skills development within the IS market, the remaining authors took a broader view of the job market through the lens of IT. One such case is found in (Surakka, 2005a) who considered specifically the development of technical skills for software engineers by tracking changes over a period of 14 years. Apart from being related to SE, the data in this study was also specific to the US market.

So, what conclusions, if any, can be drawn from longitudinal studies that show significant skill changes over a period of 25 years? The findings in this category point to implications mostly for academia, for which there is consensus about the need to keep updating the curriculum to ensure it reflects the needs of employers. This is supported by Todd *et al.* (1995) who advocated the inclusion of more technical skills in the curriculum, while Gallivan *et al.* (2004) promoted the notion of academics learning new skills which can be passed to their students. In a similar way, Surakka (2005a) echoed the need for continuing training, seen as the means to keeping up with technological advancements.

Compared to the volume of studies encountered in the previous category of paper questionnaires, it is clear that the number of published papers in this area is smaller. Apart from a number of specific limitations which are mentioned below, analysing printed job ads is proven to be a difficult and time consuming task. At the same time, the rise of internet technologies and online communication platforms changed the landscape of IT job advertising which resulted in a significant reduction of printed ads. Furthermore, the functionality of content analysis software over the last few years expanded significantly, making it much easier to mine and analyse vast online job ad data effortlessly. Despite the advantages of this type of automation, Gallivan *et al.* (2004) made an important observation about the relationship between print-based and web-based job advertising:

> […] *print ads are purchased by column inch or by work. So, by tradition, the advertiser seeks to be parsimonious in the choice and number of words describing the required job skills within a given ad limit or ad size. Thus, print space is a limited resource. In the online world however, bandwidth is plentiful and cheap, leading to a different advertising revenue model and different advertising behavior.*

This was an important point about the potential richness of paper-based ads which, however, is difficult to quantify. A further dimension to the argument about the limitations of printed ads was raised by Todd *et al.* (1995) who questioned whether this type of ad serves more than one purpose:

> *It is reasonable to question whether newspaper ads constitute an accurate reflection of the nature of actual IS jobs. While we would argue that ads should reflect organizational skill requirements, it is also clear that organizations may employ ads for other purposes, such as image enhancement and self-promotion.*

A set of more general limitations about this type of study is highlighted by Todd *et al.* (1995), Gallivan *et al.* (2004):

- Deficiencies in sampling and coding procedures relate to the selection of newspapers which may not have a national scope, or carry only particular selection of job types as a result of employer advertising preferences.

- Geographical limitations occur when possible regional differences in skills exist but are not reflected in the ads which are carried by national newspapers.
- Bias in ads exists when the characteristics and skills of the successful candidates do not reflect closely the advertised traits sought.

5.5.4 Data Collection Method: Survey (Web)

Web technologies, along with specialist software, provide great opportunities for analysing the job market to determine the skills which are in demand. Unlike paper-based questionnaire and newspaper ads surveys discussed earlier, web-based surveys offer flexibility both in terms of collecting data as well as analysing it. Predictably, the majority of the research published in this category (Table 5.3) targets employers as the main source of information about skills requirements.

Author	Discipline	Data Collection Method: Survey (Web)							
		Employees	Employers	Alumni	Students	Academics	Managers	Recruiters	Other
(Aasheim *et al.*, 2009b)	IT	⊙					⊙		
(Alshare *et al.*, 2011)	IS				⊙	⊙			
(Baravalle and Capiluppi, 2010b)	ICT		●						
(Boyle and Strong, 2006)	IT (ERP)		●						
(Chia-An and Shih, 2005)	IT		●						
(Debuse and Lawley, 2009)	ICT		●				●		
(Goles *et al.*, 2008)	IT						⊙	⊙	
(Harris *et al.*, 2012)	IT/IS		●						
(Kennan *et al.*, 2009)	IS		●						
(Lee and Fang, 2008)	IS	⊙			⊙				
(Lee and Lee, 2006)	IT		●						
(Litecky *et al.*, 2010)	IT		●						
(Liu *et al.*, 2003)	IT/IS		●						
(Prabhakar *et al.*, 2005)	IT		●						
(Stevens *et al.*, 2011)	IT	⊙				⊙			
(Wilkerson, 2012)	IS			●					
Totals	**16**	3	11	1	2	2	3	1	-

Table 5.3. Web surveys (● - single participant involved; ⊙ - two or more participants involved).

Web-based surveys use software tools that offer different levels of sophistication. As part of a set of studies with the least reliance on technology, Alshare *et al.* (2011) examined the combined views of academics and students to determine the importance each group places on certain aspects of the IS curriculum. They achieved this by designing a questionnaire which featured the typical characteristics of a paper-based questionnaire, and made it available to their target audience online. The immediate advantage of this approach, as noted by the authors, was the opportunity to 'run' the questionnaire for a period of months, thus, achieving a higher completion rate. A virtually identical approach was demonstrated by Wilkerson (2012) whose online survey featured a web-based interface that was driven by a traditional questionnaire. In a further variation to this theme, Goles *et al.* (2008) carried out their survey by emailing a web address to their target audience which enabled them to access and complete the survey online. Boyle and Strong (2006) adopted an approach that emulated Wilkerson's, as did Lee and Fang (2008).

In studies with the arguably the heaviest reliance on technology, web technologies have been used to extract and analyse vast data sets that would be impossible to process manually. A representative example of this approach is found in Litecky *et al.* (2010) who used a data mining application to extract approximately 250,000 IT jobs in the US using various search engines. Five years earlier Prabhakar *et al.* (2005) had used a similar approach that enabled them to build a picture of the popularity of skills within the IT market in the US, by extracting job ads using similar popular job search engines. The idea of building a representative national profile for the entire IT job market, but this time in the UK, inspired Baravalle and Capiluppi (2010b) to develop a sophisticated system that captured and analysed thousands of jobs ads from UK-specific online outlets. By developing a data mining extractor that parses relevant keywords, the authors were able to form a metric for IT jobs by order of skill. As the system continues to gather job ad data over time, it will become possible to build a longitudinal map that depicts the evolution of skills in the UK market.

A further set of studies that show moderate reliance on technology, take advantage of specialist software to enable the analysis of data moderate amount of data collected from the web. Examples of this can be found in work which originated from Australia. Kennan *et al.* (2009) examined the Australian IS graduate job market by using a content analysis software tool that analyses data patterns and infers relationships. The main difference between this type of work and that which uses data mining techniques almost indiscriminately to extract tens of thousands of data records, is down to a more constrained approach in the application of the web tools. More specifically, the Australian researchers applied their data collection techniques to a much more focused dataset that maps to IS as opposed to IT job ads. Furthermore, the data gathered was reviewed by specialists who were able to apply complex rules in order to determine whether a job ad can be classified as IS or not. Data filtering of this

kind is also found in a US study by Chia-An and Shih (2005) who targeted job ads that meet specific criteria derived from keywords that map to job types. Thus, instead of searching for IT jobs in general the authors use keywords that describe aspects of the IT field, such as help desk support, administrator or end user.

The ability to draw on large data sets using an automated approach offers additional advantages. A good example of that is found in another Australian study by Debuse and Lawley (2009). Instead of focusing on one country, the authors use matching categories populated by data from Australia and the US. This offers the opportunity not only to formulate national trends in job skills but, more importantly, perform a comparative study that examines the correlation of the data between the two countries. Given the availability of similar data in other countries, it would be possible to map entire regions, which could then give rise to even wider comparisons.

More than half of the 16 papers that make up Table 5.3 use job ads originating from Employers to capture the proliferation of skills. Further work, such as that by Wilkerson (2012), Stevens *et al.* (2011), considered the views of alumni and employees/academics respectively. From a methodological standpoint, neither of these examples reveal any new insights as neither do Aasheim *et al.* (2009b), Lee and Fang (2008) or Alshare *et al.* (2011), as all of their approaches fall within the same model. It is worth noting, however, that the use of technology offers more diversity than more traditional approaches.

The conclusions originating from these studies are influenced to a certain degree by the 'amount' and type of technology utilised in each case. For the first category of work that uses technology to 'dress up' an otherwise conventional survey approach, the consensus is that professionals need to continue updating their skills with the support of employers, while academia must keep up with the skills needs of industry. The second category of studies that involve large record sets analysis subjected to automated extraction and analysis tools, tends to make recommendations about specific skills which make up the profile of job category such as IT or an entire country. Prabhakar *et al.* (2005) make this point in the following way:

> *In an improving job market, it is increasingly important for IT professionals to be aware of the demand for specific skills. Professionals should also pay attention to the skills for which demand may be growing in order to better position themselves in the competitive job market. Web programming, Unix, C++, Java, SQL programming, and Oracle database seem to be the top six skills in the current job market.*

Similar to the way in which the conclusions are presented, the limitations of the research method discussed in this section follow the same pattern. For the first category the limitations are analogous to those presented in the earlier section that examined paper-based questionnaires. At the same time, large scale data analysis that results from data mining is subject to internal, external and construct validity (Baravalle and Capiluppi, 2010b). In broad

terms, validity relates to how accurately the data collection process and the appropriateness of the chosen data items to be good representatives of what needs to be measured.

5.5.5 Data Collection Method: Survey (Interviews)

Interviewing is a useful method for obtaining information that often can only be elicited by asking questions which are phrased in a specific way. Schultze and Avital (2011) argued that interviewing is unrepresented in IS although it has been shown to work well. Myers and Newman (2007) shared this view in their paper that examines the use of interviews in IS research. The essence of interviewing is explained by Fontana and Frey (1994):

> *It can be used for marketing purposes, to gather political opinions, for therapeutic reasons, or to produce data for academic analysis. It can be used for the purpose of measurement or its scope can be the understanding of an individual or a group perspective. An interview can be a one-time, brief exchange, say five minutes over the telephone, or it can take place over multiple, lengthy sessions, sometimes spanning days, as in life-history interviewing.*

Like all data gathering techniques, interviews are only suited to particular situations. Gathering hefty volumes of data from a large range of sources is not one of them. Published research that uses interviewing as the means for gathering and analysing skills data is relatively small. Table 5.4 includes a representative list of such work.

Author	Discipline	Data Collection Method: Survey (Interviews)							
		Employees	Employers	Alumni	Students	Academics	Managers	Recruiters	Other
(Benamati *et al.*, 2010)	IS					●			
(Chang *et al.*, 2010)	IS				●				
(Cheney *et al.*, 1989)	IS						●		
(Ehie, 2002)	IS						●		
(Nettleton *et al.*, 2008)	IT								●
(Simon *et al.*, 2007)	IT						●		
Totals	**6**	1	-	-	1	1	3	-	1

Table 5.4. Newspaper ad surveys (● - single participant involved).

In an article published in the Communications of the ACM, Benamati *et al.* (2010) contended the need to align the IS curriculum with industry needs. Their argument was driven by the paradoxical situation of falling IS undergraduate enrolments and rising demand for IS graduates in the US. In trying to explain this anomaly, the researchers conducted 32 thirty-minute interviews with academics from different US universities. Interestingly, the interviews

were designed to identify complex changes over time and not lists of skills (Benamati *et al.*, 2010):

> *Interview questions addressed curricular changes within the past five years, curricular changes currently in process, involvement of an advisory board, and marketing.*

A group of Australian academics used interviewing techniques to elicit the views of professional societies to better understand their perspective on the importance of developing the right skills for students (Nettleton *et al.*, 2008). They concluded that professional societies think that, contrary to general employability skills, work-ready skills are neglected, and thus, changes need to be made to the curriculum. The analysis of the data from structured interviews with 79 IS managers was discussed in a paper by Cheney *et al.* (1989). The purpose of these interviews was to consider the significance of the skills identified by IS managers in relation to the IS curriculum recommendation (Nunamaker *et al.*, 1982). In a similar manner, Ehie (2002) conducted 24 interviews with US company representatives in an attempt to devise an IS curriculum that reflected the industry's needs. A larger number of structured face-to-face or telephone interviews was documented by Simon *et al.* (2007) who argued that the size of organisations affects the skills they need and expect from the employees. The authors reached this conclusion by analysing interview data from 100 senior managers representing different industries. The evidence gathered pointed to healthy demand levels for IT graduates with a good mix of business and technical skills. Although the specific conclusions drawn from these studies are heterogeneous due to their diverse focus, the same theme noted in previous sections about the need to revise the curriculum is also present here. Benamati *et al.* (2010) made this point in their concluding remarks:

> *In summary, although some IS curricula are being updated to conform to industry's emerging needs, there is reason to believe that the gap between supply and demand will widen over the coming decade. The solution is a coupling of curricular changes with marketing efforts.*

The lack of a discussion in the papers considered about possible limitations of the approach should not be misinterpreted. As a research instrument, interviewing is prone to limitations. Myers and Newman (2007) offered nine points that summarise some of these limitations, with the most relevant for the discussion in this section being lack of time, level of entry and artificiality of the interview.

5.5.6 Data Collection Method: Survey (Mixed Methods)

The last category of research used to ascertain the skills required by industry is conveniently named mixed methods, reflecting the combination of different techniques. Table 5.5 captures some of the most representative publications in this area. As expected, the

combination of techniques are not random. In all cases the predominately qualitative methods are complimentary, aiding the researchers in gaining richer data from their sources.

Author	Discipline	Data Collection Method: (Mixed Methods)							
		Employees	Employers	Alumni	Students	Academics	Managers	Recruiters	Other
(Bailey and Mitchell, 2006) (questionnaire + focus groups + interviews)	IT (PRG)	●							
(Cheney and Lyons, 1980) (interviews + questionnaires)	IS						●		
(Havelka and Merhout, 2009) (multi-step group sessions)	IT						●		
(Huang *et al.*, 2009) (scholarly lit. + practitioner pubs. + web ads)	IT/IS	⊙							⊙
(Kurnia, 2007) (interviews + questionnaires)	IS				●				
(Lee *et al.*, 1995) (focus groups + questionnaire)	IS	⊙					⊙		
(Merhout *et al.*, 2009) (focus groups)	IT/IS						●		
(Nagarajan and Edwards, 2009) (interviews + web survey)	IT	●							
(Petrova and Claxton, 2005) (focus group + questionnaire + web ads)	IT/IS		⊙		⊙	⊙			
(Trauth *et al.*, 1993) (focus groups + questionnaire)	IS	⊙				⊙	⊙		⊙
Totals	**10**	5	1	-	2	2	5	-	2

Table 5.5. Mixed surveys (● - single participant involved; ⊙ - two or more participants involved).

One of the earliest and most notable examples of this type of work is seen in Cheney and Lyons (1980). Their study reported on the relationship between IS skills and employment trends in the US by combining interview and questionnaire techniques. Although the sample size of 32 could be seen as small, the authors view the combination of their techniques and the selection of companies that make up the sample as sufficiently representative. This approach of incremental data gathering was also observed in Lee *et al.* (1995) where the structure and content of questionnaires given to IS managers and employees was driven by emerging issues raised during a series of focus group discussions. Wanting to minimise any bias in their approach, the researchers combined people from industry and academia to conduct the investigation and manage the data collection process. A virtually identical incremental approach is also present in the work of Trauth *et al.* (1993) who used focus groups and questionnaires to elicit meaningful data about the existence of skills gaps by interrogating four different stakeholder groups. They described their efforts as a multi-phase approach of qualitative and quantitative data gathering over a period of five years.

Over twenty years later Petrova and Claxton (2005) set out to test a series of hypotheses to determine the perceptions of employers and students about the value of skills and their delivery through the IS curriculum in New Zealand. The justification in this case for the multi-phase approach rested with what the authors saw as the need to validate their findings through data triangulation. At almost the same point in time Bailey and Mitchell (2006) were focusing on an investigation in the US on the skills needed to support computer programmers. They employed a four step approach which considered online postings of job descriptions, on-site semi-structured interviews, focus group discussions, and web-based questionnaires. Concentrating on Australian students this time, Kurnia (2007) described the combination of interviews and questionnaires as a single study consisting of a qualitative and a quantitative element. The study found that IS professionals are expected to possess certain key skills. Another Australian study by Nagarajan and Edwards (2009) scrutinised the perceptions of recent IT graduates to determine their views on the contribution skills in their curriculum made to their professional well-being. It, too, used a combination of interviews and online surveys for the same reasons discussed earlier.

An overall observation made by the majority of authors in the section, echoes an earlier stated conclusion that the IS supply of students appears to be outstripped by the industry demand for IS professionals. Merhout *et al.* (2009) considered this issue worth investigating further by focusing on IS student behaviour, as did Nagarajan and Edwards (2009). More specific conclusions which feature in the majority of the work reviewed relate to implications for academia of the curriculum and for industry of the evolution of the IS/IT profession. The former is summarised by Lee *et al.* (1995):

> *Our findings suggest that the current IS curricula in many universities are not well aligned with business needs.*

The latter is described by Trauth *et al.* (1993):

> *Neither practitioners nor scholars, working alone, can shape our field. The issue is not defining who should lead and who should follow but rather creating a productive partnership. To do so we must open up the lines of communication and change perceptions. For example, during the initial data gathering activities, some IS managers had the impression that the purpose of the study was to enable practitioners to tell educators what to teach. Professors, meanwhile, at times became defensive about their "turf."*

Limitations in data collection methods that use multiple techniques are difficult to quantify. As demonstrated in previous sections, each approach has its own disadvantages which need to be considered in the context of the study undertaken. In all the cases examined here, the combining of data gathering techniques is used to ensure that single technique limitations do not hinder the overall quality of the data collection process. Where limitations are explicitly

stated, as is the case with Trauth *et al.* (1993), Cheney and Lyons (1980) and Merhout *et al.* (2009), they tend to concentrate on earlier discussed shortcomings regarding the use of interviews and questionnaires.

5.5.7 Selecting an Appropriate Data Collection Method

Selecting the most appropriate data collection method that leads to the accurate identification of what IS employers seek from graduates can potentially be achieved in different ways. As the earlier background research analysis showed, a large number of studies use questionnaires despite the fact that the bulk of IT job advertising is carried out online. Nevertheless, eliciting relevant information about the views of IS employers or employees through questionnaires can be very useful, as shown on different occasions (Igbaria *et al.*, 1991, Downey *et al.*, 2008, Leitheiser, 1992). Equally, studies which concentrate on trends about skills through the analysis of vast datasets also have an important role to play (Benamati *et al.*, 2010, Prabhakar *et al.*, 2005). Being able to select the most appropriate job skills data collection and analysis method is predicated on having a clear understanding of the requirements of a given study and the objectives it tries to meet. Undoubtedly, sending a few hundred questionnaires to a small group of companies requesting information about the IS skillset of their workforce is useful, but unlikely to provide conclusive data about the change in skills over a period of time at national level. Likewise, understanding the skills requirements of IS graduates cannot be achieved by indiscriminately analysing skills found in IT job ads posted online.

Considering one of the overarching objectives of this research to analyse skills requirements of IS graduates as stated by employers, the design of the IS graduate skills analysis study in this thesis needs to address the following three objectives:

- What are the specific IS skills that UK employers expect IS graduates to possess when searching for their initial IS jobs fresh out of university?
- What are the most common jobs which are normally offered to IS graduates across the UK?
- What other supporting information, such as national salary data, location of jobs, levels of experience and qualifications, do employers specify when advertising IS graduate positions?

Specifically regarding the last objective governing the IS graduate skills survey, it is important to remember that the focus of such survey needs to be particularly narrow if the objective of only considering graduate IS skills is to be met. Thus, gathering ad data regarding prior experience, qualifications and salary levels is necessary in order to exclude advertised

positions outside the immediate scope of graduate employment opportunities. As Keenan (2009) explained:

> *A second reason for restricting the analysis to jobs appropriate for recent graduates is the belief that after several years in the workforce, experience and post graduate studies become increasingly important in decisions about the employability of candidates. The findings of other research indicate that different knowledge and skills are valued in higher level positions (Zwieg et al. 2006, p104). This would be reflected in the content of the ads and lessen the usefulness of the findings of this research for establishing what knowledge, skills and competencies are sought in new graduates.*

In order to establish which of the earlier discussed data collection methods best support these objectives, each one needs to be examined separately.

Questionnaires

The use of questionnaires to capture IS jobs skills is well documented, as shown in section 5.4.2. Although much of the published work in this area considers the popularity of IS skills, the majority of that focuses on the skillset affecting the wider IS profession as opposed to graduates. Nevertheless, a small number of studies focusing specifically on IS graduates do exist. These surveys mainly target employers engaging in the recruitment of graduates. In one such example, Downey *et al.* (2008) argued as part of their analysis of previous research that the majority of past studies focused on either critical skills or the skills promoted by the curriculum, and that only a small number of studies, such as Noll and Wilkins (2002), considered the viewpoint of stakeholders. To address this gap in research, the authors conducted a questionnaire survey targeting a small number of organisations in order to ascertain the requisite skills of graduates and how these skills can be embedded into the curriculum. Even though the findings of the study were particularly useful, the use of a questionnaire constrained the authors to a small sample of companies, contained within a small geographical area, and affiliated to a particular academic institution. As the authors of the work concluded, the findings did not permit any generalisations, rendering this type of approach unsuitable for studies seeking to cover large geographical areas. Another study that highlights the same limitation of questionnaires being administered to small geographical areas is found in Aasheim *et al.* (2009a) whose study examined the entry level skills needed by IT graduates. In this case, the study compared the views of managers and academics to conclude that there was gap between the relevant skills that the two stakeholder groups perceived as important. In a further final example, Cappel (2001) demonstrated through the use of a selective questionnaire, that employers rate non-technical skills as being more important than technical skills. The questionnaire findings also showed that work experience was a crucial factor for employers, as was the ability of new professionals to learn on the job. Despite the importance of these findings, the author acknowledged that the findings were

derived from a very restricted sample, making it difficult to offer safe extrapolations about the wider job market.

It is evident from the above analysis that adopting a questionnaire as the primary data collection method for a UK-wide study such as this one, would be problematic. Questionnaires are powerful survey instruments capable of eliciting specific information that can otherwise be difficult to obtain. They also support the simultaneous collection and comparison of views from different stakeholders, which facilitates deeper understanding of the issues that often cause friction between them (Martz and Cata, 2008, Lee *et al.*, 2002, Zhao, 2002). Nevertheless, the objectives of this IS job skills study require the analysis of IS skills across the entire UK. Targeting representative companies throughout the UK would be a very resource intensive exercise with a relatively small probability of success. Such an approach would require a number of unverifiable assumptions, for example identifying companies that specifically recruit IS graduates, ensuring enough such companies were found in all parts of the UK, and yielding a sufficiently high response rate to either paper or online questionnaires.

Newspaper Ads

The analysis of job ads appearing in newspaper publications has the unique characteristic of invariably originating from employers. Of the small number of past surveys using this approach, the work by Todd *et al.* (1995) and Maier and Gambill (1996) is considered to be quite influential from a methodological standpoint. In particular, the former conducted one of the largest longitudinal studies of IS jobs, covering the publication of ads over a period of 20 years. This work is also seen by many as important because it offers one of the earliest cases where content analysis was used successfully. In the case of the latter, a study of job ads spanning 15 years was completed by reviewing ads published in 5 newspapers across the US.

While there are important advantages to this approach as discussed in section 5.4.3, the current number of IS job ads published by UK newspapers is extremely small. Therefore, this method was excluded on the basis of data unavailability.

Interviews

Utilising interviews to ascertain the popularity of job skills offers significant advantages. Interviews can be designed to be very focused, capable of extracting qualitatively rich information. This is evident by the small number of studies in this area which made use of this particular data collection method. Nettleton *et al.* (2008) successfully used interviews to engage eight professional societies in Australia, in their efforts to understand the roles of professional bodies in determining skills. With a much wider scope, Simon *et al.* (2007) conducted over 100 interviews with IT executives in order to understand how different organisations value critical skills. A smaller number of interviews were carried out by Benamati *et al.* (2010) who consulted 47 senior US university officers on their efforts to align the

undergraduate IS curriculum with industry needs. The efforts described as part of the last two publications reflect similar efforts which took place 20 years earlier, when Cheney *et al.* (1989) interviewed a comparable number of IS professionals to ascertain their views about the prevailing skills in IS at that time.

While the findings deduced through interviews are some of the most interesting encountered from all the categories so far, they remain constrained by the same limitations affecting questionnaires. Data derived from interviews is determined by the people participating, and as such, it can be a narrow representation of the wider views regarding an issue such as the importance of skills (Tan and Taizan, 2007). Lack of anonymity may also lead to interviewees being economical with their answers (Scott *et al.*, 2009), but perhaps more importantly interviews can be very resource intensive (Myers and Newman, 2007). On this basis data collection through interviewing was deemed inappropriate for the UK wide study.

Mixed Methods

Conceptually, mixed methods as a data gathering approach is not different from the previous categories. The main idea behind studies that use mixed methods is to customise different data collection approaches in order to capture rich data which can be subjected to cross-referencing and incremental expansion. In one of the seminal studies on job skill analysis, Trauth *et al.* (1993) utilised the combination of focus groups and questionnaires to address the very issue that characterises the nature of this research: industry expectations vs. academic preparation. Lee *et al.* (1995) carried out a similar study two years later, using the same combination of focus groups and questionnaires to conduct a further joint academic and industry investigation in relation to knowledge and skills expectations. Another selection of publications that can be grouped together according to their similar combination of methods can be seen in Cheney and Lyons (1980), Kurnia (2007), Bailey and Mitchell (2006). In all three cases, the authors combined questionnaires with interviews, and on one occasion focus groups, to enhance the quality of their data. For similar reasons of data quality but also widening the scope of their study, Huang *et al.* (2009), Nagarajan and Edwards (2009), Petrova and Claxton (2005) added the collection of web ad data in the earlier mix of interviews and questionnaires. Undoubtedly, the combination of different data collection techniques enhances considerably the scope of any study, by offering complimentary data sources which can often fill data gaps occurring due to individual technique limitations.

Despite such an advantage, a data gathering approach benefiting from the mixing of different data collection methods, remains susceptible to the inherent limitations of each method. Lee *et al.* (1995) demonstrate this point by explaining that the scope of their study had to be limited to a particular small geographical area, while Kurnia (2007) focused on graduates from one institution. Considering the advantages of mixing data collection methods for the benefit of the

UK wide survey of this research, needs to rely on the balance between employing a method which offers holistic coverage and the resources needed to combine different methods. Having argued earlier the inappropriateness of interviews and questionnaires due to their limited geographical scope, it seems highly unlikely that any of the remaining methods are capable of producing desirable results. Clearly, focus groups mixed with limited web surveys and the review of publications cannot ensure sufficient results for a study is focused on graduate skills across the UK.

Web Ads

The clear majority of surveys whose data originates from the web focus on employer requirements for employees possessing a predetermined set of skills. Web-based surveys, as discussed earlier, can be categorised according to their scope and the involvement of software tools used to capture, process and analyse relevant data. With regard to scope, the near universal online availability of job ads covering all the discipline of IT, provide numerous opportunities for studies which can have a narrow (Marion *et al.*, 2005, Kennan *et al.*, 2009, Goles *et al.*, 2008) or wide (Prabhakar *et al.*, 2005, Litecky *et al.*, 2010, Baravalle and Capiluppi, 2010a) view of the job market. Demonstrably, web-based surveys are not only benefiting from the universal availability of data at local, national and international level, but also generic or bespoke software tools which facilitate its analysis. Methodologically, the majority of web-based surveys are centred on the use of unobtrusive surveying of data which largely conforms to the principles of content analysis.

Considering the requirements of this UK study stated earlier as three distinct objectives, it appears that the work by Marion *et al.* (2005), Debuse and Lawley (2009) and in particular Kennan *et al.* (2009) offer an extremely close match. The Australian content analysis study carried out by Kennan *et al.* (2009), is the only study which has specifically considered the IS graduate requirements expressed by employers at a national scale. Unlike most of the other useful but wider work, these researchers implemented very strict data selection controls, which arguably offer the highest level of ad segregation of any study. By imposing strict data selection protocols, it also became possible to collect additional data which enhances the findings of the study but without deviating from its narrow focus of IS graduate positions.

Contrasting the reviews of earlier approaches with the review of the approach employed by Kennan *et al.* (2009), strongly indicates that it is possible to perform a similar study for the UK market which will satisfy all of the aforementioned objectives. However, it is important to note that web-based studies, irrespective of their narrow and well defined scope, are not immune to shortcomings. The analysis of these limitations is discussed in Chapter 7 which presents the design and implementation of the job ad study of this research, while a discussion

about the content analysis method that underpins the research approach of the study is offered in the next section.

5.6 Content Analysis

Despite a commonly encountered perception of being a fairly simplistic survey method, content analysis is in fact a sophisticated tool, capable of supporting a wide range of research problems. In an attempt to establish its position as one of the fastest growing quantitative research techniques and dispel certain 'myths' about its ease of application, Neuendorf (2002) explains that content analysis can be as easy or difficult to apply as the circumstances require it. This is, indeed, a very important point about content analysis and the research method implications it has for this research, as will be shown in the following section.

Content analysis is a research method that dates back to the 1940s when, according to Krippendorff (2004), the term appeared in English for the first time. Documented examples of manually performed content or text analysis can be found as early as the 1950s (Neuendorf, 2002), with more noticeable studies occurring during the following decade (Weber, 1990). The inevitable growth of content analysis is often linked to the propagation of information that continues to grow today as part of the ubiquitous nature of the internet. As more unstructured and semi-structured data is amassed, the need to analyse it, preferably using automated means, continues to grow (Fico *et al.*, 2008). Krippendorff (2004) describes content analysis as a systematic analysis of text, images and other content with particular semantic value from a neutral perspective. Neuendorf (2002) claims that content analysis is one of the fastest growing quantitative research techniques that provides quantitative analysis of messages emanating from a variety of sources that feature rich content, such as print and online media. Offering a more formal definition, Weber (1990) states:

> *Content analysis is a research method that uses a set of procedures to make valid inferences from text. These inferences are about the sender(s) of the message, the message itself, or the audience of the message.*

A summary of the most frequently stated advantages of content analysis are best presented by Krippendorff (2004). In its application, content analysis is unobtrusive, and as such, does not require external intervention. This can be a very important characteristic in situations where implied interest expressed by the action of collecting data, can cause humans possessing the information to manipulate, and by implication, distort it. In less 'extreme' situations, attempts to extract data from human sources, such as cataloguing past events, may cause inadvertent distortions as a result of inaccurate recollections. A further advantage of content analysis is seen as its ability to manage unstructured data or content which does not lend itself to easy tabulation or coding based on structured rules. At the same time, unlike many conventional research methods such as surveys or experiments, context analysis is

capable of manipulating and analysing very large quantities of data. There have been many documented cases where tens of thousands of data sources, such as newspaper articles or television content, have been included in a single sample of a content analysis study.

One of the most commonly stated disadvantages of content analysis relates to the criticism about lacking a theoretical basis that stems from its focus on 'measuring' the occurrence of events, phenomena or instances, as opposed to the underlying theoretical significance that such occurrences may have (Neuendorf, 2002, Krippendorff, 2004). Alongside this main limitation, Harwood and Garry (2003) list a series of lesser issues which deserve attention, such as the lack of credibility as a result of low reliability, validity and sampling measurements, and the overall methodological limitation relating to primarily being a method suited for the analysis of communication materials. Kim and Kuljis (2010) raises a further valid point about web-based content analysis being susceptible to constantly changing content, which, however can be addressed by performing rapid data collections or making permanent copies of the content of websites, making them available for later analysis.

Often, authors who have investigated the nature of analysis from a research method perspective, try to qualify their definitions of it by giving examples of its use in different contexts. Both Weber (1990) and Krippendorff (2004) borrow examples from Berelson (1952), to demonstrate the use of content analysis in situations requiring the comparison of media of communication, reflection of cultural content, intentions of communicators, reflection of attitudes, detection of propaganda, and many more. The wide variety of uses of context analysis capable of addressing the diverse needs of research problems which can benefit from it, are best characterised by a descriptive classification of techniques that denote variations to the main theme of context analysis (Janis, 2008, Harwood and Garry, 2003, Krippendorff, 2004):

- Pragmatic content analysis examines the possible cause or effect denoted by the frequency of items encountered in a particular context.
- Semantical content analysis is geared towards analysing the meaning of a phenomenon occurring within a given context.
- Designation analysis considers the frequency of occurrences or references to an object.
- Assertion analysis relates to the thematic analysis of objects by measuring the frequency of references to them.

In their discussion about content analysis as a method capable of facilitating empirical study, Fico *et al.* (2008) trace the emergence of the method to the social sciences. They capture its essence through its application as part of a number of operational steps:

> *In operational terms, content analysis involves a number of distinct steps. Having developed a particular research idea (conceptualization) that is suited to content analysis (rather than, say, an experiment), the researcher designs the study to achieve the particular research goal. That means the researcher must specify the unit of communication content to be examined (unitization); indicate any sampling of content that is to be used (sampling); identify the variables on which the unit of content is to be measured, provide operational definitions for the variables in the form of a coding protocol or set of instructions (operationalization), assess the reliability of the coding and measurement (reliability), and discuss the validity of the measures (validity).*

A significant part of the inherent complexity associated with most aspects of content analysis is not always present in studies such as computerised job ad analysis. This is because many of the critical aspects of the method, as described by Fico *et al.* (2008) above, have their impact minimised due to the simplistic nature of job ad surveys which often lack the need for inferences and extrapolations, and the use of computer software which eliminates human errors in coding. Before the mitigation of these issues can be elaborated upon further, it is important to consider them in more detail.

Sampling

Sampling is described as a process by which a subset of *units* is derived from the overall content for the purpose of analysing it. This is necessary because, in the vast majority of cases, an entire dataset can be extremely big, and thus very difficult and time consuming to manage (Neuendorf, 2002). According to the same author, a *unit* in this context, denotes an element of data which can be used to populate variables or be part of some structured analysis. Fico *et al.* (2008) reiterates the same point by explaining that obtaining a representative sample which will provide an adequately large and statistically significant number of *units* can be achieved either through probability sampling or a census of the entire dataset. Because censuses, as mentioned earlier, are impractical, a number of different sampling techniques have been devised to enable the most accurate collection of a sample depending on the overall size of the dataset. The main categories of sampling techniques are described as random sampling and non-random sampling techniques (Neuendorf, 2002). Utilising an appropriate random sampling technique ensures that results derived from the data analysis methods can be generalised, and thus demonstrate relevance and applicability for the entire census. Random sampling techniques are invariably preferable to non-random sampling techniques which, according to Neuendorf (2002), should only be used when no alternatives exist. Even in such cases, the generalisability of findings would be questionable.

Reliability

Explained in simple terms, reliability is related to the notion of consistency in the processes of collecting and analysing data. Weber (1990) explains that a content analysis classification procedure can only be reliable if different groups of people (coders) applying it

end up producing the same results. Demonstrating this principle in practical terms could be seen as two individuals working in parallel with the same content, producing identical results by selecting the same representative samples from a particular category. The broad distinction between types of content analysis reliability is expressed as intercoder and intracoder reliability. In the case of the former, reliability is present or absent among different coders working on the same data, whereas the latter relates to a single coder being able to reproduce the same results every time. The essence of testing reliability relies on assessing the performance of coders. As a general rule, two or more sets of coders working independently are either provided with units to be coded for a given sample, or they are asked to derive them according to a specific protocol. As each coder applies the protocol, their agreements and disagreements are recorded and compared, providing scores for each variable they code. High disagreement scores suggest low reliability, since the protocol used for coding the same units/variables is producing different results depending on the person implementing it (Fico *et al.*, 2008).

Validity

The issue of validity in content analysis but also all other research approaches is very important. As a general characterisation of what it at stake Krippendorff (2004) states:

> *Validity is the quality of research results that leads us to accept them as true, as speaking about the real world of people, phenomena, events, experiences, and actions. A measuring instrument is considered valid if it measures what its user claims it measures. A content analysis is valid if the inferences drawn from the available texts withstand the test of independently available evidence, of new observations, of competing theories of interpretations or of being able to inform successful actions.*

Despite the importance of the concept, the issue of validity is described and organised in different ways by most authors. Fico *et al.* (2008) arrange validity into two main categories: internal and external. In the case of the former the authors argue that it relates to the establishment of a casual relation or, as Harwood and Garry (2003) explain, the classification scheme in action being representative of any research hypotheses. In terms of the latter, the concept of validity relates to the results of a given study corresponding with those produced in the past by similar studies, and also with results which will be generated by future studies. On face value, it is easy to assume that validity is directly related to reliability, and therefore, by improving reliability it is possible to improve validity. However, as Krippendorff (2004) explains:

> *Two observers of the same event who hold the same conceptual system, prejudice, or interest may well agree on what they see but still be objectively wrong.*

Krippendorff's assertion effectively states that while it is possible to have two independent observers replicating the same finding due to their identical precondition which demonstrates high reliability, it is still possible for both of them to misinterpret the meaning of the findings

they observe, and thus produce an error that shows very low validity. At the same time, Krippendorff makes the important point that the possibility of increasing the validity of the results is normally hindered by the low reliability. So, the more unreliable the process of ascertaining a set of results, the more likely it is that they will be invalid. In a further attempt to qualify the efforts of achieving validity in content analysis Krippendorff (2004) provides a series of validation efforts which should be taking into consideration. Some of these will be considered in the next section that introduces the use and application of content analysis for the purposes of conducting the web-based job ad analysis of this research.

5.7 The Content Analysis Survey - Graduate IS Job Ads in the UK

The existence of a carefully designed and well implemented content analysis survey looking at IS graduate skills in Australia by Kennan *et al.* (2009), but also to some extent Marion *et al.* (2005), Debuse and Lawley (2009), offers significant credence to the decision to carry out a similar study for the UK market. In an attempt to add further weight to this decision, it was considered prudent to consider at least two more studies which exhibited similar characteristics. The lack of previous UK studies in IS led to a search for other UK-based surveys that were methodologically very similar.

One such example was found in Sodhi and Son (2010) who carried out a very similar study of Operational Research (OR) job advertisements to ascertain required skills in the UK. The authors' approach in this case appears virtually identical to Kennan *et al.* (2009). Their data collection method considered a geographical boundary that restricted the scope of the sample, while the data harvested from popular job search websites was derived using specific selection criteria (variables). Furthermore, the analysis was characterised primarily by univariate and bivariate analysis, although some further statistical techniques were used to derive correlations between data groups. A methodologically similar study can also be found in Kim and Kuljis (2010) who examined the web-based content as part of their analysis of blogs authored by UK and South Korean users. Both of these content analysis studies, as is the case with Todd *et al.* (1995), Debuse and Lawley (2009), Kennan *et al.* (2009), Marion *et al.* (2005), consider carefully the content analysis issues of sampling and validity to ensure the maximum validity of their approaches which will support the generalisation of their findings. As expected, these issues are of importance to the UK based IS survey in this thesis, and as such they deserve some attention below.

Sampling, Reliability and Validity

Determining the right sample is an important consideration which can have serious implications for the overall reliability and validity of any study. Careful consideration of the sampling strategy for the UK web-based job ad survey led to an early investigation regarding

its potential sample size. Initial test searches showed that the probable number of ads which would meet the strict ad selection criteria was relatively small. Therefore, the decision was made to include the entire census of returned ads. As Neuendorf (2002) explains, the existence of small and manageable sample populations removes the need for applying any of the random sampling techniques, since the existence of the census offers maximum level of confidence in the validity of the sample. Krippendorff (2004) elaborates on this point by explaining that sampling validity becomes problematic in all the studies which cannot incorporate the census for practical reasons, because whenever a sample is smaller than the census, unavoidable bias exists.

Another issue that has a significant impact on the validity of content analysis studies relates to the reliability of coding. Traditionally, reliability regarding coding has been associated with human coders (Neuendorf, 2002, Fico *et al.*, 2008, Harwood and Garry, 2003). In every case, improving the reliability of coding relies on training human coders to avoid bias being introduced inadvertently. Despite the amount of training, however, it is not theoretically possible to remove unreliable assessments of coding when relying on humans who are making subjective decisions about the nature of the data being coded. Neuendorf (2002) explains further that the various statistical methods (intercoder reliability coefficients) of calculating the level of reliability can sometimes produce unsatisfactory results which may necessitate the removal of a coder from the coding process. The introduction of computer software, eliminates the need for manual coding by utilising a coding dictionary. As such, any reliability calculations prior to the analysis of the data become redundant (Neuendorf, 2002).

5.8 Summary

One of the characteristics of the research presented in this thesis relates to the existence of two comparable but ultimately different types of surveys. The need for each survey stems from the objectives of the thesis which set out to examine the positions of two of IS' stakeholders in relation to skills. As such, the surveys are inter-related with many common features which make them methodologically similar. Despite their similarities, it is important to carefully examine the relevant literature in order to ascertain the best possible way of designing each of the surveys, based on validated research findings from previous studies.

As a result, this chapter was made up of two halves corresponding to the IS curriculum and IS job skill survey. In the first half, past research on the different ways of mapping the IS curriculum was considered carefully. The literature review gave rise to the creation of an IS curriculum mapping approach for the undergraduate provision in the UK. Constraints and shortcomings identified in earlier work were considered as part of the study design to ensure its quality. This meticulous approach will give rise to an IS Course Survey Framework and career tracks, two artefacts derived from the survey in Chapter 6, neither of which have been

developed previously. The second part of the chapter covered another detailed literature review regarding the design and analysis of job ad surveys. With a variety of data collection methods available, the discussion considered the advantages and disadvantages of each method, ensuring that the UK graduate skills survey presented in Chapter 7 meets all the objectives of this research.

6 IS CURRICULUM CLASSIFICATION

6.1 Introduction

The previous chapter discussed the research theory and methodological approach adopted for the purposes of completing the IS curriculum and graduate job skill surveys. This chapter presents the comprehensive mapping of the IS curriculum across UK universities. Given the size and complexity of the task, the discussion initially focuses on a pilot study that was designed to test the course mapping approach within a small geographical area, which includes a collection of heterogeneous institutions with varying emphasis on teaching and research. Lessons from the pilot are subsequently applied to a more extensive study that engages two classification methods to map the entire UK curriculum. As each of these two classification methods are assessed, the limitations which became evident lead to the conclusion that neither method is adequate. Consequently, a further survey is undertaken, resulting in the development of a robust Course Classification Framework and the identification of the Career Tracks promoted by the IS curriculum.

6.2 Surveying the IS Curriculum in the UK

The objectives of this IS curriculum survey are three-fold. The first objective is to provide an original and comprehensive view of the overall IS undergraduate curriculum in the UK. This is achieved by undertaking a module classification exercise that provides a clear view of how UK course developers are interpreting the current state of the IS field through the process of course design, curriculum development and course validation. The second objective considers the deeper analysis of the curriculum by filtering the captured data through a well-established model curriculum. In doing so, it becomes possible to examine the relationship between IS and other hierarchical and non-hierarchical disciplines, all of which contribute to the totality of the IS curriculum. The third, and final objective, enables the mapping of the IS curriculum onto career tracks that show the professional positioning of the field as perceived by academia.

Currently in the UK there is no evidence to suggest that a comprehensive mapping of the IS curriculum has previously been carried out. Even the most recent concerted effort by CISP to analyse the IS discipline in the UK, lacks any data about course provision at university level (Stowell and Probert, 2012). Professional bodies such as UKAIS and BCS offer no data in this area either. The absence of a similar past UK study exacerbates certain survey design

difficulties regarding the sourcing of accurate and comprehensive course data, choosing an appropriate vehicle for the analysis of the data, and developing a mechanism that enables any accurate repetition study in the future for the purpose of both validation and also longitudinal comparisons.

6.3 Stages of the Curriculum Mapping Survey

The survey of the IS curriculum involves a three-stage approach which includes a pilot study that was designed to ascertain the feasibility of the main task. The pilot study set out to develop and test a method for classifying the IS curriculum using UK-based descriptors derived from the IS Body of Knowledge (BoK) which is part of the UK's Quality Assurance Agency (QAA) Subject Benchmark Statement for Computing (SBSC). The study involved 43 undergraduate courses offered by 13 institutions in Greater London. The Pilot Study was deemed necessary to ensure the following issues were adequately addressed:

- Pilot an approach to establish an appropriate data collection method and ways of expanding it to subsequently cover the entire UK.
- Identify logistical problems relating to possible unavailability or partial availability of data.
- Collect preliminary data to ascertain its format and methods of processing it.
- Assess the proposed data analysis techniques to uncover potential issues.

Following the outcomes of the Pilot Study, the First Stage Mapping extended the use of the QAA SBSC as a classification method to cover the whole of the UK. At the same time, IS 2002 which has been used successfully in the past for curriculum mappings in the US, was also used to supplement the QAA SBSC approach to ensure that any deficiencies present in the QAA SBSC were adequately addressed.

The Second Stage Mapping addressed the shortcomings of both the QAA SBSC and IS 2002 methods by offering a more comprehensive set of data categories that separated the different types of modules within the IS curriculum. The use of IS 2010 at this point ensured that, for the first time, the mapping exercise conclusively categorised every single module irrespective of its content which sometimes lay outside what is considered to be IS specific knowledge and skills. Significantly, it also provided a formal mechanism to define and measure the career tracks promoted by each of the IS courses of the study through the development of Course Mapping Framework.

6.4 Sourcing the Survey Data

Ensuring the accurate collection of data that offers as precise a picture of the IS undergraduate provision as possible, posed two fundamental problems: identifying the correct

courses and obtaining sufficient data on them. The adoption of an appropriate method for the correct identification of IS courses began by reviewing similar previous studies. The findings showed different approaches with a varying degree of accuracy in the selection methods. In some cases the selection of courses was based on lists of institutions offering programmes accredited by the US-based AACSB and the ACSBP (Lifer *et al.*, 2009, Williams and Pomykalski, 2006). In another case, a similar selection method was based on the College Blue Book academic course guide (Kung et al., 2006), while another referred to analogous published sources (Anthony, 2003). Traditional survey questionnaires have also been used successfully for similar purposes (Gill and Hu, 1999).

Even though there is merit in all these approaches none would work well in the case of this study for a number of reasons. Firstly, BCS, which is a prominent accreditation body for ICT courses in the UK, and in a sense similar to the AACSB and ACSBP, offers accreditation to individual courses and not institutions or departments. Therefore, it is possible for two IS courses in the same department to have different accreditation status. Secondly, the BCS does not consider IS courses as a separate category with its own set of specific accreditation criteria. As such, there is no list of accredited IS courses in the UK similar to the AACSB and ACSBP lists of IS courses offered in the US. Even if all current BCS accredited courses were considered, it would still be necessary to put them through an elaborate course selection process in order to ensure that courses in general computing, software engineering or networking would be excluded from the final sample. Finally, selecting IS courses through UCAS, which is the definitive depository of UK degree courses and can be viewed as the UK equivalent to the College Blue Book, is not without its limitations given that a search for 'Information Systems' yields 443 courses, including course titles such as BSc Film Studies and Smart Systems.

Collecting, but also organising the data, for the different stages of the curriculum mapping survey could not be achieved as a single exercise. The initial collection of data for the Pilot Study was much more limited in its scope than the subsequent supplementary collections for the second and third stages. This was so because the Pilot Study indicated the possibility of using additional data categories, but also limitations in the way the original data was organised. Even after the collection of data for the First Stage Mapping survey further possibilities of refining the overall approach were discovered, leading to a relatively limited reorganisation of the existing data and the acquisition of a few more categories for the Second Stage Mapping survey. As a result, discussions about the extensions of the initial data collection method appear in different sections in this chapter.

6.5 Pilot Study Survey - Classifying the IS Curriculum

The pilot presented in this section describes an initial method developed for classifying the IS undergraduate degree courses offered in 2010 by 13 universities in the geographical area of Greater London. Choosing Higher Education Institutions (HEIs) in the Greater London area for the study offered some advantages. Greater London has a manageable number of universities which were expected to yield sufficient data to make the study statistically meaningful. The institutions in this geographical area include members of the Russell Group, the 1994 group and the million+ coalitions, thus providing a representative mix of research intensive and more teaching oriented universities. The complete list of universities that were considered, including the 19 colleges that form part of the University of London federation, can be found in Table 6.1 below.

University	Website
Birkbeck, University of London	http://www.bbk.ac.uk/
Brunel University	http://www.brunel.ac.uk/
City University	http://www.city.ac.uk/
Courtauld Institute of Art	http://www.courtauld.ac.uk/
Goldsmiths, University of London	http://www.gold.ac.uk/
Heythrop College	http://www.heythrop.ac.uk/
Imperial College	http://www3.imperial.ac.uk/
Institute of Education	http://www.ioe.ac.uk/
King's College London	http://www.kcl.ac.uk/
Kingston University	http://www.kingston.ac.uk/
London Business School	http://www.london.edu/
London Metropolitan University	http://www.londonmet.ac.uk/
London School of Economics and Political Science	http://www.lse.ac.uk/
London School of Hygiene and Tropical Medicine	http://www.lshtm.ac.uk/
London South Bank University	http://www.lsbu.ac.uk/
Middlesex University	http://www.mdx.ac.uk/
Queen Mary, University of London	http://www.qmul.ac.uk/
Roehampton University	http://www.roehampton.ac.uk/
Royal Academy of Music	http://www.ram.ac.uk/
Royal Holloway, University of London	http://www.rhul.ac.uk/
St George's, University of London	http://www.sgul.ac.uk/
St Mary's University College	http://www.smuc.ac.uk/
Thames Valley University	http://www.tvu.ac.uk/
The Central School of Speech and Drama	http://www.cssd.ac.uk/
The Institute of Cancer Research	http://www.icr.ac.uk/
The Royal Veterinary College	http://www.rvc.ac.uk/
The School of Oriental and African Studies	http://www.soas.ac.uk/
The School of Pharmacy	http://www.pharmacy.ac.uk/
University College London	http://www.ucl.ac.uk/
University of East London	http://www.uel.ac.uk/
University of Greenwich	http://www.gre.ac.uk/
University of the Arts London	http://www.arts.ac.uk/
University of Westminster	http://www.westminster.ac.uk/

Table 6.1. List of universities included in the Pilot Study Survey.

The findings of this pilot would support efforts to undertake a UK-wide study that should provide a more conclusive picture of the IS courses available to students (Figure 6.1).

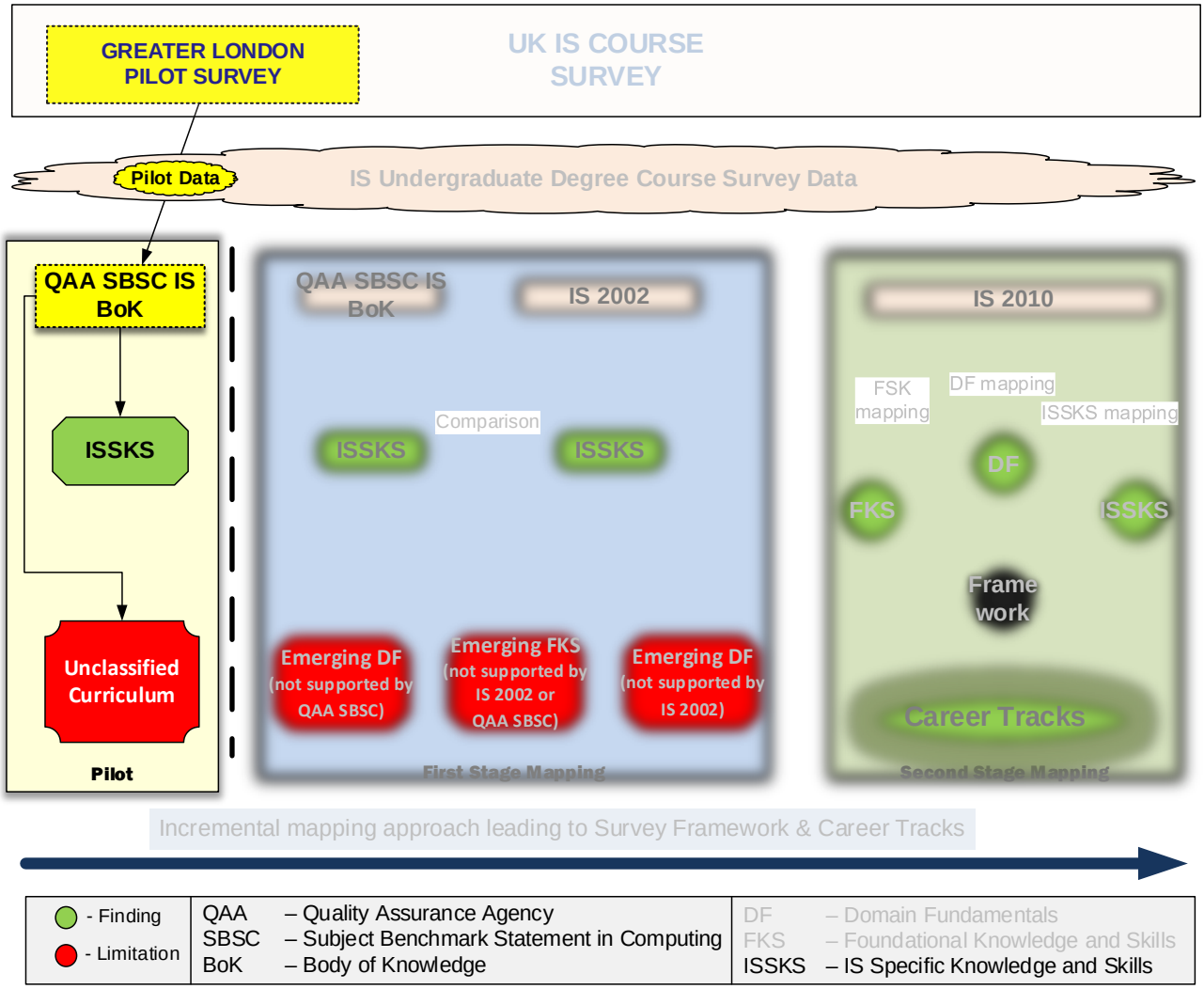


Figure 6.1. Pilot Study Survey.

As stated earlier, because of the lack of a previous UK study, the pilot offered the opportunity to test a new approach of cataloguing modules according to their content, analysing them by year of study, considering their normalised credit size, differentiating between core or option modules, and determining their contribution to the core knowledge of IS. Rankings were produced to capture the popularity of each subject.

6.5.1 Pilot Study Survey: Course Selection Methodology

The approach that was taken to identify appropriate courses began with the examination of university websites. Direct survey approaches like this make the collection and analysis of the data possible by focusing only on the aspects of the courses which are relevant to the study (Kung *et al.*, 2006). Each course was cross-referenced with UCAS to ensure that it had been confirmed to run in the 2010-11 academic year (UCAS, 2010). Additional data from

UCAS was used to confirm the duration, mode of study and the entry level requirements of each course. UCAS uses the Joint Academic Coding of Subjects (JACS) system which was jointly developed with HESA for the purpose of classifying undergraduate degree courses. The most recent version of JACS2 includes a specific code for Information Systems HESA (2006):

> *G500 Information systems: the study, design or application of computers systems which capture, process and transmit information.*

Determining which candidate degrees could be accepted for the purposes of this study posed a number of challenges. Firstly, there was no clear definition for an IS undergraduate degree course that is commonly accepted by universities which could be used to select courses. Secondly, IS courses employed changing titles that reflect shifting industry trends in the hope to attract students who wish to follow courses perceived to be leading to 'fashionable' careers. Often such titles are transient, rendering selection attempts based solely on a few commonly used terms inadequate. Thirdly, in addition to the G500 JACS2 code, there were numerous other codes such as G501, G502, G503, G510, G520 and many others, all of which were being used to classify courses with similar content belonging to different universities. Further complications existed as a result of constituent subjects being combined together to form courses which could be classified as IS, for instance combining the JACS2 codes of G5 (IS) with N5 (Business and Administrative Studies). Finally, universities would place IS courses in either computer science or business departments. There was a general view that IS courses reside in either computing or business departments depending on whether the emphasis was on the soft or hard aspects of IS. A more likely explanation could be that, more often than not, departments and courses were organised based on decisions of managerial convenience and not some elaborate course classification system. In any case, providing an exhaustive list of candidate IS courses could not be achieved unless departmental websites of both computer science and business are scrutinised.

To ensure the correct selection of each course, the course descriptions and their overall aims were compared to the definition, domain of study and the scope of domain of study of IS as specified by UKAIS (1999). Candidate courses featuring major/minor combinations were excluded on the basis that the non-IS element of a major or minor would considerably dilute the accuracy of the data by introducing a large number of unclassified modules that bear no relevance to the discipline of IS. A further restriction was placed on courses which did not meet the criteria of being three-year full-time, four-year sandwich or up to five-year part-time degree/sandwich degree courses.

The application of these criteria necessitated the exclusion of courses with foundation years often classified as year 0, level 0 or level 3. Foundation degree courses offered by Further Education (FE) colleges affiliated with universities were also excluded as were degree

courses which only allowed direct entry into either the second or the third year of study. Finally, a small number of courses advertised on university websites as both full-time and part-time were found to only have one UCAS course code, and as such, they were only given a single entry. Further UCAS cross-referencing also revealed that certain courses had already been withdrawn even though they were still being advertised on university departmental websites.

The process of careful course selection produced 43 IS degrees from 13 universities. Of the 43 courses, 70% were listed as 3 year full-time undergraduate courses, 23% were offered as 4 year full-time sandwich courses which include one year industrial placements, with the remaining being 4 and 5 year part-time courses. Table 6.2 summarises the IS courses identified.

Type (mode) of course	Nos.
3 year, full-time	30
4 year, full-time (sandwich)	10
4 year full-time (MComp)	1
4 year part-time	1
5 year part-time	1
Total number of courses	**43**

Table 6.2. Modes of IS courses selected.

6.5.2 Pilot Study Survey: Data Collection Approach

Although the QAA IS BoK may be limited in its purpose but not necessarily its scope, it offers an opportunity to quantify the provision of IS courses by using the most definitive set of descriptors that have been devised by UK academics for IS. It is on this basis that the 16 descriptors which make up the QAA IS BoK are codified for the purpose of matching undergraduate degree course module descriptions against them (see Table 6.4 for full list). Efforts to analyse the QAA IS BoK statements benefited greatly from the work done earlier by UKAIS. In drafting a definition for IS, UKAIS used 10 of the QAA's IS BoK original 16 descriptors to define the Scope of Domain of Study of IS (UKAIS, 1999). While the UKAIS paper focuses on only 10 of the statements all 16 were included in this study to ensure completeness.

Cataloguing the modules involved separating them into core and option module groups per level (year) of study. Short descriptions were recorded for virtually all modules, often containing certain keywords that could be matched with the BoK descriptors. While the primary source of course structures and module descriptions were the individual course web pages offered by universities, in some cases additional documents such as programme specifications, course handbooks or module description documents needed to be also used. Efforts to capture specific information about module pre-, co- and dis-requisites, as well as the type of technologies used for programming and database modules were abandoned due to the unavailability of such information. Further research in this area would offer a better

understanding of not only the type of technology universities use to reinforce the teaching of many fundamental IS and computing concepts, but also the amount of relevance the particular technology has in relation to the skills employers expect newly qualified graduates to possess.

During the early stages of cataloguing core and option modules according to the newly devised scheme, it became evident that there were two types of modules that could not be accommodated adequately in any of the existing BoK descriptors: final year projects, very common to the majority of courses, and numerous modules such as *Mathematics for Computing* or *IT Education and Training*, which do not meet the criteria of any of the existing descriptors. As a result two new categories were introduced: 'project' and 'n/a' for not applicable. The wide diversity of modules and courses encountered revealed a further problem relating to double modules.

While most degree courses appeared to offer mainly 15-credit modules, there were certain modules which were listed as 30-credit double modules, such as the final year project. Wanting to ensure that the statistical significance of double modules was not lost, they were recorded twice and annotated accordingly. In cases where courses offered 20-credit modules (with a 40 credit project module for example) no further distinction was made, so these modules were counted as single or double modules. In a very small number of cases courses had a mixture of 15 and 20 credit modules or 15 and 10 credit modules, all of these were also counted as single modules.

6.5.3 Pilot Study Survey: Profile of Courses

The UCAS advertised entry requirements expressed as tariff-points shown in Table 6.3 are for 41 degree courses under examination (2 of the courses were designed for part-time professionals and had no formal UCAS entry recruitments). The average entry requirement was 243 points.

UCAS Entry Requirements	Points
Highest	320
Lowest	150
Average	243
Median	260

Table 6.3. Modes of IS courses selected.

The degree title names used across the 43 courses appear fairly uniform. Twenty names featured the word "Business" at the beginning of the title, with the most common name being Business Information Systems. A further 19 courses were named Information Systems, with the majority featuring qualifying names in brackets such as (Business), (Internet Business) or (e-Commerce). The remaining 4 degrees used a combination of the above terms. It should be

noted that courses which were listed as 3 year full-time and 4 year sandwich with two separate UCAS course codes were counted twice despite the course title being identical for both. A discussion about course naming conventions can be found in Chapter 3.

In an attempt to ascertain the level of professional endorsement afforded to the courses, an analysis of how many of the 43 courses were accredited by BCS was carried out. Twenty out of the 43 courses were confirmed as BCS accredited offering exemption from BCS' professional examinations and various pathways to Chartered status. In most cases courses were given partial exemption for one of BCS' membership types, subject to various conditions such as passing a final year project module at the first attempt. It is important to note that the accreditation data provides no information regarding which or how many courses were subjected to the accreditation process; it simply states which courses were accredited and for how long. A detailed discussion about entry level qualifications and course level accreditation took place in Chapter 3.

6.5.4 Pilot Study Survey: Findings - Core Module Rankings

The results were organised into two categories: total number of modules and ranking of modules. The first category considers the classification of the total number of modules in all courses which include individual modules that are single, double or in a few cases even triple in terms of credit weighting. Results of this type ensure that a subject, such as programming for example, is counted as many times as the number of modules in which it is featured. Thus results which consider the credit weighting of modules are presented in tables that capture the total number of modules offered in a particular area as defined by the relevant BoK descriptor. Separate tables are used to capture core and option modules.

The second category of results presents the popularity of subjects by uniquely counting the number of occurrences of modules in a subject across all courses. For example, when trying to rank the popularity of programming across the 43 surveyed degree courses, the occurrence of programming is recorded once for each degree course irrespective of the number of modules which cover programming in that course.

The total number of core modules was 806, giving an average of 18.72 modules per degree course. Modules carrying 0 credits and modules not listed as level 4, 5 or 6 were not included. Courses with an industrial placement year considered as part of this study featured no formal credit-bearing modules during that year, and therefore, none were included in the above total.

Table 6.4 shows the number of core modules that make up the 43 courses which were surveyed.

QAA Code	BoK Descriptors	Nos. of Core Modules in Courses	% of Cores
QAA1	Theoretical underpinnings	12	1.5
QAA2	Data, information and knowledge management	153	19
QAA3	Information in organisational decision making	21	2.6
QAA4	Integration of IS with organisational strategy & development	39	4.8
QAA5	Information systems design	45	5.6
QAA6	Systems approaches	23	2.9
QAA7	Compression technologies	0	0
QAA8	Development, implementation and maintenance of IS	142	17.6
QAA9	Information and communications technologies (ICT).	51	6.3
QAA10	Decision support	8	1
QAA11	Management of information systems and services	26	3.2
QAA12	Content management systems.	0	0
QAA13	Organisational and social effects of ICT-based IS	35	4.3
QAA14	Economic benefits of ICT-based IS	27	3.3
QAA15	Personal information systems	0	0
QAA16	Digital libraries	0	0
project*	Final Year Project	78	9.7
n/a*	Unclassified	146	18.1
	Total number of modules in 43 IS courses	**806**	**100%****

Table 6.4. QAA BoK classification of total number of core modules in all courses. Categories with '*' are not part of the QAA IS BoK (rounding).**

Just over 18% of all core modules could not be classified using the QAA BoK classification. This was an indication that the method used in this pilot does not cater for a number of subjects that have grown in popularity or were introduced after the SBSC is written in 2001. It was also an indication that either the BoK was not designed to be detailed enough to capture the majority of the different aspects of modern IS modules or that it is simply inadequate. An examination of the unclassified modules revealed the following four themes to which the majority of the 146 modules belong:

- Modules covering subjects that deal with maths, formal methods, probability and maths for computing.
- Modules that could be considered as pure business modules, such as marketing or accounting.
- Modules that could be considered as pure computing modules. Examples include AI, multimedia design and developing multimedia applications.
- Modules covering generic study skills such as presentation and writing skills.

This was an early indication that the IS curriculum in the UK includes a significant number of modules that either belong to other domains or are of a foundational nature that applies to most disciplines. These issues would need to be considered as part of the subsequent course surveys to ensure more accurate results.

Data, information and knowledge management coded as QAA2 (Table 6.4) is the domain of study with the highest percentage of modules (19%). It is described by UKAIS (1999) as:

> *Understanding of how data, information and knowledge can be modelled, stored, managed, processed and disseminated by computer systems. Knowledge of techniques and technologies used to organise data and information and enable their effective use by individuals, groups and organisations*

With 17.6% QAA8 - *Development, implementation and maintenance of IS*, is the category with the second highest number of module occurrences confirming the importance of programming and project management as one of the most essential sets of subjects in IS degree courses. The final year project is the third most popular domain of study with 9.7% of the entire core curriculum content of the 43 courses surveyed being devoted to it. For the large majority of courses, the final year project is a double module spanning two semesters in the final year of study.

Table 6.5 shows that in terms of popularity 98% of all degree courses reviewed, that is 42 out of 43 courses in total, offer at least one core module in the area of systems analysis and databases, followed by programming and project management with 93% and the final year project with 91%. At the opposite end of the scale, *Decision support systems*, once a very popular subject of IS, appears only in 12% of the courses surveyed.

BoK Descriptors	%
Data, information and knowledge management	98
Development, implementation and maintenance of IS	93
Project*	91
Unclassified*	81
Information systems design	60
Information and communications technologies (ICT).	58
Management of information systems and services	53
Integration of IS with organisational strategy and development	51
Organisational and social effects of ICT-based information systems	49
Systems approaches	47
Economic benefits of ICT-based information systems	44
Information in organisational decision making	35
Theoretical underpinnings	26
Decision support	12
Compression technologies	0
Content management systems	0
Personal information systems	0
Digital libraries	0

Table 6.5. Core module popularity ranking based on the QAA IS BoK classification. Categories with '*' are not part of the QAA IS BoK.

6.5.5 Pilot Study Survey: Findings - Option Module Rankings

In addition to the core modules there were 275 option modules spread across all course levels giving an average of 6.4 option modules per degree course. In the majority of cases

most option modules tend to be offered towards the end of a degree. There were a considerable number of courses which offered no option modules at level 4 (first year).

The results show that a significant portion of option modules fall outside the scope of the designated IS subjects, as shown in Table 6.6 In a similar pattern to the unclassified core modules, unclassified option modules tend to either be specialist computing or business modules. The considerable percentage of unclassified modules, 32.4%, suggests a number of possible explanations:

- Option modules loosely related to a specific subject are often offered to students to allow them to specialise in areas that are not within the traditional domain of IS. For example: Environmental Management and Business Strategy, Strategic Management and Operations Management.
- Option modules available to a particular course may be serving as core modules in another course. By reusing existing modules from other non-IS degrees the course provision overheads are kept to a minimum.
- From an academic standpoint, option modules in marketing or multimedia can be viewed as important subjects that students should be exposed to even though such subjects might be viewed by some as less relevant to IS.
- Departments may not necessarily possess the required expertise to offer option modules which would be classified as 'pure' IS modules.

QAA Code	BoK Descriptors	Nos. of Option Modules in Courses	% of Options
QAA1	Theoretical underpinnings	0	0
QAA2	Data, information and knowledge management	38	13.8
QAA3	Information in organisational decision making	7	2.5
QAA4	Integration of IS with organisational strategy & development	16	5.8
QAA5	Information systems design	16	5.8
QAA6	Systems approaches	1	0.4
QAA7	Compression technologies	1	0.4
QAA8	Development, implementation and maintenance of IS	30	10.9
QAA9	Information and communications technologies (ICT).	17	6.2
QAA10	Decision support	3	1.1
QAA11	Management of information systems and services	1	0.4
QAA12	Content management systems.	2	0.7
QAA13	Organisational and social effects of ICT-based IS	14	5.1
QAA14	Economic benefits of ICT-based information systems	34	12.4
QAA15	Personal information systems	0	0
QAA16	Digital libraries	0	0
project*	Final Year Project	6	2.2
n/a*	Unclassified	89	32.4
	Total number of modules in 43 IS degree courses	275	100%**

Table 6.6. QAA BoK classification of total number of option modules in all courses. Categories with '*' are not part of the QAA IS BoK (** rounding).

In terms of popularity 67% of all degree courses offer at least one option which cannot be classified according to the QAA BoK. The next two most popular categories are IS Economic benefits of ICT-based information systems and Data, information and knowledge management with 49% and 44% respectively, suggesting that just under half the sampled courses offer specialisation modules in those categories. Table 6.7 show the complete list of rankings.

BoK Descriptors	%
Unclassified*	67
Economic benefits of ICT-based information systems	49
Data, information and knowledge management	44
Information systems design	35
Integration of IS with organisational strategy & development	33
Information and communications technologies (ICT).	28
Development, implementation and maintenance of IS	23
Organisational and social effects of ICT-based IS	21
Information in organisational decision making	16
Decision support	5
Management of information systems and services	5
Project*	5
Content management systems.	2
Systems approaches	2
Compression technologies	2
Theoretical underpinnings	0
Personal information systems	0
Digital libraries	0

Table 6.7. Option module popularity ranking based on the QAA IS BoK classification. Categories with '*' are not part of the QAA IS BoK.

Personal information systems and *Digital libraries* are two descriptors that do not feature any option or core modules. Although there is no statistical significance of these particular scores in relation to the rest of the results, they raise two questions. Why were these categories included in the original BoK by the benchmarking group and what is the significance or relevance of these categories to modern IS curricula? The answer to the latter is probably none. It is only possible to speculate about the former, that the authors of the SBSC were trying to develop a BoK that was as wide-reaching as possible.

6.5.6 Pilot Study Survey: Conclusions

The pilot study produced a series of encouraging findings which support the viability of more detailed surveys by demonstrating that it is possible to overcome the earlier stated issues which led to the commissioning of the pilot. Firstly, the content analysis data collection approach proved successful in identifying the totality of data needed for the pilot. Secondly, it was shown that any partial unavailability of web based data could be obtained through additional publicly available course documents that resided on university web pages. Thirdly, the format of the data collected was consistently uniform, suggesting that a much larger study would not face additional difficulties in this area. Finally, the data analysis techniques can be extended to cover data that is richer in content and meaning.

In addition to highlighting these limitations, the pilot also showed that the QAA IS BoK is unable to capture many of the contemporary IS subjects that UK universities have introduced in the last 10 years or so because of the amount of time elapsed since its creation. At the same time, although 44 courses could be seen as an acceptable statistical sample of IS courses in the UK (approximately 20% of the overall number of IS courses discussed later), the entire sample is based on universities from one small geographical area. Without a wider study there is no way of ascertaining the degree of commonality between IS courses in Greater London which is the result of close completion between universities situated only a few miles apart. As a final point, given the statistically significant high percentages for both unclassified core and option modules, it would be reasonable to assume that the lack of categorisation of the unclassified modules skews the overall picture of what subjects are being taught to IS undergraduate students. A UK-wide study was needed to provide a much more accurate picture of the curriculum, building on the advantages offered by the pilot while also addressing its limitations.

6.6 QAA SBSC / IS 2002 Survey

Following the promising results of the pilot in terms of the methodological approach to cataloguing and analysing modules, the next step involved the extension of the already tested QAA SBSC method and the introduction of IS 2002 in order to capture the UK undergraduate IS course provision in its entirety.

The advantages of using two separate classifications methods in this First Stage Mapping are three-fold. Firstly, the accuracy of the findings can be validated by cross-referencing the categories of modules which exhibit similar characteristics. Secondly, given that the QAA SBSC classification method has not been applied before on this scale, it is important to test its validity by comparing it to the well-established IS 2002 classification method. Finally, extending the QAA SBSC classification method should provide a more unique UK perspective that may not be present in IS 2002 which was designed for the US market with minimum international input. So, utilising both methods in the study offered the most appropriate approach to overcome the limitations of each, and enabled the cross-referencing of the data to enhance the validity of the results Figure 6.2.

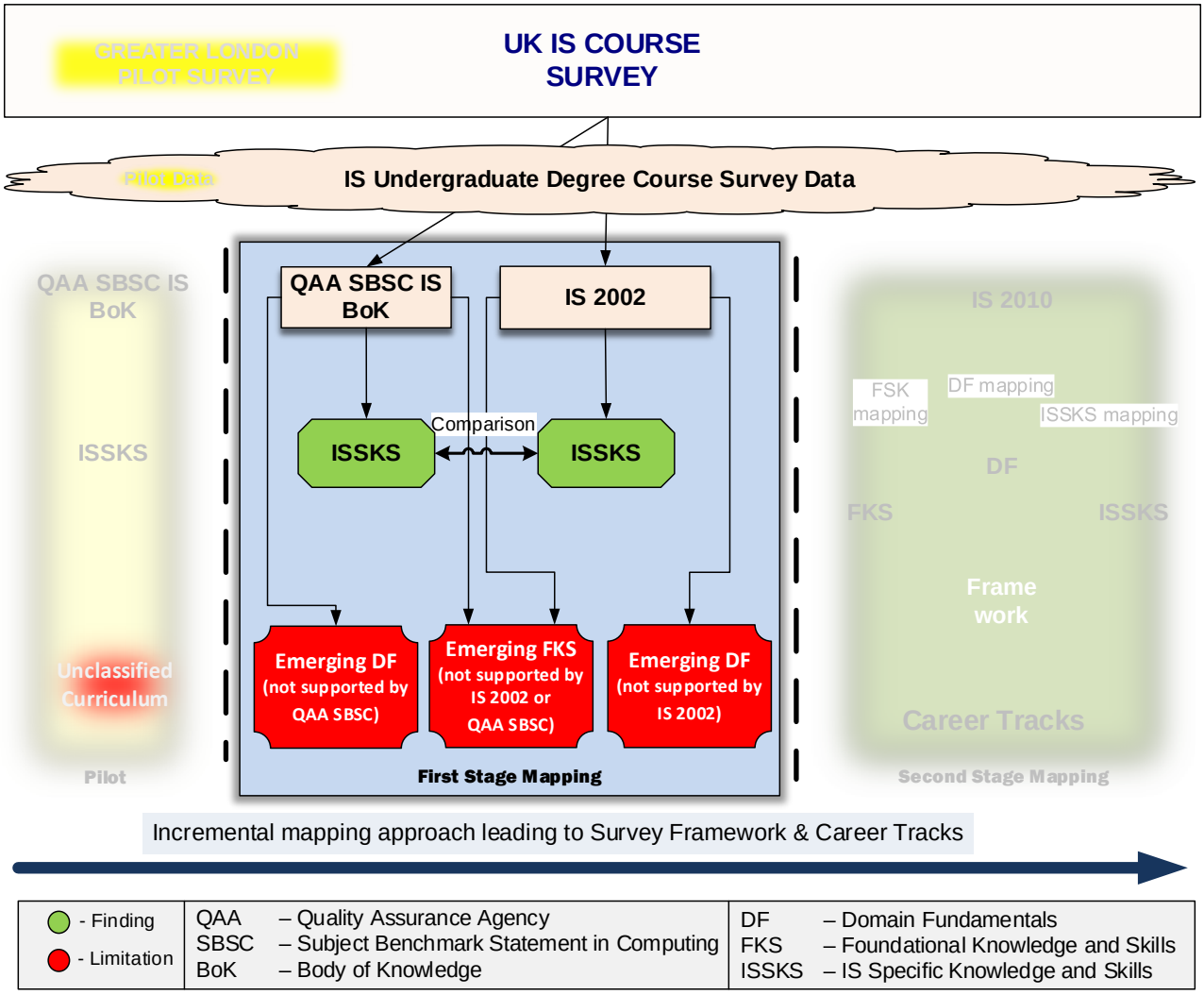


Figure 6.2. First Stage Mapping.

The rationale behind the decision to simultaneously utilise two different methods is based on the following:

- Although the QAA SBSC pilot shows limited success in the comprehensiveness of the classification of modules due to the BoK's deficiencies, it is not possible to conclude the inappropriateness of the approach without reviewing the country-wide data set.
- IS 2002 is a well-tried and tested method for mapping IS curricula in the US, and as such, it should offer results which are produced by a methodologically acceptable approach.
- As the QAA SBSC and the IS 2002 methods originate from the UK and the US respectively, a comparison of the findings can help determine any underlying differences in the differing structures of each method.

As each classification method utilises different categories to classify module content, discrepancies in the presentation of the data are noted to support a better understanding of the results.

6.6.1 QAA SBSC / IS 2002 Survey: Extended Course and Data Collection

Wanting to expand the successful pilot data gathering approach and avoid the problems of a course selection method that could be somewhat arbitrary, the inclusion of the total number of universities in the UK became necessary. Universities underwent a process of elimination based on their offering of IS courses residing in Computing or Business schools. The course identification and selection involved examining over 160 UK university and college websites while cross-referencing the UCAS course listing for 2010/11 to ensure that selected courses were confirmed to run (Appendix B). At the time of conducting the survey UCAS no longer listed 2009/10 courses. In a similar manner, virtually all of the university websites examined were listing courses for the 2010/11 academic year only. The measure by which courses were deemed to belong to the IS, as opposed to wider computing or business, family of courses, involved the approach used in the pilot of comparing each of the course descriptions to UKAIS' definition, domain of study and the scope of domain of study of IS (UKAIS, 1999). In cases where course descriptions were inadequate either because they were not sufficiently detailed or they were too specific, an inspection of online module details was carried out to provide a better understanding of the course title. As each course was selected, further data was sought about its content. The mode of study (full-time or part-time), duration (3-years, 4-years or in some cases 5-years), the entry requirement expressed as a tariff in terms of A-Level point score, the modules offered by each course, the level at which modules were offered and a description for each module were recorded for all courses. As demonstrated by the pilot, the majority of course information gathered was available on departmental or university websites. Most universities provided additional comprehensive online information about their courses, often presented in course or module handbooks. Furthermore, many universities publish Programme Specification documents which offer detailed course descriptions along with module outlines. While the majority of Programme Specifications do not list the content of modules, they invariably include a detailed list of modules titles and their corresponding credit weighting per year of study. Despite the plethora of information on university websites there were a small number of cases where not all relevant information could be obtained online. To ensure the essential accuracy and completeness of the dataset, approximately a dozen successful attempts were made to contact academic colleagues via email, requesting help with obtaining data about their courses.

6.6.2 QAA SBSC / IS 2002 Survey: Extending the classification methods

Cataloguing modules in a systematic way exposed a problem present in both the IS 2002 and the QAA SBSC classification approaches which was first observed during the pilot study. While the categories of each method of classification were reasonably unambiguous to enable accurate codification, there was a significant proportion of modules that did not fit any of the categories available. Moreover, the final year project, which was found in virtually all courses either as a core or sometimes option module, has no specific category in the QAA SBSC classification method, unlike IS 2002 which has a *Project Management and Practice* category that incorporates final year projects. Previous studies that use IS 2002 concentrated on classifying modules based on its eleven categories available without explicitly discussing the modules that fall outside the scope of those categories. Wanting to avoid compromising the comprehensiveness of the results and, by implication, any subsequent conclusions drawn from them, it was decided to extend the classification of both methods by introducing a common new category. Conveniently named '*Unclassified*', the new category was made up of three subjects which were further broken down into constituent units (Table 6.8). The broad subject areas chosen to reflect the content of the *Unclassified* modules were *Business*, *Computing* and *Other*. In deciding the breakdown for each subject care was taken not to include too many unit titles that would make subsequent statistical data too small to be of significance.

Business	Computing	Other
General	General	Geographic IS
Management	Multimedia	Study Skills
Accounting	Games	Law
Marketing	Graphics	Languages
Economics/Finance		Mathematics
HR		Research Methods
		Work-Based Learning
		Education
		Teamwork/Consultancy

Table 6.8. Subjects making up the Unclassified category.

Addressing the issue of the final year project under the QAA SBSC classification method required a similar solution for two reasons. Firstly, since IS 2002 already offered a category for projects it made sense to have a comparable category for the QAA SBSC method, albeit an artificial one, to enable direct comparison of results. Secondly, the only other credible option for dealing with projects apart from discarding them would be to infer that they were in essence the culmination of the skills and knowledge of the taught part of a course, and thus, assign their credit weighting to the rest of the corresponding modules of that course. Such an assumption, however, would be dangerous as it would be an oversimplification of the nature of undergraduate projects. But even if the assumption was based on fact, it would still be

intrinsically difficult to devise a generic formula that accurately reflected the correct distribution of project credits to the taught modules. The introduction of the *Work-Based Learning* and *Teamwork/Consultancy* units in the *Unclassified* category further strengthened the case for measuring the frequency of project modules separately since a significant number of project-like modules could now be categorised more accurately. A similar benefit was offered by the inclusion of the *Research Methods* unit which was designed to capture modules that often act as a precursor to the final year project.

The variation in module credit weighting was wide both within individual courses but also across the board. Broadly speaking, the credits assigned to a module gave an indication of the amount of work a student has to perform for that module in relation to the level of difficulty of the learning. Examples of typical modules encountered included general study skills or business maths modules (neither of which can be easily classified under either of the classification methods employed) being worth 10 credits, while in the same year of study a programming or systems analysis module was worth twice or three times as many credits. In order to circumvent the inevitable distortion of the data that a simple count of individual modules would cause, modules were normalised using a standard 15-credit measurement by converting the total sum of credits per subject into 15-credit units. The range of module credits encountered spanned from 7.5 to 60 credits. Using 15 credits as the measurement of one unit or module, 7.5 credits were worth 0.5 of a module whereas 60 credits were worth 4 modules.

6.6.3 QAA SBSC Survey: Findings

There are three ways in which the results in this study support the understanding of the IS curriculum provision. Firstly, a breakdown of the combined core and option modules across all degrees based on the QAA SBSC and IS 2002 model curriculum classification methods is presented. Secondly, the data is further broken down to distinguish between core and option modules. Thirdly, the classification of those modules that fall outside the scope of the classification method categories is presented, supporting a more holistic analysis of the data.

Overall, 228 courses from 85 UK universities were catalogued with a total number of 7,452 modules (all subsequent figures presented annotated with '*' have been rounded for simplicity and as a result may sometimes present small arithmetic inconsistencies). Of those, 4,585 were core modules with the remaining 2,867 being option modules (Table 6.9). The distribution of courses in relation to the country in which their respective universities reside was as follows: 194 courses (85%) were offered in England, 19 (8%) in Scotland, 14 (6%) in Wales and 1 (<1%) in Northern Ireland. Modules contributing to courses varied significantly in terms of credit weighting depending on the emphasis attributed to the subjects they covered but in all cases, with the exception of courses offered by Scottish universities, the total number of credits for a course was 360, with an equal split between the three years of study.

	Total no of modules	%	Avg. modules per course
Core	4,585	62	20
Option	2,867	38	13
Total:	**7,452**	**100**	**33**

Table 6.9. Overall module data and breakdown.

According to the QAA SBSC method the analysis of the 7,452 modules catalogued revealed that 1,871 (25%) of core and option modules were judged to be unclassified (see Table 6.10 for the overall classification data). The next category with the highest occurrence was *QAA8 - Development, Implementation and Maintenance* of IS with 1,340 (18%) modules confirming programming, project management and testing as one of the most popular subjects of IS. A further 905 (12%) of modules were dedicated to databases, database design and object oriented analysis and design (QAA2). At the opposite end of the spectrum, a mere 19 (<1%) and 10 (<1%) of modules were found to cover *QAA16 - Digital Libraries* and *QAA12 - Content Management Systems* respectively.

QAA SBSC Code	Description of Categories	Total Number of Modules	% of Total
QAA1	Theoretical Underpinnings	297	4%
QAA2	Data, Information and Knowledge Management	905	12%
QAA3	Information in Organisational Decision Making	56	1%
QAA4	Integration of IS with Organisational Strategy & Development	260	3%
QAA5	Information Systems Design	352	5%
QAA6	Systems Approaches	312	4%
QAA7	Compression Technologies	4	<1%
QAA8	Development, Implementation and Maintenance of IS	1,340	18%
QAA9	Information and Communications Technologies (ICT).	593	8%
QAA10	Decision Support	136	2%
QAA11	Management of Information Systems and Services	124	2%
QAA12	Content Management Systems.	10	<1%
QAA13	Organisational and Social Effects of ICT-Based IS	352	5%
QAA14	Economic Benefits of ICT-Based Information Systems	122	2%
QAA15	Personal Information Systems	51	1%
QAA16	Digital Libraries	19	<1%
Project (17)	Final Year Project	648	9%
Unclassified	Unclassified	1,871	25%
	Total:	**7,452**	**100%***

Table 6.10. QAA SBSC overall data classification (* rounding).

The breakdown of modules into core and option provided a more informative view of the emphasis that is placed upon different subjects. By capturing what students must study as opposed to what they could choose to study, the breakdown provides a strong indication of what IS course developers consider essential subjects which in turn could help identify the core skills that IS graduates are expected to possess. This is best demonstrated by the project module (Table 6.11), coded *Project (17)* which has the highest ratio of core to option (9.1 : 1) confirming that over 90% of project modules are classified as core, effectively forcing the vast

majority of IS students to undertake projects. A more balanced split between core and option was found in *QAA9 - ICT*, whose 1.4 : 1 ratio showed that over 40% of modules in the category that spans networking, operating systems, hardware and security, are offered as choices to students, often supplementing introductory core modules of the same subject. Similarly QAA2 and QAA8, that broadly cover databases and programming respectively, have relatively low ratios which are the result of introductory modules in the first year of study, followed by more advanced and often optional modules in later years. A further noteworthy observation concerns the ratio between core and option unclassified modules. With the majority of unclassified modules offered as options, it appears that option modules are being used to supplement what is considered core IS teaching by introducing topics which may be important but peripheral to IS.

QAA SBSC Code	Core Modules	% of Total Core	Option Modules	% of Total Option		Core : Option Ratio	% of Category Core	% of Category Option
QAA1	210	5%	86	3%		2.4 : 1	71%	29%
QAA2	571	12%	334	12%		1.7 : 1	63%	37%
QAA3	36	1%	20	1%		1.8 : 1	65%	35%
QAA4	173	4%	87	3%		2.0 : 1	66%	34%
QAA5	205	4%	147	5%		1.4 : 1	58%	42%
QAA6	254	6%	58	2%		4.4 : 1	81%	19%
QAA7	0	0%	4	<1%		-	0%	100%
QAA8	964	21%	376	13%		2.6 : 1	72%	28%
QAA9	341	7%	252	9%		1.4 : 1	58%	42%
QAA10	82	2%	54	2%		1.5 : 1	60%	40%
QAA11	74	2%	49	2%		1.5 : 1	60%	40%
QAA12	7	<1%	3	<1%		2.2 : 1	69%	31%
QAA13	231	5%	122	4%		1.9 : 1	65%	35%
QAA14	60	1%	61	2%		1.0 : 1	50%	50%
QAA15	19	<1%	32	1%		0.6 : 1	37%	63%
QAA16	5	<1%	14	1%		0.3 : 1	26%	74%
Project (17)	584	13%	64	2%		9.1 : 1	90%	10%
Unclassified	770	17%	1101	38		0.7 : 1	41%	59%
Total:	**4,585***	**100%***	**2,867***	**100%***		-	-	-

Table 6.11. QAA SBSC classification breakdown with module ratios (* rounding).

Demystifying the content of the 1,871 (25%) unclassified modules (Table 6.12) revealed a clear but not so profound difference in the distribution of subjects. With 42%, *Business* is the area with the most subjects in the unclassified category, followed by 35% in the *Other* category and 23% in *Computing*. While the distribution of subjects in the *Business* area is equal between core and option, the opposite is true for subjects in the *Other* area showing a clear bias towards core modules. Setting aside the two categories of *Business-General* and *Computing-General* worth 21% and 13% respectively, attention should be given to the two highest scoring categories of *Maths* and *Study Skills* that follow. This shows that in each of the two categories there are 150 (8%) modules, giving noticeable prominence to both subjects. Averaging out the number of modules for each category across all courses, suggests that each of the 228

courses in this study contains just over one and a half study skills modules and just over one and a half maths modules.

Unclassified Modules QAA SBSC	% Overall	% Core	% Option
Business			
General	21%	17%	23%
Management	3%	4%	2%
Accounting	5%	6%	4%
Marketing	7%	7%	7%
Economics/Finance	2%	3%	2%
HR	4%	4%	3%
Business total:	42%*	41%*	41%*
Computing			
General	13%	9%	16%
Multimedia	5%	5%	5%
Games	2%	1%	2%
Graphics	3%	<1%	5%
Computing total:	23%*	15%*	28%*
Other			
Geographic IS	<1%	<1%	<1%
Study Skills	8%	18%	2%
Law	2%	1%	2%
Languages	4%	0%	6%
Maths	8%	11%	6%
Research Methods	3%	6%	1%
Work-Based Learning	3%	1%	4%
Education	2%	<1%	4%
Teamwork/Consultancy	5%	6%	4%
Other total:	35%*	43%*	29%*
Overall total:	100%*	100%*	100%*

Table 6.12. QAA SBSC classification method percentage breakdown of unclassified modules (* rounding).

Other popular subjects include *Marketing* (7%), *Accounting* (5%), *Multimedia* (5%) and *Teamwork/Consultancy* (5%). *Computer Games* (2%) maintains a relatively small presence in the overall pool of unclassified modules, yet it demonstrates that popular subjects always find a way even into courses that have little academic use for them.

6.6.4 IS 2002 Survey: Findings

The data from the second classification method based on IS 2002 is now discussed (see Table 6.13 for the overall classification data). As can be seen with 2,305 (31%) modules, the *Unclassified* category dwarfs the second most popular category by just over 2.5 times. IS 2002.10 is the second most popular category with 894 (12%) combined core and option modules across 228 courses dedicated to project management final year projects. IS 2002.3 which focuses on organisations, strategy and decision making is a close third with 837 (11%) followed by programming and databases which receive less prominence. Unsurprisingly, the number of modules that fall under *IS 2002.0 Elementary IT Skills* is extremely small given the

nature of the category which over the years has become obsolete due to the advancement of IT skills and technology.

IS 2002 Course	Description	Total Number of Modules	% of Total
IS 2002.0	Elementary IT skills	21	<1%
IS 2002.1	Fundamentals of IS	433	6%
IS 2002.2	E-commerce, e-business and web development	704	9%
IS 2002.3	Organizations, strategy and decision making	837	11%
IS 2002.4	Operating systems, hardware and architecture	214	3%
IS 2002.5	Programming	589	8%
IS 2002.6	Networks and communications	271	4%
IS 2002.7	Systems analysis and design	482	6%
IS 2002.8	Databases, data mining	543	7%
IS 2002.9	Development	157	2%
IS 2002.10	Project management, final project/dissertation	894	12%
Unclassified	Various/unclassified	2,305	31%
	Total:	7,452*	100%*

Table 6.13. IS 2002 overall data classification (* rounding).

The core to option ratios are relatively low with the exception of IS 2002.10 confirming that the final year project along with project management are the two subjects that 88% of all IS students will be expected to take in order to complete their studies (Table 6.14). IS 2002.1 that captures modules dealing with introductory IS concepts features a relatively small number of combined modules (433), the vast majority of which are understandably offered as core. Reassuringly, programming and systems analysis feature heavily as core modules. A reasonable number of options for these two categories suggest that the teaching of both subjects is reinforced further, a clear sign of their significance.

IS 2002 Course	Core Modules	%	Option Modules	%		Core : Option Ratio	% of Category Core	% of Category Option
IS 2002.0	11	<1%	9	<1%		1.2 : 1	55%	45%
IS 2002.1	370	8%	63	2%		5.9 : 1	85%	15%
IS 2002.2	396	9%	308	11%		1.3 : 1	56%	44%
IS 2002.3	523	11%	314	11%		1.7 : 1	63%	37%
IS 2002.4	159	3%	55	2%		2.9 : 1	74%	26%
IS 2002.5	430	9%	159	6%		2.7 : 1	73%	27%
IS 2002.6	145	3%	126	4%		1.2 : 1	54%	46%
IS 2002.7	377	8%	105	4%		3.6 : 1	78%	22%
IS 2002.8	367	8%	176	6%		2.1 : 1	68%	32%
IS 2002.9	83	2%	74	3%		1.1 : 1	53%	47%
IS 2002.10	787	17%	107	4%		7.4 : 1	88%	12%
Unclassified	934	20%	1372	48%		0.7 : 1	40%	60%
Total:	4,585*	100%*	2,867*	100%*		-	-	-

Table 6.14. IS 2002 classification breakdown with module ratios (* rounding).

Business subjects are dominant in the breakdown of unclassified modules with 2 out of 5 (40%) in this category devoted to them (Table 6.15). The core option split of business subjects is identical at 41%. Similar to the QAA SBSC method results, study skills and maths are

considered important core subjects with 15% and 12% of unclassified modules respectively being dedicated to them. Computer games (2%) is only slightly less popular than research methods which stands below teamwork/consultancy, a subject that tries to promote skills necessary for working in the real world, making it perhaps one of the most vocational subjects of the list.

Unclassified Modules IS 2002	% Overall	% Core	% Option
Business			
General	21%	18%	23%
Management	3%	4%	2%
Accounting	4%	6%	4%
Marketing	6%	6%	6%
Economics/Finance	2%	2%	2%
HR	4%	5%	4%
Business total:	**40%***	**41%***	**41%***
Computing			
General	19%	14%	22%
Multimedia	4%	4%	5%
Games	2%	<1%	2%
Graphics	3%	<1%	4%
Computing total:	**28%***	**18%***	**33%***
Other			
Geographic IS	<1%	<1%	<1%
Study Skills	7%	15%	1%
Law	2%	1%	3%
Languages	3%	<1%	5%
Maths	9%	12%	6%
Research Methods	3%	5%	1%
Work-Based Learning	2%	1%	3%
Education	2%	<1%	3%
Teamwork/Consultancy	4%	5%	3%
Other total:	**32%***	**39%***	**25%***
Overall total:	**100%***	**100%***	**100%***

Table 6.15. IS 2002 classification method percentage breakdown of unclassified modules (* rounding).

6.6.5 QAA SBSC / IS 2002 Survey: Comparison

The results generated by the two classification methods offered an important insight into the relative emphasis that IS course developers place on individual subjects. A direct comparison between them, however, should be carried out with caution because of the incompatibility of the categories in terms of the combination of subjects. Considering as an example the subject of programming, the discrepancy between the results of the QAA8 and IS 2002.5 categories is large, capturing 1,340 and 589 15-credit modules respectively. Even though the categories may appear broadly the same, QAA8 has a much wider scope since it captures modules related to project management, web development and testing, whereas project management is part of IS 2002.10 which also includes final year projects. Similar discrepancies are found in other categories. Although the inconsistencies in the categories of the methods impede efforts to carry out direct comparisons, they highlight the importance of

maintaining a high level view when analysing the data and attempting to draw conclusions from it. Would a hypothetical breakdown of the 1,340 modules under the QAA8 category into subcategories of Java programming, C++ programming, Visual Basic, testing and PRINCE2 project management make a great difference in terms of enhancing our collective understanding of the importance of programming in IS? Perhaps it would to a small extent, but this is one occasion when the devil is not in the detail.

Looking beyond the module data that conforms to the prescribed categories, it is important to consider the significance of the unclassified categories captured by both methods. In terms of difference, IS 2002 captured 434 more unclassified modules than the QAA SBSC method. The most obvious explanation rests with the difference in the number of categories between the methods. The scope of QAA SBSC encompasses subjects such as mobile computing, decision support systems, content management systems, e-government, legal issues and many more, which are not equally represented in IS 2002. A comparison between the three main areas of *Business*, *Computing* and *Other* of the *Unclassified* category reveals that both methods capture similar numbers of business related subjects given that the overall percentages for Business are 42% for the QAA SBSC method and 40% for IS 2002. The gap widens slightly for subjects in the *Other* category and reaches a 5% difference for *Computing* subjects, suggesting that IS 2002 has a narrower scope in relation to computing modules, beyond those already included within the existing IS 2002 categories. It is difficult to make conclusive judgments about the effectiveness of the two classification methods since neither the IS 2002 model curriculum nor the QAA SBSC was intended to be used in this way, as discussed earlier. Criticism reserved for the large percentage of *Unclassified* modules which appears to skew the overall results could be mitigated by incorporating the subjects of the unclassified category as new categories to both methods, thus presenting a unified set of extended results. A similar attempt to extend IS 2002 by incorporating additional subjects has been made in the past Tastle *et al.* (2008). By taking an alternative perspective, *Unclassified* modules can be seen as making up part of the representative capabilities and knowledge expected for IS graduates which IS 2002 justifies as the exit characteristics of IS graduates, necessary to produce well rounded professionals (Gorgone *et al.*, 2002). In doing so, a significant number of modules captured by the *Other* category map closely to what IS 2002 refers to as *Analytical and Critical Thinking*, and *Interpersonal Communication and Team Skills*. Conversely, modules in the *Business* area are closely related to *Business Fundamentals*, and *Computing Technology*.

Modules that cover general study skills tend to focus on presentation, academic writing, professionalism and career skills, often presented as transferable skills. *Maths* modules are in their majority designed to address the specific skill set that students studying fundamental computing and IS topics such as programming, networking, hardware and software need to

master. Often maths modules are presented as quantitative methods for business, discrete maths for computing or introductory statistics. *Research Methods* modules almost exclusively appear as preparatory modules for the final project. They cover a range of topics such as referencing, conducting background research, selecting research topics, lines of enquiry and investigation techniques. Modules appearing under the *Law* heading are either focused on business law or legal issues relating to IT, or they cover general introductory law, making it more difficult to relate them to IS topics. Two more noticeable categories that offer transferable skills are populated with modules that cover work-based learning and work experience or consultancy. In both cases these modules concentrate on enhancing the employability skills of students by exposing them to the world of business and its expectations of new graduates. *Foreign Language* modules are almost exclusively offered as options. The majority are offered as introductory or intermediate language training, with the small exception of language for engineers or science offering language skills tied to relevant professions.

6.6.6 QAA SBSC / IS 2002 Survey: Observations

The significant number of unclassified modules that both classification methods makes the issue of relevance of the methods prominent. But judging the success of either of the classification methods should not necessarily depend on the amount by which the data conforms to the suggested categories. The purpose of the classification methods is to provide the means by which the content of courses can be catalogued as accurately as possible, taking into consideration the inherent difficulties that exist as a result of wide-ranging modules which often mix different topics, based on sound academic reasons. Consider the following example: Software Project Management is a module worth 7.5 credits, with a module description that states that students will gain an understanding of the difficulties of managing complex projects and some of the technical and social problems that might arise; they will develop transferable skills to aid them in dealing with human factor issues and technical complexities of large projects. As one of the smallest modules recorded in terms of credit weighting, Software Project Management has a clear focus on project management which is evident both in its name as well as the module description, making its classification under either method straight-forward. At the opposite end of the spectrum, Business Functions in Context is a 60 credit module with a description that suggests this integrated module focuses on the essential organisational functions of human resources, marketing, operations management, information management, accounting and finance. Furthermore, in this module, students are expected to examine their key practices, processes and thinking, and their contributions to organisations and their operations - with a strong emphasis on practice-based learning. Given the size of Business Functions in Context which is eight times that of the Software Project Management, choosing the appropriate classification category can have a significant impact on overall

classification of the course, as this module alone constitutes 50% of academic credits in one year of study. Upon closer examination of the description, it becomes evident that the content of the module spans multiple categories, most of which fall within the unclassified band. One way to ensure accurate classification in this case requires that the module is broken up into smaller parts such as human resources, marketing, operations management and other, with each part being assigned a corresponding number of credits out of the total of 60. However, such an approach is not without its own problems as it would be virtually impossible to ascertain correctly the credit value of each constituent part of the module unless the module handbook with appropriate breakdown was available. Despite the significance of this issue, it is important to remember that the problem presented does not lie in the inadequate design of the classification methods but in the intrinsic complexity within the nature of modules which were not intended to be quantified in a simplistic way.

An aspect of the use of the classification methods that could attract criticism relates to the combination of topics within certain categories, such as in the case of IS 2002.10 that combines the final project with project management or QAA2 that combines object oriented analysis and design with entity relationship modelling and databases. Such criticism, however, would be misplaced in the case of IS 2002 because it was merely designed to offer curriculum recommendation and not to act as an oversimplified array of groupings. Similarly, the UKAIS Scope of Domain of Study that largely informed the QAA classification method does not encourage such use. Combining closely related subjects together is sensible as well as desirable. Having a list of categories, each of which covers an atomic subject, may make the classification of modules easier but not necessarily more academically justifiable as it would be difficult to see why grouping networking and hardware as one category (IS 2002.6 and QAA9) is less meaningful than having two separate categories, one for networking and one for hardware.

It is to the credit of universities in the UK that over the years they have chosen to offer an ever increasing amount of useful course information on-line, ranging from general course descriptions to detailed individual module assessment components. Invariably, the amount of information provided by universities differs. Often, information availability fluctuates significantly between different schools or departments within the same institution. At times, finding the necessary information was only possible by carrying out detailed searches with composite keywords using popular search engines, bypassing complex webpage navigation structures. Securing the necessary data in a small number of cases was only possible by directly contacting helpful colleagues via email to request the data. Although every effort was made to ensure the accuracy of the information collected, it is important to note some limitations. The course and module data was harvested during 2010. The data described courses on offer in the 2010/11 academic year. In some cases, course data described as

2010/11 was unavailable, most likely due to website update tardiness, which resulted in collecting course data about the 2009/10 academic year. Although course changes from year to year tend to be small, there is always the possibility that a given course went through revalidation, which could cause its content to change considerably, after the snapshot was taken. However, in this research an important safeguard was in place to ensure course eligibility by consultation of UCAS to confirm the actual availability of courses in the 2010/11 academic year.

6.6.7 QAA SBSC / IS 2002 Survey: Limitations

The methods used to survey the IS curriculum in the previous section offer a limited measure of success. First, despite its UK origin, the IS BoK making up the QAA SBSC method is clearly inadequate in terms of forming the basis for a comprehensive mapping of the curriculum. There is an apparent need to reconsider the BoK in relation to the advances in the field over the last twelve years if it is to serve a purpose other than of a descriptive list of topics which has become outdated. Second, IS 2002 is unable to produce comprehensive data not only due to its outdated subject definitions but most importantly because of its rigid structure that fails to recognise domains and foundational knowledge, two areas that represent significant number of modules found in modern IS courses.

Pursuing the development of an all-inclusive mapping framework, therefore, necessitates the use of the IS 2010 curriculum guidelines which became available after the First Stage Mapping got underway. As discussed in Chapter 4, IS 2010 identifies three main categories of knowledge that underpin the essence of IS as an academic subject: IS Specific Knowledge and Skills, Domain Fundamentals and Fundamental Knowledge and Skills. It also supports the formation of career tracks based on the combining of specialist optional modules that enable specialisations in various areas of IS. As such, it is expected to address the shortcomings identified so far.

6.7 IS 2010 Survey

The application of IS 2010 forms the Second Stage Mapping that builds on the existing survey data set. By refining the data further, the mapping of the IS curriculum is carried out according to courses grouped by university affiliations (Russell Group, million+, 1994 Group, University Alliance and No Affiliation). By taking advantage of the new flexible structure of IS 2010 it should be possible to eliminate all previous unclassified or partially classified modules, while formally defining the hierarchical disciplines that lend topics to the IS curriculum. As an extension of this approach, it should also be possible to capture those modules that contribute to the Foundational Knowledge (FK) of IS that is also applicable to most other disciplines (Figure 6.3).

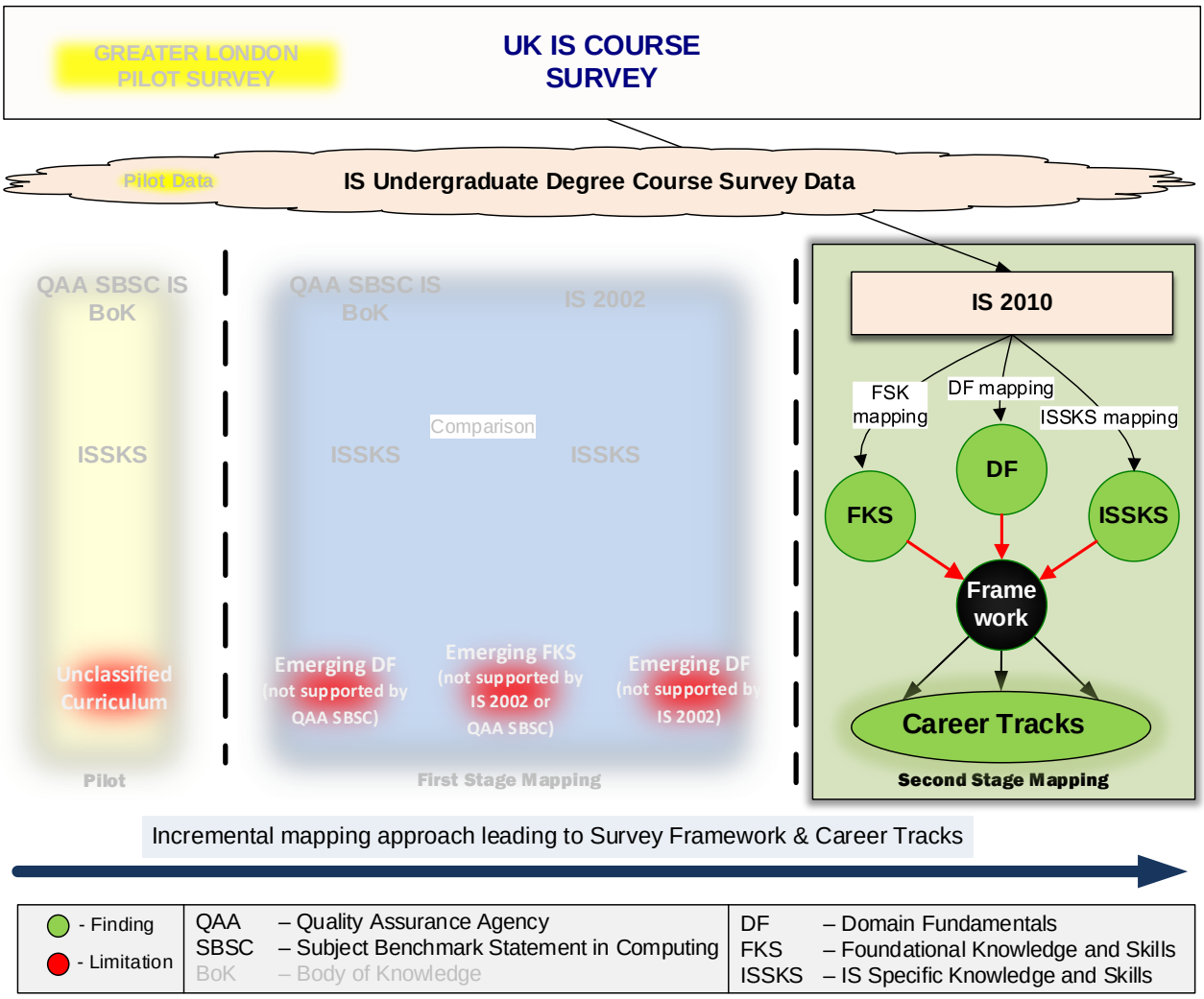


Figure 6.3. Second Stage Mapping.

6.7.1 IS 2010 Survey: Dataset Manipulations

Harvesting complete sets of course data from university websites using content analysis was shown to be a protracted but effective task. Upon collection, the data requires appropriate formatting and structuring to enable its accurate analysis. This section offers the final part of the discussion on the way data collected earlier was transformed, the implementation of IS 2010 'rules' that were used to calculate the popularity of modules according to their mode of study, the computation of relative module values in terms of their contribution to a particular career track, and the correlation of core and option modules with core and option IS 2010 subjects.

The first stage of the data accumulation phase that took place as part of the Pilot Study, involved the recording of basic information about each course. At the time of reaching the Second Stage Mapping this data took its final shape (Figure 6.4). Apart from the original data items that determined the location of the course, its name and host institution, additional information was also recorded about its BCS accreditation status which was cross-referenced

with data drawn from the BCS website, the unique UCAS code which was cross-referenced with UCAS alongside the A-Level entry points needed to obtain admission, the mode of study and the department that owned it.

University	Country	Region	City	Website	Department	BCS	UCAS	Mode	A-Level	Course Name
Brunel University	England	Greater London	London	http://www	Department of IS & Computing	Yes	G524	4yrs, san	320	BSc Information Systems
City University	England	Greater London	London	http://www	School of Informatics	Yes	G501	3yrs, ft	280	BSc Information Systems
University of Bath	England	South West	Bath	http://www	Department of Computer Science	No	G500	3yrs, ft	340	BSc Computer Information Systems
University of Bradford	England	Yorkshire and the Humber	Bradford	http://comp	School of Computing, Informatics & Media	Yes	G510	3yrs, ft	240	BSc Business Computing
Loughborough University	England	East Midlands	Lboro	http://www	Department of Computer Science	Yes	G462	3yrs, ft	280	BSc Information Management and Computing

Figure 6.4. IS course information collected for each institution (sample).

Once all the course entries had been confirmed, individual course details were recorded separately. The first set of such details is shown in Figure 6.5 which depicts a section of the data stored on the individual modules that make up a course. Apart from the names of modules, credits are the other important data item in this table as they play a crucial role in the normalisation of the percentage contribution that a module makes to the overall course. For instance, year 1 core module Computer Systems has a credit value of 10 and thus, 2.4% weighting against the degree course which is made up of 360 credits. Similarly, the Project module in year 3 has a weighting of 8.3% since it carries three times the number of credits.

Descriptions of each modules were recorded to ensure there was sufficient information to enable the correct attribution of each module to a particular category. In the case of IS 2010, for example, *Computer Systems* was allocated code 5 (Figure 6.5) which corresponds to IS2010.5 that is the fifth module in the sequence of IS 2010 modules (Figure 4.5) Similarly, codes were assigned earlier for the codification of modules against the IS 2002 and QAA SBSC methods. To codify the captured module data in a unique way, each module was assigned a code which matched one of the 18 sequential codes allocated to the subjects of IS 2010. The mapping of each module was carried out by carefully reviewing its content and matching it to one of the existing IS 2010 subjects. This approach led to the identification of a number of modules that did not match any of the 18 IS 2010 subjects (7 core and 11 option). Instead, they belonged to subjects aligned with Domain Fundamentals, or Foundational Knowledge and Skills. Given the nature of these categories, all such modules were deemed outside the scope of the initial category that dealt with IS Foundational Knowledge and Skills, including the final year project, which was present on virtually all courses but not part of the IS 2010 model. For the modules that make the final list, codes 1-7 were used to match them to core subjects, 8-18 to option subjects, 19 for final year projects, and 20 for modules belonging

to DM and FKS categories. A further code annotation was necessary to capture the core or option status of course modules.

	Loughborough University			Main page			
G462	BSc Information Management and Computing			Stats page			
	Modules online: http://www.lboro.ac.uk/departments/dis/studying/imc.html						
	Modules	Credits	Description	IS2002	QAA Code	IS2010	IS2010 %
Year 1	Computer Systems	10	Historical developme	4	9	5	2.8
Year 1	Essential Skills for Computing	10	This module will intr	11	18	20	2.8
Year 1	Studying Information Science	10	General introduction	11	18	20	2.8
Year 1	The Information Society	10	The information soci	2	13	18	2.8
Year 1	Management Problem Solving	10	The systematic conte	11	18	20	2.8
Year 1	Databases	10	The aim of this modu	8	2	2	2.8
Year 1	Organisational Theory	10	Defining organisatio	3	1	20	2.8
Year 1	Programming for the WWW	20	The aim of this modu	2	8	8	5.6
Year 1	Server-side programming	10	On completion of thi	2	8	8	2.8
Year 1	Retrieval and Organisation of Information	10	Introduction to datab	8	2	2	2.8
Year 1	Web Design and Authoring	10	Basic WWW and Inte	2	8	8	2.8
Year 2	Requirements Analysis	10	What is involved in R	7	5	6	2.8
Year 2	Human Resource Management	10	Human resource plan	11	18	20	2.8
Year 2	Information Retrieval	20	Students will be give	11	16	14	5.6
Year 2	Systems Design and HCI	10		3	5	13	2.8
Year 2	Operating Systems, Networks and the Internet	10	Introduction to Oper	6	9	5	2.8
Year 2	Subject Analysis and Indexing	10	General indexing pri	11	16	14	2.8
Year 2	Research Methods	10	Introduction to the r	11	18	20	2.8
Year 2	Team Projects	20	The main aim of this	11	18	19	5.6
Year 2	Users & Information Service Design	10		7	5	13	2.8
Year 2	Systems Design & HCI	10	The Unified Modellin	o7	o5	o13	2.8
Year 2	2D Computer Graphics	10	Introduction and sco	o11	o18	o20	2.8
Year 2	Information and Knowledge Management	10	The implementation	o3	o2	o17	2.8
Year 2	Informatics and Systems	10		o1	o3	o3	2.8
Year 2	Systems Modelling	10		o7	o6	o3	2.8
Year 3	Legal and Professional Issues in Computing	10	Freedom of informat	2	13	1	2.8
Year 3	Project	30	A supervisor appropr	10	17	19	8.3
Year 3	Software Project Management	10	The 'life-cycle' of a sy	10	8	4	2.8
Year 3	Strategic Planning and Marketing	20	Strategic decision ma	11	10	20	5.6

Figure 6.5. A sample of the content and format of course data.

Following the assignment of codes to each of the modules that made up a course, the next step in the process involved the calculation of the relative contribution modules make to the overall coverage of an IS 2010 subject. As noted earlier, modules were recorded according to their mode, i.e., core and optional. When a core module of a given percentage that is offered during a particular year of study was captured, its relative score was calculated as shown in Figure 6.6.

		IS 2010 CORE MODULES						
CORE		IS2010.1	IS2010.2	IS2010.3	IS2010.4	IS2010.5	IS2010.6	IS2010.7
	Code	1	2	3	4	5	6	7
	Year 1	0.0	1.3	0.0	0.0	0.7	0.0	0.0
	Year 2	0.0	0.0	0.0	0.0	0.7	0.7	0.0
	Year 3	0.7	0.0	0.0	0.7	0.0	0.0	0.0
	Count	0.7	1.3	0.0	0.7	1.3	0.7	0.0
% of core contributing to IS2010 core		33.3	66.7	0.0	33.3	66.7	33.3	0.0
		33.3	66.7	0.0	33.3	66.7	33.3	0.0

Figure 6.6. Capturing the relative contribution each module makes.

Figure 6.7 depicts only part of one of the tables that focuses on core modules and calculates the '% of core contributing to IS 2010 core'. Additional tables like this were present for the rest of the categories. In order to calculate the contribution each module made across all 228 IS courses to the overall standing of a subject, it was necessary to compute the occurrence of modules in each year of study (Figure 6.7).

	CORE MODULES IS 2010 - RUSSELL GROUP COURSES									
	IS2010.1	IS2010.2	IS2010.3	IS2010.4	...	IS2010.17	IS2010.18	Project	N/A	Total
Year 1	37	4	0	3	...	0	0	8	36	161.0
Year 2	7	20	0	13	...	1	4	8	35	159.3
Year 3	3	2	1	9	...	2	1	63	35	145.3
All Years	46	26	1	24	...	3	5	78	106	465.7
Year 1	23%	2%	0%	2%	...	0%	0%	5%	23%	100.0%
Year 2	4%	13%	0%	8%	...	1%	3%	5%	22%	100.0%
Year 3	2%	1%	1%	6%	...	1%	1%	43%	24%	100.0%
All Years	10%	6%	0%	5%	...	1%	1%	17%	23%	100.0%

Figure 6.7. Capturing the individual module scores per year of study.

As an example consider IS 2010.4, *Data and Information Management* as shown in Figure 6.7. For this subject the number of IS courses offered by Russell Group universities generate a total of twenty four 15-credit (normalised) modules. Three of these modules appear in the first year of study, with the remaining 13 and 9 appearing in second and third years respectively. Apart from the whole numbers, equivalent percentages were recorded for each year, showing in a comparative way the contribution these modules make to the entire degree. As expected the adding up of all the percentages of all the modules across all years of study comes to a rounded 100% score. By adding up the individual scores from each university affiliation group, it became possible to produce a final table that depicts the ultimate module popularity list for all 228 course of the study. A series of such tables are presented in the following section. An identical method to the above was used for calculating the scores for DF and FKS modules. A discussion and tables depicting their popularity are also provided in the following section.

The final significant element of this process of crunching data relates to the way career tracks promoted by the IS curriculum was measured for each course (section 6.8 in this chapter discusses the findings relating to careers tracks). Determination of how well each IS course matches a career track rests on the definition of 'significant coverage' and 'some coverage' of each subject for a given course (Figure 4.5, key). According to the structure of IS 2010, each subject that contributes to a particular career track, be it core or optional, is expected to either offer 'significant', 'some' or no coverage of the topics it covers. Unlike option subjects that may not be offered as part of a particular career track, core subjects must either have 'significant' or 'some' coverage but cannot be absent from the IS curriculum. Quantifying the subject coverage of a module is difficult due to the ambiguity of module names, generic module descriptors, variable module sizes which need to be normalised, inter-dependency between similar topics as well as attributing a value to something as vague as 'significant' or 'some' coverage. Consequently, the correct classification and mapping of individual modules to the subjects of IS 2010 is crucial.

As the content of each module is matched against a core or option subject of IS 2010, the cumulative value of that module in terms of coverage is limited to 'significant' or 'some'. Where a course features a large number of modules, all of which cover the same subject, it is necessary to limit the overall contribution of the module coverage to the maximum contribution set by the 'significant' coverage variable. A similar limit standard becomes necessary for modules contributing to subjects with only 'some' coverage within a particular career track. 'Significant' coverage is set to be equivalent to 30 credits, approximately 8.3% of the teaching offered in one academic year as part of one or more modules covering a particular subject. Equally, 'some' coverage is deemed to be equivalent to 15 credits, approximately 4.2% of the teaching in a given year. The determination of coverage value was based on two factors.

First, the IS degrees considered in this study, usually 3 years long, feature credit-bearing, modular structures where each student is expected to successfully complete 120 credits per year. QAA advises that each credit represents ten notional hours of learning that need to be devoted to mastering a subject, and thus a 15-credit module involves 150 hours of study (QAA, 2009). The majority of courses examined use mostly 15-credit or 20-credit modules which result in the study of eight or six distinct modules, respectively in each academic year. Setting the limit for 'some' and 'significant' coverage to the aforementioned levels represents a reasonable amount of study effort that could justify 'some' or 'significant' subject expertise. Second, if 'some' coverage is set to one 15-credit and 'significant' coverage to two 15-credit modules, the number of modules that are needed for each career track according to the structure of IS 2010 ranges from 12 to 21 (average 17.4). Assuming a 15-credit module as the base unit, a degree course would feature 24 modules over three years which, not only allows for the prescribed average of 17.4 core and option modules of each career track, but also

offers 'spare capacity' for the coverage of additional subjects not captured explicitly by the career track subjects. IS 2010 classifies these subjects to be part of the remaining two categories that provide knowledge and skills to IS graduates: Foundational Knowledge (primarily subjects from the hierarchical disciplines of business and computing) and Skills and Domain Fundamentals (subjects that mostly cover transferable skills such as communication and teamwork) (Topi et al., 2010).

Figure 6.8 shows a partial representation of the table of formulae which derive and capture this information. Each red column heading in this figure (A max con, B max con, etc.) refers to a particular career track as shown in (IS 2010 structure, Figure 4.5), with A being Application Developer, B being Business Analyst and so forth. As such, A max con refers to the MAXimum CONtribution that a particular subject of IS 2010 makes to a particular career track.

		Core Code	Option Code	Core module % contrbtn	Option module % contrbtn	Overall module % contrbtn	A max con	B max con	C max con	D max con	E max con	F max con
IS2010 CORES	IS2010.1 C	1	o1	2.8	2.8	5.6	5.6	5.6	5.6	5.6	5.6	5.6
	IS2010.2 C	2	o2	5.6	2.8	8.3	8.3	4.2	4.2	8.3	8.3	4.2
	IS2010.3 C	3	o3	0.0	5.6	5.6	4.2	5.6	4.2	4.2	4.2	5.6
	IS2010.4 C	4	o4	2.8	2.8	5.6	5.6	4.2	4.2	4.2	4.2	5.6
	IS2010.5 C	5	o5	5.6	0.0	5.6	4.2	4.2	4.2	5.6	4.2	4.2
	IS2010.6 C	6	o6	2.8	0.0	2.8	2.8	2.8	2.8	2.8	2.8	2.8
	IS2010.7 C	7	o7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS2010 OPTIONS	IS2010.8 O	8	o8	11.1	2.8	13.9	8.3	4.2	4.2	4.2	4.2	4.2
	IS2010.9 O	9	o9	0.0	0.0	0.0	NONE	0.0	0.0	NONE	NONE	0.0
	IS2010.10 O	10	o10	0.0	0.0	0.0	NONE	NONE	NONE	NONE	NONE	0.0
	IS2010.11 O	11	o11	0.0	2.8	2.8	NONE	2.8	NONE	2.8	2.8	2.8
	IS2010.12 O	12	o12	0.0	0.0	0.0	NONE	0.0	0.0	0.0	0.0	0.0
	IS2010.13 O	13	o13	5.6	5.6	11.1	8.3	NONE	NONE	NONE	NONE	4.2
	IS2010.14 O	14	o14	8.3	0.0	8.3	NONE	4.2	NONE	4.2	8.3	NONE
	IS2010.15 O	15	o15	0.0	0.0	0.0	0.0	NONE	0.0	0.0	0.0	0.0
	IS2010.16 O	16	o16	0.0	2.8	2.8	2.8	NONE	NONE	2.8	2.8	2.8
	IS2010.17 O	17	o17	0.0	8.3	8.3	NONE	8.3	NONE	4.2	NONE	4.2
	IS2010.18 O	18	o18	2.8	2.8	5.6	NONE	NONE	NONE	NONE	NONE	NONE
	Project	19	o19	13.9	0.0	13.9						
	N/A	20	o20	22.2	27.8	50.0						
	SUM			47.2	38.9	86.1	50.0	46.0	29.3	48.7	47.3	46.0

Figure 6.8. Calculating the relative scores of modules in relation to career tracks.

As discussed earlier, the *Project*, DM and FKS modules shown as Project and N/A in Figure 6.8 after IS2010.18 O, do not contribute to overall career tracks since IS 2010 only considers the core and option subjects to be of relevance in this case.

With the relative scores for each career track calculated, the next stage (Figure 6.9) involved the calculation of overall weighting scores and career track percentages. As an example used here to illustrate how the calculations were carried out, the BSc Information

Management and Computing from Loughborough University with UCAS code G462 is shown to promote the career tracks depicted in the bottom half of Figure 6.9 as the percentage scores shown for each category. Based on the partial information shown in the figure, this particular course places more emphasis on preparing students for the career of Application Developer in IS (71%) as opposed to any other.

Weighting of modules needed for career track. Significant coverage=2, Some coverage=1	17	21	16	18	17	20	18	19	17	15	21
	70.72	87.36	66.56	74.88	70.72	83.2	74.88	79.04	70.72	62.4	87.36
	App Develp	Bus Analyst	Bus Proc Analyst	DB Admin	DB Analyst	e-Bus Manager	ERP Specialist	Info Audit Compliance	IT Architect	IT Asset Manager	IT Consultan
Percentage by which the course fulfils the career track:	71%	53%	44%	65%	67%	55%	58%	51%	57%	60%	53%

Figure 6.9. Career track scores for a course based on weightings.

6.7.2 IS 2010 Survey: Extending the Dataset

Further analysis of the previously identified 7,452 modules across 228 IS courses from 84 UK universities resulted in a slightly altered total number of modules with a statistically insignificant variance of 0.3%. The identification of the additional twenty-three 15-credit modules was produced by resolving earlier module classification ambiguities given the newly defined topics that populate IS 2010. The 84 universities offering IS courses were divided into 5 categories reflecting the affiliation each institution has (Table 6.16). Even though university affiliations do not conclusively show specific status or standing, the groupings allow for curricula comparisons between groups, offering insights into how universities with varying foci on research and teaching, view the IS curriculum. For example, 91% of University Alliance institutions, mainly ex-polytechnics that have a strong teaching focus, offer nearly a quarter of the IS courses in the study, whereas only 40% of the research intensive Russell Group institutions teach IS at undergraduate level, contributing just 10% of IS courses in the study.

University Group	Total per Group	Total per Group Offering IS	% of Group Offering IS	Courses per Group	% of IS Course Total
Russell Group	20	8	40%	22	10%
million+	27	22	81%	60	26%
1994 Group	19	11	58%	29	13%
University Alliance	23	21	91%	53	23%
No Affiliation	44	22	50%	64	28%
Total	133	84	-	228	100%

Table 6.16. UK universities offering IS courses shown by affiliation.

The initial analysis of the data shows the distribution of core and option modules across the 5 university categories (Table 6.17). Overall, the ratio of core to option modules for the 228 courses stands at 1 : 0.65. A total of 7,475 modules make up the 228 courses, of which 62% or 4,598 of all modules are classified as core, while the remaining 38% are options. Russell

Group universities offer the smallest average number of modules per course, and the highest percentage of core modules (67%). At the opposite end of the spectrum, IS courses offered by University Alliance institutions have the highest average number of modules (36) with the smallest number of cores (56%). Without further analysis of the topics covered by the corresponding core and option modules for each university group, it is difficult to interpret the meaning of the data beyond what is being suggested by the numbers: University Alliance IS courses have a more liberal and less prescriptive view of IS, offering more choice to students; Russell Group courses on the other hand, demonstrate a more narrow focus of IS.

	Russell Group		million+		1994 Group		University Alliance		No Affiliation		All	
Core	466	67%	1208	63%	574	61%	1087	56%	1263	64%	4598	62%
Option	224	33%	721	37%	373	39%	838	44%	721	36%	2877	38%
Total:	690		1929		947		1925		1984		7475	
AVG Modules per Course	31		32		33		36		31		33	
Core AVG per Course	21		20		20		21		20		20	
Option AVG per Course	10		12		13		16		11		13	
Core : Option	1 : 0.47		1 : 0.6		1 : 0.65		1 : 0.76		1 : 0.55		1 : 0.65	

Table 6.17. Core/Option module breakdown across all universities.

6.7.3 IS 2010 Survey: Course Survey Framework

The analysis of the data is based on the course survey framework shown in Figure 6.10. The framework provides the context which defines the categories used to capture the content of modules. On average, the typical IS course in a UK university consists of about 33 modules (module sizes are normalised to 15-credits), 20 of which are core, with the remaining 13 being options (Table 6.17). Irrespective of their type, for these modules to be catalogued in a meaningful and consistent way with IS 2010, they need to either be matched against the ISSKS, FKS, or DF categories, with the exception of the Final Year Project that exists outside these categories. The categorisation of modules becomes more complex because the structure of IS 2010 separates core and option subjects. So, a core or option module of an IS degree may potentially map to a core or option subject of IS 2010, which belongs to either the ISSKS or FKS or DF category, assuming it is not a project. As an illustration of the complexity involved consider the following scenario: a BSc Information Systems course offers a first year core module called Mathematics for Computer Science measured as one unit or 4.2% of the curriculum that maps onto the FKS category. Another module, Project Management, is offered in year 2 of the degree, which IS 2010 considers to be a core subject, yet it is offered as an option module. A third module in year 3 called Human-Computer Interaction is offered as core

but does not correspond to any of the declared core or option IS 2010 subjects, as it is part of FKS which IS 2010 does not elaborate on.

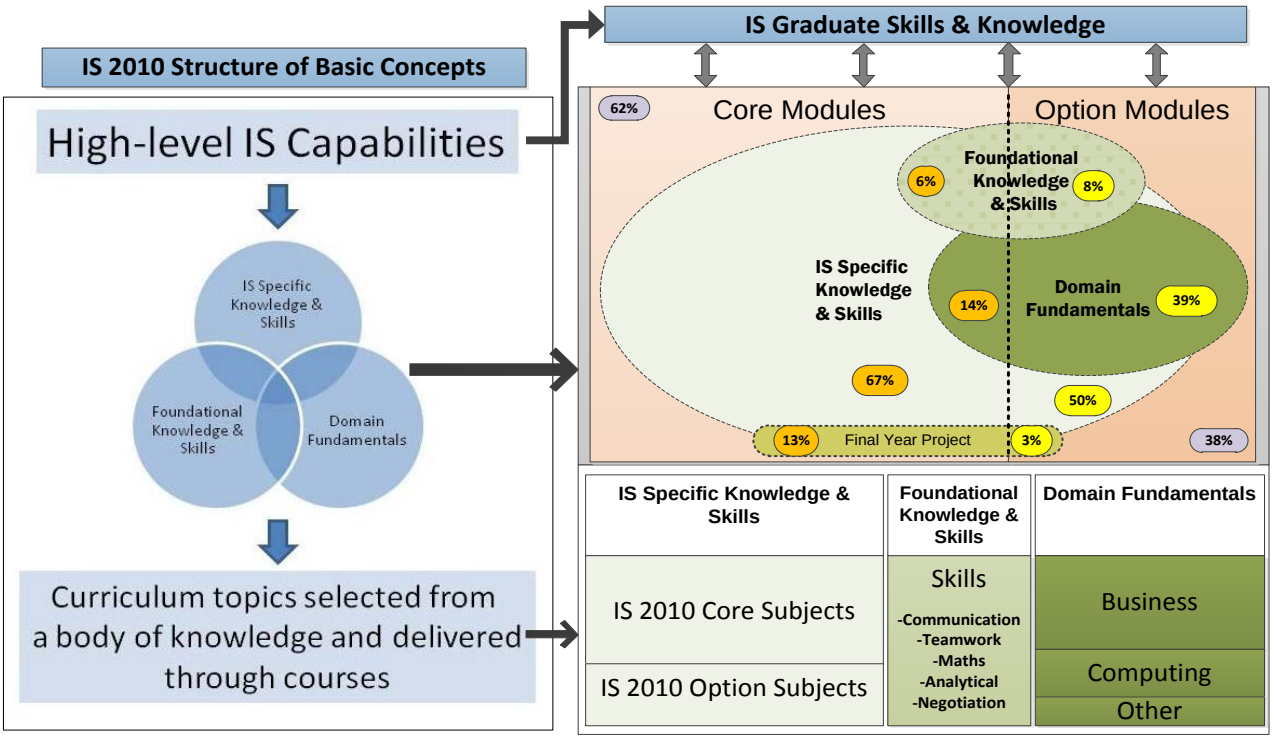


Figure 6.10. Course Survey Framework (right) based on IS 2010 Basic Concepts (left).

The basis of the framework is the IS knowledge and skills expressed through the IS 2010 basic concepts. UK students completing IS degrees are equipping themselves with skills, capabilities, and knowledge which will hopefully match the needs of industry. The level of convergence between graduate skills and the skills industry expects is independent of the framework since the right balance of IS skills requires curriculum re-development with input from multiple stakeholders (Lee et al. 2002; Lynch et al. 2007).

Whatever the exiting competencies graduates may bring to the professional world of IS, the conduit for acquiring such knowledge is expressed by the three fundamental categories of ISSKS, FKS, and DF. Even though the predominant interest of IS 2010 is rightly placed in ISSKS through the specification of the seven core subjects, the framework expands the remaining two categories by deliberately mapping modules that belong to hierarchical knowledge domains (Business and Computing), and generic professional skills. It also considers the option subjects that IS 2010 uses to support career tracks through IS specialisations by capturing specific data about those modules as well. Since modules exist as cores or options within university courses, the framework differentiates between them for every category. It also isolates the provision of the Final Year Project as a separate entity that is the culmination of the taught part of the vast majority of IS degree courses (Clear *et al.*, 2001, McGann and Cahill, 2005, Surendran and Schwieger, 2011).

As before, the mapping of the three categories of the framework is carried out as a series of normalised modules. The presentation of the results that follows in the next section is done with the aid of tables that show overall ranking of subjects, and rankings based on courses offered by different university groupings. As an overview of the findings, Figure 6.10 which depicts the framework developed, is annotated with percentage values that show the scores for each category: Overall, 62% of modules are core and 38% are options. Core modules mapped to ISSKS subjects make up 67% of the total core modules, while 50% of them are options. Combined results for modules that make up the domain fundamental categories show that 14% are core and 39% are options. Similarly, core skills modules account for 6% of the overall core number of modules, with a further 8% as options. Projects are predominately offered as core, with 13% of them contributing the overall core module pool, while 3% of option modules are identified as projects.

While the value of simply measuring the number the core modules of IS courses that map directly to the core subjects of IS 2010 alone is great in demonstrating how well IS courses capture the essence of IS 2010 (ISSKS), it is important to note that such measurement only shows part of the overall picture. To illustrate this point better, Table 6.18 isolates the core and option subjects of IS 2010 by showing only the extent to which core and option IS degree modules map to them without taking into account Final Year Project and modules that belong to other domains or address generic skills. Nearly half (46.8%) of core modules map directly to IS 2010 core subjects, effectively confirming the compulsory exposure that students have to 'pure' IS teaching. A further 18.2% of core IS 2010 subjects are covered by option modules, but the available data does not indicate how popular these modules are when compared with other options modules. A significant amount of core modules (16.4%) address topics that IS 2010 views as optional specialisation subjects, while a further 12.5% of option modules deal with option subjects. It is, therefore, worth remembering, when examining the results of the survey, that to judge the true contribution of a subject to the IS curriculum we must consider the mode of study of the module in relation to the mode of study of the subject to which the module maps onto.

	Russell Group	million+	1994 Group	University Alliance	No Affiliation	All
% CORE modules contributing to IS 2010 CORE SUBJECTS	46.2%	53.5%	36.8%	55.%	44.6%	**46.8%**
% OPTION modules contributing to IS 2010 CORE SUBJECTS	8.9%	22.1%	14.9%	26%	12.9%	**18.2%**
% CORE modules contributing to IS 2010 OPTION SUBJECTS	15.6%	15.5%	16.6%	16.8%	16.9%	**16.4%**
% OPTION modules contributing to IS 2010 OPTION SUBJECTS	9.3%	10.2%	13.8%	14.9%	13.1%	**12.5%**

Table 6.18. Core/Option module contributing to Core/Option IS 2010 subjects.

6.7.4 IS 2010 Survey: Survey results

This section presents the main results of the study aided by a series of tables. Continuing with the earlier trend of grouping course data according to university affiliations, the data tables show both individual and total group results. The presentation of the results follows a logical pattern: first data pertaining to ISSKS subjects are examined. Specifically, core and option module rankings are considered in relation to the core and option subjects of IS 2010. Subsequently, DF data is presented by considering the contribution of core and option modules that belong to the Business and Computing domains. Then module data contributing to generic skills as suggested by the FKS category is presented. Finally, the Final Year Project and the contribution it makes to the overall IS curriculum is considered in relation to the rest of the curriculum. Because of the large volume of available data, only summarised results are shown in this section. Detailed data tables offering complete findings are placed in Appendix A. (Note: Rounding of percentage figures may sometimes lead to small arithmetic inconsistencies).

Figure 6.11 offers a synopsis of the overall module findings. The chart plots the contribution of IS degree modules to the three subject categories: non-IS subjects, covering modules that belong to the combined FKS and DF categories; the Final Year Project which exists outside the three categories of ISSKS, DF, and FKS; and IS 2010 core and option subjects combined together. As the chart suggests, core are differentiated from option modules -4,598 and 2,877 respectively- for the 228 courses in the survey. For the non-IS category, core modules such as *HRM*, *Accounting*, *Graphics*, and *Multimedia* (the former two correspond to the Business domain and the latter to Computing) are counted together along with modules such as *Communications Skills*, and *Maths* (Skills Category) to produce the 'Core' set of figures. Similarly, modules from the same thematic background listed as options, produced the 'Option' figures of the chart. The Final Year Project follows the same pattern, as do IS 2010 core and option modules.

Overall, 67% of all core modules map directly to the 18 core and option subjects of IS 2010. This is also the case for an additional 48% of option modules that match the IS 2010 subjects. The lack of data from similar past studies makes it difficult to judge whether this kind of distribution is desirable or comparable to IS courses in other countries. Yet, as a rule of thumb, having two thirds of core modules map to what IS 2010 defines as the essential topics for IS appears to be reasonable. The figure for the Final Year Project suggests that IS course developers in the UK place strong emphasis on the value of projects. Of the 4,598 core modules of the study, 579 (13%) are classified as projects, giving an average of 2.53 project modules per IS course. Russell Group universities consider the Final Year Project to be of higher importance to the core element of IS courses than other university groups.

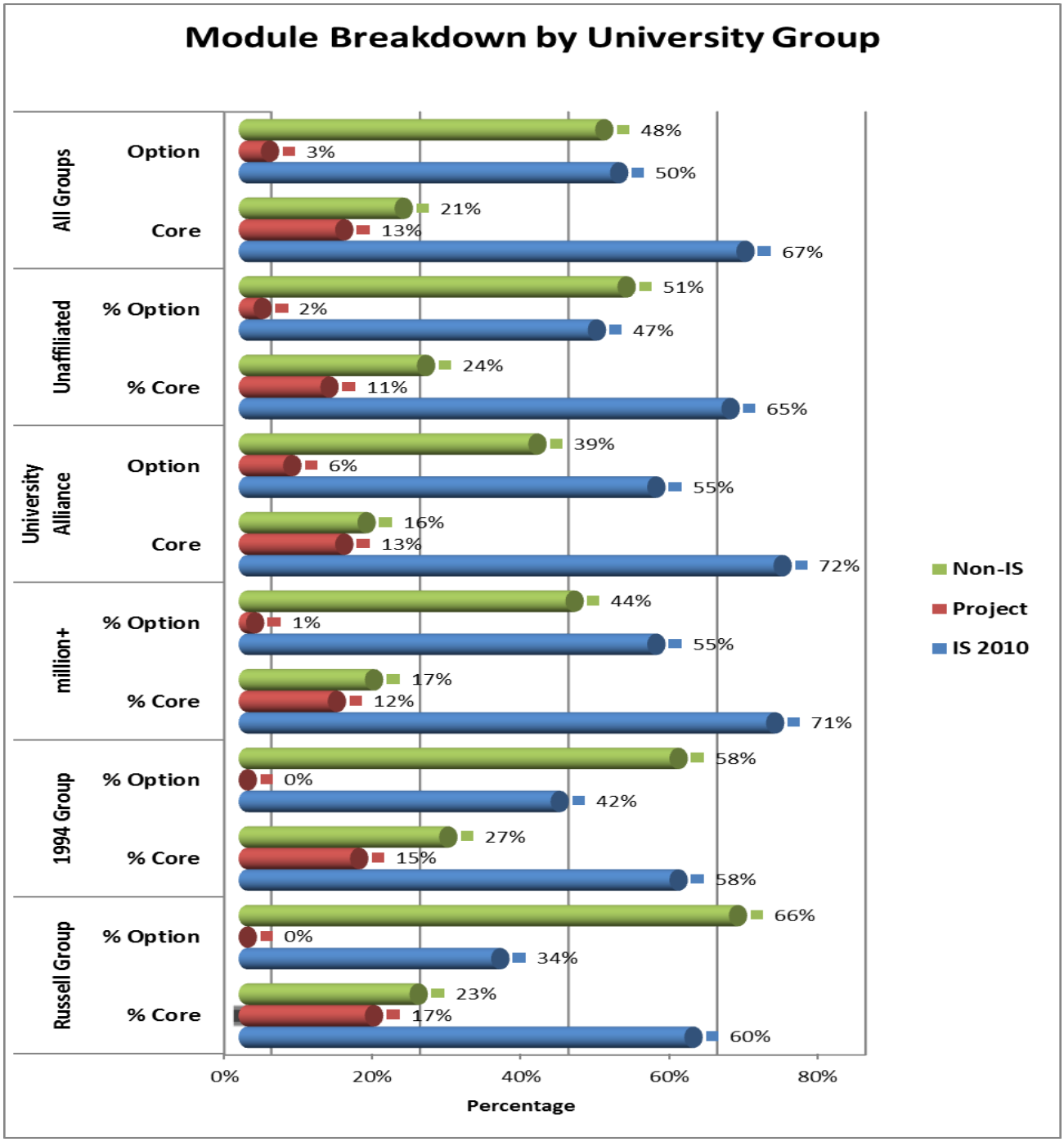


Figure 6.11. Breakdown of module data according to IS and non-IS groupings.

With 17% of cores modules classified as projects and without a single project offered as an option, Russell Group surpass the No Affiliation universities which achieve a much lower project score of 11%, with a further 2% of projects as options. Non-IS modules make a significant contribution to the IS curriculum through the provision of Business and Computing modules (a very small 'Other' category is discussed later). Interestingly, IS course developers place the majority of non-IS modules in the option category, which suggests that the decision about what hierarchical domain subjects to study is mostly left to students. Nearly half of all

option modules (48%) are modules that are part of one of the hierarchical domains of IS. University Alliance courses give significantly less prominence to non-IS modules (option, 39%) while Russell Group non-IS courses have 66% of such optional modules.

6.7.5 IS 2010 Survey: IS Specific Knowledge and Skills

An earlier discussion argued the importance of considering module data that goes beyond the seven core subjects that IS 2010 has put forward. Understandably though, given the importance of core subjects, this category becomes the starting point for all subsequent data categories. Table 6.19 captures the popularity of these modules for each university group along with its respective ranking, while the overall ranking list shows *Foundations of IS* to be the most popular core module, matching accurately the 'significant coverage' of the subject that IS 2010 prescribes. At the opposite end, *IS Strategy, Management and Acquisition* is the least popular core module with a 3% contribution to the curriculum. The rankings of the individual university groups are fairly consistent with most modules reaching similar popularity levels among the groups. A noticeable exceptions exists in the case of *IT Infrastructure* which ranks fifth for the Russell Group.

IS 2010 CORE Subjects	All	R	Russell Group	R	1994 Group	R	million+	R	University Alliance	R	No Affiliation	R
Foundations of IS	26%	1	30%	1	35%	1	21%	1	28%	1	25%	1
Enterprise Architecture	19%	2	17%	3	19%	3	19%	3	18%	2	19%	3
IT Infrastructure	19%	2	10%	5	10%	4	25%	2	14%	4	23%	2
Systems Analysis & Design	16%	3	21%	2	25%	2	15%	4	15%	3	15%	4
Data and Information Management	9%	4	16%	4	6%	5	7%	6	9%	5	10%	5
IT Project Management	8%	5	5%	6	4%	6	11%	5	9%	5	6%	6
IS Strategy, Management & Acquisition	3%	6	1%	7	0%	7	2%	7	5%	7	2%	7

Table 6.19. Core modules mapping to Core IS 2010 Subjects (R = Ranking).

Table 6.20 provides the complete listing of the 18 core and option IS 2010 subjects in order of popularity. *Application Development*, a subject that IS 2010 lists as optional, is the most popular by far with 21.4% of all teaching, excluding non-IS topics and projects, devoted to it. *Foundations of IS* (13.1%) is the second most popular subject that IS 2010 suggests should receive the highest teaching coverage irrespective of the career track(s) promoted by the course in question. The next three subjects, *Systems Analysis & Design* (11.4%), *Enterprise Architecture* (11.2%), and *IT Infrastructure* (10.2%), are core subjects with almost equal importance to the IS curriculum.

IS 2010 CORE+ OPTION Subjects	All	R	Russell Group	R	1994 Group	R	million+	R	University Alliance	R	No Affiliation	R
Application Development	**21.4%**	**1**	28.8%	**1**	25.9%	**1**	18.0%	**1**	18.6%	**1**	24.0%	**1**
Foundations of IS	**13.1%**	**2**	14.0%	**2**	13.8%	**3**	11.9%	**5**	13.7%	**2**	13.0%	**2**
Systems Analysis & Design	**11.4%**	**3**	11.4%	**3**	13.9%	**2**	13.1%	**4**	11.1%	**4**	9.0%	**4**
Enterprise Architecture	**11.2%**	**4**	8.5%	**4**	8.4%	**4**	13.3%	**3**	13.0%	**3**	8.9%	**5**
IT Infrastructure	**10.2%**	**5**	5.2%	**7**	4.2%	**8**	14.4%	**2**	8.0%	**5**	12.2%	**3**
Human Computer Interaction	**6.8%**	**6**	7.4%	**6**	5.9%	**5**	6.0%	**7**	6.2%	**6**	8.2%	**6**
IT Project Management	**5.1%**	**7**	3.0%	**8**	3.6%	**9**	6.8%	**6**	6.2%	**6**	3.6%	**9**
Data & Information Management	**4.9%**	**8**	7.6%	**5**	3.4%	**10**	4.3%	**8**	5.5%	**7**	4.8%	**7**
IT Security and Risk Management	**2.6%**	**9**	1.6%	**13**	4.3%	**7**	2.0%	**11**	3.8%	**8**	1.6%	**13**
Data Mining / Business Intelligence	**2.5%**	**10**	1.1%	**15**	2.0%	**12**	2.1%	**10**	2.8%	**10**	3.3%	**10**
IS Strategy, Management & Acquisition	**2.3%**	**11**	1.5%	**14**	1.4%	**13**	1.8%	**12**	3.5%	**9**	2.0%	**11**
Social Informatics	**2.3%**	**11**	2.2%	**10**	1.8%	**14**	1.1%	**14**	2.4%	**11**	3.7%	**8**
Enterprise Systems	**2.0%**	**12**	1.9%	**12**	1.8%	**14**	2.5%	**9**	1.9%	**12**	1.7%	**12**
Knowledge Management	**1.7%**	**13**	2.1%	**11**	4.4%	**6**	0.9%	**15**	1.5%	**14**	1.5%	**14**
Business Process Management	**1.5%**	**14**	2.4%	**9**	1.4%	**13**	1.6%	**13**	1.6%	**13**	1.0%	**15**
Information Search and Retrieval	**0.6%**	**15**	0.9%	**16**	3.2%	**11**	0.1%	**17**	0.1%	**15**	0.6%	**17**
Collaborative Computing	**0.4%**	**16**	0.4%	**17**	0.3%	**15**	0.2%	**16**	0.1%	**15**	0.9%	**16**
IT Audit and Controls	**<0.1%**	**17**	0.0%	**18**	0.2%	**16**	0.1%	**17**	0.0%	**17**	0.0%	**18**

Table 6.20. IS Degree Course Core & Option Module Rankings (excluding Project & Non-IS) (R = Ranking).

At the bottom end of the popularity list, a cluster of 6 subjects attract small coverage that implies very little interest in their content: *Business Process Management* (3%), *Enterprise Systems* (3%), *Knowledge Management* (3%), *Collaborative Computing* (1%), *Information Search and Retrieval* (1%), and *IT Audit and Controls* (<1%).

Appendix A shows the detailed breakdown of core and option module percentages for each of the 18 IS 2010 core and option subjects. It also shows the contribution the Final Year Project and non-IS modules make to the overall curriculum. A breakdown of non-IS modules follows in the next section.

6.7.6 IS 2010 Survey: Domain Fundamentals

Subjects belonging to the DF category make up 24% of the entire curriculum. These subjects are primarily derived from the hierarchical Business and Computing domains, with the remaining attributed to a general category conveniently named 'Various'. In total, there are

1038 business modules (Table 6.21) whose descriptors indicate that these are not hybrid business modules adjusted to serve the curriculum needs of IS courses which predominantly reside in computing departments. In fact, they are modules which very often are being 'borrowed' from business courses that reside in business departments. The DF data is presented as part of three separate tables below: Business, Computing, and Other. As Figure 6.11 shows, DF modules account for 48% of option and 21% of core modules respectively, or 31% combined. Modules from the domain of Business are by far popular in occurrence and number of different modules. Within the DF category Business modules provide 58%, Computing 33%, and Various 9% of the combined core and option subjects.

Table 6.21 shows the list of business subjects in order of popularity. *General Business* became necessary to capture those business subjects with very low occurrence to be statistically significant, and to deal with modules with mixed content. For example, a module described as "An introduction to and understanding of issues, debates and preoccupations in Human Resource Management, Organisational Psychology and Technology & Organisation", was assigned to the *General Business* category to maintain the accuracy of the other categories as much as possible, because it combines different constituent parts that on their own would normally be part of other subjects. Apart from *Marketing*, general *Management*, *Enterprise*, and *Accounting* feature strongly in the list of business modules.

	Rank (% Business)	Total Modules	% of Business DF	% of All DF Modules	% of All Modules
General Business	1	192	19%	11%	3%
Marketing	2	178	17%	4%	1%
Management	3	100	10%	5%	1%
Enterprise	3	105	10%	10%	2%
Accounting	4	98	9%	3%	1%
Finance	5	65	6%	3%	1%
HRM	5	59	6%	1%	<1%
Operational Management	6	57	5%	2%	<1%
Organisational Behaviour	6	49	5%	6%	1%
Global Business	7	37	4%	3%	1%
Economics	8	34	3%	6%	1%
Supply Chain Management	8	28	3%	2%	<1%
Strategy	9	21	2%	1%	<1%
Business Law	10	15	1%	2%	<1%
Total	-	1038	100%	-	-

Table 6.21. Business - Domain Fundamentals (combined Core & Option).

The introduction of *General Computing* in Table 6.22 shares the same rationale as *General Business* in the previous table. *Multimedia* and *AI* are the two subjects that record the highest module occurrences, with *End User Computing*, *Bioinformatics* and *GIS* barely making the list.

	Rank (% Computing)	Total Modules	% of Computing DF	% of All DF Modules	% of All Modules
General Computing	1	223	37%	12%	3%
Multimedia	2	130	22%	7%	2%
AI	3	114	19%	6%	2%
Graphics	4	60	10%	3%	1%
Games	5	36	6%	2%	<1%
End User Computing	6	13	2%	1%	<1%
Bioinformatics	6	13	2%	1%	<1%
GIS	7	9	1%	<1%	<1%
Total	-	598	100%*	-	-

Table 6.22. Computing - Domain Fundamentals (combined Core & Option) (* rounding).

Table 6.23 captures a small number of subjects that are not part of either of the previous domains. Although the numbers of these modules are small when taking into account the overall number of modules, the ranking and occurrence of *Research Methods* deserves an explanation. Based on the *Final Year Project* descriptors examined, research methods were often embedded into the project module. The choice to include a separate category for *Research Methods* reflected those modules which purely concentrate on that subject, often being the precursor to the project in the form of a pre-requisite. Appendix A contain a breakdown of the entire DF category with analytical data about core and option modules for each university group.

	Rank (% Various)	Total Modules	% of Various DF	% of All DF Modules	% of All Modules
Foreign Language	1	73	44%	4%	1%
Research Methods	2	62	37%	3%	1%
Other	3	26	3%	1%	<1%
Law	4	5	16%	0%	<1%
Total	-	166	100%	-	-

Table 6.23. Domain Fundamentals (combined Core & Option).

6.7.7 IS 2010 Survey: Foundational Knowledge and Skills

IS 2010 provides the five categories that capture the essence of FKS listed in Table 6.24. *Communication Skills* is the most popular subject in this category, with *Negotiation* only registering 3 modules. Appendix A includes the data breakdown for the FKS category. Four out of five types of subjects that make up the FKS category in IS 2010 mapped the modules surveyed accurately. The only exception was *Negotiation*, which as (Topi *et al.*, 2010) suggest, can be an extension to *Communication Skills*. The most popular subject in this area with a 37% total is indeed *Communication Skills*. The overall size of the FKS category (7%) was lower than anticipated.

	Ranking	Total Modules	%	% of All Modules
Communications Skills	1	194	37%	3%
Collaboration / Teamwork	2	107	21%	1%
Maths	3	111	21%	1%
Analytical Thinking	4	103	20%	1%
Negotiation	5	3	1%	<1%
Total	-	518	100%	-

Table 6.24. Foundational Knowledge and Skills

Topi *et al.* (2010) explains the essence of this category in the following way:

> *Foundational knowledge and skills are not unique to Information Systems as a discipline. Instead, most programs that educate knowledge professionals intend to develop some or all of these skills and capabilities. Still, they are very important for Information Systems programs because it is impossible for IS graduates to exhibit the required high-level IS capabilities without these foundational knowledge and skills.*

6.7.8 IS 2010 Survey: Final Year Project

The Final Year Project is treated as a separate category for two reasons. Firstly, IS 2010, along with previous editions of model curricula, do not explicitly include the project within the recommended topics for teaching. Secondly, it is important to measure how strongly projects feature in the IS curriculum. The best practical way to achieve these aims necessitated the creation of a separate category. Out of the 228 courses in this study, only 4 do not offer a project of any kind in any year. Invariably, the Final Year Project, as the name suggests, appears in the last year of study, although a number of courses offer project modules in earlier years. In the end, these two types of 'projects' were combined into the same category. Table 6.25 shows the provision of projects in the IS curriculum. By far the largest occurrence of projects takes place in year 3 as a compulsory element of the overall diet of IS modules.

Project - Core		% of All Modules	Project - Option		% of All Modules
Year 1	17	1%	Year 1	0	0%
Year 2	63	4%	Year 2	12	2%
Year 3+	500	36%	Year 3+	61	3%
Total	579	-	-	72	-

Table 6.25. Final Year Project

6.7.9 IS 2010 Survey: Observations

A further examination of the findings as part of the ISSKS category that contributes 60% of the modules to the typical IS degree course confirms that *Application Development* is the most popular subject of IS courses in the UK. Its popularity is evident both as a core and option subject. In terms of volume in the core category of modules, there are 692 15-credit programming modules (15% of all core modules, including those in the FKS, DF, and the Final Year Project category) out of a total of 4,598. The second most popular subject is the Project (579 modules) with *Foundations of IS* being the third with 506 modules. Programming

maintains its clear lead in the option modules category with 271 modules out of 2,877, while the second most popular is Systems Analysis and Design with 199. Previous editions of model curricula are at odds with IS 2010 that treats *Application Development* as an option subject of IS, and as such, not part of the seven compulsory topics illustrated in Figure 4.6. In their discussion about the differences between IS 2010 and IS 2002, Topi *et al.* (2010) argue that:

> *By offering application development as an elective [option] the IS 2010 model curriculum increases its reach into non-business IS programs while also creating flexibility for curricula that choose to include an application development course.*

This argument may be stronger for business schools that are the main providers of IS courses in the US (Pierson *et al.*, 2008) as opposed to the UK, where 203 (89%) of the 228 courses are offered by computing departments, with only 25 (11%) of IS courses being affiliated to business departments as shown in Chapter 3. Looking at Table 6.20 which captures the core and option module ranking of the eighteen IS 2010 core/option subjects, excluding the Final Year Project and non-IS subjects, *Application Development* is again the dominating module with 21.4%, while *Foundations of IS* stands at 13.1%. *Application Development* is the most popular subject across the five university affiliation groups, although for Russell Group universities the figure stands at 28.8% whereas for University Alliance and million+ universities it is 18.6% and 18% respectively. This is by far the most noticeable difference between the university groups, demonstrating a clear difference in emphasis on the importance of programming in IS degree courses. Most other variations that exist between the rankings of subjects are relatively small. *Foundations of IS*, for example, is the fifth most popular subject for million+ universities but the second most popular for No Affiliation institutions, yet the difference in the provision is a small 1.1% in the favour of the former.

Beyond *Application Development*, the ranking of subjects reveals the next four positions on the list to be occupied by *Foundations of IS*, *Systems Analysis & Design*, *Enterprise Architecture*, and *IT Infrastructure*, all of which are core IS 2010 subjects (Table 6.19). *Human-Computer Interaction* is the next most popular subject, which IS 2010 classifies as an option. As the sixth most popular subject, it appears above *IT Project Management* and *Data Information Management*, both of which are core subjects. More surprisingly, *IS Strategy, Management & Acquisition*, a core subject, only manages position eleven, with a relatively small 2.3% of subject contribution to IS teaching. At the bottom of the list *Collaborative Computing* is the subject that appears in the courses of every university group. *IT Audit and Controls*, however, has a minute presence in two of the five groups only.

Four out of five types of subjects that make up the Foundational Knowledge and Skills category in IS 2010 map the surveyed modules accurately. The only exception is *Negotiation*, which as (Topi et al. 2010) suggest, can be seen as an extension to *Communication Skills*.

The most popular subject in this area with a 37% total (Table 6.24) is *Communication Skills*. The overall size of the FKS category (7%) was lower than anticipated; often, informal discussions between academic colleagues highlight the 'trend' of an increasing number of FKS modules creeping into the IS curriculum to address the pre-university academic deficiencies of contemporary undergraduate students. This may well be an indication that the occasional unwarranted apprehensions about the evolution of the IS curriculum could be misguided.

Subjects belonging to the DM category make up 24% of the entire curriculum. These subjects are primarily derived from the hierarchical Business (58%) and Computing (33%) domains, with the remaining 9% attributed to a general category conveniently named Various. In total, there are 1,038 business modules (Table 6.21) whose descriptors indicate that these are not hybrid business modules adjusted to serve the curriculum needs of IS courses which predominantly reside in computing departments. In fact, they are modules which are very often being 'borrowed' from business courses that reside in business departments. This type of cross-subsidising of teaching and resources can be very beneficial for students and academics alike. It helps reduce the creation of thematic silos that often extend into research areas within universities, and ensures the fertilisation of IS courses with the necessary business knowledge and skills. From a practical viewpoint, it also explains how the computing departments, which offer the majority of IS courses, manage to support the business subjects that are outside their area of expertise.

The Final Year Project module is to a large extent the focal point of the IS curriculum. The 579 recorded project modules make up 9% of the overall curriculum. Although the Final Year Project is second in popularity to Application Development, it is the only subject that in four out of five courses of our survey appears as a double or triple module. Particular attention is afforded to the project by the BCS which considers it an imperative part of the curriculum that students must complete at the first attempt to qualify for accreditation.

6.7.10 IS 2010 Survey: Limitations

The most noticeable disadvantage of IS 2010 stems from its inherently flexible nature. As stated earlier, IS 2010 moves away from the repeatedly criticised rigid structure of IS 2002 that makes no distinction between optional subjects that offer specialist IS knowledge which leads to career tracks, and core subjects that are key to the IS field (Topi *et al.*, 2010). By introducing optional subjects IS 2010 serves one of its important primary purposes as a model curriculum report but hinders its use as a curriculum classification method.

As demonstrated earlier in Table 6.18, in order to full appreciate the level of adherence of an IS degree to the structure of IS 2010, it is necessary to consider how degree core modules map to the core IS 2010 subjects and how they also map to optional IS 2010 subjects. At the

same time, the same analysis needs to be performed with regards to the level of mapping between degree option modules and their correlation with core / optional IS 2010 subjects.

6.8 Career Tracks in the IS Curriculum

The amount of attention afforded to the idea of examining IS curricula based on thematic specialisations, often described as career tracks, is very limited. One such study, (Downey *et al.*, 2008) analyses the relationship between skills, the IS curriculum and newly qualified IS professionals. The results highlight the importance of developing varying course specialisations to cover a wider range of relevant skills. Similar findings emphasising the significance of career tracks are noted elsewhere (Noll and Wilkins, 2002, Fang *et al.*, 2005, Ehie, 2002). In a rare study focusing specifically on career tracks Hwang and Soe (2010) demonstrate their importance through one of the largest analyses of its kind by examining a large number of IS courses in the US, and concluding that courses with well-defined career tracks are more adaptable to technological changes and their prevalent skills.

The need to understand the career tracks promoted through the IS curriculum in the UK relates to the earlier stated premise shared by this research and many authors in the field who claim that curriculum relevance is an important issue that affects the discipline. Having conclusively classified, in the previous section, the IS curriculum in terms of its content, the next step in understanding its nature, is to appreciate the types of careers which are being promoted by the combination of modules that make up the undergraduate degree courses in the UK.

6.8.1 Career Tracks: Categorising Job Skills

Table 6.26 shows the overall ranking and percentage averages by which each of the eighteen IS 2010 career tracks is fulfilled by the undergraduate degree courses in IS. With the exception of the top three and last career track, the majority show a relatively small difference in their scores within a range of 7.5%. This is an indication that career tracks share a considerable number of subjects and as a result skills, suggesting that these professional roles have much in common. User Interface Designer stands as the undisputed leader with a score which clearly differentiates it from other categories. The same applies to Business Analyst but at the opposite end of the table. Beyond the numerical scores that produce a straight-forward ranking of tracks, it is worth considering what the percentage scores might indicate. Since no comparable data exist from a similar study, it is difficult to ascertain the true meaning of the scores. IS 2010 claims that the option subjects included in its structure are by no means definitive (Topi *et al.*, 2010). In fact, it recommends that IS departments should consider replacing or adding their own option subjects to supplement those already offered, and thus, develop courses with career tracks that serve specific local needs (Topi *et al.*, 2010).

Therefore, by including a different set of option subjects it would be theoretically likely to have average scores that are generally higher or lower, or a mixture of both. A review of the individual scores of the 228 courses in the study reveals a wide range of percentage scores, with some career tracks scoring in the low 30's and other similarly named courses with averages in the high 70's. One possible explanation for such disparity is that certain courses sit closer to the IS 2010 depiction of the IS curriculum than others. Equally, it could be argued that the consistency in the definition of IS among different academic institutions in the UK is relatively low, with some institutions having more liberal views about what should make up the IS curriculum.

Track Orientation	Rank	Career Track	%
More →	1	User Interface Designer	67.9
Technically →	2	IT Operations Manager	61.8
Orientated →	3	Application Developer	61.5
Career →	4	IT Architect	55.5
Tracks →	5	IT Asset Manager	54.2
→	6	Network Administrator	53.0
	7	ERP Specialist	52.7
	8	IT Security & Risk Manager	52.3
	9	Database Administrator	52.1
	10	Web Content Manager	51.3
→	11	Project Manager	50.5
More →	12	Database Analyst	50.0
Conceptually →	13	Business Process Analyst	49.4
Orientated →	14	Information Auditing & Compliance Specialist	49.2
Career →	15	e-Business Manager	48.0
Tracks →	=	IT Consultant	48.0
	17	Business Analyst	43.9

Table 6.26. Career track rankings.

A closer examination of the data gives rise to a further observation. The distribution of career tracks at either end of Table 6.26 indicates the formation of two clusters: tracks occupying the top end of the table appear to have a more technical underpinning that those at the opposite end; the latter appear to be of a conceptual nature. Aside from any arguments about the precise definition that accurately determines the balance between technical and conceptual classifications, career tracks in the conceptual cluster feature the keywords 'business' and 'analyst' extensively, both of which are absent from the technical cluster. Similarly, technical tracks feature the acronym 'IT' much more frequently in their titles. This

may well be the strongest indication yet that IS courses in the UK are more geared towards producing IS graduates for technical jobs.

Supplementary analysis of the constitution of each career track offers further explanations about their standings in the ranking table. Table 6.27 captures the number of modules in descending order that each career track requires for 100% coverage. Contrasting data in Table 6.26 with Table 6.27 reveals that the 4 more conceptually oriented career tracks that are the least popular require the largest module coverage. As an illustration, consider the career track Business Analyst. It requires twenty one 15-credit modules that cover a wide range of core and option IS subjects, which is equivalent of 315 out of 360 credits of a 3-year IS undergraduate degree course. At the same time, User Interface Designer, the most popular career track occupying the top position in Table 6.26, only requires fourteen 15-credit modules. Assuming that the representation of career tracks in the IS 2010 structure is adequately balanced, it is not surprising that the less conceptually orientated careers are those that require the least amount of specialist IS teaching.

	Career Track	Modules Needed for Coverage
B	Business Analyst	21
K	IT Consultant	21
F	e-Business Manager	20
H	Information Auditing & Compliance Specialist	19
D	Database Administrator	18
G	ERP Specialist	18
M	IT Security and Risk Manager	18
O	Project Manager	18
Q	Web Content Manager	18
A	Application Developer	17
E	Database Analyst	17
I	IT Architect	17
C	Business Process Analyst	16
N	Network Administrator	16
J	IT Asset Manager	15
P	User Interface Designer	14
L	IT Operations Manager	12

Table 6.27. Career tracks measured by module coverage.

6.8.2 Career Tracks: Observations

Table 6.28 provides an insight into the career track result classification by showing the relative coverage each career track offers in relation to the remainder. Thus, for any one career track with 100% course coverage, it is possible to see all the relative scores of the remaining tracks, including the ones with the highest and lowest correlation. Apart from providing a better understanding about the quantification of the career tracks used in this study, the data in Table 6.28 gives a clear indication about the extent to which knowledge and skills that make up each

career track is shared with the remainder. Five career tracks (A, B, G, H and K) share an identical skillset with five other distinct tracks. For example, a degree course that features modules capturing 100% of the requirements for career track A, Application Developer also covers career track P, User Interface Designer, in its entirety. Notwithstanding any other modules on such course, it could be argued that a future course graduate would be equally equipped to pursue a career in either one of the aforementioned professions.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Application Developer	Business Analyst	Business Process Analyst	Database Administrator	Database Analyst	e-Business Manager	ERP Specialist	Information Auditing &	IT Architect	IT Asset Manager	IT Consultant	IT Operations Manager	IT Security & Risk Manager	Network Administrator	Project Manager	User Interface Designer	Web Content Manager
	Module coverage needed for career track 'significant' coverage = two 15-credit modules / 'some' coverage = one 15-credit module																
	17	21	16	18	17	20	18	19	17	15	21	12	18	16	18	14	18
	Percentage by which a degree course fulfils the career track (%)																
A	100	48	69	67	71	65	72	63	65	74	67	75	67	69	72	100	78
B	59	100	88	78	77	75	84	69	77	74	76	100	67	69	78	72	67
C	65	67	100	61	65	60	78	74	59	80	67	92	61	69	67	71	61
D	71	67	69	100	94	70	78	79	88	87	67	92	89	88	67	64	72
E	71	62	69	89	100	65	72	74	82	73	67	92	83	81	67	64	78
F	77	71	75	78	77	100	89	74	77	87	86	92	72	88	89	79	78
G	76	71	87	78	77	80	100	79	71	87	76	100	72	81	78	79	72
H	71	62	88	83	83	70	84	100	88	93	76	100	89	94	72	64	67
I	65	62	63	83	82	65	67	79	100	74	67	92	83	88	67	65	61
J	65	52	75	72	65	65	72	74	65	100	57	75	67	75	67	64	61
K	82	76	88	78	83	90	89	84	82	80	100	100	78	82	89	79	72
L	53	57	69	61	65	55	67	63	65	60	57	100	61	69	56	64	56
M	71	57	69	89	88	65	72	84	88	80	67	92	100	94	72	64	72
N	65	52	69	78	77	70	72	79	82	80	62	92	83	100	67	64	72
O	77	67	75	67	71	80	78	69	71	80	76	84	72	75	100	79	78
P	82	48	63	50	53	55	61	48	53	60	53	75	50	56	61	100	67
Q	82	57	69	72	83	70	72	63	65	74	62	84	72	81	78	86	100

Table 6.28. Career track correlation with highest and lowest scores highlighted.

A less surprising finding validates the earlier supposition about the relationship between the career tracks of Business Analyst (B) and User Interface Designer (P), in terms of the number of modules needed to cover each one of them. A course that covers 100% of the subjects necessary for P only covers 48% of the knowledge and skills necessary for (B).

Conversely, a course that covers 100% of (B) covers 72% of (P), suggesting that 'User Interface Designer' is a subset of 'Business Analyst', and that the latter has a much higher knowledge base than the former.

6.8.3 Career Tracks: Limitations

While the introduction of career tracks in IS 2010 is not designed specifically for the purpose of accurately measuring the specialisations promoted by the curriculum, the method employed to achieve this goal is robust. Nevertheless, it is important to remember that career tracks are partly determined by the option subjects that make up the IS recommended curriculum, and that the list of option subjects in IS 2010 is not exhaustive Topi *et al.* (2010):

> *It is not possible to offer a complete collection of career track electives in a model curriculum document, but we include a number of elective course descriptions as examples. Notable changes in the included courses are as follows:*
>
> *a. Application development is no longer included in the core of the curriculum.*
>
> *b. Data networking and computer architecture are covered at a higher level of abstraction in an IT Infrastructure course.*
>
> *c. Enterprise architecture and IS project management are now part of the core.*
>
> *d. The personal productivity tools course has been removed from the curriculum.*
>
> *e. The prerequisite structure has been simplified.*
>
> *Notably, both data and information management and systems analysis and design have maintained their central roles in core of the curriculum. In addition to the core curriculum, we provide some examples of possible career tracks and career track electives; we also illustrate the use of the model curriculum in three different academic contexts with varying general degree requirements.*

Arguably, the inclusion of additional option subjects into the model would produce further career tracks or possibly affect the ranking of the existing ones. Similarly, it could be argued that the exclusion of DF and FKS modules affects the results in a particular way although IS 2010 advocates that career tracks are independent of DF and FKS topics since they are not part of the essential knowledge and skills that make up IS.

6.9 Summary

The IS curriculum survey discussed in this chapter represents a significant aspect of the research in this thesis. Considered in isolation, the survey offers a comprehensive view of the IS curriculum in the UK which has never been quantified in such detail before. At the same time, the development of the Course Survey Framework provides a tried and tested method for repeating similar surveys in the future which would enable a longitudinal view on the

evolution of the IS curriculum. A further important element of the work in this chapter is found in the development of Career Tracks which also offer a previously absent view of the IS curriculum in relation to the professional careers it promotes.

Taking these important findings forward, the next chapter will present the analysis of the graduate careers and skills sought by UK employers, by examining IS job ads. The outcome of the investigation of the employers' perspective will enable the comparison between the career tracks promoted by the curriculum and the careers sought by employers. This final step will form the basis for the culmination of this research, which set out to examine the alignment of industrial IS careers with current academic IS provision in the UK.

7 IS GRADUATE JOB SKILLS

7.1 Introduction

The IS curriculum surveys in the previous chapter provided a unique insight into the composition of the IS curriculum across the UK. The findings presented, constitute the first of two steps in the effort to understand the level of correlation between academic knowledge and skills imparted to IS students, and the graduate skills that are in demand by the IS industry. As part of the second step, this chapter focuses on the classification of IS jobs skills by analysing job advertisements which target fresh university graduates in the UK. In addition to complementing the findings of Chapter 6, the job survey in this chapter is particularly important since there is currently no comprehensive UK data that specifically discusses the IS skills which businesses expect graduates to possess. By identifying graduate employment skills it will be possible to understand the level of alignment between universities and industry through a comparison of the two, which is presented in the next chapter.

7.2 Surveying IS Jobs

The review of published research in job ad surveys discussed in Chapter 5, considered a range of survey approaches in order to ascertain their respective merits and advantages. Although quite useful, many of the job ad surveys reviewed had a relatively wide scope which was determined by broad search criteria that did not lead to a sufficiently narrow focus in relation to career level, experience, salary and other such variables. Regardless of such focus, the extensive review formed the background research about the methodological approaches to conducting surveys that determine employer sought skills.

Despite the usefulness of the wide perspective on IS graduate skills, none of the background research papers share the same motivation as this research, which is to understand specifically the graduate skills requirements of IS employers in the UK and ultimately compare them to the skills of fresh university graduates. Apart from differentiating the nature of a job survey study from those previously reviewed, conducting a survey which focuses exclusively on UK graduate skills requires the consideration of a very narrow aspect of the IS job market. Such narrowly focused study is likely to be governed by three determining criteria that restrict the range of suitable ads:

- University graduates with a Bachelor's qualification.
- Job ads covering the whole of the UK without any geographic restrictions.
- Ads specially promoting IS graduate skills without prior work experience.

7.2.1 Surveying IS Graduate Jobs in the UK

Adopting such narrow criteria does not alter the methodological approach of a job ad survey. Whatever the focus may be, the study needs to adhere to the same research principles highlighted in the job ad survey background research. However, the design of a study with a deliberately narrow focus is shaped mostly by three considerations about restricting the range of candidate ads, and thus ensure its narrow focus:

- Deviating from the narrowing ad selection requirements would have a detrimental effect on the relevance of the findings. This view is supported by Kennan *et al.* (2009) who argued in their investigation of the graduate job market in Australia that, by not focusing exclusively on IS graduates job ads, it becomes difficult to differentiate between graduate skills and any additional skills that employers would require potential applicants to possess, as a result of prior work experience.
- Focusing on job ads that only cover part of the UK, such as Greater London which is one of the largest ICT workforce hubs in the country, would weaken the overall assessment of the market while creating a fundamental incompatibility in the forthcoming comparison between the IS career tracks promoted by the IS curriculum across the UK and the jobs skills sought in just one part of the country.
- Even though there are a small number of UK-specific studies that investigate skills, their focus is either too wide in terms of the field of study (Baravalle and Capiluppi, 2010a, Baravalle and Capiluppi, 2010b) or does not related to directly IS at all (Den Hartog *et al.*, 2007, Sodhi and Son, 2010, Sutherland, 2009).

One noticeable exception among the plethora of publications considered as part of the background research that attempts to meet all three of the earlier stated criteria, is found in Latham (2001) who briefly reviewed a small number of IS job ads from Computer Weekly in early 2001. Latham's work focused on aspects of IS education such as teaching and learning, the IS professional and the state of the IS discipline, none of which required a detailed analysis of jobs ads. As a result, the author understandably only paid brief attention to an area that lay immediately outside its scope. Nevertheless, the contribution of the work is of significance as it offers an early view into an area of IS education in the UK that remains even today

substantially under-investigated. Latham (2001) explained the method used to collect data presented in Table 7.1 in the following way:

> *An analysis of job advertisements in the Computer Weekly for the third week in October 2000, the third week in January 2001 and the third week in April 2001 was carried out. Positions noted as senior appointments were not included. In addition, full page/two page advertisements for recruitment agencies, where similar positions were advertised, were not included. For each week, the number of times that any 'personal' skills were requested is listed. Where a specific knowledge/skill was requested in ten or more advertisements, the topic and number of occurrences is noted.*

	Computer Weekly 19/04/2001	Computer Weekly 18/01/2001	Computer Weekly 19/10/2000
Programming (C, C++, Java, VB, Pascal etc.)	52	73	102
Databases (Oracle, SQL, etc.)	40	47	71
Operating systems (Unix, NT etc.)	29	32	47
Web development (HTML, JavaScript, VBScript etc)	17	22	20
Microsoft development (Office etc.)	14	19	19
Analysis and design	-	11	21
Networking (Novell etc.)	10	10	10
Communication/Interpersonal skills	8	8	4
Project management	6	7	1
Attention to detail	-	2	-
Problem solving	1	2	1
Team player	3	2	5
Change management	-	1	2
Managing self	1	1	2
Willingness to learn	-	1	2
Ability to adapt	-	-	1
Organisational Skills	2	-	-
People Skills	1	-	-
Working to deadlines	1	-	-

Table 7.1. Skills derived from UK job ads in 2001. Adapted from (Latham, 2001) by merging data categories.

Whilst inconclusive due to its indicative nature, the data in Table 7.1 suggests that Programming followed by Operating Systems and Web Development were the three most sought after skills by employers. In addition to these hard skills, a series of soft skills appeared in the ads but with low scores, making it difficult to attribute any significance to them. Despite that, the list of skills alone provided a reasonable basis for a subsequent comparison with the findings of the current study.

Earlier work by Latham (2000) had surveyed employers and IS graduates together in order to ascertain their views on the importance and relevance of skills. That approach was part of Latham's effort to determine how well IS education catered for the wider needs of

business and industry but without focusing exclusively on graduate positions. The survey method used was that of a questionnaire, similar to the numerous studies which were discussed in section 5.8.1. Initially, Latham gauged the views of employers and upon receiving completed questionnaires from them, the researcher issued further questionnaires targeting recent IS graduates already employed by these organisations. This approach provided additional data that enabled the comparison of views held by the two different stakeholders. As demonstrated earlier, choosing which stakeholders to combine is dictated by the objectives of each particular study. Apart from Latham (2000), examples of different stakeholder pairings are found in (Azevedo *et al.*, 2012, Janicki *et al.*, 2004, Lee and Fang, 2008, Lee *et al.*, 2002, Martz and Cata, 2008, Zhao, 2002). By juxtaposing employer and recent graduate views about the importance of IS knowledge and skills, Latham (2000) was able to conclude that:

> *Information Systems graduates must be multi-skilled. They need to be organisationally as well as technically competent, and need a mix of knowledge and skills that will enable them to work effectively in a modern organisation and also equip them for life-long learning.*

Beyond Latham's UK specific work there is no conclusive documented evidence about the UK graduate IS skills requirements from an employer's perspective. Broad data about the IT & Telecoms workforce in the UK from e-skills (2012) shows that 1 in 25 people in the UK are employed in this sector with the total number of employees exceeding the one million mark. Despite the extremely detailed and informative nature of this annual report, the only relevant statistics to the current study relate to the geographical distribution of jobs across the country and the industries that they belong to. Both of these categorisations are features used in the data analysis of the study presented later in this chapter. Similarly, graduate destination statistics, which were discussed in Chapter 3, provide some information about IS graduate jobs but from an academic perspective. Skills that are associated with these jobs would need to be inferred since the data does not examine the skills required for these positions; it simply considers job categories.

Adopting a different survey approach outside the UK market, Prabhakar *et al.* (2005), Lee and Lee (2006), Benamati *et al.* (2010) offer some of the best examples of studies which utilise web-based technologies that crawl the web using popular job search engines to harvest vast amount of data that can be analysed to extract relevant skills. By emulating the methodological approach of these studies, Baravalle and Capiluppi (2010b) carried out one of the most extensive recent analyses of IT skills in the UK which took into account the entire breadth of the field. Their work adopted a longitudinal perspective on the proliferation of IT skills in the UK job market. The implementation of this ambitious study relied on an automated extraction and parsing tool which sifted through a vast number of IT job ads featured on www.monster.com. Wanting to contextualise their findings by means of comparison, the

authors analysed a small sample of online university course and module descriptors in IT, which produced a list of popular keywords. Although the size of the sample and the method of deriving it require closer analysis, Baravalle and Capiluppi (2010b) performed comparisons of the two sets of data that revealed a disappointing picture of universities significantly trailing the business and industry in the provision of appropriate IS skills.

7.2.2 Surveying IS Graduate Job outside the UK

The wide range of categories of the surveys discussed earlier according to the specific data collection method they employ (paper questionnaire, newspaper ads, web surveys, interviews, mixed methods), highlighted the need to choose the right survey approach in order to address the specific requirements of a given research investigation. Without re-examining the merits of each approach, this section briefly considers a small number of these surveys for three reasons. First, to provide a context for the subsequent discussion by highlighting the findings in other countries; second, to demonstrate some of the practical steps researchers take to conduct this type of work; and third, to illustrate the variety in scope that methodologically similar studies can have.

Harris *et al.* (2012) offered one of the most interesting longitudinal studies alongside Gallivan *et al.* (2004), Todd *et al.* (1995), Maier *et al.* (2002) whose work is considered by many to be particularly influential in this area. The work by Harris *et al.* (2012), which embraces context analysis over different media, differed from most other similar work by being delivered in instalments. The authors considered the IS job market in the US over a period of nearly forty years by carrying out 3 separate but interlinked surveys. Given the length of time involved, inevitable changes took place in the way data was collected and analysed. Initially, the authors utilised a traditional paper-based newspaper job ad data collection approach before they proceeded to harvest IS job ads from web sources very similar to those used in this study. By collecting more than ten thousands ads, the survey identified a staggering 79,025 skills which were categorised according to geographical and chronological groupings. The detailed analysis of the data showed that the most popular skill, which was consistently ranked highest with the exception of the 1970s when it came second, was *Experience*. Examination of the last period of data covering the early 2010s showed that *Experience* with 92.5% dwarfs *Communication* which was ranked second with 43.1%. Interestingly, *Communication* had not been featured in the top ten list of popular skills in any of the previous years from 1970's to 1990's, suggesting a significant shift in the expectations of employers. Setting aside *Experience* for a moment as it is not part of the scope of this study whose results will be unravelled in the following sections, it is worth noting the ranking of *Communication* for subsequent comparison purposes. Addressing the issue of *Experience* as part of their discussion regarding possible implications for the IS academic curriculum, Harris *et al.* (2012)

concluded that universities need to maximise their efforts to enable students to get as much work experience as possible during their time at university.

The work by Debuse and Lawley (2009) differed considerably from the previous study both in terms of its scope as well as its approach. Instead of a longitudinal study about IS skills the authors in this case considered ICT skills across Australia and the US. From a methodological standpoint, these authors also used content analysis as their primary research instrument and employed a well-known software product to analyse their results (a brief description of such products follows in the next section). Snapshots of the employment market in both countries was taken by reviewing the ICT job ads listed on popular job search engines, using what is often referred to as a data mining approach. *Experience* was also found in this study to be the highest ranking concept that employers in both countries consider the most important, as were a series of technological skills. Beyond the ranking of skills for the two countries and the comparison that showed many similarities between them, Debuse and Lawley (2009) enhanced their discussions about their findings by considering curriculum data derived from the Australian Computer Society BoK of IS (Snoke, 2007) and ACM's IS 2002 curriculum recommendations (Gorgone *et al.*, 2002). Somewhat surprisingly, the data comparison between employment and the curriculum suggested a relatively close match between them with the exception of *Experience*, prompting the authors to conclude that placements and internships may be the solution to closing an otherwise narrow gap.

A final noticeable job ad survey worthy of a brief discussion here is found in Kennan *et al.* (2009). Methodologically, this Australian study of graduate IS skills borrowed many good ideas from an earlier work carried out by Marion *et al.* (2005). The survey began by providing a clear justification regarding the need to examine what might appear to be a distinct part of the job market. The authors argued that it was not possible to understand the needs of IS employers who seek fresh university graduates without carrying out a study which specifically focuses on them. Kennan *et al.* (2009), similar to Debuse and Lawley (2009), came to the conclusion that the value of the findings of such study can only be acceptable if the data is as representative as possible of the skills requirements of a wide range of employers. Such an approach, ensures a comprehensive view has both a wide scope by including all employers, and a narrow focus as a result of concentrating on a small number of representative ads. The findings put forward by Debuse and Lawley (2009) did not immediately match those of Harris *et al.* (2012) since the former understandably chose to exclude jobs ads that specified prior experience as a precondition for employment, and thus no experience category existed to match the top ranking category of the former two studies. Closer inspection, however, showed *Personal Characteristics* and *Communication Skills* (treated as two separate categories) to be ranked as the second and third most popular skills for IS graduates behind IS Development. Much like Harris *et al.* (2012), Debuse and Lawley (2009), confirmed that employers were keener on

employing rounded graduates who possess skills that enable them to grow into their jobs, as opposed to just technically proficient young professionals lacking in the ability to self-develop.

7.2.3 Content Analysis Software

The proliferation of content analysis software over the past 30 years followed a similar path to the proliferation of most business software, such as word processing, spreadsheets and email. Addressing a growing business need, the development of analytical software to aid researchers in their quest to manipulate data in quantitative and qualitative ways took different forms. A portal containing information about content analysis software which features numerous early products, still hosted by the University of Alabama at the time of writing this thesis (http://bama.ua.edu/~wevans/content/csoftware/software_menu.html), lists 98 different software products, many of which are currently obsolete. The software packages are grouped according to content analysis software, software for qualitative data analysis, software for video analysis, text management software, image and video management software and audio management software. This is an indication that early software products in this area tended to specialise in different aspects of content analysis instead of trying to group different aspects of functionality together. The most sophisticated content analysis products available in the market today, however, combine most of these functions within the same package.

In the UK, the University of Surrey conducted funded research in the area of Computer Assisted Qualitative Data AnalysiS (CAQDAS) from 1994 until 2011 when external funding ceased. During that time, the Surrey research centre developed extensive expertise in the development and use of software packages that could be used for content analysis purposes. Part of the nature of the applied research which is available publicly is described at (http://www.surrey.ac.uk/sociology/research/researchcentres/caqdas/about/index.htm):

> *The CAQDAS Networking Project was formally established in 1994 when we first received ESRC funding. The project grew out of the first Surrey Research Methods conference in 1989 at which time Ray Lee and Nigel Fielding coined the term Computer Assisted Qualitative Data AnalysiS (CAQDAS). This conference brought together pioneers in the field and resulted in an edited volume of papers by methodologists and software developers (Fielding and Lee 1991/1993). This volume provides an historical context to the early development of software and is therefore a seminal work in the development of CAQDAS technology and its adoption by researchers.*

A number of useful publications borne out of the expertise developed within the University of Surrey CAQDAS research centre address many of the issues researchers face when attempting to choose the right tools for their work. In one such publication Lewins and Silver (2009) explained the early stages of research strategies such as selecting the right software package and how data needed to be handled. Although the emphasis of CAQDAS is on qualitative analysis as its name implies, many of the software packages reviewed cover

quantitative content analysis as well. Practical papers on the use of most of these software packages but also others which are not mentioned here are available on CAQDAS website http://www.surrey.ac.uk/sociology/research/researchcentres/caqdas/support/choosing/index.htm. Short descriptions of the most prominent content analysis software packages which are considered as strong candidates for this study are provided below.

7.2.4 Content Analysis Software Packages

NVivo (http://www.qsrinternational.com/default.aspx) is primarily a qualitative software product that also caters for mixed research methods. It is widely used in the research world of academia but also in business. In its latest version NVivo incorporates social media technologies by interfacing with popular platforms such as Facebook, LinkedIn, Twitter, and YouTube which provide rich data content. Analysing complex forms of data requires sophisticated ways of processing it, and thus NVivo offers frequent updates that add functionality to its core.

Leximancer (http://www.leximancer.com/) is a product with many similar features to NVivo. It, too, promotes itself as a powerful tool for qualitative analysis that is capable of manipulating the rich data content that is prevalent today. Debuse and Lawley (2009) used Leximancer successfully in their comparative study between ICT skills in Australia and the US. In a further example of its content analysis usefulness that matches closely the job ad survey undertaken as part of this study, Leximancer was proven to be a good tool for the quantitative analysis of IS academic publications in a study carried out by Indulska *et al.* (2012).

Very similar to the two analysis software products described above, MAXQDA (http://www.maxqda.com/) is another popular tool that specialises in qualitative analysis. It too claims to have academic, scientific and business application uses as a result of its ability to handle complex and rich data. In a similar way to other products, MAXQDA promotes its qualitative capabilities much more than its quantitative ones. This suggests that the former is a much more sophisticated task that eclipses the limited features needed for quantitative analysis that primarily uses pattern matching and statistical analyses.

Dedoose (http://www.dedoose.com/) packages very similar qualitative, quantitative and mixed methods analyses that are also found in other popular products. It promotes collaborative work among dis-located users and claims to have uses across different fields of business and academia.

QDA Miner/WordStat (http://provalisresearch.com/) is a family of software packages that specialise in qualitative and quantitative analysis respectively. The former has been successfully used by Marion *et al.* (2005), Kennan *et al.* (2009) who examined the IS skills sought by Australian and US employers. The research approach, methodological design but

also use of content analysis software found in the work of these authors forms the basis for the job ad analysis undertaken as part of the study in this chapter.

7.3 Design of the Study

Choosing an appropriate content analysis software plays a significant part in the effort to carry out a robust job ad analysis study. Apart from the software, however, it is important to design the study in a way that it addresses potential limitations and maximises the use of the technology to ensure the accuracy of the findings. At the start of the process, selecting the most appropriate source of data is an important consideration shared by many researchers. Kennan *et al.* (2009), Debuse and Lawley (2009) opted for job listing websites which were the most popular in the countries where their studies were based, accepting that different search customisations would be necessary for each website to ensure consistency. In a similar way, Surakka (2005a) deliberately chose job websites popular with software engineering ads to ensure a sufficiently large sample for a study which focused on the analysis of skills for software engineers. As part of their UK specific study Baravalle and Capiluppi (2010b) took a similar approach which involved the evaluation of job search engines based on their appropriateness, determined by factors such as technical reasons, categorisation of ads and market comprehensiveness.

Given the limitations encountered in similar studies and the narrowly defined criteria that determine the profile of jobs relevant to this study, it became necessary to consider a wide variety of popular job sites that carry the majority of the UK based advertisements. The original search for IT job websites yielded a large number of results which after an initial assessment was reduced to the 12 listed in Table 7.2.

Job search website	Description
http://www.monster.co.uk/	Very comprehensive carrying large number of jobs
http://www.jobserve.com/gb/en/Job-Search/	Medium size site
http://www.itcontractjobs.co.uk/	Scope limited to contracting
http://www.jobsite.co.uk/jobs/it	Large provider covering many sectors
http://itjobs-online.com/	Relatively small
http://www.technojobs.co.uk/	Large site including jobs of 28 smaller ones
http://www.cwjobs.co.uk/	Relatively small featuring full-time and contract work
http://www.indeed.co.uk/	Very comprehensive with very wide scope
http://www.itjobsinlondon.com/	Scope limited to London and the South East
http://www.cv-library.co.uk/	Large database of jobs covering the whole of the UK
http://www.totaljobs.com/	Large provider covering all regions of the UK
http://www.webdesignjobs.co.uk/	Scope limited to web design

Table 7.2. Candidate websites.

The subsequent process of elimination retained sites that offered adequate flexibility in terms of including jobs for the IT/ICT industry while utilising search parameters that are sufficiently elaborate. Of the 12 candidates that appear in Table 7.2,

(www.webdesignjobs.co.uk/), (www.itcontractjobs.co.uk/) and (www.itjobsinlondon.com/) were eliminated because they covered a narrow field which was incompatible with the scope of this study, focused on one type of employment only and were restricted to one geographical area, respectively. At the same time, (http://itjobs-online.com/) along with (http://www.jobserve.com/gb/en/Job-Search/) and (http://www.cwjobs.co.uk/) were excluded because their relatively small size makes them less likely to carry the type of IS graduate job that is of interest to this study. The remaining 6 were deemed adequate for further assessment, with (http://www.monster.co.uk/) and (http://www.indeed.co.uk/) being the most comprehensive.

As part of the next step, the appropriateness of the 6 remaining job sites was tested further by running a series of preliminary job scans based on the use of specific search parameters. This was necessary, as shown by Kennan *et al.* (2009), to determine the accuracy and consistency of the results across the different websites. It also highlighted problems relating to limited functionality as well as the general availability of the specific type of ad sought by this study. Due to its relatively simplistic 'advanced search' features and the lack of relevant results, (http://www.totaljobs.com/) was deemed inadequate and was thus excluded from the candidate list which ultimately consisted of five providers. Even though the total of five jobs websites was greater than the number used by Surakka (2005a), Debuse and Lawley (2009), Baravalle and Capiluppi (2010b), Litecky *et al.* (2010), Kennan *et al.* (2009) all of whom used three, but also Chia-An and Shih (2005) who used two, while Harris *et al.* (2012), Prabhakar *et al.* (2005) used just one, the decision was justified given the relatively small number of job ads yielded by each website as part of the preliminary tests.

7.3.1 Search Parameters

In order to assess the validity of the selected websites further, it was necessary to test the selection parameters that would determine the search criteria for ads which exclusively targeted IS graduates. Following the earlier discussion which highlighted the lack of a clear definition of what constitutes IS, there was limited possibility of accurately identifying jobs based on the name 'Information Systems' or any job titles that can be safely associated with IS. Kennan *et al.* (2009) argued that the lack of terminology standardisation makes it impossible to choose job ads based on the degree qualifications they may specify. For instance, some jobs mentioned *BSc Information Systems* as a prerequisite but many others simply stated *Computing*. Ambiguity of this magnitude made it necessary to consider a series of additional of search parameters which together filtered all of the job ads down to a small number of listings suitable for further analysis. The following parameters made up the search query:

- Location: postings were only accepted if they referred to a job offered in the UK.
- Education level: a Bachelor's degree was the only acceptable qualification. Positions requesting additional qualifications such as professional certification or mentioning postgraduate qualifications as being advantageous, were excluded from the selection process.
- Job Type: the ad had to specify a full-time position. Part-time jobs with a clear time limit were not accepted but fractional posts presented as part-time were. Fixed term contracts as they appear in the majority of contracting jobs were also excluded but a contract or project that was ongoing was not.
- Career Level: there were a few variations which can be summarised as jobs targeting students, junior or senior managers and directors -all of which were excluded. Jobs indicated for graduates however were accepted.
- Education Level: this was a further parameter that complemented Career Level. The range encountered covered pre-university qualifications such as A-Level (rejected), vocational qualifications (rejected), graduate degree (accepted) and postgraduate qualification (rejected).
- Industry: most ads listed subcategories of industry classifications which placed a particular job within a specific sector. No restrictions were applied in this case as any IS graduate job would be acceptable provided it met all the remaining criteria. Data was collected about this category in order to capture the business sectors that generated the highest activity.
- Category: this parameter related to industry and acted as a superset of its groups. The category 'IT' for instance could include a number of industries such as manufacturing, which in turn includes IT departments.
- Salary: it provided a relatively crude but nevertheless important way of establishing the career level stipulated by the ad. Cases, for instance, where an ad claimed to seek a graduate with no prior experience but offered a salary of £40,000, were deemed to be targeting non-graduates.
- Years of Experience: this offered an indication of the amount of experience the successful applicant was expected to have. For graduate positions, the most obvious assumption would be zero, however, employers often expected applicants to have experience gained through part-time work during the time at university or gap years. Because the definition of experience was not explicitly stated in this case, a certain amount of flexibility was necessary.

7.3.2 Search Terms

In contrast to the search parameters whose purpose was to restrict the scope of ad searches, search terms aim to maximise the number of relevant ads returned. The majority of job ad websites allow the inclusion and simultaneous exclusion of multiple search terms. Thus, it was possible to perform a generic search for "information systems" while excluding those ads that featured "senior manager" or other unwanted specialisations. Using a wide variety of specific and generic specialist terms was needed in order to yield the maximum number of ads that met the predetermined parameters as discussed in the previous section. Often, the use of multiple terms provided more results but unless the terms were combined in a meaningful way, the return data was of limited use.

The list of search terms used was extensive. They included all the degree course names identified in Chapter 3, the career tracks derived from IS 2010 described in Chapter 6, terms that used in previous studies and the key terms that make up the Scope of the Domain of Study of IS (UKAIS, 1999).

7.3.3 Search Data

Using multiple websites to extract relevant IS jobs poses the problem of duplicate ads occurring. This is an issue that can affect the statistical validity of the findings of the study by skewing its results (Debuse and Lawley, 2009, Kennan *et al.*, 2009). Addressing the problem of eliminating duplicate ads depends on the size of the sample and the methods of processing it. In studies where the sample involved tens or hundreds of thousands of ads (Litecky *et al.*, 2010, Baravalle and Capiluppi, 2010b) it was imperative to adopt an automated method of elimination of duplicates. In other cases, including this study, the relatively small number of ads enables the manual scanning of posts which, if done properly, can eliminate ad duplication (Surakka, 2005a, Kennan *et al.*, 2009).

Manually scanning candidate ads offers a further important advantage: the opportunity to analyse and distinguish between postings that can be classified as IS graduate ads and others which belong to IT, ICT or CS. This can be a particularly important issue capable of affecting the overall quality of the study. Kennan *et al.* (2009) partly mitigated this problem by using certain Bachelor degree course names as one of the ad selection criteria, while in cases where no degree name was specified, the authors manually applied the ACS indicative criteria for IS to make individual ad assessments. Their approach of using ACS's description of IS to classify ads strongly resembles the approach taken in the identification and selection of IS courses for the curriculum survey discussed in Chapter 6, where potential IS courses were assessed using the UKAIS definition and description of IS. Ad analysis studies where the sample of job ads was significantly higher (Litecky *et al.*, 2010, Debuse and Lawley, 2009), proved to be much less susceptible to 'cross-discipline' contamination since the scope of these studies covered

a very wide range of ICT posts. In other cases, authors took a more 'liberal' approach in their definition of IS jobs. Harris *et al.* (2012) for example, explained that their main search criterion was "Information Technology" even though the study looked at the IS market.

With regard to this study, potential IS graduate ads were manually evaluated after they passed the first stage automatic assessment based on the aforementioned search parameters which eliminated ads that lay outside the scope of the study. This first stage filtering emulated Kennan *et al.* (2009) who applied the same filtering rule. For example, if an ad for a graduate position requiring a computing degree focused almost exclusively on programming or software development, it was deemed to be a SE related job as opposed to IS. At the same time, a graduate position that required development skills along with some project management and customer interaction was judged to fall within the IS category. In order to qualify such assessments better, additional clues were sought in the ad text. Background information about the company, the type of work and the interaction expected with colleagues and customers, were also considered carefully. Collectively, such information became sufficient to differentiate between IS and non-IS posts.

Prior to undertaking the final data gathering exercise, a test involving 30 ads was carried out not only to determine the viability of the overall approach but also to test the recording and data analysis features of the QDA Miner software. Its successful conclusion led to the main data collection exercise a month later. The data gathering took place from 8th April 2012 until 3rd August 2012, approximately 17 weeks. Possible concerns about the seasonality of jobs could not be entirely dismissed since there was no conclusive information to confirm their absence or presence (Surakka, 2005a). The motivation behind gathering the data during this period was influenced by the academic cycle of university study which sees the majority of undergraduate students complete their studies in late spring or early summer, triggering a wave of interest in graduate employment positions. It was, therefore, assumed that employers looking for graduates could be targeting this period as a potentially good recruitment opportunity.

Since measuring the size of the market was of no interest, no other concerns about the period of data gathering existed. Ad searches were carried out every seven days using the full range of the previously discussed keywords, using all five ad websites. As each candidate job was identified, it was assessed to determine whether or not it could be classified as an IS post. Each successful ad was checked against existing approved ads to avoid duplicates before it was added to QDA Miner as a new case pending further analysis. A total of 1,157 job ads met the graduate position criteria based on the search parameters discussed earlier. Approximately 3% were duplicate ads while a further 2.5% were very poorly defined and thus

were eliminated due to their indeterminate nature. Of the remaining 1,093 ads, 23% (252) were confirmed as graduate IS job ads, meeting all the selection criteria.

Although the final sample of 252 ads may not initially appear high, it is important to remember that the scope of the search was extremely narrow. Also, the data collection processes involved one of the highest number of websites used in previous studies and went on for a period of 17 weeks. An examination of number of final sample sizes of similar studies has shown comparatively similar sample sizes. Despite collecting data for 10 weeks only, Kennan *et al.* (2009) fared well by managing to accumulate a final sample of 400 ads, although the overall number of ads reviewed was not specified. At the same time, Debuse and Lawley (2009) limited their respective final samples to 1,000 per country of study. However, their investigation focused on the loosely defined ICT market that requires much more generic search terms that cover a comparatively large pool of ads. Similarly, Chia-An and Shih (2005) considered a sample of 484 ads but as they state in their work, their sample was derived by using generic search terms, and thus the focus of their study was much wider. Finally, Surakka (2005a) used a sample of 1,004 ads but for a longitudinal study that spanned over ten years it could be seen as being very small, compared to other similar studies that feature much larger samples.

7.3.4 Dictionary Terms

Processing the final list of 252 job ads using the QDA Miner content analysis software requires the creation of a dictionary that captures keywords that denote skills while excluding common words of no consequence to the results of the study. QDA Miner offers the option of automatically creating the keyword dictionary by parsing each ad (case) and capturing those keywords that appear frequently. To improve the accuracy of this process, the software uses an existing dictionary of excluded terms which lists common words that are of no significance. Enhancing the effectiveness of the exclusion dictionary, users can manually edit its content, thus improving the overall result.

Several attempts to automatically construct the dictionary proved unsuccessful as each time the resulting dictionary contained a large number of words of no significance while omitting others which were important. Efforts to customise the exclusion dictionary by improving its scope proved tedious and time consuming, with limited confidence in the accuracy of its final content. As a result, the equally time consuming but highly accurate task of manually parsing every single ad to record its keywords was undertaken. This process emulated the work of Marion *et al.* (2005), Kennan *et al.* (2009). It ensured that all possible keywords were correctly evaluated, leading to the development of a hierarchical dictionary shown in Table 7.3.

Code Definitions	Sub codes
Architecture	Infrastructure, ITIL
Auditing and Compliance	Compliance, IT
Business Management	Analysis, business practice controls, marketing, resource planning, strategy, transformation
Business/Systems Analysis	Agile, business analysis, data modelling, design, DSDM, functional specification, ISEB, process modelling, reporting, requirements, systems analysis, UML
Enterprise Resource Planning	Enterprise planning, enterprise solution
Hardware	Hardware, computer, peripherals
Information and Database Management	Data analysis, data integrity, data integration, data migration, database administration, database design, database development, DBMS, relational database, warehousing, data mining
IS Development	.Net, application development, documentation, life cycle, object oriented, programming, systems maintenance, system optimisation, testing, user interface design, web development
IT Operations	1st/2nd/3rd level support, application support, helpdesk, technical documentation, technical support, troubleshooting, user query, user training
Networks and Operations	Broadband, Cisco, Citrix, DNS, firewall, FTP, network configuration, networking, protocols, routers, switches, VLAN, VOIP, VPN, wireless
Operating Systems	Linux, UNIX, Windows, operating system
Personal Attributes	ability to learn, ambitious, aptitude, attention to detail, bright, committed, creative, customer focus/service, discreet, dynamic, enthusiastic, flexible, hardworking, humour, interaction, interpersonal skills, liaising, logical, methodical, motivation, multitask, offer training, outgoing, passionate, positive, prioritise, professional, show initiative, team player, versatile, work independently, work to deadline
Programming Languages	ADO.net, ASP.net, C#, C++, Java, MySQL, Perl, PHP, PL/SQL, Python, Ruby, SQL, T-SQL, Visual Basic, XSLT
Project Management	Prince 2, project design, project lifecycle, project manage, project planning, project reporting
Security and Risk	Cyber security, forensics, network security, risk, security
Soft Skills	Analytical, communication, flexibility, negotiation, numerate, organisation, planning, presentation, problem solving, research, telephone manner, verbal, written
Software	Access, Apache, Business Objects, Content Management System, Creative Suite, Crystal Reports, DotNetNuke, Dreamweaver, Drupal, Excel, Flash, Google Analytics, Google Maps, Illustrator, InDesign, Joomla, LAMP, Matlab, Microsoft Office, Omniture, Oracle, Outlook, Photoshop, Power Point, Project, SAP, SharePoint, Silverlight, SPSS, SQL Server, Umbraco, Visio, Visual Studio, Word, Wordpress
Web Technologies	AJAX, CSS, HTML, JavaScript, jQuery, JSLT, JSP, VBScript, web analytics, XHTML, XML

Table 7.3. Keyword dictionary developed for QDA Miner.

The construction of the dictionary made it possible to perform a number of different operations on the accumulated keywords, ranging from simple univariate and bivariate frequency analyses to more sophisticated statistical manipulations. The results of such analyses and the overall findings of the study appear later in this chapter.

7.3.5 Design Limitations

The review of job ad surveys in Chapter 5 highlighted the range of approaches undertaken by the various researchers seeking to uncover the graduate skills relevant to different stakeholders. Alongside the shared similarities in the research design approaches, these studies also share a number of limitations which, as the discussion showed, are linked to the particular data collection method used in each case. The job ad survey presented in this chapter is not immune to some of the limitations affecting unobtrusive data collection methods that rely on harvesting data from the internet. By grouping them together, it is possible to devise three categories which enable better differentiation between issues that affect data content, the way in which the study is conducted and the limitations affecting the methodological approach used i.e. content analysis.

The first category deals with the representativeness of the chosen ads and the ad selection criteria used. Ads must be derived using clear criteria that exclude jobs that are not part of the scope of this study which concerns itself with IS graduate skills only. But even in cases where the criteria are accurate and their application correct, it is still possible to end up with ads whose content is not entirely clear Surakka (2005b). Reinforcing this point, Kennan *et al.* (2009) explained that certain ads are bound to offer more accurate textual descriptions than others. This is not surprising since there is no standard template for job ads which are often written by employment agency staff with variable expertise. At the same time, identifying ads that conform to specific criteria when trawling through thousands of potentials postings, relies on the application of well-defined keyword search criteria (variables) which must be present in the ads themselves if they are to be captured by the search terms used (Gallivan *et al.*, 2004). Vagueness and ambiguity in the text of an ad make their selection as well as analysis partially subjective, especially when it is carried out in an automated manner without sufficient human intervention (Den Hartog *et al.*, 2007). Even when all of these issues are mitigated, it is still possible that the pool of ads is not entirely representative. This study, as is the case with the majority of studies reviewed, extracts its data from the most popular job search websites, which as noted by Debuse and Lawley (2009), Kennan *et al.* (2009) are not necessarily used by the larger employers. At the same time, the use of multiple data feeding websites carries the risk of receiving duplicate ads that either have identical or slightly different text (Marion *et al.*, 2005).

Addressing the potential issues of this first category is achieved to a large extent by adopting an interventionist approach that involves the difficult task of assessing the quality of ads manually. Coupled with a strong set of selection criteria, manual processing ensures that vagueness, ambiguity, poorly defined descriptions and duplication are handled successfully. As explained earlier, such an approach can only work for studies that involve relatively small number of ads (Kennan *et al.*, 2007, Surakka, 2005a) as opposed to those that consider tens of even hundreds of thousands of ads (Baravalle and Capiluppi, 2010b, Prabhakar *et al.*, 2005, Litecky *et al.*, 2010). While costly in terms of time, the manual scanning of IS ads for this particular study addressed all the issues raised in this category and ensured a reliable representative sample of IS graduate job ads, appropriately primed for further analysis.

The second category of limitations relates to the way in which the study is conducted, which effectively defines its nature. A number of the IS/IT skills analyses in the past considered the job market from a chronologically-static and geographically-specific standpoint. They reviewed ads which appeared in relatively narrow periods of time (Kennan *et al.*, 2009) or targeted segments of the market in a narrow part of a country (Plice and Reinig, 2007, Sodhi and Son, 2010). At the same time, other researchers approached this issue from the opposite end by undertaking longitudinal studies which were capable of depicting trends that capture the evolution and proliferation of skills over time (Gallivan *et al.*, 2004, Todd *et al.*, 1995, Maier *et al.*, 2002, Harris *et al.*, 2012). A further set of researchers considered sample ads from areas that were easily manageable due to their geography or the size of the market (Snoke, 2007, Kennan *et al.*, 2007, Baravalle and Capiluppi, 2010a). Understandably, studies whose data was collected over a short period of time, as is the case with this study, were prone to issues of seasonality (Debuse and Lawley, 2009). Equally, longitudinal studies could not always reflect the current skills in the job market because of their diffused focus (Gallivan *et al.*, 2004).

Demonstrably, the nature of any study of this kind will introduce its own set of restrictions. It is, therefore, important to ensure that the focus of the study is determined based on a clear set of goals which serve an explicit need. Thus, choosing to perform a time-limited study to ensure accuracy (Debuse and Lawley, 2009), which is also geographically-wide in order to be comprehensive (Kennan *et al.*, 2009), addresses two fundamental points which underpin the nature of this study:

- Perform a previously absent analysis of IS graduate skills to enable similar future single-point-in-time or longitudinal studies for comparative purposes, gradually building a comprehensive IS skills map for the UK.
- Perform an ad analysis study that covers the same UK-wide geographical area used to map the IS undergraduate degree course curriculum, thus enabling a comparison between the respective findings.

The third and final category of potential limitations that could affect the quality of the outcome of the execution of a job ad analysis study, relates to the content analysis methodology itself. The discussion on context analysis in Chapter 5 from a research methodology standpoint raised a number of issues that researchers need to consider prior to using it. While it would be superfluous to restate these points here, it is important to remember that the use of context analysis can take a number of forms ranging from the straightforward to the descriptive. Issues about data sampling, reliability and validity need to be addressed to ensure the accuracy of the findings (Fico *et al.*, 2008). Similarly, the application of content analysis needs to follow a series of interrelated steps to safeguard the quality of the methodological approach (Neuendorf, 2002, Kim and Kuljis, 2010). Much of the work in this area that is considered as foundational examines these limitations in an attempt to mitigate them. Todd *et al.* (1995) considered the validity of the coding scheme and any inherent bias present in the coders, as did Gallivan *et al.* (2004). Data sampling considerations were present in Surakka (2005a) and Anandarajan and Lippert (2006) as well, all conscious of the need to mitigate a potential issue with significant implications.

Studies that employ content analysis in the field of IS/IT tend to range from those that use the uncomplicated concept of collecting and measuring the occurrence of data items using simple univariate and bivariate analysis (Kung *et al.*, 2006, Bell *et al.*, 2013, Lifer *et al.*, 2009, Kennan *et al.*, 2009, Debuse and Lawley, 2009, Jonathan and Angela, 2005), to those which involve statistical analyses and hypotheses testing in order to make inferences and extrapolations about relationships among the data (Alshare *et al.*, 2011, Boyle and Strong, 2006, Cappel, 2001). Clearly, the latter requires much more complex analysis that leads to extrapolated trends, patterns and differences (Krippendorff, 2004). Another way of describing this type of work is that of Neuendorf (2002) who views inferential, psychometric and predictive content analyses as more challenging than descriptive content analysis.

Studies, such as this one, which require simple univariate and bivariate analyses minimise their exposure to potential issues which are present in the research method. The use of a software tool further contributes to the minimising of potential errors by making redundant a series of coding, sampling and reliability stages of the process which would otherwise be carried out by human operators prone to making mistakes (Neuendorf, 2002). As part of recent UK study that looked into Operational Research jobs ads to infer skills Sodhi and Son (2010) stated:

> *The third step [analysis] is relatively simple, since it can usually be done by content analysis software (if a dictionary is being used) or standard statistical software if only categorical variables are used. As mentioned before, the analytical techniques used for keywords and categories are similar to those used with categorical data, for example (1) frequencies of ads by category, and (2) cross-tabulation between categories, say between*

degree categories and the skills categories. This is because text data are converted to counts for different categories based on the frequency of ads in which category keywords appear.

In another similar UK study that examined the recruitment of business leaders through the analysis of newspaper ads, the authors viewed the process of applying content analysis as relatively safe given the simple frequency measurements used (Den Hartog *et al.*, 2007). Moreover, Kennan *et al.* (2009), Marion *et al.* (2005), Debuse and Lawley (2009) whose work has been used to model this study, associate the majority of the limitations of their work with issues described as part of the earlier two categories discussed above, and not content analysis itself.

7.4 Analysis

The first set of results in this section discuss the univariate analysis of the parameters (independent variables) used to distil the IS ads selected from the large pool of candidate ads. Among the most important variables are Location, Industry, Average Salary and Job Name. The analysis of skills in terms of their overall popularity is presented next.

7.4.1 Job Name

The purpose of the Job Name variable, as is the case with a few of the variables that follow in this section, is two-fold. First, names or titles of jobs are useful indicators for assessing the likelihood that a particular ad can be deemed to represent an IS job. Second, like any other filter, Job Name acts as an initial set of filtering for the large volume of potential ads, albeit a relatively crude one. The emphasis in this case is placed on the former since the latter has a limited effect as explained earlier in this chapter.

An important aspect of the analysis of job ads relates to the correct identification and categorisation of job titles. Names of jobs provide an easy but not necessary accurate view of the job market. The lack of standardisation of job titles in IS but also the wider field of computing, combined with the constant changes in computing technologies which often lend their names to job titles, make it difficult to measure the popularity of IS job based solely on title names. As part of their review of the Australian IS job market (Kennan *et al.*, 2009) reached the conclusion that advertised job titles can be used as a preliminary identifier of positions but further analysis was necessary before accurate conclusions could be drawn. Part of the reason for this type of unambiguity stems from the observation noted in the Australian study that IS job advertisements tend to use names or keywords within their titles that are not directly relevant to the job itself. The authors mentioned that keywords such as “Junior”, “Graduate” and “Entry-level” often make up job ad titles that also include terms like “SQL”, “Java” or “C#”, making the disambiguation of position titles difficult. Other studies which attempted to classify jobs based on titles reached the same conclusion regarding the wide variety and variation in

titles names. One such example is found in Park *et al.* (2009) who as part of their job title analysis examined 349 advertisements that showed a wide variety of names describing similar positions.

Accepting the analysis limitations imposed by inadequate advertised job titles often leads to methods of parsing of titles for the purpose of distilling or normalising them so that they conform to clearly defined categories. This type of refining is seen in Choong Kwon and Hyo-Joo (2008) as well as Chia-An and Shih (2005) who narrowed the list of titles based on various selection criteria appropriate to the requirements of their studies. In cases where content analysis was not the chosen data collection method, alternative approaches of recording unambiguous titles could be used. One such example, Davis (2003) asked IS graduates to declare their job titles as part of a questionnaire. Elsewhere, (Choong Kwon and Hyo-Joo, 2008) analysed around 850 job ads which mentioned explicitly in the title the keywords "programmer" or "analyst". Elsewhere Gallivan *et al.* (2004) took into account the changes in titles names over time and adjusted their categories accordingly. Finally, Surakka (2005a) noted that jobs ads often featured multiple titles and, as a result, proceeded to examine the content of the ads manually to ensure each was assigned the correct job title.

Despite the difficulties associated with 'cleaning' raw job titles, it is important to devise a list of representative title names that convey a clear picture of the IS job market. While job titles are not synonymous with skills, they provide a good indication of what employers are seeking from IS graduates. The preferred solution for the parsing of titles for this study follows the method of manually filtering jobs as described in Surakka (2005a). As each of the 252 IS ads was analysed, its provisional job title was recorded. Often, the title recorded was the one used in the ad itself, although on a few occasions it became necessary to consider alternative titles to replace very generic or ambiguous ones. For example, a job advertised as "SQL" was annotated with "database development" after its content was examined, confirming that the employer was seeking someone with knowledge of SQL to develop database applications. Fortunately, the majority of ads featured reasonably straight-forward titles which were similar to those noted in previous studies (Davis, 2003, Gallivan *et al.*, 2004).

A level of title abstraction and name aggregation became necessary in order to avoid the creation of an unmanageably long list of titles that would have great similarities between them (Kennan *et al.*, 2009). Titles such as "Junior Business Analyst", "Junior Business Consultant", "Business Systems Analyst" and "Business Systems Consultant" were grouped together to form one category, provided however, that the job descriptions mapped closely to the title. Although infrequent, it was not entirely uncommon to come across an ad entitled "Business Systems Consultant" whose content was entirely devoted to describing a post for managing client projects by keeping track of deadlines and providing progress reports as opposed to

conducting business analysis or design. In such cases, the job title was reclassified to reflect the content of the ad and not its given title.

The emerging set of titles shown in Table 7.4 was the result of vetting the complete set of 252 IS jobs, a process that removed trivial naming details and introduced a clearly descriptive title for each job. The titles that emerged exhibit great similarities with those that are used in previous studies (Simon *et al.*, 2007, Aasheim *et al.*, 2009b, Yen *et al.*, 2001, Panko, 2008, Litecky *et al.*, 2010).

Job Name (Job Ad Title)	Frequency	Total %
Information and Database Management	61	24.2%
Application Development	57	22.6%
Internet and the Web	44	17.5%
IT Support Operations	31	12.3%
Business Systems Analysis	21	8.3%
Project Management	11	4.4%
Networking	9	3.6%
IT Management	7	2.8%
Consultancy	4	1.6%
IT Security and Risk	4	1.6%
ERP	1	0.4%
Auditing	1	0.4%
e-Business	1	0.4%
TOTAL	252	100.0%

Table 7.4. Ranking of Job Name.

Compiling the job names into a list makes it possible to show the frequency of occurrence of each title. Titles, and by implication jobs, related to the functions of Information and Database Management as well as Application Development make up the two most popular set of job ads, with 24.2% and 22.6% respectively. Specifically, the former captures an array of job ads that require a wide range of database related skills, including database development. Although it is possible to including any type of development work within the Application Development category (as is the case for Internet and the Web), the decision not to do so removed some of the inevitable skewing of the results that would otherwise prevail. Application Development did not include all types of development, and should not be seen as a category that captures those jobs that are about programming. Pure programming was deemed to be outside the scope of this study, and as such, job ads deemed to be targeting programmers were placed in the Computer Science or Software Engineering pile of rejected job ads. Similarly, Business Systems Analysis and Project Management are two job titles in the middle of the table that represent jobs which reflect a strong IS context. Many of the 1,157 ads which did not make the final cut, described positions that initially aligned themselves with these titles

in an obvious way. Upon closer inspection, however, it was clear that many of the ads in question related to project managing software engineering or networking projects, placing them beyond the narrowly defined scope of IS. The second half of Table 7.4 beyond Project Management features a total of just 26 jobs, which is 10.3% of all ads of the study, spread across seven different categories. The discrepancy in terms of job popularity shown by the halves of Table 7.4 suggests that employers are targeting a relatively narrow range of possible IS jobs which feature some of the most popular skills in IT, such as programming, databases, web technologies and IT support.

7.4.2 Industry

The design of the search criteria needed for the accurate identification of job ads that firmly lie in IS as opposed to other peripheral disciplines do not include constraints regarding the industry a particular employer belongs to. Indeed, the great majority of ads either featured a single term stating the industry the business aligns with or provided a short description that had the same effect. This observation holds also true for Kennan *et al.* (2009) who noted that most organisations choose to describe their industry as part of the ad preamble.

Recording industry data about businesses seeking to employ IS graduates enhances the appreciation of the overall job market. Although far from being conclusive, quantitative data about different industries can indicate how narrow or wide the IS field is seen by the world of business. By the same token, job ads that are specific to a single or very small number of industries can be viewed as being derived from a narrow pool of possible job ads. Many of the job ad analysis studies reviewed in Chapter 5 examined the different industries advertising businesses belonged to (Zhao, 2002, Wilkerson, 2012, Trauth *et al.*, 1993, Stevens *et al.*, 2011, Simon *et al.*, 2007, Petrova and Claxton, 2005). For the purposes of this study, the type of originating industry for a business placing an ad did not form any type of conditional acceptance or rejection of the ad. Instead, as each ad was processed, its associated industry was recorded, producing the final list of entries that make up Table 7.5.

Despite an often unstated assumption that most IS ads are the result of positions needed by the IT industry, around 20% of all ads are shown to originate from industries unrelated to IT (Table 7.5). At the same time, 5.2% and 4.8% of ads list “Unspecified” and “All” respectively as their industry affiliation. In the case of “All” it was assumed that the ad either reflected a large employer that operates across multiple industries or the information provided was missing or incomplete. At the same time, it could be argued that “IT” was a superset of many of the other industry categories included, such as “IT/Telecoms”, “Internet Services” and “Computer Software”. This kind of ambiguity can only reinforce the earlier point about Industry as a variable whose value needs to be indicative as opposed to conclusive.

Industry	Frequency	%
IT	107	42.5%
Computer/IT Services	29	11.5%
Unspecified	13	5.2%
All	12	4.8%
Computer Software	11	4.4%
Financial Services	10	4.0%
Telecommunication Services	8	3.2%
Management Consulting Services	8	3.2%
Insurance	7	2.8%
Internet Services	6	2.4%
Healthcare Services	6	2.4%
Other/Not Specified	4	1.6%
Advertising and PR Services	3	1.2%
Energy and Utilities	3	1.2%
Business Services	3	1.2%
Retail	3	1.2%
Government and Public Sector	3	1.2%
Education	3	1.2%
Manufacturing	2	0.8%
Transport	2	0.8%
Waste Management	2	0.8%
IT/Software Development	1	0.4%
Accounting and Auditing Services	1	0.4%
IT/Telecoms	1	0.4%
Legal Services	1	0.4%
Charity	1	0.4%
Publishing	1	0.4%
Marketing	1	0.4%
TOTAL	252	100.0%

Table 7.5. Ranking of Industry.

7.4.3 Location

Like Industry, Location is another independent variable whose purpose was to capture the spread of IS job advertisements across the countries of the UK. As a term, it provides an indication of how the jobs are distributed geographically and highlights those areas that appeared to be more active. Traditionally, the majority of IT jobs tend to exist within Greater London and the South East of England. In their annual reports about the proliferation of skills in the job market, e-skills (2012) discussed the variations that exist between the different nations of the UK, often the result of national policies and initiatives that seek to promote certain industries.

Figure 7.1 shows the distribution of job ads according to the administrative geography of the UK. London, referring to the 33 districts that make up Great London, occupies the top position in the chart with a quarter of all job ads being generated by businesses residing there. South East England features 18.7% of ads, making it the second highest entry, while the North West takes up the third spot but with a significantly lower score of 11.1%. The relatively small populations of Wales and Northern Ireland can partly explain the low scores of 2% and 1.2% respectively, while Scotland which is the second biggest nation of the UK generates 4.8% of ads. While the Midlands show consistent scores just over 5%, the North East of England barely manages an entry with 0.8% which translates to 2 out of 252 job ads.

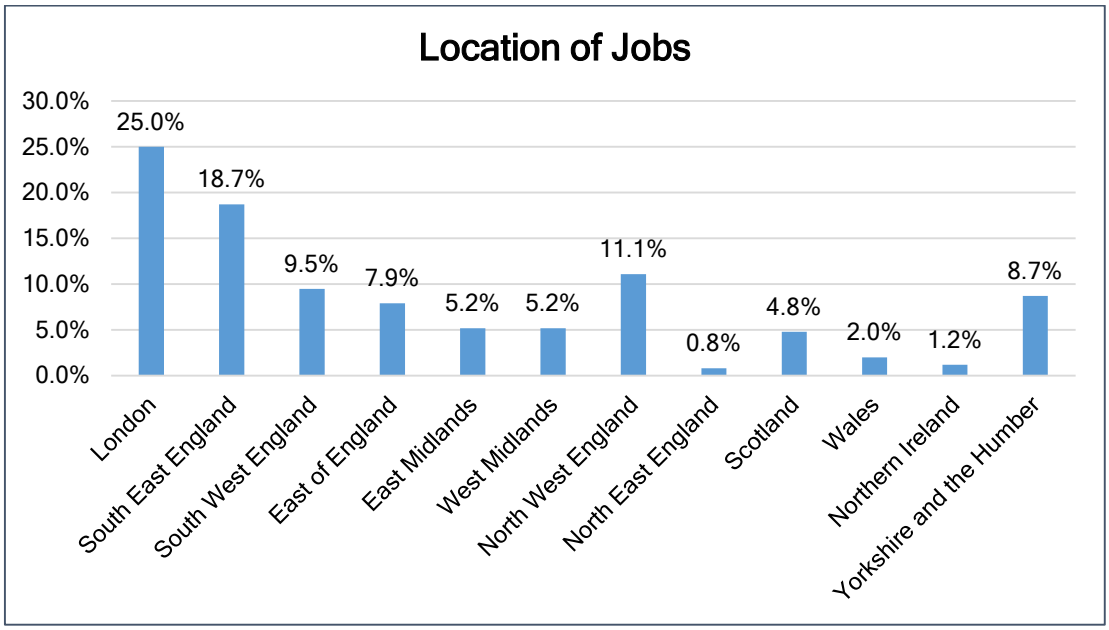


Figure 7.1. Distribution of Job Ads across the UK.

Even though the ads were harvested from websites that place no regional restrictions, it could be argued that the distribution of jobs ads between the nations of the UK but also its regions are partly biased as a result of advertising preferences that exist at regional level. Earlier in this chapter the discussion about the limitations of the study explained that only job websites that offer national coverage were included as part of the unobtrusive mechanism of job ad harvesting. As a result, websites which focused on specific markets in the UK such as http://www.itjobsinlondon.com/, were not utilised. Despite this safeguard, it is reasonable to assume that a number of jobs that were advertised using local websites such as http://www.s1jobs.com/ in Scotland were not necessarily featured in the larger UK-wide websites, and thus causing the job location statistics to be skewed.

7.4.4 Job Type, Experience, Career Level, Salary and Education

An additional set of parameters used to narrow the scope of candidate ads is discussed here. The first such parameter is Job Type. Its purpose in the study was to limit job ads to

those which were of a permanent nature as opposed to ad-hoc, temporary or placement jobs that might not be representative of range of IS skills expected in graduate positions. The majority of ads were for full-time positions, while a very small number were classified as positions specific to a 'project' -possibly fractional Table 7.6:

	Frequency	%
Full-time/Permanent	243	96.40%
Contract/Project	9	3.60%
TOTAL	252	100%

Table 7.6. Ranking of Job Type.

Education was a further variable whose aim was to filter out job ads that target potential employees with qualifications other than a recently acquired Bachelor's degree. Of the 252 job ads, 247 (98%) listed "Bachelor's Degree" as the desired qualification while the remaining 9 provided no specific mention of the qualification, although it could be inferred in all cases. Ads which included professional qualifications in addition to an undergraduate degree were excluded, as were those which required an HND, Foundation Degree or a series of A-Levels. Similarly, ads for seemingly graduate posts specifying Master's or other postgraduate academic qualifications were excluded as well, even though they targeted young professionals with little or no prior work experience.

Career Level and Experience were a further two variables that complement each other. For the vast majority of ads reviewed initially, Career Level descriptions could be grouped either as "Entry Level", "Graduate", "Student", "Manager" or "Senior Executive". Clearly, the last three descriptions fell outside the scope of this survey. At the same time, "Entry Level" could was interpreted to be synonymous with "Graduate" or a position requiring no formal academic qualifications (Table 7.7).

	Frequency	%
Entry level	222	88.10%
Graduate	10	4.00%
Unspecified	20	7.90%
TOTAL	252	100%

Table 7.7. Ranking of Career Level.

Some disambiguation regarding the term "Entry Level" is necessary given that the overwhelming majority of the accepted job ads (88.1%) are described as "Entry Level" which could have multiple meanings. "Entry Level" could be used to refer not only to graduate positions but also others which bear no formal qualifications or experience. By considering the different variables together it became clear that "Entry Level" ads referred to "Full Time"

positions for graduates with a "Bachelor's Degree" with very little prior work experience, and thus they were accepted as equivalent to posts described as suitable for "Graduate" positions.

A further ambiguity in the ad selection process initially highlighted by Kennan *et al.* (2009), exists as part of the poorly defined "Experience" variable. Since the ads under review were targeting fresh university graduates, any expectation for prior work experience could be seen as contradictory. Table 7.7 however shows that approximately half the ads that make the final selection require either less than 1 or 1 year of experience, while the other half expect more than 1 year of experience – excluding the "Unspecified" category.

	Frequency	%
Less than 1 year	58	23.00%
1 year	51	20.20%
1+ years	111	44.00%
2 years	1	0.40%
2+ years	10	4.00%
Unspecified	21	8.30%
TOTAL	252	100%

Table 7.8. Ranking of Experience.

Kennan *et al.* (2009) explained this ambiguity by arguing that given the other variables which supported the case for classifying these jobs as graduates positions, "Experience" in this instance referred to part-time work that students might undertake during their studies. Such experience, the authors believed, did not dilute the strict definition of a position for a graduate fresh out of university. Their assumption becomes credible, and thus is accepted as a mitigated study design risk, following the careful manual scan of the ads confirming that no actual job experience was specified in any of the ads which eventually made the final selection. Although there is no way to know exactly what type or level of part-time work experience employers had in mind, it is safe to deduce that university graduates with some work experience are likely to fair better in their struggle to secure the often elusive initial job.

A final variable which compliments the aforementioned ones is "Salary". With the 223 out 252 of job ads listing a minimum to maximum salary range, it is possible to use salary values as a determining mechanism that partly qualifies the level of experience, education and career stage implied in job ads. Arriving at the overall average salary (£22,651) of the accepted ads of the study was achieved by calculating the average between the minimum and maximum salaries listed in each ad, before averaging out all the averages. Indicatively speaking, an average salary of around £22.6K for IS graduates with no prior work experience appears reasonable in today's economic climate. Considering for a moment the estimation that the average salary for IT & Telecoms professionals in the UK is approximately £40K (e-skills, 2012), a starting salary of just over 50% of that amount does not appear unreasonable.

The 29 ads that did not feature accurate salary data follow the same pattern observed in some of the earlier mentioned variables which also have missing or incorrect values. Some of the ads reviewed showed £0 minimum and maximum salaries, while others carried no values at all. On a few occasions, the salary value was used as the final determinant for assessing the appropriateness of an ad. Shown also in Kennan *et al.* (2009), a few ads appeared to target graduates without great experience, yet they offered salaries normally offered to seasoned professionals, ranging from £30K to £45K. Closer inspection showed that these ads were poorly worded, inaccurately suggesting they were positions for graduates. As a result, they were removed from the candidate list of ads to safeguard the quality of the data.

7.5 Popularity of Skills in IS Graduate Job Ads

The set of results presented in Table 7.9 examine the frequency of categories for all newspaper ads along with statistics for each category. By ranking the categories according to their count it is possible to deduce that the most popular category that appears in 71.8% of ads is Personal Attributes. This is a significant finding suggesting that employers are more interested in graduates who possess personal traits, which enable them to function effectively in a professional setting, rather than actual hard skills. In terms of significance, Kennan *et al.* (2009) also noted a similar finding in their study which ranked Personal Characteristics (analogous category) second. IS Development and Programming Languages are the next two popular categories with virtually identical frequencies of occurrence. In fact the former with a count of 485 appears in 151 ads whereas the latter appears in 145 ads with a count of 484, just one less than IS Development. The fourth popular category is Software, confirming the relative importance for graduates to be at least familiar with a variety of software packages which employers consider to be the contemporary tools of the trade. As a category, Software is made up of much more transient codes which are expected to change as technology advances. Studies carried out twenty or thirty years ago listed COBOL, FORTRAN and Basic as some of the most prominent software packages at the time (Cheney and Lyons, 1980, Leitheiser, 1992, Trauth *et al.*, 1993), while later studies featured .Net, C# and various web related technologies as being critical (Wilkerson, 2012, Harris *et al.*, 2012, Stevens *et al.*, 2011, Litecky *et al.*, 2010). Similar findings about Software are noted in Australia by Kennan *et al.* (2009), Debuse and Lawley (2009), Snoke and Underwood (2002).

By occupying the fifth position, Soft Skills reinforces the earlier finding on Personal Attributes, confirming that employers are keen to employ well-rounded individuals that bring the right attitude to a job. Such findings are not surprising; Cappel (2001) noted that non-technical skills are considered by employers to be more important that technical skills, while Aasheim *et al.* (2009b) showed both interpersonal and personal skills to be the two highest ranking categories. In a further study confirming similar findings Downey *et al.* (2008) showed

that the first seven ranked categories feature no technical skills, instead they are made up of Problem Solving Skills, Critical Thinking Skills, Team Skills, Communication Skills (oral), Creative Thinking Skills and Communication Skills (written). Virtually identical findings are also noted by Davis (2003), Huang *et al.* (2009), Lee *et al.* (2002), Stevens *et al.* (2011).

Skills Category	Count	% Category	Ads	% Ads
Personal Attributes	587	15.7%	181	71.8%
IS Development	485	13.0%	151	59.9%
Programming Languages	484	13.0%	145	57.5%
Software	422	11.3%	166	65.9%
Soft Skills	385	10.3%	147	58.3%
Web Technologies	385	10.3%	92	36.5%
IT Operations	272	7.3%	107	42.5%
Business/Systems Analysis	146	3.9%	82	32.5%
Information and Database Management	125	3.4%	65	25.8%
Project Management	93	2.5%	38	15.1%
Networks and Operations	91	2.4%	32	12.7%
Business Management	80	2.1%	52	20.6%
Operating Systems	69	1.8%	42	16.7%
Security and Risk	54	1.4%	27	10.7%
Architecture	18	0.5%	14	5.6%
Hardware	17	0.5%	13	5.2%
Enterprise Recourse Planning	12	0.3%	5	2.0%
Auditing and Compliance	5	0.1%	1	0.4%
Totals	3730	99.80%*	-	-

Table 7.9. Overall popularity of IS job skills (* rounding).

Web Technologies appear after Soft Skills although their actual count is the same (385). In terms of frequency in ads, however, Web Technologies feature in just 92 ads (36.5%) while Soft Skills is much more popular by appearing in 147 ads which is more than half of the total (58.3%). As the proliferation of the web and its technologies continue to grow there is an expectation that the popularity of Web Technologies as a category will follow suit. Studies that have considered the popularity of such technologies, show an increasing number of web-based 'solutions' to be rising in terms of popularity with employers (Prabhakar *et al.*, 2005, Litecky *et al.*, 2010, Benamati *et al.*, 2010, Lee and Lee, 2006).

The cluster of categories that occupy the middle of the table deserve some attention; they are Business/Systems Analysis, Information and Database Management and Project Management. Along with programming, these three categories are often thought of as the 'traditional' career destinations for many IS professionals (Zwieg *et al.*, 2006, Chrysler and van

Auken, 2002, Bullen *et al.*, 2007, Stevens *et al.*, 2011) although their actual positions in rankings may be interpreted as suggesting otherwise. However, the categories listed in Table 7.9 are not synonymous with actual job titles. Instead, they provide meaningful names for a collection of keywords that describe a category of knowledge and skills that employers consider important. This kind of approach is very common in job ad studies that utilise content analysis (Debuse and Lawley, 2009, Kennan *et al.*, 2009, Park *et al.*, 2009, Sodhi and Son, 2010) who make the distinction between the skills that make up an actual job and an actual job quite clear.

The remaining categories occupy the bottom half of Table 7.9 with increasingly diminishing frequency values. While it is difficult to accurately identify the reasons for these low scores apart from what could be an obvious statement about their respective popularity, partial explanations can be found in the job ad selection process discussed earlier in this chapter. Many of the 1,157 job ads initially reviewed featured Operating Systems or Hardware 'profiles' but did not make the final list because they were deemed to be geared towards computing or IT positions.

An alternative way to consider the category rankings of Table 7.9 is by looking at them in the form of a dendrogram or tree structure. Through this perspective, the vertical axis is made up of the categories in question while the horizontal axis captures the clusters formed through correlation. Figure 7.2 depicts these clusters and their relationships. Kennan *et al.* (2009) successfully used the same approach to highlight relationships between different categories. A similar depiction method that highlights category associations is also found in Debuse and Lawley (2009) who use concept maps, also known as heat maps.

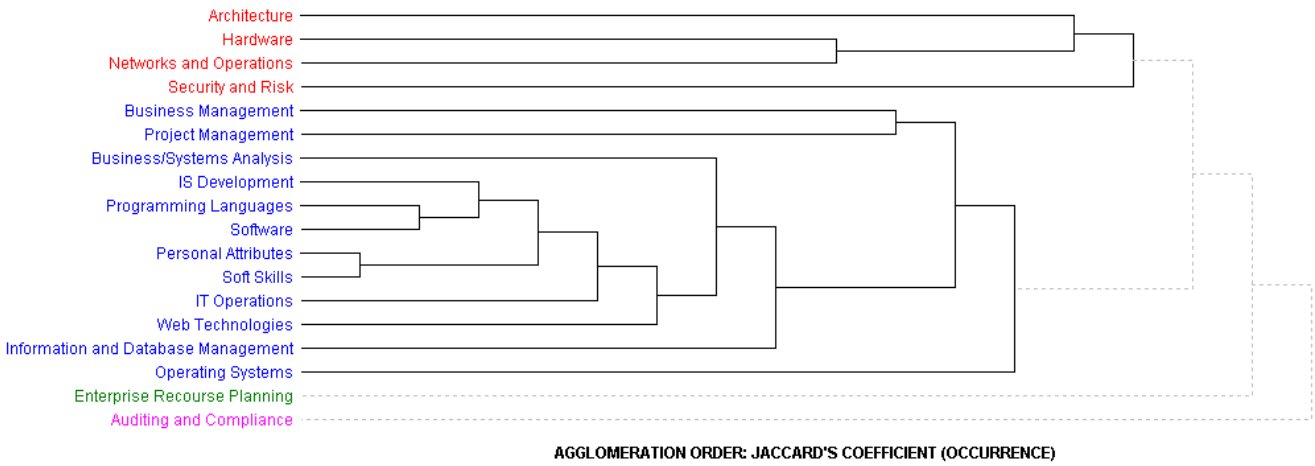


Figure 7.2. Cluster analysis of IS job skills.

The dendrogram in Figure 7.2 depicts four clusters using the Jaccard index which is a common statistical method for comparing the similarity and diversity of sample data sets by

measuring the correlation between them (Sepkoski, 1974). The first cluster shown in blue is made up of twelve categories. Given the correlation between these categories and the fact that they form the majority group out of the total number of eighteen categories, this cluster signifies the core codes that populate the jobs ads under review. As such, they can be seen as the critical knowledge and skills that employers want from graduates at this early stage of their careers (Kennan *et al.*, 2009). Within this cluster there are a number of categories which exhibit close relationships. Personal Attributes and Soft Skills are one such example, reaffirming the great emphasis placed by employers to the close association between the two sets of characteristics. Past studies suggested that non-technical skills, as they are sometimes referred to, are more significant than technical skills because of their universal applicability. As an example, Cappel (2001) argued that specific technical skills may be important in one area, such as networking, but not another, whereas non-technical skills are vital to employees irrespective of their technical specialisation. Similarly, Wilkerson (2012) showed that personal and interpersonal skills have a relative importance that outweighs any technical skills.

A further close relationship between categories can be observed between Business Management and Project Management, suggesting that employees with expertise in the areas of business strategy, business analysis and business transformation need to have Project Management skills to ensure they are in a position to manage complex projects. Noll and Wilkins (2002), Lee and Mirchandani (2010) pointed to the same conclusion as part of their work which considered the correlation of different sets of skills. Another set of categories of closely related skills exists in the form of Programming Languages and Software. Combined together, these two categories show a close relationship with IS Development which, as the name suggests, involves a variety of technical skills necessary for building technical solutions. These types of technical skills tend to change frequently as part of continuous technological advancements. In a study of the skills of software developers Surakka (2005a) noted that developers were becoming more versatile by adopting additional development skills as their careers progressed. Furthermore, the author made the point that graduates were facing increasing industry expectations about the range of programming languages they are familiar with. This was echoed by Choong Kwon and Hyo-Joo (2008) whose review of large employers suggests the need to have a wide range of development skills that satisfy the prevailing needs of the market.

While the third and fourth clusters show no correlations, and thus have no associative significance, the third cluster shown in red in Figure 7.2 merits some attention. Hardware and Networks and Operations make up the main group of the cluster which shows further relationships with Architecture and Security and Risk respectively. These associations are virtually identical to the findings noted by Kennan *et al.* (2009) who argued that the aforementioned cluster was made up of skills that strongly related to the technological aspects

of IS, and as such, it lay close to the field of computer science and software engineering. Nevertheless, employers seeking IS graduates with strong technical skills is observed in many studies which span a number of years (Igbaria *et al.*, 1991, Huang *et al.*, 2009, Goles *et al.*, 2008, Debuse and Lawley, 2009).

7.6 Conclusions

The purpose of the job ad analysis presented in this chapter was to identify and rank the skills sought by employers who seek to recruit IS graduates in the UK. Understanding the skill needs of employers is seen by many researchers as the most relevant way to improve the IS curriculum in a way which makes it more attractive to prospective students anxious to ensure good career prospects after graduation. Analysing job ads requires a careful design in order to minimise limitations that affect both the data collection but also the data analysis aspects of the study. The search criteria needed to extract only relevant data must be cautiously controlled to ensure they meet the strict requirements of the study which is focused exclusively on IS graduates in the UK. Alongside the skills, the study also considers a number of variables that frame the findings in relation to job titles, industries the jobs belong to, expected salaries, qualification levels and work experience of graduates.

The identification of graduate employment skills along with the career tracks identified in the previous chapter will make it possible to quantify the level of alignment between universities and industry by the means of a direct comparison. The discussion about this comparison and the overall research contribution of this thesis appears in the following chapter.

8 SKILLS ALIGNMENT AND OTHER EMERGING ISSUES

8.2 Introduction

This chapter focuses on the research findings emerging from the comparison of skills found in the IS curriculum and the graduate job skills sought by employers. The discussion considers the relative level of alignment which exists between the two sets of skills, and the practical approach that can be taken to improve alignment in cases where either new IS courses are designed or existing ones are updated.

With the alignment of skills ascertained, the rest of the chapter considers a number of emerging issues from the perspectives of the academic and employer stakeholders. Many of these issues were originally observed as part of the introductory chapters of this thesis. Their importance to this research has become more prominent as a result of the discussions regarding the findings of the two surveys.

8.3 In Search of IS Curriculum and Job Alignment

The lack of alignment between IS academic programmes and IS jobs in relation to relevant skills has been well documented within Chapter 5 which provided the literature review and research methods pertinent to the surveys. As demonstrated earlier, studies which compare curriculum and job skills almost invariably follow the same approach. Initially, data about prominent job skills is gathered using a survey method such as interviews, questionnaires or content analysis. Subsequently, the curriculum is analysed using a direct survey approach which identifies its core modules and the skills they promote. This commonly leads to a comparison between the two sets of findings, and a discussion about the implication of incongruities regarding the mismatch of prevailing skills (Aasheim *et al.*, 2009a, Lee *et al.*, 2002). Armed with comparative data from such analyses, researchers make judgements about the alignment between the two skillsets, as shown in the work of Benamati *et al.* (2010):

> *To establish how IS academics view their programs, we asked each interviewee to estimate the percentages of their 2007 IS curriculum that were technical and managerial. Eight of the curricula were more managerial, twelve were more technical, and twelve were best viewed as a balanced blend. Since CIOs' recent comments suggest a desire for a more managerial perspective, it appears that a substantial proportion of the curricula may still be somewhat out of balance as of 2007.*

In a similar but perhaps clearer way of describing the same approach, Lee *et al.* (1995) stated the following:

> *Our findings suggest that the current IS curricula in many universities are not well aligned with business needs. For example, many of the technical subjects emphasized in the typical IS curriculum (e.g., decision support systems, expert systems, etc.) are considered low priorities by the respondents in our study, and university curricula often lag in updating critical new technologies such as networks and telecommunications.*

While the overall comparison technique between the emerging set of skills offers reasonable reliability and validity, the methods used to compile each skillset deserve additional attention. In the case of job skills, the data collection and analysis methods commonly used are relatively robust, limited only by their inherent methodological shortcomings. With interviews, for example, the job data is derived by asking employers questions regarding the specific skills they expect from their employees (Trauth *et al.*, 1993), while content analysis of job ads extracts detailed categories of skills based on the textual descriptions of jobs (Todd *et al.*, 1995, Kennan *et al.*, 2009). Elsewhere, more detailed skills analyses based on data mining techniques produce detailed clusters of skills, resulting from hundreds of thousands of job postings harvested from online sources (Litecky *et al.*, 2010).

By comparison, the process of categorising curriculum skills appears to be less detailed. Setting aside the lack of data on option modules that seems to be a common feature of most studies, in two noticeable examples (non-UK examples) Lifer *et al.* (2009), Kung *et al.* (2006) both used module names and descriptions to categorise the core subjects of their surveyed courses, and thus identify the skills of the curriculum. Elsewhere, Chrysler and van Auken (2002) used module names to measure the perceived value of the curriculum skills according to the views of academics and alumni. Based on these examples, which are typical of the research undertaken in this area, the average curriculum survey deduces skills by reviewing modules with names and descriptions which indicate certain skills.

So, why is it that while the categorisation of job skills can be considerably detailed, categorising curriculum skills is more abstract? Arguably, it is so because data derived from module names and descriptions cannot yield sufficient information about the skills which are embedded within them. Moreover, modules come in different sizes and with descriptions which vary in detail, often making them unreflective of their content. To demonstrate this point, it is worth considering the following example of two programming modules borrowed from the survey data in Chapter 6. The first one is called Programming for the WWW, it is worth 20 credits and is listed as a first year core module with the following description: *"The aim of this module is to provide the student with the essentials of web-based programming using a language that is in widespread use and to present structured programming concepts and techniques that form the underlying aspects of all procedural programming"*. The second

module is called Implementation of Programming Languages, it is worth 10 credits and is listed as a third year option module with the following description: *"Implementation of imperative languages, Lexical analysis, Parsing, Code Generation. Implementation of functional languages, Evaluation Styles, Combinators. Type Systems, Strong Type Checking, Polymorphic Type Checking."* At face value, both of these modules can be classified under the programming category. Evidently though, there are significant differences between them, not least the fact that one is twice as large in terms of content than the other.

One possible solution to overcoming the complexity of classifying the skills promoted by modules would be to devise an elaborate method of breaking down each module into its constituent parts in order to derive (and measure) the various skills embedded within its syllabus. With limited prospects of success due to the logistical complexities involved with such a task but also potential reliability issues, it is not surprising that no such attempt has been found in the literature. Instead, the vast majority of researchers striving to understand the skills promoted by the IS curriculum consider module names and their descriptions as the means to classifying curriculum skills. As a result, comparisons between curriculum and job skills are not always based on equally detailed data sets. Wanting to mitigate the impact of this problem, and thus conduct a more thorough comparison as part of this thesis, the discussion below considers the comparison of skills from two separate perspectives. First, Career Tracks are reviewed in relation to Job Names before curriculum skills derived from modules are compared to the job skills extracted from job ads.

8.3.1 IS Skills Alignment: Career Tracks vs. Job Titles

The adoption of Career Tracks as part of the structure of IS 2010 was a significant departure from the rigid curriculum design approaches found in earlier curriculum recommendation reports (Topi *et al.*, 2010). Although not a new concept, the introduction of Career Tracks injected additional flexibility into the proposed curriculum structure that had been absent from previous reports. An early effort to highlight the importance of separating core and option subjects in the IS curriculum, which eventually gave rise to Career Tracks, was made by Lightfoot (1999) whose work advocated the need to separate core from option modules. Lightfoot's argument was based on the idea that by creating Career Track specialisations through the introduction of option modules, it would be possible to address the changing skill requirements of industry. Thus, all students would benefit from studying the core topics which made up IS, alongside optional specialisations offering curriculum flexibility through elective modules. Additional research into the popularity and use of Career Tracks over ten years later, offered mixed results. Hwang and Soe (2010) found inconsistencies in the naming of tracks and the combination of modules giving rise to them. Yet, their findings also suggested that Career Tracks can have a positive effect by prompting more frequent

updates to the curriculum. Despite this early assessment providing mixed results, their inclusion in IS 2010 made possible a new way of 'measuring' the curriculum in terms of its specialisations, as demonstrated in Chapter 6.

Declaring the titles of jobs in studies which examine IS job skills is not common, as evidenced in the majority of studies which were reviewed in Chapter 5 and 7. Nevertheless, some examples exist in literature. Davis (2003) compiled a list of popular job titles in addition to detailed demographic data originating from IS graduates in an effort to map their early career progression and the skills relevant to them. Similarly, Choong Kwon and Hyo-Joo (2008) recorded job titles for each of the 837 job ads they analysed in order to restrict their skills analysis to a specific number of jobs. In a further example, Lee *et al.* (2002) captured job titles as part of their study to measure the perception gap in skills between IS academics and practitioners. The value of recording job names in all of these cases was significant because it made it possible to consider relevant skills from a job-specific perspective. A similar approach shown below, whereby job titles have been used to enhance the comparison of results, has been adopted for this study. Before the comparison between Career Tracks and Job Names can take place it is necessary to consider the correlation between the two categories (Table 8.1). In the case of the first category, the Career Tracks have been taken from the curriculum survey in Chapter 6, while the second category of Job Names was developed as part of the job ad survey of Chapter 7.

Curriculum Career Tracks		Job Names (Job Ad Titles)
Application Developer	1:1	Application Development
Business Analyst Business Process Analyst	M:1	Business/Systems Analysis
Database Administrator Database Analyst	M:1	Information and Database Management
e-Business Manager	1:1	e-Business
ERP Specialist	1:1	ERP
Information Auditing & Compliance Specialist	1:1	Auditing
IT Architect IT Asset Manager	M:1	IT Management
IT Consultant	1:1	Consultancy
IT Security & Risk Manager	1:1	IT Security and Risk
Network Administrator	1:1	Networking
IT Operations Manager	1:1	IT Support Operations
Project Manager	1:1	Project Management
User Interface Designer Web Content Manager	M:1	Internet and Web

Table 8.1. Correlation between Career Track names and Job Names.

As the first table entry, Application Development directly maps to the Application Developer track which is promoted heavily by many of the IS courses under consideration. This pattern of one-to-one mapping appears in nine out of the thirteen job titles identified. The remaining four map to two very similar career names, forming clearly associating pairings. The need to group Career Tracks together in a small number of cases has been the result of different levels of granularity between the two sets of data. For example, Database Administrator and Database Analyst are shown as separate Career Tracks requiring a slightly different set of modules to achieve each specialisation, yet both are capable of producing students able of working in the area of Information and Database Management.

Table 8.2 depicts the rankings for each category. The first part of the table (left) lists the Career Tracks promoted by the IS courses, which were derived as part of the surveys in Chapter 6. The second part of the table (right) captures the IS graduate positions (Job Names) offered by IS employers, as identified in the graduate IS job skills survey of Chapter 7. By comparing their popularity it is possible to realise the importance each side places on IS professional specialisations and how closely the views of the two stakeholders are aligned.

Ranking	IS Curriculum Career Tracks	IS Job Names (Job Ad Titles)	Ranking
9	Database Administrator	Information and Database Management	1
12	Database Analyst		
3	Application Developer	Application Development	2
1	User Interface Designer	Internet and Web	3
10	Web Content Manager		
2	IT Operations Manager	IT Support Operations	4
17	Business Analyst	Business/Systems Analysis	5
13	Business Process Analyst		
11	Project Manager	Project Management	6
6	Network Administrator	Networking	7
4	IT Architect	IT Management	8
5	IT Asset Manager		
15*	IT Consultant	Consultancy	9
8	IT Security & Risk Manager	IT Security and Risk	10
7	ERP Specialist	ERP	11
14	Information Auditing & Compliance Specialist	Auditing	12
15*	e-Business Manager	e-Business	13

Table 8.2. Skills alignment: direct comparison of curriculum careers with industry jobs (* denotes equal ranking position).

Three of the most popular advertised jobs enjoy close correlation with careers promoted by the curriculum. Application Development, Internet and the Web, and Support Operations with respective rankings of 2nd, 3rd and 4th, show a near identical match with the corresponding careers of Application Developer, User Interface Designer/Web Content Manager and IT Operations Manager. Application Development, which occupies ranking positions 3 and 2 in

each category, is confirmed as one of the most significant careers available to IS graduates, as is that of IT support, ranked 2nd and 4th respectively. Despite the mixed ranking scores (1st and 10th) of the combined Career Track titles that correspond to jobs falling under the Internet and the Web category, it is clear that a significant number of IS graduates are expected to establish their careers by working with internet related technologies.

A rather worrying ranking mismatch is observed in the area of databases. Based on its ranking, Information and Database Management is the most popular job offered to IS graduates (ranked 1st). Yet, the popularity of the equivalent (combined) Career Track is significantly low, suggesting that the IS courses do not cover the subject as extensively. The same pattern is also observed with Business and Systems Analysis, a job category which is ranked 5th with employers but scores extremely low as a combined Career Track (13th and 17th).

Networking, IT Management, and IT Security and Risk show close correlation in terms of their respective scores, suggesting that the IS curriculum places sufficient emphasis on these careers, matching the expectations of employers. Auditing and e-Business are a further two job categories which feature similar scores with their corresponding careers, albeit low ones. Conversely, Project Management and Consultancy show a relatively high discrepancy between the two categories.

8.3.2 IS Skills Alignment: Module Skills vs. Job Skills

Unlike the assessment of Career Tracks and Job Names which offers relatively direct comparisons between the similarly named categories, the comparison between curriculum and job skills is not as straightforward. Past studies which carried out similar assessments generally employed generic category names that were relatively easy to attribute to skill data originating from employers and the curriculum (Trauth *et al.*, 1993, Lee *et al.*, 1995). To ensure consistency with the Career Tracks and Job Names findings considered in the previous section, Table 8.3 has also been organised as two ranked lists. The first list shows the ranking of ISSKS modules identified in Chapter 6 as part of the IS 2010 curriculum survey. This list deliberately omits DF and FKS subjects to avoid the dilution of the data with statistically small module occurrences. The second list shows the skills derived from the IS job ad survey in Chapter 7, ranked according to popularity.

Programming skills, shown as Application Development, occupy the highest position in the curriculum which is also the second highest skill in demand by employers (IS Development). Setting aside Personal Attributes and Soft Skills which are two job skill categories that cannot be mapped directly to the IS curriculum, programming, expressed as IS Development, is undisputedly the most important skill for IS graduates. Its pervasiveness is

further reinforced by the high popularity of Programming Languages, Software and Web Technologies skills (positions 3, 4 and 6 respectively), which can be thought of as closely related skills.

Ranking	Modules (Skills)	Job Skills	Ranking
1	Application Development	Personal Attributes	1
2	Foundations of IS	IS Development	2
3	Systems Analysis & Design	Programming Languages	3
4	Enterprise Architecture	Software	4
5	IT Infrastructure	Soft Skills	5
6	Human Computer Interaction	Web Technologies	6
7	IT Project Management	IT Operations	7
8	Data and Information Management	Business/Systems Analysis	8
9	IT Security and Risk Management	Information and Database Management	9
10	Data Mining / Business Intelligence	Project Management	10
11	IS Strategy, Management & Acquisition	Networks and Operations	11
=	Social Informatics	Business Management	12
13	Enterprise Systems	Operating Systems	13
14	Knowledge Management	Security and Risk	14
15	Business Process Management	Architecture	15
16	Information Search and Retrieval	Hardware	16
17	Collaborative Computing	Enterprise Recourse Planning	17
18	IT Audit and Controls	Auditing and Compliance	18

Table 8.3. Skills alignment: indirect comparison of IS curriculum and industry skills.

A somewhat surprising finding relates to the popularity of database skills ranked at 8th and 9th respectively. While the curriculum ranking of database skills in Table 8.3 reflects very closely its position as a Career Track in Table 8.2, its popularity as a job skill (9th) may be skewed. As mentioned earlier, despite their immense popularity Personal Attributes and Soft Skills are non-technical categories. Equally, IS Development along with Programming Languages, Software and Web Technologies notionally belong to the same family of skills, bound to appear together in ads promoting technical positions (Figure 7.2. in the previous chapter demonstrates this point by depicting the cluster analysis of IS job skills). Considering the implications of such 'clustering' arrangements, the popularity of database as a graduate job skill may not be as low as it is shown by its ranking. If this argument was to be accepted, the relative positions of the database related skillset for both skill categories in Table 8.3 becomes very similar to those encountered in Table 8.2 which depicted the popularity of databases in relation to career and job title standings. Such a conclusion, effectively confirms

the earlier finding that although database related jobs are very popular with employers, they receive insufficient support by the curriculum as a career.

The positions of networking skills, expressed as IT Infrastructure skills in the curriculum and Networks and Operations by employers, may not be as wide as their rankings suggest. Their relative positions (5th and 11th respectively) suggest a noticeable gap, however, if the earlier argument about the ranking of databases in relation to the cluster of programming related skills was applied to this case, the ranking of networking skills would be closer. Analogous inferences could also be made about Systems Analysis & Design, and IT Security and Risk Management which show large differences in their corresponding rankings.

A gap in this approach of comparing the relative popularity of skills relates to the inability to compare the popularity of Personal Attributes and Soft Skills (employers) with equivalent categories representing similar skills found in the curriculum. Clearly, the high ranking of such skills makes their importance for employers paramount but the unavailability of such skills data about the curriculum makes it very difficult to draw any further conclusions. Repeated studies have pointed to the increasing emphasis employers are placing on soft skills as opposed to technical skills with a relatively short life span (Joseph *et al.*, 2010, Alshare *et al.*, 2011, Litecky *et al.*, 2004). Additionally, examining the issue from the students' perspective, Merhout *et al.* (2009) contended that IS enrolments may have fallen because students no longer believe they need a large amount of hard skills which are normally available through IS courses, instead they are seeking other courses with emphasis on the more valued soft skills.

The issue of identifying and measuring soft skills in the IS curriculum is complex. Such skills are embedded deep within the assessment and learning and teaching methods found in all modules which make up the IS curriculum, and as such, they cannot be deduced by simply reviewing module names and their descriptions. Clearly, a far more sophisticated method of quantifying such skills would be needed before further comparisons can take place (Noll and Wilkins, 2002). Ways to address this issue are considered below.

8.3.3 The Existence of Alignment

The existence of alignment between academia and industry skills cannot be defined in precise quantitative terms. There are no exact levels of alignment or sliding scales which can be assigned data values derived from the comparison of skills. Despite the empirical nature of surveys which generate data values based on frequencies and occurrences, the final measurement of alignment ultimately rests with an interpretation of the significance of the findings. Tye *et al.* (1995) confirmed this view by concluding their work with a statement about coverage of skills:

However, the curriculum is not aligned with industry needs in the future. Twenty-seven of the important IS skills have not been sufficiently emphasized in the curriculum.

Following the same descriptive approach as Tye *et al.* (1995) and Lee *et al.* (1995) whose assessment also used similar terms to describe 'not well aligned' skills, it would be realistic to state that the skills promoted by the IS curriculum in the UK are fairly well aligned with the skills demanded by employers for graduate positions. The basis for this assertion can be found in the reasonably close correlation between many jobs and their corresponding skills as shown in Table 8.2 and Table 8.3. By contrast, the analogous comparison of employment and curriculum skills carried out by Trauth *et al.* (1993) showed no two categories with equal or even closely correlated rankings. In fact, the closest ranking in that work differed by six positions, with practitioners ranking Telecommunications as the 2nd most popular skill, while academics placed it in 8th position.

As expected, the findings of this study have also highlighted some significant skill popularity inconsistencies, especially in the areas of databases and systems analysis. Additionally, the popularity of Project Management and Consultancy jobs show a similar mismatch in the importance academics and employers place on them. Despite this significant but small number of discrepancies, the rest of the categories show considerably close scores from both sides, suggesting a reasonably aligned views about the importance attributed to the majority of skill categories. Further evidence supporting the overall assertion of relative alignment, is found in some cases where the rankings of skill categories (Table 8.3) match those of their equivalent Career Tracks and Job Names (Table 8.2), as is the case with IS Development (job skills) Application Development (Job Name).

8.3.4 Aligning Careers and Skills

In spite of the encouraging outcome regarding the overall alignment of views on skills between business and academia, there is scope for further work to improve the standing of those skills which are not currently closely matched. The method for making such improvements relies on utilising the IS Skills Survey Framework and Career Tracks to design new IS courses or reconfiguring existing ones which match more accurately the skill needs of employers.

8.3.5 Emerging Alignment Issues

The discussion on the level of alignment between academia and employers has given rise to a number of suggestions that can improve their relationship further.

Constant Change

Both stakeholders need to accept that advancements in technology in the wider field of IT will continue to have a significant impact on the skill requirements of IS professionals.

Equally, organisational advancements will continue to take place at a fast pace, necessitating changes to working practices and employability skills (Igbaria *et al.*, 1991, Litecky *et al.*, 2010). It is important, therefore, to maintain a constant watch on the level of skills alignment to ensure that any discrepancies caused by technological advancement or changes in the working practices in the field, are addressed quickly by revising and updating the IS curriculum at regular intervals. This process should be guided by a careful consideration with regard to changes in job skills requirements.

Communication

Academia and industry need to maintain a strong communication to monitor the level of skills alignment by continuously evaluating the skills of new graduates in relation to changing business realities (Todd *et al.*, 1995). Such communication can be supported by professional bodies, positioned between academia and business as facilitators. Dialogue and feedback between the two sides should also take into account the views of students and graduates (alumni) who are in a unique position to explain the most effective ways to impart relevant knowledge and skills.

Balance of Skills

The balance between soft and hard skills is likely to be in a constant flux as jobs evolve to meet the needs of changing business environments (Tye *et al.*, 1995). Anticipating the right balance of skills for the entire IS field may not be feasible due to wide skill variations within different positions. Instead, IS jobs expressed in the form of Career Tracks and Job Names can be examined to understand the skill requirements of specialisations. As such, the overall diet of skills offered to students can be adjusted through the configuration of modules to reflect their choice of specialism.

Expanding Research

The most striking finding from the graduate job ad analysis has been the confirmation that employers are more interested in soft skills over any other type of skill. Clearly, this is an important finding which needs to be investigated carefully in relation to the level and type of soft skills embedded in the IS curriculum. The lack of an existing IS study in this area makes it very difficult to ascertain how popular soft skills are in the curriculum.

8.4 Emerging Issues from Academia

Much of the discussion in the early parts of this thesis was devoted to understanding the issues affecting IS, both in relation to its academic but also professional standing. The strong perception about the disconnect between academia and business, thought to be one of the main reasons behind the problematic status quo of the field, continues to keep the two sides

apart. As Hirschheim and Klein (2003) explained, the views of the two stakeholders about one another leave much to be desired:

> *They [non-IS practitioners] have an unrealistic image of IS and concomitantly, unrealistic expectations about what IS can and cannot accomplish. But there is also a significant disconnect between IS practitioners and IS academics that is well known. IS practitioners feel academics live in ivory towers engaging in research that is devoid of any practical relevance. IS academics, on the other hand, feel that practitioners do not understand the need for theory and are only interested in vocational training.*

Despite the seemingly equal share of 'responsibility' for the state of the relationship between academia and business, the majority of the literature reviewed implies that the burden (and blame) rests mostly with academia. To a large extent, this is because the academic dimension of a particular field has a profound effect on the health of the profession it promotes (Abbott, 1988). It is, therefore, easy to see why the focus is placed on academics when a profession is experiencing difficulties. As Lightfoot (1999) explained, IS businesses are 'customers' who buy 'products' from academia by employing graduates, and as such they can express their demands or dissatisfaction about the quality of what they receive.

In order to understand the role of academia better, as evidenced by the research findings on the characteristics of the field and its curriculum, it is important to assess the impact of some of these findings by briefly revisiting them.

8.4.1 IS Identity Crisis

The review of the identity crisis in Chapter 2 has shown that the field of IS has been in a near-perpetual state of ambiguity since its very early stages. In their analysis of the significance of the crisis, Agarwal and Lucas Jr (2005) noted:

> *The crisis is real and threatens our ability to grow and thrive as a field. If a micro focus dominates IS research, we are likely to end up conducting narrow research on matters that are of limited interest. The consequences in terms of resources, maintaining an IS presence in the curriculum, promotion and tenure, and the existence of the field potentially are dangerous.*

Deconstructing the above concluding comment highlights two aspects of the identity issue, both of which are of interest to the relationship between business and academia. Firstly, the future of the field, as suggested by Agarwal and Lucas Jr (2005) is effectively tied to its ability to overcome this crisis. Secondly from a wider perspective, it appears that the cause of the problem is the type of research undertaken or more specifically its direction and scope. Based on this interpretation, it seems that a healthy research agenda in IS could ensure the health of its academic position. Moreover, accepting the earlier argument by Abbott (1988), it would also be reasonable to assume that the health of the academic dimension of the field can ensure the health of the profession. So, why is it that the majority of the research regarding

the crisis of IS, which has dangerous implications about the future of the field and its professionals, devotes little attention to IS education, curriculum development, skills, teaching methods, and other such issues that define the relationship between academia and industry? Finding quick answers to the identity crisis issue has understandably not been possible. The debates which continue to take place do consider IS education as one of the important issues, but not sufficiently important. Perhaps, it would be more helpful if these debates were to take a less theoretical and more applied stance on the issues in hand, reflecting the applied nature of the field of IS whose birth was characterised by the need to solve practical problems in organisations with the use of technology (Wilson and Avison, 2007, Davis *et al.*, 2005).

8.4.2 IS Course Demand

The issues affecting student recruitment in IS, as shown in Chapter 3, are not easy to address. The magnitude of the falling enrolment issue initially became clear to the IS research community because of its impact on the health of academic courses (Koch *et al.*, 2010, Granger *et al.*, 2007). Soon after, business and industry realised the severity of the situation as a result of the reduction in the number of qualified graduates able to fill vacant graduate positions (Benamati *et al.*, 2010). In the UK, prior to the work by Stowell and Probert (2012), there had been very limited data available about the levels of IS recruitment at national level.

As to be expected, the IS identity crisis has often been cited as one of the reasons affecting recruitment (Hirschheim and Klein, 2003, Bakshi, 2007). More specifically, however, research into the views of students about IS and their willingness to pursue it as a field of study leading to a subsequent career, indicated concerns about the prospect of future jobs (Scott *et al.*, 2009, Granger *et al.*, 2007). Hirschheim (2007) captured the essence of the recruitment problem by identifying three areas of improvement. Firstly, the (academic) field needs to evolve and accept the organisational changes of the recent past which have seen many IS functions moving to new markets, even though new functions have replaced them. These changes need to be reflected in the IS curriculum which should focus on the key competences that are associated with employment opportunities. Secondly, IS courses need to change by becoming better aligned with developments within the industry. Thirdly, the field needs to find ways of changing the negative perception about the lack of job opportunities. Addressing all three issues both at national and international level is a complex task that requires business and academia to work closely together.

8.4.3 IS Entry Level Qualifications

Evidence about the admissions criteria used to accept students onto IS courses is very limited. Part of the difficulty associated with admissions criteria relate to the complexities regarding the correct identification of IS courses. As was demonstrated in Chapter 3, the

previously undocumented UK admissions criteria for IS courses vary significantly across the 228 courses examined. Comparison between the minimum and maximum A-Level point divergence of advertised undergraduate entry qualifications, showed significant variance between the lowest advertised score of 120 points and the highest of 340 points. Given the existence of such gap, and the implications it has in relation to prior knowledge, it would be important to investigate the composition of the relevant IS courses, their embedded skills, and learning and teaching methods.

8.4.4 IS Course Accreditation

In a strict sense, accreditation sits within the sphere of influence of the professional bodies stakeholder. Nevertheless, a brief discussion is merited here since the importance of the issue of accreditation has grown significantly over the last few years. The willingness to increase IS course accreditations is primarily driven by academia which views accreditation as a way of legitimising and promoting its links with business and industry (Lidtke and Yaverbaum, 2003).

The data in Chapter 3 on the level of accreditation of IS courses in the UK is disappointing. Unlike the efforts in the US, the UK is currently lacking an accreditation system specifically designed to support undergraduate IS programmes. The existing accreditation efforts by BCS lack focus because of their generic nature of covering many related IT disciplines. It is important to examine the merits of an IS-specific accreditation process for IS courses in the UK, and how such process can facilitate the efforts to align academia with business.

8.4.5 IS Curriculum Observations

Certain observations about the state of the IS curriculum have become possible as a result of the earlier curriculum analysis.

Skills in the IS Curriculum

Over the years there has been increasing pressure on UK universities to ensure their graduates are not only successful in securing employment, but do so within a relatively short period of time following graduation. University league tables, which in recent years have been attracting more public attention, use graduate employment statistics as part of their ranking formulae. Consequently, it appears that offering transferable skills to students has become a prominent feature for the majority of courses. The analysis of the modules as part of the IS curriculum mapping has shown that skills are broadly separated into two categories: study skills and employability skills. Study skills are mostly delivered through first year modules addressing personal and professional development, general study skills and communication and presentation skills. Through study skills, students, especially those from non-traditional backgrounds whose exposure to traditional further or higher education may be limited, are given support to develop learning approaches that meet the demands of undergraduate

degree courses. As students approach graduation they are presented with a range of employability skills designed to support their successful transition from academia to business. Both sets of skills, while often delivered through modules with titles such as Professional Skills Development or Employability Skills, are frequently found embedded in other modules, including research methods and final year projects. Employability skills which promote career development principles are delivered through modules on entrepreneurship, work-based development and team work or consultancy. Courses which enjoy close relationships or affiliations with industry often feature modules that are delivered in partnership with employers, giving students the opportunity to undertake assessments that are based on real life case studies. Apart from the teaching and learning opportunities such relationships afford to students, there is also an obvious course marketing advantage for universities.

Key Foundational Knowledge

Maths and its many incarnations, such as quantitative modelling, maths for business, maths for computing or formal methods, are gradually becoming an integral component of IS degrees. Interestingly, most IS courses do specify a minimum maths prior qualification, normally at GCSE level, as one of the necessary entry criteria for students. Many academics teaching programming or business modelling have been privately voicing their concerns for some time about the poor level of maths undergraduate students possess. Arguments mainly relate to the level, type and extent to which maths need to be taught to first year undergraduate students as opposed to whether maths should be part of the curriculum. Where maths modules exist, they tend to be presented either as maths geared towards computing or maths relevant to business, including statistics and forecasting. In some cases maths skills are included in generic skills modules which package maths along with study and professional skills. Research methods is another topic that is gaining in popularity across the IS curriculum. A large number of research methods modules are offered as core prior to the commencement of the final year project. Their content covers the broad areas of techniques and skills needed to ensure that final year projects have a sufficiently strong academic dimension that goes beyond the usual development of an artefact which often involves some form of prototyping.

Option Modules Affecting Career Tracks

As shown in Chapter 6, the determination of Career Tracks is based on the combination of core and option modules that make up a particular programme. While the analysis carried out has identified the specialisations that each course promotes though the identification of its Career Tracks, it is important to remember that the available data does not provide information about the actual combination of option modules that students elect to follow. Instead, Career Tracks findings can only be used to demonstrate the propensity of programmes to promote different careers but not their popularity with students.

With such a distinction made, a rather obvious but nevertheless significant observation needs to be made about the interpretation of data regarding option modules. The relationship between the course average of 20 core and 13 option modules confirms that option modules make up approximately 38% of undergraduate degree courses. Given such a high percentage, students may opt to avoid certain thematic groupings of option modules because they consider them hard, outdated or simply not sufficiently 'cool'. In doing so, students could miss out on important areas of knowledge and skills with a detrimental effect on their subsequent professional lives. While it is beyond the scope of this study to examine whether the ratio of core to option modules in IS is adequate or comparable with other disciplines, it is important to note two points. Firstly, the existence of option modules is paramount if course developers are to be allowed to offer valuable specialisations which enhance the appreciation of IS. Secondly, 'choice' is a contemporary phenomenon that seems to be permeating most aspects of modern life, and IS curricula are no exception. By reducing it, there is a possibility that students could be alienated, triggering a further fall in student recruitment. Accepting the inevitable importance of choice through option modules should not, however, assume the removal of the necessary pedagogical safeguards that ensure the appropriateness of the overall learning outcomes of option modules in an IS course. At the same time, it is important to remember that too much choice may potentially result in students on the same course graduating having mastered demonstrably different areas of expertise. Some implied criticism of option modules may be unwarranted and easily mitigated, especially when option modules have been chosen according to sound academic principles. As an example, many of the 228 courses encountered offer predictable patterns of 'growth' from early core to late option modules where in the first year of study core introductory modules cover systems analysis, databases and programming, followed in later years by multiple option modules that cover advanced topics in the aforementioned subjects. Yet, it is difficult to reconcile the structure of a course with a fairly consistent spread of credits across modules, in which 28 of the 39 modules are options, or another where 56 out of 60 modules are listed as options. In conclusion, the interpretation of the importance of the classification of option modules and any extrapolation about their value should be carried out with caution.

8.5 Emerging Issues from Business and Industry

Much like the academic stakeholder, business and industry have an important role to play by contributing to efforts supporting the harmonisation of their relationship. The following issues from the perspective of industry deserve some attention.

8.5.1 Outsourcing of Jobs

As part of an analysis of the impact of outsourcing or offshoring of IS, Hirschheim and Newman (2010) explained that similar to manufacturing in the past, some IS jobs are moving out of industrial countries to take advantage of cheaper costs found in developing economies. Although the phenomenon of outsourcing in IS has contributed to a measured reduction of available jobs (Hirschheim *et al.*, 2007), it had considerable impact on students' perception about job availability (Martz and Cata, 2008). Panko (2008) observed the importance of outsourcing for companies which are able to gain a competitive advantage by reducing their costs. This natural cycle in the evolution of business that operate within a global setting, however, is seen negatively by students who view it as an unattractive feature of the job market. Despite this negative perception held by students, there is evidence that the job market for IS graduates is not shrinking because of jobs lost to offshoring. In fact, Granger *et al.* (2007) argued that the opposite was true about the job market because of the increase in unfilled IS positions. This increase, Panko (2008) argued was not only the result of a reduction in the supply of new graduates due to low enrolments, but also because new specialist jobs tend to replace those which fall victim to offshoring.

Changing the perception about the lack of employment opportunities due to outsourcing requires a strong intervention by academia (Hirschheim *et al.*, 2007). The effort to propagate the message, however, should not be restricted only to academia which ultimately has little control over offshoring business practices. Political actions, but also business initiatives, should also be considered as possible ways forward (Panko, 2008). Ultimately, offshoring should become an accepted reality of the IS field, encouraging academia and business to work together by educating its students about this overtly emotive issue.

8.5.2 Dotcom Burst

Alongside offshoring, the dotcom burst has generally been acknowledged as one of the contributing factors which led to the substantial reduction in IS enrolments around the world (Choudhury *et al.*, 2010). As a phenomenon, the collapse of technology companies in 2000 was the result of investors seeking to make quick profits without considering the medium or long term effects of risky, and often complex, business ventures (Hirschheim and Newman, 2010). The implications of such actions, some of which are still ongoing, go well beyond the collapse and bankruptcy of technology companies. Purely from an IS perspective, the failure of IT companies brought about the loss of employment to a large number of professionals in the field. At the same time, fresh graduates coming out of universities in search of career opportunities, were left competing against experienced professionals (Hirschheim and Newman, 2010). The effects of the burst of the dotcom bubble have been gradual and much wider than originally anticipated. Stock markets, national unemployment levels, economic

growth and large organisations not directly related to the technology industry were all caught in the aftermath (Panko, 2008). Clearly, the changes observed as a result of the dotcom collapse as well as offshoring, go beyond the narrow boundaries of a field such as IS. However, understanding the issues which have affected IS along with the rest of the disciplines in IT, is an important step towards safeguarding the field by addressing the recruitment difficulties it has been facing.

8.6 Summary

This chapter presented a comparative analysis of the findings of the surveys discussed in the previous two chapters. It has also considered a number of emerging issues which will form the basis for some of the suggested future work discussions which are outlined in the next chapter. The level of alignment between the graduate skills promoted by the IS curriculum in the UK and those sought by industry has been found to be relatively good. Unlike the majority of similar studies in other countries, the skills comparison in this case was carried out as a two stage process. As part of the first stage, popular graduate jobs offered by employers were compared to the Career Tracks promoted by the curriculum. In the second stage, ranked graduate employment skills were compared with those found in the IS curriculum.

By taking these important findings forward, the next and final chapter will take a retrospective look at the research objectives of this thesis and examine the degree to which they have been met. Finally, emerging issues from this chapter will form the basis for future research possibilities.

9 CONCLUSIONS

9.1 Introduction

This chapter begins by presenting the key research findings and some reflective thoughts on particular key aspects of this work. It then proceeds to examine the original thesis objectives introduced in Chapter 1, and the contribution to the IS field this research has made through addressing these objectives. Concluding thoughts on the thesis are preceded by a detailed discussion on future research avenues which have become apparent as a result of the current study.

9.2 Research Findings

The overall findings of this research have been organised in a way that reflect the structure of the thesis and the empirical investigations which appear in it: surveying the IS curriculum and investigating the requirements of IS employers. The findings of the surveys, representing the interests of the two key IS stakeholders, are combined together in order to establish the level of alignment which exists between the two sets of skills.

9.2.1 The Undergraduate IS Curriculum in the UK

There has been little conclusive past evidence about the state of the IS curriculum in the UK. This research has presented the results of a detailed survey about the provision of IS undergraduate degree courses in the UK using, among others, the recently developed IS 2010 curriculum guidelines as its basis. IS 2010 identified three main categories of knowledge that underpin the essence of IS as an academic subject: IS Specific Knowledge and Skills, Domain Fundamentals and Fundamental Knowledge and Skills. The desire to offer a holistic and conclusive representation of the curriculum was supported by the development of an IS curriculum survey framework which catered for the mapping of every subject that populates the IS curricula of undergraduate degrees in the UK, including subjects which are generic or are derived from other hierarchical disciples. In an effort to qualify the findings of the study in a practical way, the results were grouped based on affiliations of the universities that offer them. Supplementary data about admission qualification standards and the professional accreditation status of IS courses completed the emerging survey map that offered conclusive findings about the subjects which make up IS. Application Development is the subject that

covers the highest proportion of the IS curriculum across the board. Knowledge and skills that sit within the realms of the business and computing disciplines play an important part to the constitution of the IS curriculum. A lesser but equally important role in the curriculum is defined by generic knowledge and professional skills, deemed essential for every IS professional of the future. Additional analysis gave rise to the development of a method for ranking the career tracks promoted by individual courses, which conclusively determines the careers promoted by IS programmes.

9.2.2 The IS Graduate Market in the UK

The purpose of this survey was to ascertain the IS graduate skill requirements posed by UK employers. Findings derived from the graduate job ad analysis made a significant contribution to understanding the position of employers who often call for better qualified university graduates.

Employers, above all, seek graduates who possess strong soft skills and an ability to grow into different positions within an organisation with minimum intervention or training. This requirement for well-rounded independent thinkers is frequently presented in ways which can be thought of as confusing, often due to seemingly contradicting requirements. Most of the job ads examined juxtaposed skill such as “be able to work independently” and “work well within a team” or “be analytical” and “be practical”. Beyond such personal attributes, employers were found to require a clear cluster of knowledge and competency skills which focus on distinct technical capabilities. Strong understanding of databases, programming languages and web development tools were presented as particularly important skill qualifications for young IS graduates.

9.2.3 Skills Alignment

The preceding discussion on the existence of alignment between the skills promoted by the IS curriculum and those required by IS graduate employers argued that ‘alignment’ cannot be measured in precise numerical terms. Despite its suggestive nature, the data clearly indicates that the supply and demand of IS skills between academia and industry is reasonably well aligned. Such statement, however, needs to be treated with caution because of a particular set of skills embedded within the curriculum which cannot be adequately quantified without further research.

Due to their conceptual nature, soft skills exist within academic programmes embedded into the entire course as opposed to hard skills such as programming or databases which are housed within conveniently named modules. As such, measuring the existence of soft skills is particularly difficult. Soft skills primarily depend on the Learning and Teaching methods employed by each module, and as such, they are contingent upon the correct implementation

of such methods. For example, a module which covers introduction to programming could successfully 'transmit' programming skills to first year students but not necessarily teach them how to become more articulate by giving good presentations because, it could be argued, writing code is not ideally suited for presentations.

9.3 Reflections on the Research Approach

The complementary surveys which underpin this research share similarities in the way in which data has been collected and analysed. Although each study has its own limitations specific to the survey technique involved, empirical studies such as these, where available information is methodically collected and systematically analysed, are not particularly prone to errors. Criticisms of the effectiveness of unobtrusive survey methods are often warranted due to bias being introduced as part of the application of data sampling techniques which becomes necessary when dealing with large quantities of data (Harwood and Garry 2003). Such an issue, however, did not arise in this research due to the holistic nature of the surveys which utilised the relevant census in each case. Apart from design issues affecting the nature of surveys, a further drawback relates to their implementation which can be particularly resource intensive. In the case of the curriculum mapping survey, the data collection, documentation and analysis of the 7,475 modules proved a particularly arduous task which lasted many months. While sometimes it is possible to use automated data collection methods, curriculum surveys require direct input from researchers to ensure appropriate manipulation of the large quantities of unstructured data (Bell *et al.*, 2013, Kung *et al.* 2006, Gill and Hu 1999).

The lack of previous UK-based IS curriculum and graduate skills studies proved to be both a great prospect for carrying out innovative work and a challenge. Conducting research in areas which have not received adequate attention in the past offers an opportunity to make a considerable research contribution with the potential to influence the direction of future work. Despite considerable interest over the last few years research into IS education still remains relatively limited in the UK. It is the intention of the author that the work presented in this thesis will support the ongoing debate on the vital importance of enhancing the IS curriculum and entice more researchers to continue to make research contributions to IS education.

9.4 Reflections on the Survey Findings

Most IS research is devoted to understanding the needs of employers has repeatedly highlighted the importance of technical skills (e-skills, 2012, Trauth *et al.,* 1993, Todd *et al.*, 1995). Increasingly though, the importance of soft skills and personal attributes which suggest an ability to self-develop, is becoming more prominent (Joseph *et al.*, 2010). The findings of the graduate skills survey in this thesis confirm this trend in a conclusive way. The survey

analysis demonstrated that employers are more interested in the ability of IS graduates to communicate, convey information in an articulate way and work comfortably within a team setting, as opposed to simply being proficient in the latest technology. Undoubtedly, hard skills continue to be important. After all, graduate IS positions tend to have a more technical than conceptual orientation, confirming the importance of technical skills. Nevertheless, the evidence suggests that a well-rounded graduate has a better chance of succeeding in securing an initial employment position.

In relation to the curriculum, findings noted in Chapter 6 on Foundational Knowledge and Skills (FKS) subjects showed that modules which cover communication skills, teamwork, analytical thinking and maths, make a very small overall contribution to the current curriculum. As a result, two important questions arise in relation to the UK IS curriculum. Firstly, is the current FKS contribution appropriate or does it need to be increased to meet employer requirements for soft skills? Secondly, is there a way of quantifying the soft skills which are embedded into the learning and teaching methods across all modules of the curriculum? Perhaps the reason IS programmes do not include more FKS modules which specifically cover soft skills is because academics feel there is sufficient coverage through the wide range of modules which make up the IS courses. Whatever the case may be, there is clearly an interesting research avenue open and a great deal of important work ahead.

9.5 Reflections on the Skills Alignment

Much of the research over the years, which examined the possible existence of a gap between the skills promoted by the IS curriculum and those sought by employers, has concluded that a gap has existed for a long time and persists even today. As a result, there was great anticipation by the author regarding the conclusive finding of this study in relation to the UK market. The arrival of the results engendered a definite sense of relief and satisfaction.

The sense of relief was caused by realising that the IS academic community in the UK is not in a state of isolation and disconnection from industry. The curriculum offered to IS students in the UK can certainly benefit from further improvement, but it appears to be more aligned with the needs of employers than many of the research findings outside the UK suggest - specific technical skills and general soft skills. At the same time, the conclusion of this research effort brought about a sense of satisfaction underpinning the belief that the thesis can make a tangible contribution to the efforts by all IS stakeholders to continually improve the quality and effectiveness of graduates of the field.

9.6 Demonstrating the Research Aim

The research aim, upon which the research objectives were based, was stated as follows:

> It is possible to align industrial IS careers to current academic IS provision in the UK by conducting a comprehensive analysis of both the current undergraduate IS curriculum provision relevant to specific identified professional career tracks, and the skill requirements of IS employers. Such analysis will facilitate communication between industry and academia with regard to determining appropriate required skills for IS graduates.

The thesis has shown that it is possible to organise the IS academic provision in a way that aligns to future IS careers. It can therefore be concluded that the research aim has been achieved.

9.7 Contribution of the Research

Chapter 1 introduced the gap in IS education literature in relation to the alignment of the provision of IS graduate skills. This research has endeavoured to investigate the shortcomings which characterise the contentious relationship between industry and academia by carefully investigating the supply of and demand for IS skills, and developing a process by which academics can inject the appropriate skills into IS courses while maintaining strong pedagogy.

Supporting the articulation of the skills alignment issue which underpins this research, Chapter 1 also introduced the seven objectives driving the overall research aim of this work. The main body of this thesis successfully demonstrated how each of the objectives was attained. By doing this, it became demonstrably clear that there is a process by which academics can regulate the diet of modules of IS courses to ensure that they reflect the prevailing skills which are in demand by graduate employers.

In this section these objectives are revisited to discuss specifically how each was met. Collectively, the attainment of the objectives supports the realisation of the research aim.

9.7.1 Scope of the IS academic provision in the UK

> *Academic Stakeholder: Investigate the size and type of the IS undergraduate degree provision in the UK and ascertain its entry level qualification levels, degree naming convention, levels of professional body accreditation, recruitment levels, first destination statistics and associated skills/careers.*

Scoping the academic provision of IS in the UK has provided, for the first time, a clear measurement of the size, type and constitution of the undergraduate degree courses offered by universities in the UK. The contribution of this exercise played an important role in the successful execution of the subsequent surveys which drove this research forward. The analysis of the data gave rise to national student recruitment trends which support the debate about the future growth of the IS field, while highlighting the entry level standards applied by institutions in their efforts to attract well qualified students. Additionally, the data identified crucial information about the level of accreditation IS courses enjoy and the general

employability characteristics they articulate in their students. The findings suggest that more work is needed by professional bodies to enhance the accreditation status of IS courses, while universities need to consider ways of enhancing the employability of their students.

9.7.2 Measure the IS curriculum provision in the UK

Academic Stakeholder: Determine the popularity (ranking) of modules and, by implication, subject categories that make up the entire range of IS courses. Analyse the findings according to core/options modes, modules that make up the core of the IS discipline, modules that are derived from hierarchical disciplines, and modules that are predominantly skills orientated.

At the heart of the work presented in this thesis lay a comprehensive survey of the undergraduate IS courses in the UK. Modules were catalogued according to their content, analysed by year of study, credit size, core or option mode, and contribution to either the core knowledge of IS or knowledge that is part of other hierarchical domains. Rankings were produced to capture the popularity of each subject. Classification categories were developed to accurately record the range of topics which are borrowed from traditional disciplines such as business and computing. In doing so, the results showed a clear distribution between core IS, business, computing and other generic topics which make up IS degrees in UK universities. This mapping of the IS curriculum, in one of the most comprehensive ways possible, should enable academics, IS course developers and researchers in their quest to improve IS curricula and its alignment with business needs.

9.7.3 Develop a Course Survey Framework

Academic Stakeholder: Create a reusable, hierarchical and domain-independent course mapping framework that can be used to both map existing IS courses but also direct the design of new ones.

The Course Survey Framework captured the entire thematic array of modules that populate UK IS courses. It allowed for the separation of core and option subjects across four different categories: IS Specific Knowledge and Skills, hierarchical business and computing subjects as part of Domain Fundamentals, generic skills as part of Foundational Knowledge and Skills and final year projects. As a tool to map IS courses, the framework proved capable of classifying any module irrespective of its size or type. Equally, it separated modules according to their domain, which implies it can be used to map IS courses in other 'non-traditional' IS areas such as healthcare or accounting. Apart from mapping large course provisions, the framework could be used for the analysis of a single course, ascertaining its characteristics and enabling further work that shows the skills it promotes. Used as a design support tool, the framework could support course developers to configure the diet of modules

they wish to see in a new or existing course, based on the relative emphasis they place on the different aspects of the curriculum.

9.7.4 Identify curriculum career tracks

Academic Stakeholder: Determine the career tracks promoted by the IS curriculum by measuring the thematic contributions made by the combination of different modules that make up a degree course.

The development of Career Tracks formed an extension to the IS curriculum survey which was underpinned by the Course Survey Framework. Career Tracks considered the weighted contribution each subject made to an IS course, and calculated the propensity of courses to promote IS careers based on the requisite skills which define them. The research has shown that the IS curriculum in the UK strongly promotes Career Tracks that have a technological orientation, while more conceptually orientated areas receive less coverage in the curriculum.

9.7.5 Analyse employer-driven IS graduate skills requirements

Business Stakeholder: Classify IS jobs skills by analysing job advertisements which target fresh university graduates.

The purpose of the job ad analysis undertaken in this thesis was to examine a section of the UK job market by investigating the skills and knowledge employers require from fresh IS graduates. Understanding the needs of employers in this way provides an important way of improving the IS curriculum and making it more attractive to prospective students. The ranking and classification of job skills provides an additional perspective to the earlier derived academic skills promoted by the IS curriculum.

9.7.6 Compare academic with business skills

Academic & Business Stakeholders: Contrast the skills sought by employers embedded into advertised graduate positions and those developed through the implemented curricula.

There has been much academic and professional debate on the need to align the IS curriculum with industry requirements as a way forward to securing the future of the discipline. Specifically for the UK, the research presented here has contributed to this debate by examining important aspects of IS academic provision and professional job markets which had not been considered before. The comparison between academic and business skills was carried out in an elaborate way which involved two separate approaches. Firstly, the career tracks promoted by the IS curriculum were compared with the graduate jobs being offered by industry. Secondly, skills promoted by the IS curriculum were reviewed against those sought by industry. These comparisons provided tangible and conclusive evidence on the existence

of a gap between the skills offered by university courses and those in demand by the IS industry.

9.7.7 Determine a method for aligning the identified skills gap

Academic & Business Stakeholders: Devise ways to regulate the IS curriculum so that it matches industry requirements without sacrificing academic pedagogy.

Success in aligning the skills gap between academia and business stakeholders is dependent upon an ability to identify it clearly and correctly. The process of identification relied on measuring the existing skills gap as accurately as possible, and devising a means to clarify the factors that cause it. Determining the skills gap during this thesis has been possible due to the development and dissemination of two comprehensive surveys, which resulted in a detailed dataset of both the skills instilled and nurtured in students through implemented curricula, and those required by the employers. Each dataset was derived through the utilisation of carefully devised, verifiable techniques. By comparing the results of these two datasets, it has been possible to show that adjustments need to be made to selective areas of the curriculum which promote the Career Tracks that map directly to jobs sought by graduates with specialisations in databases and system analysis. These adjustments can be implemented as part of new IS course, or to existing ones undergoing reconfiguration, by introducing a selective diet of modules promoting the business skills which are currently underrepresented.

9.8 Reflections on the Contributions

The work presented in this thesis is underpinned by a strong desire to support the IS academic community in the UK and elsewhere in its endeavour to devise increasingly more relevant IS curricula. Although some important UK studies have been carried out in the past in this area, with the most notable and influential being that of Latham (2001), none have focused specifically on examining the entire academic provision of IS courses and the skills UK employers seeking from IS graduates. As a result, the contributions made by this research constitute an early step in an attempt to understand the level of correlation between academic knowledge and skills imparted to IS students in the UK, and the skills that are in demand by the UK industry.

The main benefit of this research will be for UK academics to be able, for the first time, to gain a broad understanding of the state of the IS discipline in terms of course and curriculum variation which will hopefully form the basis to improve future IS course development and future research in the areas of course accreditation and its influence on IS curricula, student perceptions of IS curricula, and the relationship between IS academy and employers.

9.8.1 Practical Implications for IS Academics

Supporting academics in their efforts to align IS curricula in their own institutions with the skills expectations of employers who are the recipients of their graduates, has been a strong underlying goal which prompted the undertaking of this research. The process of performing such task can be customised to address either existing or new courses.

Existing Courses

The first step in this process would require the identification of the skills which employers need for a given IS graduate position. This information could be gathered using a mixture of quantitative and qualitative methods, to ensure the employer requirements for the job are captured in the most comprehensive way. Upon establishing a complete list of skills, the next step would involve the mapping of the skills which make up the corresponding Career Track in the curriculum. A direct comparison between the two sets of skills would highlight any missing or underrepresented skill sets which would need to be added to the curriculum by reconfiguring some of its modules. The reconfiguration would be achieved through the use of the Course Survey Framework that has been shown to aid both the development of new courses and the redesign of existing ones.

New Courses

Designing new IS courses to meet the requirements of specific graduate jobs would follow a process similar to that described in the previous section, with the exception of the analysis of an existing Career Track. In this case, the Career Track would be defined ab initio. Its module composition would be guided by the Course Survey Framework which would reverse engineering the list of modules necessary to capture the relevant skills.

9.9 Future Work

The work presented in this thesis has demonstrated the plausibility of the research. The findings have stimulated the pursuit of new ideas which could benefit wider aspects of IS education in the UK. This section discusses these ideas from the perspective of different stakeholders, and the way they can be developed.

9.9.1 Stakeholder: Employers

Employers are a key stakeholder in this research, and as such, opportunities for further work in support of their interests are significant.

Soft Skills

Litecky *et al.* (2004) argued that empirical research into the importance of soft skills may not have been assessed properly by failing to recognise how employers evaluate such skills when recruiting new staff. This may have implications for studies which concluded that

employers value soft skills more than technical skills (Cappel, 2001, Lynch *et al.*, 2007). It may also have potential consequences for the findings of this research which established that personal attributes and soft skills are two of the most sought after skillsets by UK employers offering IS graduate jobs. Demonstrably, the importance of soft skills is paramount to employers, and as such, further investigation into the way they are imparted to students and are assessed by employers would be very useful.

Longitudinal Study of IS Graduate Skills

There have been important longitudinal studies tracking the evolution of IS skills over a period of time (Harris *et al.*, 2012, Todd *et al.*, 1995, Maier *et al.*, 2002, Gallivan *et al.*, 2004). The importance of such studies is often seen in the contribution they make to supporting academics to develop more relevant IS curricula that meet the needs of industry. While a holistic representation over time of general IS skills can be advantageous for aligning the needs of industry with academia, there have been no longitudinal studies in the UK focusing specifically on the development of IS graduate skills. Using the findings of the job ad survey as a starting point, subsequent surveys could be conducted at regular intervals in order to derive the evolution of graduate skills nationally.

Employability

Research into work-related learning has indicated that graduates following courses with embedded employability skills stand a better chance of securing employment opportunities (Hills *et al.*, 2004). Furthermore, there is evidence to suggest that employers, students and academics prioritise employability skills in different ways which can have a detrimental effect on the curriculum (Wickramasinghe and Perera, 2010). As a result, the lack of sufficiently qualified IS graduates capable of meeting graduate job vacancies merits further study from the perspective of utilising work-based learning opportunities in the most beneficial way for all stakeholders concerned.

9.9.2 Stakeholder: Academics

Academics are another key stakeholder of this research, and as such, opportunities for further work in support of their interests are significant.

IS Curriculum Analysis

The comprehensive mapping of the IS curriculum has provided a previously absent understanding of the depth and breadth of the IS undergraduate provision in the UK. Further to the extensive findings derived from the curriculum mapping presented in Chapter 6, there is further scope for additional analysis of the IS curriculum. Firstly, by investigating the technologies used to deliver the technical modules of the curriculum it would be possible to gain a better understanding of not only the type of technology universities use to support the

teaching of many fundamental IS concepts, but also the relevance the particular technology has in relation to the skills that employers expect newly qualified graduates to possess (Kung *et al.*, 2006). Secondly, there is a need for a more contextualised mapping of skills. Specifically, it would be useful to quantify the soft skills present in the IS curriculum given their huge importance to employers. Such findings could provide the basis for appropriate adjustment to the provision of soft skills. Thirdly, with the aid of the Course Survey Framework it would be possible to repeat the survey of the IS curriculum across the UK in order to develop a longitudinal view of its evolution.

IS Career Tracks

The existence of Career Tracks in the IS curriculum play an important part in its healthy development (Hwang and Soe, 2010). Career Tracks can also actively support IS professionals who wish to specialise in a particular aspect of the field by identifying the set of relevant skills for a given specialisation (Lee and Mirchandani, 2010). Ultimately, Career Tracks rely on the provision of optional modules in the curriculum. In order to understand the skillset promoted by each Career Track, further investigation is needed on the uptake of option modules. Data from such investigation would demonstrate the popularity of each track, and by implication, the specific skills acquired by students who follow them.

IS Course Survey Framework

The development of the Course Survey Framework has been necessary in order to have a mechanism which supported the holistic quantification of the IS curriculum in its entirety. Its potential, however, extends beyond simply cataloguing courses. The Course Survey Framework could also be used as supporting tool for designing a new, or updating an existing, IS course. As a starting point, the development of a new IS undergraduate course can be used a case study to establish its effectiveness.

Demand for IS Courses

Research in IS student recruitment levels carried out as part of this thesis complemented the findings by Stowell and Probert (2012), who provided one of the first UK-wide set of figures for the combined undergraduate and postgraduate IS provision. Although the conclusions from both studies present a much healthier picture for the UK than other countries, further work is needed to understand the factors influencing student choice to follow IS courses. A further dimension to this issue is added by the impact of reduced admissions on the number of graduates being able to fill new positions (Scott *et al.*, 2009). Both the UK and international markets have experienced a surge in graduate demand, yet in most countries there is a significant shortage in qualified graduates (Granger *et al.*, 2007, e-skills, 2012).

Analysis of IS Entry Level Qualifications

The noticeable discrepancy in IS entry level qualifications among UK universities merits further investigation. The admissions criteria discussed in Chapter 3 showed that some courses require entry points which are more than two and a half times higher than others. Given the size of the difference, it is reasonable to assume that there may be variations worth investigating in the syllabi of these courses and the skills they promote.

FKS Contribution

As suggested earlier in this chapter, further work would be useful to understand the indirect contribution made to the IS curriculum by the soft skills which are embedded into the learning and teaching methods across all modules of the curriculum.

9.9.3 Stakeholder: Students

Lightfoot (1999) described the students' stakeholder position as unenviable because of their limited ability to exert pressure on the IS curriculum. Furthermore, students have little control over the initial stages of their future careers which are determined by the graduate employment market which they hope to become part of. Despite such a 'passive' stance, student perceptions about the IS curriculum, skills and future career development can be very valuable to academia and industry. A flurry of previously unseen interest in the views of IS students was noted soon after the dotcom bubble burst which saw a reduction in enrolments. The research published in this area was predominantly concerned with trying to understand why students were abandoning IS (Walstrom *et al.*, 2008). As an extension to this type of work, further research inquiries examined the perception of students about skills (Medlin *et al.*, 2007), the IS profession (Berry *et al.,* 2006), the field of IS/IT (Courte and Bishop-Clark, 2009), and outsourcing and its impact to employment (Martz and Cata, 2008).

Most of the work in each of these areas has been carried out in the US or Australia, with little evidence on how UK students perceive their field of study. This is clearly a significant gap in the research which can benefit from further work to enhance the better understanding of skills. As such, additional work could focus on the analysis of IS students' perception about relevant skills and their perception of how well the IS curriculum enables them to meet the demands of the IS profession. The engagement of first year university students in such research could investigate the reasons behind their decisions to pursue IS courses, while a focus on graduating students could help enhance the development of the IS curriculum. Alumni perspectives could contribute further by showing the transition from academia to industry and the ways in which such transition can be managed more effectively. Such considerations should be made in the backdrop of the relatively recent introduction and increase in student fees, which are making students and their families more careful about their 'investment'.

9.9.4 Stakeholder: Professional Bodies / Accreditation

Accreditation of IS courses in the UK has been shown to be patchy with inconclusive evidence about its effectiveness. Professional bodies, which often provide accreditation services, have an important role to play as strategic enablers between academia and industry. The impact of accreditation on IS programmes has been investigated at length, and it is widely accepted that it makes a positive contribution to the improvement of IS education (Reichgelt and Gayle, 2007). Despite such evidence, the main professional bodies which support IS in the UK (UKAIS, BCS) do not provide specific accreditation for IS courses. Apart from accrediting courses, the views of professional bodies on IS curriculum development can be very important. Moreover, professional bodies are very well placed to facilitate the development of strong relationship between business and academia.

As one of the possible extensions of this study, it would be useful to adopt the research approach by Nettleton *et al.* (2008) which considered ways of engaging professional bodies to enhance the development of work-ready graduates. Such an approach would involve the investigation of employability skills in the IS curriculum which can be tailored to specific Career Tracks with input from professional body experts. Contextualising skills according to individual professional careers could help support the employability of graduates by aligning their knowledge with the skill expectations of specific jobs.

9.10 Conclusions

The changes permeating IS are significant. Organisations are constantly evolving to meet the challenges of a globalised business environment which is unforgiving. In equal measure, higher education is being commoditised at a rapid pace because of financial and political pressures and changing student requirements.

IS education is a relatively unrepresented research area of IS but one, as evidenced in this thesis, with an important role to play. The growth and development of field is largely dependent on its ability to attract and sustain a healthy body of students willing to transform themselves into successful future IS professionals, enjoying good career prospects.

This research has presented an approach which supports the relationship between IS academia and business in the UK. The existence of a strong and healthy relationship between the two key IS stakeholders is paramount for the future of IS professionals.

Twenty years ago Trauth *et al.* (1993) contemplated whether universities were providing the right type of education for future IS professionals. This research has gone some way to further exploring and answering this question for the UK market.

BIBLIOGRAPHY

Aasheim, C. L., Lixin, L. & Williams, S. (2009a). Knowledge and Skill Requirements for Entry-Level Information Technology Workers: A Comparison of Industry and Academia. *Journal of information Systems Education,* 20 (3), 349-356.

Aasheim, C. L., Williams, S. & Butler, E. S. (2009b). Knowledge and Skill Requirements for IT Graduates. *Journal of Computer Information Systems,* 49 (3), 48-53.

Abbott, A. (1988). The System of Professions: An Essay on the Division of Expert Labor, University of Chicago Press.

ACM. 2013. *ACM Curricula Recommendations* [Online]. Online: ACM. Available: http://www.acm.org/education/curricula-recommendations [Accessed 2 April 2013].

Adams, D. R. & Athey, T. H. (1982). DPMA Model Curriculum for Undergraduate Computer Information Systems Education, Data Processing Management Association Education Foundation.

Agarwal, R. & Lucas Jr, H. C. (2005). The Information Systems Identity Crisis: Focusing on High-Visibility and High-Impact Research. *MIS Quarterly,* 29 (3), 381-398.

Agresti, W. W. (2008). An IT Body of Knowledge: The Key to an Emerging Profession. *IT Professional,* 10 (6), 18-22.

Akbulut, A. Y. & Looney, C. A. (2007). Inspiring Students to Pursue Computing Degrees. *Communications of the ACM,* 50 (10), 67-71.

Aken, A. & Michalisin, M. D. (2007). The Impact of the Skills Gap on the Recruitment of MIS Graduates. SIGMIS-CPR 2007 - Proceedings of the 2007 ACM SIGMIS CPR Conference: The Global Information Technology Workforce, Saint Louis, MO.

Albrecht, C. C., Romney, M., Lowry, P. B. & Moody, G. (2009). The IS Core: An Integration of the Core IS Courses. *Journal of Information Systems Education,* 20 (4), 451-468.

Alshare, K. A., Lane, P. L. & Miller, D. (2011). Business Communication Skills in Information Systems (IS) Curricula: Perspectives of Is Educators and Students. *Journal of Education for Business,* 86 (3), 186-194.

Alter, S. (2012). The Knowledge Cube: Scaffolding for a Body of Knowledge about Information Systems. European Conference of Information Systems (ECIS).

Anandarajan, M. & Lippert, S. K. (2006). Competing Mistresses? Academic vs. Practitioner Perceptions of Systems Analysis. *Journal of Computer Information Systems,* 47, 114-126.

Anthony, E. (2003). Computing Education in Academia: Toward Differentiating the Disciplines. Proceedings of the 4th Conference on Information Technology Curriculum, Lafayette, Indiana, USA.

Apigian, H. C. & Gambill, E. S. (2010). Are we Teaching the IS 2009* Model Curriculum? *Journal of Information Systems Education,* 21 (4), 411-420.

Atchison, W. F., Conte, S. D., Hamblen, J. W., Hull, T. E., Keenan, T. A., Kehl, W. B., McCluskey, E. J., Navarro, S. O., Rheinboldt, W. C., Schweppe, E. J., Viavant, W. & David M. Young, J. (1968). Curriculum 68: Recommendations for Academic Programs in Computer Science: A Report of the ACM Curriculum Committee on Computer Science. *Communications of the ACM,* 11 (3), 151-197.

Athey, S. & Plotnicki, J. (1998). The Evaluation of Job Opportunities for IT Professionals. *Journal of Computer Information Systems,* 38 (1), 71-78.

Avgerou, C., Siemer, J. & Bjorn-Andersen, N. (1999). The Academic Field of Information Systems in Europe. *European Journal of Information Systems,* 8 (2), 136-153.

Avison, D. & Elliot, S. (2006). Scoping the Discipline of Information Systems. *Information Systems: The State of the Field*, 3-18.

Avison, D. E., Dwivedi, Y. K., Fitzgerald, G. & Powell, P. (2008). The Beginnings of a New Era: Time to Reflect on 17 Years of the ISJ. *Information Systems Journal,* 18 (1), 5-21.

Avison, D. K., G.M.; Pernici, B.; Ramos, I.; Roode, D. (Eds.) (2008). Advances in Information Systems Research, Education and Practice, Pringer.

Azevedo, A., Apfelthaler, G. & Hurst, D. (2012). Competency Development in Business Graduates: An Industry-Driven Approach for Examining the Alignment of Undergraduate Business Education with Industry Requirements. *The International Journal of Management Education,* 10 (1), 12-28.

Bacon, C. J. & Fitzgerald, B. (2001). A Systemic Framework for the Field of Information Systems. *SIGMIS Database,* 32 (2), 46-67.

Bailey, J. & Mitchell, R. B. (2006). Industry Perceptions of the Competencies Needed by Computer Programmers: Technical, Business, and Soft Skills. *Journal of Computer Information Systems,* 47 (2), 28-33.

Bakshi, S. (2007). Crisis in the Information Systems Discipline: A Reflection. 18th Australasian Conference on Information Systems, Toowoomba.

Baravalle, A. & Capiluppi, A. IT Jobs in UK: Current Trends. Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on, 9-11 July 2010 2010a. 714-718.

Baravalle, A. & Capiluppi, A. (2010b). Matching Demand and Offer in on-Line Provision: A Longitudinal Study of Monster.Com. 12th IEEE International Symposium on Web Systems Evolution (WSE 2010), Timisoara, Romania.

Barki, H., Rivard, S. & Talbot, J. (1993). A Keyword Classification Scheme for IS Research Literature: An Update. *MIS Quarterly,* 17 (2), 209-226.

Baskerville, R. L. & Myers, M. D. (2002). Information Systems as a Reference Discipline. *MIS Quarterly,* 26 (1), 1-14.

Bell, C., Mills, R. & Fadel, K. (2013). An Analysis of Undergraduate Information Systems Curricula: Adoption of the IS 2010 Curriculum Guidelines. *Communications of the Association for Information Systems,* 32 (1), 73-94.

Benamati, J. H., Ozdemir, Z. D. & Smith, H. J. (2010). Aligning Undergraduate IS Curricula with Industry Needs. *Communications of the ACM,* 53 (3), 152-156.

Benbasat, I., Dexter, A. S. & Mantha, R. W. (1980). Impact of Organizational Maturity on Information System Skill Needs. *MIS Quarterly,* 4 (1), 21-34.

Benbasat, I. & Weber, R. (1996). Research Commentary: Rethinking “Diversity” in Information Systems Research. *Information Systems Research,* 7 (4), 389-399.

Benbasat, I. & Zmud, R. W. (1999). Empirical Research in Information Systems: The Practice of Relevance. *MIS Quarterly,* 23 (1), 3-16.

Benbasat, I. & Zmud, R. W. (2003). The Identity Crisis within the IS Discipline: Defining and Communicating the Discipline's Core Properties. *MIS Quarterly,* 27 (2), 183-194.

Berelson, B. (1952). Content Analysis in Communication Research, Free Press.

Berry, R., Rettenmayer, J. & Wood, J. T. (2006). An Investigation of Student Perceptions about the Information Systems Profession. *Journal of Computing Sciences in Colleges,* 21 (5), 130-136.

Beulen, E. (2010). Long-Held Perceptions of the Consequences of IT Offshoring Will Become a Reality: Fewer Is Jobs in Developed Countries. *Journal of Information Technology,* 25 (4), 376-377.

Boyle, T. A. & Strong, S. E. (2006). Skill Requirements of ERP Graduates. *Journal of Information Systems Education,* 17 (4), 403-412.

Brittan, J. N. I. T. C. E. (1974). An International Curriculum for Information Systems Designers, Rome, IBIICC; Intergovernmental Bureau for Informatics.

Bryant, K. C. (2003). A Methodology for the Design of Courses in Information Systems. Proceedings of the fifth Australasian Conference on Computing Education - Volume 20, Adelaide, Australia.

Buckingham, R. A. (1987). Information Systems Education: Recommendations and Implementation / Edited by Richard A. Buckingham ... [Et Al.], Cambridge: Cambridge University Press on behalf of the Cambridge Computer Society, 1987.

Buckingham, R. A., Hirschheim, R. A., Land, F. F. & Tully, C. J. (1987). Information Systems Curriculum: A Basis for Course Design, Information Systems Education: Recommendations and Implementation, Cambridge University Press.

Bullen, C. V., Abraham, T. & Galup, S. (2007). IT Workforce Trends: Implications for Curriculum and Hiring. *Communications of AIS,* 2007 (20), 545-554.

Cappel, J. J. (2001). Entry-Level Is Job Skills: A Survey of Employers. *Journal of Computer Information Systems,* 42 (2), 7.

Carr, N. G. (2003). It Doesn't Matter. *Educause Review,* 38, 24-38.

Cassel, L., Clements, A., Davies, G., Guzdial, M., McCauley, R., McGettrick, A., Sloan, R., Snyder, L., Tymann, P. & Weide, B. (2008). Computer Science Curriculum 2008: An Interim Revision of CS 2001. *Report from the interim review task force*.

Challa, C. D., Kasper, G. M. & Redmond, R. (2005). The Accreditation Process for IS Programs in Business Schools. *Journal of Information Systems Education,* 16 (2), 207-216.

Chang, C. L.-H., Chen, V., Klein, G. & Jiang, J. J. (2010). Information System Personnel Career Anchor Changes Leading to Career Changes. *European Journal of Information Systems*, 20 (1), 103-117

Chen, W. & Hirschheim, R. (2004). A Paradigmatic and Methodological Examination of Information Systems Research from 1991 to 2001. *Information Systems Journal,* 14 (3), 197-235.

Cheney, P. H., Hale, D. P. & Kasper, G. M. Information Systems Professionals: Skills for the 1990s. System Sciences, 1989. vol. IV: Emerging Technologies and Applications Track, Proceedings of the Twenty-Second Annual Hawaii International Conference on, 3-6 Jan 1989. 331-336.

Cheney, P. H. & Lyons, N. R. (1980). Information Systems Skill Requirements: A Survey. *MIS Quarterly,* 4 (1), 35-43.

Chia-An, C. & Shih, S. C. (2005). Organisational and End-User Information Systems Job Market: An Analysis of Job Types and Skill Requirements. *Information Technology, Learning, and Performance Journal,* 23 (2), 1-15.

Ching-Chang, L. & Ting-Peng, L. (2007). The Information Systems Academic Discipline in Taiwan - 2006: A Focus on Top-Tier Universities. *Communications of AIS,* 2007 (21), 116-136.

Choong Kwon, L. & Hyo-Joo, H. (2008). Analysis of Skills Requirement for Entry-Level Programmer/Analysts in Fortune 500 Corporations. *Journal of Information Systems Education,* 19 (1), 17-27.

Choudhury, V., Lopes, A. B. & Arthur, D. (2010). Issues and Opinions--IT Careers Camp: An Early Intervention Strategy to Increase IS Enrollments. *Information Systems Research,* 21 (1), 1-14.

Chrysler, E. & van Auken, S. (2002). Entry Level Value versus Career Value of MIS Courses: Faculty Expectations versus Alumni Perceptions. *Journal of Computer Information Systems,* 42 (3), 38.

Clarke, R. (2006). Key Aspects of the History of the Information Systems Discipline in Australia. *Australasian Journal of Information Systems,* 14 (1), 16.

Claver, E., González, R. & Llopis, J. (2000). An Analysis of Research in Information Systems (1981-1997). *Information & Management,* 37 (4), 181-195.

Clear, T., Goldweber, M., Young, F. H., Leidig, P. M. & Scott, K. (2001). Resources for Instructors of Capstone Courses in Computing. Working Group Reports from ITiCSE on Innovation and Technology in Computer Science Education, Canterbury, UK.

Cohen, E. E. (2000). Curriculum Model 2000 of the Information Resource Management Association and the Data Administration Managers Association.

Couger, J. D. (1973). Curriculum Recommendations for Undergraduate Programs in Information Systems. *Communications of the ACM,* 16 (12), 727-749.

Couger, J. D., Davis, G. B., Dologite, D. G., Feinstein, D. L., Gorgone, J. T., Jenkins, A. M., Kasper, G. M., Little, J. C., Longenecker Jr, H. E. & Valacich, J. S. (1995). IS'95: Guideline for Undergraduate IS Curriculum. *MIS Quarterly,* 19 (3), 341-359.

Courte, J. & Bishop-Clark, C. (2009). Do Students Differentiate between Computing Disciplines? Proceedings of the 40th ACM Technical Symposium on Computer Science Education, Chattanooga, TN, USA.

Cronin, B. (2001). Bibliometrics and Beyond: Some Thoughts on Web-Based Citation Analysis. *Journal of Information Science,* 27 (1), 1-7.

Davis, D. C. (2003). Job Titles, Tasks, and Experiences of Information Systems and Technologies Graduates from a Midwestern University *Journal of Information Systems Education,* 14 (1).

Davis, D. C. & Woodward, B. (2006). An Analysis of Skills Required of Graduates of an Information Systems Program. *Information Technology, Learning, and Performance Journal,* 24 (2), 11-21.

Davis, G., Massey, A. & Bjoern-Andersen, N. Securing the Future of Information Systems as an Academic Discipline. International Conference on Information Systems, 2005 Las Vegas, USA.

Davis, G. B. 2006. Information Systems as an Academic Discipline. *The Past and Future of Information Systems: 1976-2006 and Beyond.* Springer.

Davis, G. B., Gorgone, J. T., Couger, J. D., Feinstein, D. L. & Herbert E. Longenecker, J. (1996). Is '97: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. *SIGMIS Database,* 28 (1), 101-194.

Davis, G. B., Gray, P., Madnick, S., Nunamaker, J. F., Sprague, R. & Whinston, A. (2010). Ideas for the Future of the IS Field. *ACM Transactions on Management Information Systems,* 1 (1), 1-15.

Debuse, J. & Lawley, M. (2009). Desirable ICT Graduate Attributes: Theory vs. Practice. *Journal of Information Systems Education,* 20 (3), 313-323.

Decter, M. H. (2009). Comparative Review of UK-USA Industry-University Relationships. *Education and Training,* 51 (8), 624-634.

DEEWR (2008). Undergraduate Applications, Offers and Acceptances 2008.

Den Hartog, D. N., Caley, A. & Dewe, P. (2007). Recruiting Leaders: An Analysis of Leadership Advertisements. *Human Resource Management Journal,* 17 (1), 58-75.

Downey, J. P., McMurtrey, M. E. & Zeltmann, S. M. (2008). Mapping the MIS Curriculum Based on Critical Skills of New Graduates: An Empirical Examination of IT Professionals. *Journal of Information Systems Education,* 19 (3), 351-363.

Dumond, E. & Johnson, T. (2013). Managing University Business Educational Quality: ISO or ACSB? *Quality Assurance in Education,* 21 (2), 2-2.

Dwivedi, Y. K. & Kuljis, J. (2008). Profile of IS Research Published in the European Journal of Information Systems. *European Journal of Information Systems,* 17 (6), 678-693.

Dwivedi, Y. K., Lal, B., Mustafee, N. & Williams, M. D. (2008). Profiling a Decade of Information Systems Frontiers' Research. *Information Systems Frontiers*, 1-16.

Dwivedi, Y. K. & Mustafee, N. (2010). Profiling Research Published in the Journal of Enterprise Information Management (JEIM). *Journal of Enterprise Information Management,* 23 (1), 8-26.

Dwyer, C. & Knapp, C. A. (2004). How Useful is IS 2002? A Case Study Applying the Model Curriculum. *Journal of Information Systems Education,* 15 (4), 409-416.

e-skills. (2012). Technology Insights 2012. London, UK: e-skills.

Ehie, I. C. (2002). Developing a Management Information Systems (MIS) Curriculum: Perspectives from MIS Practitioners. *Journal of Education for Business,* 77 (3), 151-158.

Engel, G. & Roberts, E. (2001). Computing Curricula 2001 Computer Science. *IEEE-CS, ACM. Final Report*.

Fang, X. (2004). Critical Factors Affecting Job Offers for New MIS Graduates. *Journal of Information Systems Education,* 15, 189.

Fang, X., Lee, S. & Koh, S. (2005). Transition of Knowledge/Skills Requirement for Entry-Level IS Professionals: An Exploratory Study Based on Recruiters' Perception. *Journal of Computer Information Systems,* 46 (1), 58-70.

Fernandez-Sanz, L. Analysis of Non Technical Skills for ICT Profiles. 2010 Santiago de Compostela.

Fico, F. G., Lacy, S. & Riffe, D. (2008). A Content Analysis Guide for Media Economics Scholars. *Journal of Media Economics,* 21 (2), 114-130.

Finkelstein, A. (1993). European Computing Curricula: A Guide and Comparative Analysis. *The Computer Journal,* 36 (4), 299-319.

Firth, D., Lawrence, C. & Looney, C. A. (2008). Addressing the IS Enrollment Crisis: A 12-Step Program to Bring About Change through the Introductory Is Course. *Communications of the Association for Information Systems,* 23.

Fitzgerald, G. (2003). Information Systems: A Subject with a Particular Perspective, no more, no less. *European Journal of Information Systems,* 12 (3), 225-228.

Fontana, A. & Frey, J. (1994). The Art of Science, Thousand Oaks: Sage Publications.

Foster, A. L. (2005). Student Interest in Computer Science Plummets. *Chronicle of Higher Education,* 51 (38), A31-A32.

Gable, G. G. (2008). The Information Systems Academic Discipline in Australia, ANU E Press.

Galliers, R. D. & Whitley, E. A. (2007). Vive Les Differences? Developing a Profile of European Information Systems Research as a Basis for International Comparisons. *European Journal of Information Systems,* 16 (1), 20-35.

Gallivan, M. J., Truex III, D. P. & Kvasny, L. (2004). Changing Patterns in IT Skill Sets 1988-2003: A Content Analysis of Classified Advertising. *Data Base for Advances in Information Systems,* 35 (3), 65-85.

Garfield, E. (1979). IS Citation Analysis a Legitimate Evaluation Tool? *Scientometrics,* 1 (4), 359-375.

George, F. J., Valacich, S. J. & Valor, J. Does Information Systems Still Matter? Lessons for a Maturing Discipline. Twenty-Fifth International Conference on Information Systems, 2004 Washington DC, USA.

Gill, T. G. & Hu, Q. (1999). The Evolving Undergraduate Information Systems Education: A Survey of U.S. Institutions. *Journal of Education for Business,* 74 (5), 289.

Goles, T., Hawk, S. & Kaiser, K. M. (2008). Information Technology Workforce Skills: The Software and IT Services Provider Perspective. *Information Systems Frontiers,* 10 (2), 179-194.

Gorgone, J. T. (2006). Information Systems Accreditation: Preparation, Process, and Standards. *Communications of the Association for Information Systems,* 17 (1), 19.

Gorgone, J. T., Couger, J. D., Davis, G., Feinstein, D., Kasper, G., Little, J. & Longenecker, H. E. (1994a). Information Systems Curriculum -- a Status Report. *SIGCSE Bull.,* 26 (4), 2-4.

Gorgone, J. T., Couger, J. D., Feinstein, D., Kasper, G. & Herbert E. Longenecker, J. (1994b). Information Systems '95 Curriculum Model: A Collaborative Effort. *SIGMIS Database,* 25 (4), 5-8.

Gorgone, J. T., Davis, G. B., Valacich, J. S., Topi, H., Feinstein, D. L. & Longenecker, H. E. (2002). IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. *Communications of the Association for Information Systems,* 11 (1), 1-63.

Gorgone, J. T., Gray, P., Stohr, E. A., Valacich, J. S. & Wigand, R. T. (2006). MSIS 2006: Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems. *SIGCSE Bull.,* 38 (2), 121-196.

Gorgone, J. T., Lidtke, D. K. & Feinstein, D. (2001). Status of Information Systems Accreditation. Proceedings of the Thirty-Second SIGCSE Technical Symposium on Computer Science Education, Charlotte, North Carolina, United States.

Gou, J. & Tatnall, A. (2006). Three Questions to Guide Study and Practice in the Information Systems Field. *Journal of Business Systems, Governance and Ethics,* 1 (3), 49-56.

Granger, M. J., Dick, G., Luftman, J., Van Slyke, C. & Watson, R. T. (2007). Information Systems Enrollments: Can They Be Increased? *Communications of the Association for Information Systems,* 20.

Harris, A. H., Greer, T. H., Morris, S. A. & Clark, W. J. (2012). Information Systems Job Market Late 1970's-Early 2010's. *Journal of Computer Information Systems,* 53 (1), 72-79.

Hart, R. & Graham, R. 2012. The ICT Profession Body of Knowledge. Available: http://www.acs.org.au/__data/assets/pdf_file/0007/7792/The-ICT-Profession-Body-of-Knowledge.pdf [Accessed 07/02/2013].

Harwood, T. G. & Garry, T. (2003). An Overview of Content Analysis. *Marketing Review,* 3 (4), 479-498.

Hatzakis, T., Lycett, M. & Serrano, A. (2007). A Programme Management Approach for Ensuring Curriculum Coherence in IS (Higher) Education. *European Journal of Information Systems,* 16 (5), 643-657.

Havelka, D. & Merhout, J. W. (2009). Towards a Theory of Information Technology Professional Competence. *Journal of Computer Information Systems,* 50 (2), 106-116.

HESA. 2006. *Jacs2 Codes - Hesa* [Online]. Available: http://www.hesa.ac.uk/index.php/component/option,com_studrec/task,show_file/Itemid,233/mnl,07051/href,JACS2.html/ [Accessed 29/03/2010].

HESA. 2010. *Students and Qualifiers Data Tables* [Online]. Available: http://www.hesa.ac.uk/index.php?option=com_datatables&Itemid=121&task=show_category&catdex=3 [Accessed 29/03/2010].

Hickson, J. (2000). First Steps to an IT Career. *Computer Bulletin (London),* 2 (pt 1), 28-29.

Hills, J. M., Robertson, G., Walker, R., Adey, M. A. & Nixon, I. (2003). Bridging the Gap between Degree Programme Curricula and Employability through Implementation of Work-Related Learning. *Teaching in Higher Education,* 8 (2), 211-231.

Hilton, T. S. E. & Lo, B. W. N. (2007). Is Accreditation in AACSB Colleges Via ABET. *Journal of the Association for Information Systems,* 8 (1), 1-U2.

Hirschheim, R. (2007). The Looming Crisis for the IS Field: Where Have All the Students Gone? *Wirtschaftsinformatik,* 49 (3), 232-234.

Hirschheim, R. & Klein, H. K. (2003). Crisis in the IS Field? A Critical Reflection on the State of the Discipline. *Journal of the Association for Information Systems,* 4 (1), 237-293.

Hirschheim, R. & Klein, H. K. (2012). A Glorious and Not-So-Short History of the Information Systems Field. *Journal of the Association for Information Systems,* 13 (4), 188-235.

Hirschheim, R., Loebbecke, C., Ewman, M. & Valor, J. (2007). Offshoring and its Implications for the Information Systems Discipline: Where Perception Meets Reality. *Communications of the Association for Information Systems,* 20, 1-22.

Hirschheim, R. & Newman, M. (2010). Houston, We've Had a Problem...Offshoring, IS Employment and the IS Discipline: Perception is Not Reality. *Journal of Information Technology,* 25 (4), 358-372.

Huang, H., Kvasny, L., Joshi, K. D., Trauth, E. M. & Mahar, J. (2009). Synthesizing It Job Skills Identified in Academic Studies, Practitioner Publications and Job Ads. Proceedings of the Special Interest Group on Management Information System's 47th Annual Conference on Computer Personnel Research, Limerick, Ireland.

Hwang, D. & Soe, L. (2010). An Analysis of Career Tracks in the Design of IS Curricula in the U.S. *Information Systems Education Journal,* 8 (13), 17.

Igbaria, M., Greenhaus, J. H. & Parasuraman, S. (1991). Career Orientations of MIS Employees: An Empirical Analysis. *MIS Quarterly,* 15 (2), 151-169.

Iivari, J., Hirschheim, R. & Klein, H. K. (2004). Towards a Distinctive Body of Knowledge for Information Systems Experts: Coding ISD Process Knowledge in Two Is Journals. *Information Systems Journal,* 14 (4), 313-342.

Impagliazzo, J., McGettrick, A. D. & IEEE. New Models for Computing Education. 37th ASEE/IEEE Frontiers in Education Conference, Oct 10-13 2007 Milwaukee, WI. IEEE, 973-978.

Indulska, M., Hovorka, D. S. & Recker, J. (2012). Quantitative Approaches to Content Analysis: Identifying Conceptual Drift across Publication Outlets. *European Journal of Information Systems,* 21 (1), 49-69.

ISACA (1998). Model Curricula for Information Systems Auditing at the Undergraduate and Graduate Levels.

ISACA (2012). ISACA Model Curriculum for IS Audit and Control, 3rd Edition.

Jackson, N. (2001). Benchmarking in UK HE: An Overview. *Quality Assurance in Education,* 9 (4), 218-235.

Janicki, T., Gowan, A. J., Kline, D. & Konopaske, R. (2004). Matching Employer Needs with IS Curriculum: An Exploratory Study. *Information Systems Education Journal,* 2 (21), 3.

Janis, I. (2008). The Problem of Validating Content Analysis. *The Content Analysis Reader*, 358.

Jonathan, F. & Angela, L. (2005). Developing Expertise in E-Commerce: A Content Analysis of Students' Knowledge of Online Auctions. *Journal of Information Systems Education,* 16 (1), 85-91.

Joseph, D., Ang, S., Chang, R. H. L. & Slaughter, S. A. (2010). Practical Intelligence in IT: Assessing Soft Skills of IT Professionals. *Communications of the ACM,* 53 (2), 149-154.

Kaarst-Brown, M. L. & Guzman, I. R. (2005). Who Is "the IT Workforce"?: Challenges Facing Policy Makers, Educators, Management, and Research. Proceedings of the 2005 ACM SIGMIS CPR conference on Computer personnel research, Atlanta, Georgia, USA.

Kennan, M. A., Willard, P., Cecez-Kecmanovic, D. & Wilson, C. S. (2009). A Content Analysis of Australian IS Early Career Job Advertisements. *Australasian Journal of Information Systems,* 15 (2), 21.

Kennan, M. A., Willard, P., Cecez-Kecmanovic, D., Wilson, C. S. & Pacis (2007). IS Early Career Job Advertisements: A Content Analysis*,* Kaohsiung, Natl Sun Yat-Sen Univ.

Kim, I. & Kuljis, J. Applying Content Analysis to Web Based Content. Information Technology Interfaces (ITI), 2010 32nd International Conference on, 21-24 June 2010. 283-288.

Kim, Y., Hsu, J. & Stern, M. (2006). An Update on the IS/IT Skills Gap. *Journal of Information Systems Education,* 17 (4), 395-402.

King, J. & Lyytinen, K. (2006). The Future of the IS Field: Drawing Directions from Multiple Maps. *Information Systems: The State of the Field*.

King, J. L. & Lyytinen, K. (2004). Reach and Grasp. *MIS Quarterly,* 28 (4), 539-551.

Klein, H. K. & Hirschheim, R. (2008). The Structure of the Is Discipline Reconsidered: Implications and Reflections from a Community of Practice Perspective. *Information and Organization,* 18 (4), 280-302.

Koch, H., Van Slyke, C., Watson, R., Wells, J. & Wilson, R. (2010). Best Practices for Increasing IS Enrollment: A Program Perspective. *Communications of the Association for Information Systems,* 26, 477-493.

Krippendorff, K. (2004). Content Analysis: An Introduction to its Methodology, SAGE Publications, Incorporated.

Kung, M., Yang, S. C. & Yi, Z. (2006). The Changing Information Systems (IS) Curriculum: A Survey of Undergraduate Programs in the United States. *Journal of Education for Business,* 81 (6), 291-300.

Kurnia, S. (2007). An Evaluation of Information Systems Course: A Reflection from Final Year Students*,* Kaohsiung, Natl Sun Yat-Sen Univ.

Lange, C. (2005). Development and Status of the Information Systems / Wirtschaftsinformatik Discipline - an Interpretive Evaluation of Interviews with Renowned Researchers: Part Ii - Results Information Systems Discipline. Universität Duisburg-Essen.

Latham, A. (2000). Information Systems Graduates: The Challenge for Course Designers ECIS 2000. *ECIS 2000 Proceedings*, 102.

Latham, A. 2001. *The Emergence of Undergraduate Information Systems Education in the United Kingdom and Its Challenges for the Future: A Pluralistic, Multi-Stakeholder Perspective.* PhD, The University of Warwick.

Lee, D. M. S., Trauth, E. M. & Farwell, D. (1995). Critical Skills and Knowledge Requirements of IS Professionals - a Joint Academic-Industry Investigation. *MIS Quarterly,* 19 (3), 313-340.

Lee, K. & Mirchandani, D. (2010). Dynamics of the Importance of IS/IT Skills. *Journal of Computer Information Systems,* 50 (4), 67-78.

Lee, S. & Fang, X. (2008). Perception Gaps About Skills Requirement for Entry-Level IS Professionals between Recruiters and Students: An Exploratory Study. *Information Resources Management Journal,* 21 (3), 39-63.

Lee, S., Koh, S., Yen, D. & Tang, H. L. (2002). Perception Gaps between IS Academics and IS Practitioners: An Exploratory Study. *Information & Management,* 40 (1), 51-61.

Lee, S. M. & Lee, C. K. (2006). IT Managers' Requisite Skills. *Communications of the ACM,* 49 (4), 111-114.

Lee, Z., Gosain, S. & Im, I. (1997). Topics of Interest in IS: Evolution of Themes and Differences between Research and Practice. *Information & Management,* 36, 233-246.

Leitheiser, R. L. (1992). MIS Skills for the 1990s: A Survey of MIS Managers' Perceptions. *Journal of Management Information Systems,* 9 (1), 69-91.

Lending, D. & Mathieu, R. G. (2010). Workforce Preparation and ABET Assessment, New York, The Association Computing Machinery.

Lewins, A. & Silver, C. 2009. Choosing a CAQDAS Package. *CAQDAS QUIC Working Papers* [Online]. Available: http://www.surrey.ac.uk/sociology/research/researchcentres/caqdas/resources/workingpapers/ [Accessed 4 Dec 2013].

Lidtke, D. K., Meiselwitz, G. & Schroeder-Thomas, C. (2002). Panel: Information Systems Accreditation. *Journal of Computing Sciences in Colleges,* 17 (3), 35-39.

Lidtke, D. K. & Stokes, G. E. An Information Systems-Centric Curriculum ISCC 99. Frontiers in Education Conference, 1999. FIE '99. 29th Annual, 10-13 Nov. 1999. 15-12B15/20 vol.12.

Lidtke, D. K. & Yaverbaum, G. J. (2003). Developing Accreditation for Information Systems Education. *IT Professional*, 41-45.

Lifer, J. D., Parsons, K. & Miller, R. E. (2009). A Comparison of Information Systems Programs at AACSB and ACBSP Schools in Relation to IS 2002 Model Curricula. *Journal of Information Systems Education,* 20 (4), 469-476.

Lightfoot, J. M. (1999). Fads versus Fundamentals: The Dilemma for Information Systems Curriculum Design. *Journal of Education for Business,* 75 (1), 43-50.

Litecky, C., Aken, A., Ahmad, A. & Nelson, H. J. (2010). Mining for Computing Jobs. *Software, IEEE,* 27 (1), 78-85.

Litecky, C. R., Arnett, K. P. & Prabhakar, B. (2004). The Paradox of the Soft Skills Versus Technical Skills in IS Hiring. *Journal of Computer Information Systems,* 45 (1), 69-76.

Liu, X., Lai C., L., Koong, K. S. & Lu, J. (2003). An Examination of Job Skills Posted on Internet Databases Implications for Information Systems Degree Programs. *Journal of Education for Business,* 78 (4), 191.

Longenecker Jr, H. E., Feinstein, D., Couger, J. D., G., D. & Gorgone, J. T. (1994). Information Systems '95: A Summary of the Collaborative Is Curriculum Specification of the Joint DPMA, ACM, AIS Task Force. *Journal of Information Systems Education,* 6 (4), 174-187.

Lord, A. T. (2004). ISACA Model Curricula 2004. *International Journal of Accounting Information Systems,* 5 (2), 251-265.

Lunt, B., Ekstrom, J., Reichgelt, H. A. N., Bailey, M. & Leblanc, R. (2010). IT 2008: The History of a New Computing Discipline. *Communications of the ACM,* 53 (12), 133-141.

Lynch, K. & Fisher, J. (2007). Tomorrow's Workforce Today. *Information Systems and Technology Education M1 - Book, Section*, 311.

Lyytinen, K. (1999). Empirical Research in Information Systems: On the Relevance of Practice in Thinking of IS Research. *MIS Quarterly*, 25-27.

MacKinnon, J. R. & Han, H.-J. (2008). Analysis of IS Programs Accredited by ABET. *Communications of the IIMA,* 8 (1), 19.

Maier, J. L. & Gambill, S. (1996). CIS/MIS Curriculums in AACSB-Accredited Colleges of Business. *Journal of Education for Business,* 71 (6), 329.

Maier, J. L., Greer, T. & Clark, W. J. (2002). The Management Information Systems (MIS) Job Market Late 1970s-Late 1990s. *Journal of Computer Information Systems,* 42 (4), 44.

Marion, L., Kennan, M. A., Willard, P. & Wilson, C. S. (2005). A Tale of Two Markets: Employer Expectations of Information Professionals in Australia and the United States of America.

Martz, B. & Cata, T. (2008). Students' Perception of IS Academic Programs, IS Careers, and Outsourcing. *Journal of Education for Business,* 84 (2), 118-125.

McAleer, B. & Szakas, S. J. (2009). Forces for Change in the New Is 20xx Curriculum. *Information Systems Education Journal,* 7 (44).

McGann, S. T. & Cahill, M. A. (2005). An IS Capstone Course for the 21st Century Emphasizing Experiential & Conceptual Aspects, Soft Skills and Career Readiness. *Issues in Information Systems,* 6 (1), 6.

McGann, S. T., Frost, R. D., Matta, V. & Huang, W. (2007). Meeting the Challenge of IS Curriculum Modernization: A Guide to Overhaul, Integration, and Continuous Improvement. *Journal of Information Systems Education,* 18 (1), 49-62.

Medlin, B. D., Dave, D. S. & Vannoy, S. A. (2001). Students' Views of the Importance of Technical and Non-Technical Skills for Successful IT Professionals. *Journal of Computer Information Systems,* 42 (1), 65.

Merhout, J. W., Havelka, D. & Hick, S. N. Soft Skills Versus Technical Skills: Finding the Right Balance for an IS Curriculum. Americas Conference on Information Systems (AMCIS), 2009.

Mesaric, J. & Dukic, B. (2005). Implementing International IS Curricula in the Croatian Universities. *ITI 2005: Proceedings of the 27th International Conference on Information Technology Interfaces*, 313-318.

Mills, R. J., Hauser, K. & Pratt, J. A. (2008). A Comprehensive Two-Level Framework for Information Systems Curriculum Design, Assessment and Improvement. *Journal of Computer Information Systems,* 49 (1), 16-16.

Mustafee, N. Evolution of IS Research based on Literature Published in two Leading IS Journals-EJIS and MISQ. Proceedings of the European Conference on Information Systems, 2011.

Myers, M. D. & Newman, M. (2007). The Qualitative Interview in IS Research: Examining the Craft. *Information and Organization,* 17 (1), 2-26.

Myers, W. Is '91 -- DPMA's Latest Curriculum Model. Southeastern Small College Computing Conference, 1991 Nashville Tennessee USA.

Nagarajan, S. V. & Edwards, J. (2009). The Relevance of University Degrees for Developing Work-Ready Information Technology Graduates. 32nd HERDSA Annual Conference, Darwin, Australia.

Nelson, H. J., Ahmad, A., Martin, N. L. & Litecky, C. R. A Comparative Study of IT/IS Job Skills and Job Definitions. SIGMIS-CPR 2007 - Proceedings of the 2007 ACM SIGMIS CPR Conference: The Global Information Technology Workforce, 2007 Saint Louis, MO. 168-170.

Nelson, R. R. (1991). Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements. *MIS Quarterly,* 15 (4), 503-525.

Nettleton, S., Lichtfield, A. & Taylor, T. (2008). Engaging Professional Societies in Developing Work-Ready Graduates. 32nd HERDSA Annual Conference, Darwin, Australia.

Neuendorf, K. A. (2002). The Content Analysis Guidebook, SAGE Publications, Incorporated.

Neufeld, D., Fang, Y. & Huff, S. L. (2007). The IS Identity Crisis. *Communications of the Association for Information Systems,* 19, 17.

Noll, C. L. & Wilkins, M. (2002). Critical Skills of IS Professionals: A Model for Curriculum Development. *Journal of Information Technology Education,* 1 (3), 12.

Nunamaker, J. F. J. (1981). Educational Programs in Information Systems: A Report of the ACM Curriculum Committee on Information Systems. *Communications of the ACM,* 24 (3), 124-133.

Nunamaker, J. F. J., Couger, J. D. & Davis, G. B. (1982). Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs. *Communications of the ACM,* 25 (11), 781-805.

Orlikowski, W. J. & Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research,* 2 (1), 1-28.

Outlay, C. N. & Krishnan, P. Skill Gaps and Careers in IS Compliance: Implications for Is Degree Programs in the U.S. 2010 Vancouver, BC. 130-135.

Palvia, P., Pinjani, P. & Sibley, E. H. (2007). A Profile of Information Systems Research Published in Information & Management. *Information & Management,* 44 (1), 1-11.

Panko, R. R. (2008). IT Employment Prospects: Beyond the Dotcom Bubble. *European Journal of Information Systems,* 17 (3), 182-197.

Park, J.-r., Lu, C. & Marion, L. (2009). Cataloging Professionals in the Digital Environment: A Content Analysis of Job Descriptions. *Journal of the American Society for Information Science and Technology,* 60 (4), 844-857.

Pervan, G. & Shanks, G. (2006). The 2005 Survey of Information Systems Research in Australia. *Australasian Journal of Information Systems,* 14 (1).

Petrova, K. & Claxton, G. (2005). Building Student Skills and Capabilities in Information Technology and Ebusiness: A Moving Target. *Journal of Information Systems Education,* 16 (1), 27-41.

Phelan, T. J. (1999). A Compendium of Issues for Citation Analysis. *Scientometrics,* 45 (1), 117-136.

Pierson, J. K., Kruck, S. E. & Teer, F. (2008). Trends in Names of Undergraduate Computer-Related Majors in AACSB-Accredited Schools of Business in the USA. *Journal of Computer Information Systems,* 49 (2), 26-31.

Plice, R. K. & Reinig, B. A. (2007). Aligning the Information Systems Curriculum with the Needs of Industry and Graduates. *Journal of Computer Information Systems,* 48 (1), 22-30.

Plice, R. K. & Reinig, B. A. (2009). Leveraging Alumni and Business Community Relations to Assess the Information Systems Curriculum. *Journal of Education for Business,* 84 (3), 142-150.

Pouloudi, N., Poulymenakou, A. & Pramatari, K. (2012). A Profile of Information Systems Research in the Mediterranean Region. *European Journal of Information Systems,* 21 (4), 345-357.

Prabhakar, B., Litecky, C. R. & Arnett, K. (2005). IT Skills in a Tough Job Market. *Communications of the ACM,* 48 (10), 91-94.

QAA (2007). Subject Benchmark Statement: Computing.

Reichgelt, H. & Gayle, Y. (2007). Accountability and Accreditation: Putting Information Systems Accreditation into Perspective. *Communications of the Association for Information Systems,* 20 (1), 13.

Riemenschneider, C. K., Armstrong, D. J. & Moore, J. E. (2009). Meeting the Demand for IT Workers: A Call for Research. *European Journal of Information Systems,* 18 (5), 458-461.

Riihijarvi, J. & Iivari, J. The Practical Relevance of IT Education: Skill Requirements and Education Expectations of Practitioners. *In:* AVISON, D. K. G. M. P. B. R. I. R. D., ed. IFIP TC 8 Information Systems Conference held at the 20th World Computer Congress, Sep 07-10 2008 Milan, ITALY. Springer, 1-13.

Ryker, R., Fanguy, R. & Legendre, A. M. Y. (2008). Undergraduate Special Topics Courses: What's on the Menu? *Journal of Computer Information Systems,* 49 (2), 81-85.

Sahami, M., Guzdial, M., McGettrick, A. & Roach, S. (2011). Setting the Stage for Computing Curricula 2013: Computer Science -- Report from the ACM/IEEE-CS Joint Task Force. Proceedings of the 42nd ACM Technical Symposium on Computer Science Education, Dallas, TX, USA.

Schultze, U. & Avital, M. (2011). Designing Interviews to Generate Rich Data for Information Systems Research. *Information and Organization,* 21 (1), 1-16.

Scime, A. & Wania, C. (2005). Computing Curricula: A Comparison of Models. *International Journal of Information and Communication Technology Education,* 1 (2), 18.

Scott, C. K., Fuller, M. A., MacIndoe, K. M. & Joshi, K. D. (2009). More Than a Bumper Sticker: The Factors Influencing Information Systems Career Choices. *Communications of AIS,* 2009 (24), 7-26.

Sepkoski, J. J., Jr. (1974). Quantified Coefficients of Association and Measurement of Similarity. *Journal of the International Association for Mathematical Geology,* 6 (2), 135-152.

Shackelford, R., McGettrick, A., Sloan, R., Topi, H., Davies, G., Kamali, R., Cross, J., Impagliazzo, J., LeBlanc, R. & Lunt, B. (2006). Computing Curricula 2005: The Overview Report. Proceedings of the 37th SIGCSE Technical Symposium on Computer Science Education, Houston, Texas, USA.

Sidorova, A. & Harden, G. Achieving Alignment between IS Research and IS Curriculum: Towards Stronger Is Discipline Identity. AMCIS 2012.

Simon, J. C., Kaiser, K. M., Beath, C., Goles, T. & Gallagher, K. (2007). Information Technology Workforce Skills: Does Size Matter? *Information Systems Management,* 24 (4), 345 - 359.

Snoke, R. (2007). Generic Attributes of IS Graduates -an Australian IS Academic Study. Australasian Conference on Information Systems Toowoomba, Australia.

Snoke, R. & Underwood, A. (2002). IS Curriculum Evaluation for Core Capabilities: A Methodology for Determining the Coverage. Americas Conference on Information Systems (AMCIS).

Snoke, R., Underwood, A. & Bruce, C. (2002). An Australian View of Generic Attributes Coverage in Undergraduate Programs of Study: An Information Systems Case Study. 2002 Annual International Conference of the Higher Education Research and Development Society of Australasia (HERDSA), Perth, Australia.

Sodhi, M. S. & Son, B. g. (2010). Content Analysis of or Job Advertisements to Infer Required Skills. *The Journal of the Operational Research Society,* 61 (9), 1315-1327.

Soe, L., L & Hwang, D. (2007). Career Track Design in IS Curriculum: A Case Study. *Information Systems Education Journal,* 5 (29), 19.

Stevens, D., Totaro, M. & Zhiwei, Z. H. U. (2011). Assessing IT Critical Skills and Revising the MIS Curriculum. *Journal of Computer Information Systems,* 51 (3), 85-95.

Stone, G. W., Joseph, M., Phelps, L. & Berken, A. (2006). A Content Analysis on the Role of Ethics in the Business Curriculum. *Journal for Advancement of Marketing Education,* 9, 31-42.

Stowell, A. F. & Probert, S. K. (2012). A Survey and Analysis of the Information Systems (IS) Discipline in the UK for the Council of Information Systems Professors (CISP) and the Higher Education Academy. Council of Information Systems Professors.

Surakka, S. (2005a). Analysis of Technical Skills in Job Advertisements Targeted at Software Developers. *Informatics in Education,* 4 (1), 22.

Surakka, S. (2005b). Trend Analysis of Job Advertisements: What Technical Skills do Software Developers Need? *Helsinki University of technology*.

Surendran, K. & Schwieger, D. (2011). Incorporating Capstone Courses in Programs Based upon IS2010 Model Curriculum. *Information Systems Education Journal,* 9 (2), 9.

Sutherland, J. (2009). Skills and Training in Great Britain: Further Evidence. *Education+ Training,* 51 (7), 541-554.

Tan, B. C. Y. & Taizan, C. (2007). The Information Systems Academic Discipline in Singapore 2006. *Communications of AIS,* 2007 (21), 104-115.

Tang, H. L., Lee, S. & Koh, S. (2000). Educational Gaps as Perceived by IS Educators: A Survey of Knowledge and Skill Requirements. *Journal of Computer Information Systems,* 41 (2), 76-84.

Tapper, T. & Filippakou, O. (2009). The World-Class League Tables and the Sustaining of International Reputations in Higher Education. *Journal of Higher Education Policy and Management,* 31 (1), 55-66.

Tastle, W. J., White, B. A., Valfells, A. & Shackleton, P. (2008). Information Systems, Offshore Outsourcing, and Relevancy in the Business School Curriculum. *Journal of Information Technology Research,* 1 (2), 61.

Tatnall, A. & Burgess, S. 2009. Evolution of Information Systems Curriculum in an Australian University over the Last Twenty-Five Years. *Education and Technology for a Better World.* Springer.

Teichroew, D. (1971). Education Related to the Use of Computers in Organizations. *Communications of the ACM,* 14 (9), 573-588.

Teo, T. S. H. & Srivastava, S. C. (2007). Information Systems (IS) Discipline Identity: A Review and Framework. *Information Systems (IS),* 10, 30-2007.

Tesch, D. B., Crable, E. A. & Braun, G. F. (2003). Evaluating IS Curriculum Issues through an ongoing Alumni Assessment Mechanism. *Journal of Computer Information Systems,* 44 (2), 40-48.

Todd, P. A., McKeen, J. D. & Gallupe, R. B. (1995). The Evolution of IS Job Skills - a Content-Analysis of IS Job Advertisements from 1970 to 1990. *MIS Quarterly,* 19 (1), 1-27.

Topi, H. (2009). Is Education: Accreditation of Degree Programs in Information Systems. *SIGCSE Bull.*: ACM.

Topi, H. (2010). IS 2010 is Ready and Available for your Use! *ACM Inroads,* 1 (1), 16-17.

Topi, H., Valacich, J. S., Kaiser, K. M., Nunamaker Jr, J. F., Sipior, J. C., de Vreede, G. J. & Wright, R. T. (2007). Revising the IS Model Curriculum: Rethinking the Approach and Process. *Communications of the AIS,* 20 (45), 728-740.

Topi, H., Valacich, J. S., Wright, R. T., Kaiser, K., Nunamaker, J., F., J., Sipior, J. C. & de Vreede, G. J. (2010). Is 2010: Curriculum Guidelines for Undergraduate Degree Programs in Information Systems. *Communications of the Association for Information Systems,* 26 (1), 69.

Topi, H., Valacich, J. S., Wright, R. T., Kaiser, K., Nunamaker Jr, J. F., Sipior, J. C. & de Vreede, G. J. (2008). Revising Undergraduate IS Model Curriculum: New Outcome Expectations. *Communications of the Association for Information Systems,* 23 (1), 32.

Trauth, E. M., Farwell, D. W. & Lee, D. (1993). The IS Expectation Gap: Industry Expectations versus Academic Preparation. *MIS Quarterly,* 17 (3), 293-307.

Tucker, A. B. (1991). Computing Curricula 1991. *Communications of the ACM,* 34 (6), 68-84.

Tuson, A. 2008. University IT Curriculum Is Failing UK Enterprises. *Computer Weekly*.

Tye, E. M. W. N., Poon, R. S. K. & Burn, J. M. (1995). Information Systems Skills: Achieving Alignment between the Curriculum and the Needs of the IS Professionals in the Future. *SIGMIS Database,* 26 (4), 47-61.

UCAS. 2010. *UCAS - Course Search* [Online]. Available: http://www.ucas.com/students/coursesearch/coursesearch2010/ [Accessed 31 March 2009].

UKAIS. 1999. *The Definition of Information Systems* [Online]. UKAIS. Available: http://www.ukais.org/ [Accessed 2 April 2009].

Walstrom, K. A., Schambach, T. P., Jones, K. T. & Crampton, W. J. (2008). Why are Students not Majoring in Information Systems? *Journal of Information Systems Education,* 19 (1), 43-54.

Weber, R. P. (1990). Basic Content Analysis, Sage Publications, Incorporated.

Werth, J., Gorgone, J., Davis, G., Feinstein, D., Longenecker, B. & Kasper, G. (1995). Proposed Joint Acm/Dpma/Ais Undergraduate Information Systems Degree Curriculum Model (Abstract). Proceedings of the twenty-sixth SIGCSE Technical Symposium on Computer Science Education, Nashville, Tennessee, USA.

White, G. W. (2004). Business Information Courses in LIS Programs: A Content Analysis. *Journal of Business & Finance Librarianship,* 10 (2), 3-15.

White, S. & Irons, D. A. (2007). Informatics in the UK: Current Perspectives. *Italics,* 6 (3).

Wickramasinghe, V. & Perera, L. (2010). Graduates', University Lecturers' and Employers' Perceptions towards Employability Skills. *Education and Training,* 52 (3), 226-244.

Wilkerson, J. W. (2012). An Alumni Assessment of MIS Related Job Skill Importance and Skill Gaps. *Journal of Information Systems Education,* 23 (1), 85.

Wilkins, S. & Huisman, J. (2012). UK Business School Rankings over the last 30 years (1980-2010): Trends and Explanations. *Higher Education,* 63 (3), 367-382.

Williams, C. & Pomykalski, J. (2006). Comparing Current IS Curricula to the Is 2002 Model Curriculum. *Information Systems Education Journal,* 4 (76).

Williams, G. (2005). Subject Benchmarking in the United Kingdom. Chapel Hill: The University of North Caroline at Chapel Hill.

Wilson, N. & Avison, D. (2007). Double Jeopardy: The Crises in Information Systems, an Australian Perspective 18th Australasian Conference on Information Systems Toowoomba, Australia.

Woratschek, R. C. Student Attitudes and Perceptions Regarding Computing and its Related Disciplines: A Preliminary Study in the United Kingdom. Information Systems Educators Conference (2010 ISECON Proceedings), 2010 Nashville Tennessee, USA.

Wu, J.-H., Chen, Y.-C. & Chang, J. Is Knowledge Gaps: An Industrial Perspective. System Sciences, 2006. HICSS '06. Proceedings of the 39th Annual Hawaii International Conference on, 04-07 Jan 2006. 5a-5a.

Xiang, F., Sooun, L., Lee, T. E. & Wayne, H. (2004). Critical Factors Affecting Job Offers for New MIS Graduates. *Journal of Information Systems Education,* 15 (2), 190-204.

Yang, S. C. (2012). The Master's Program in Information Systems (IS): A Survey of Core Curriculums of U.S. Institutions. *Journal of Education for Business,* 87 (4), 206-213.

Yen, D. C., Chen, H.-G., Lee, S. & Koh, S. (2003). Differences in Perception of IS Knowledge and Skills between Academia and Industry: Findings from Taiwan. *International Journal of Information Management,* 23 (6), 507-522.

Yen, D. C., Sooun, L. & Seokha, K. (2001). Critical Knowledge/Skill Sets Required by Industries: An Empirical Analysis. *Industrial Management & Data Systems,* 101 (8/9), 11.

Zhang, W. (2007). Why IS: Understanding Undergraduate Students' Intentions to Choose an Information Systems Major. *Journal of Information Systems Education,* 18 (4), 447-458.

Zhao, J. J. (2002). Computer End-User Skills Important for Business Professionals Now and toward 2005. *Journal of Computer Information Systems,* 42 (3), 31.

Zwieg, P., Kaiser, M. K., Beath, M. C., Bullen, C., Gallagher, P. K., Goles, T., Howland, J., Simon, C. J., Abbott, P., Abraham, T., Carmel, E., Evaristo, R., Hawk, S., Lacity, C. M., Gallivan, M., Kelly, S., Mooney, G. J., Ranganathan, C., Rottman, W. J., Ryan, T. & Wion, R. (2006). The Information Technology Workforce: Trends and Implications 2005-2008. *MIS Quarterly Executive,* 5 (2), 7.

APPENDIX A

List of IS 2010 modules which correspond to the table on the following page:

(C) Denotes Core Modules
(O) Denotes Option Modules

[IS2010.1 - Foundations of IS (C)
IS2010.2 - Enterprise Architecture (C)
IS2010.3 - IS Strategy, Management and Acquisition (C)
IS2010.4 - Data and Information Management (C)
IS2010.5 - Systems Analysis & Design (C)
IS2010.6 - IT Infrastructure (C)
IS2010.7 - Project Management (C)
IS2010.8 - Application Development (O)
IS2010.9 - Business Process Management (O)
IS2010.10 - Collaborative Computing (O)
IS2010.11 - Data Mining / Business Intelligence (O)
IS2010.12 - Enterprise Systems (O)
IS2010.13 - Human-Computer Interaction (O)
IS2010.14 - Information Search and Retrieval (O)
IS2010.15 - IT Audit and Controls (O)
IS2010.16 - IT Security and Risk Management (O)
IS2010.17 - Knowledge Management (O)
IS2010.18 - Social Informatics (O).

CORE AND OPTION MODULES MAPPED TO ISSKS

	Subject Code	Russell Group			million+			1994 Group			University Alliance			No Affiliation			All		
CORE SUBJECTS	IS2010.1	C	46	10%	C	125	10%	C	60	10%	C	149	14%	C	126	10%	C	506	11%
		O	4	2%	O	24	3%	O	7	2%	O	22	3%	O	25	3%	O	81	3%
	IS2010.2	C	26	6%	C	115	10%	C	24	6%	C	97	9%	C	92	7%	C	363	8%
		O	4	2%	O	51	7%	O	8	2%	O	66	8%	O	11	2%	O	140	5%
	IS2010.3	C	1	<1%	C	10	1%	C	0	0%	C	27	2%	C	11	1%	C	49	1%
		O	4	2%	O	12	2%	O	7	2%	O	17	2%	O	13	2%	O	53	2%
	IS2010.4	C	24	5%	C	41	3%	C	11	2%	C	49	5%	C	48	4%	C	173	4%
		O	3	1%	O	13	2%	O	5	1%	O	19	2%	O	7	1%	O	48	2%
	IS2010.5	C	32	7%	C	88	7%	C	42	7%	C	80	7%	C	73	6%	C	315	7%
		O	8	4%	O	76	11%	O	25	7%	O	59	7%	O	31	4%	O	199	7%
	IS2010.6	C	15	3%	C	149	12%	C	17	3%	C	76	7%	C	113	9%	C	371	8%
		O	3	1%	O	31	4%	O	3	1%	O	23	3%	O	27	4%	O	89	3%
	IS2010.7	C	8	2%	C	67	6%	C	7	1%	C	50	5%	C	30	2%	C	163	4%
		O	3	1%	O	18	2%	O	10	3%	O	27	3%	O	11	1%	O	68	2%
ELECTIVE SUBJECTS	IS2010.8	C	92	20%	C	154	13%	C	109	19%	C	139	13%	C	198	16%	C	692	15%
		O	11	5%	O	72	10%	O	17	5%	O	92	11%	O	79	11%	O	271	9%
	IS2010.9	C	8	2%	C	15	1%	C	4	1%	C	13	1%	C	3	<1%	C	44	1%
		O	1	<1%	O	6	1%	O	3	1%	O	7	1%	O	9	1%	O	24	1%
	IS2010.10	C	1	<1%	C	1	<1%	C	2	<1%	C	0	0%	C	10	1%	C	14	<1%
		O	0	0%	O	1	<1%	O	0	0%	O	1	<1%	O	1	<1%	O	3	<1%
	IS2010.11	C	1	0%	C	15	1%	C	3	1%	C	15	1%	C	10	1%	C	46	1%
		O	3	1%	O	11	1%	O	7	2%	O	19	2%	O	27	4%	O	66	2%
	IS2010.12	C	3	1%	C	16	1%	C	2	<1%	C	14	1%	C	12	1%	C	47	1%
		O	4	2%	O	15	2%	O	6	2%	O	9	1%	O	7	1%	O	42	1%
	IS2010.13	C	11	2%	C	40	3%	C	19	3%	C	38	3%	C	52	4%	C	160	3%
		O	15	7%	O	36	5%	O	9	3%	O	40	5%	O	43	6%	O	143	5%
	IS2010.14	C	0	0%	C	1	<1%	C	5	1%	C	0	0%	C	3	<1%	C	9	<1%
		O	3	1%	O	0	0%	O	10	3%	O	1	<1%	O	4	1%	O	19	1%
	IS2010.15	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	0	0%
		O	0	0%	O	1	<1%	O	1	<1%	O	0	0%	O	0	0%	O	2	<1%
	IS2010.16	C	3	1%	C	7	1%	C	4	1%	C	16	1%	C	2	<1%	C	32	1%
		O	2	1%	O	18	2%	O	17	5%	O	31	4%	O	16	2%	O	85	3%
	IS2010.17	C	3	1%	C	6	<1%	C	8	1%	C	1	<1%	C	12	1%	C	30	1%
		O	4	2%	O	5	1%	O	13	3%	O	17	2%	O	6	1%	O	45	2%
	IS2010.18	C	5	1%	C	8	1%	C	2	<1%	C	18	2%	C	23	2%	C	57	1%
		O	3	1%	O	5	1%	O	7	2%	O	12	1%	O	19	3%	O	46	2%
OTHER	Project	C	78	17%	C	142	12%	C	86	15%	C	136	13%	C	137	11%	C	579	13%
		O	0	0%	O	9	1%	O	0	0%	O	49	6%	O	15	2%	O	72	3%
	Other	C	106	23%	C	209	17%	C	156	27%	C	170	16%	C	307	24%	C	947	21%
		O	149	66%	O	317	44%	O	218	58%	O	326	39%	O	371	51%	O	1380	48%

CORE AND OPTION MODULES MAPPED TO DF (BUSINESS)

	Module Names	Russell Group			million+			1994 Group			University Alliance			No Affiliation			All		
BUSINESS DOMAIN	General Business	C	10	14%	C	10	13%	C	14	15%	C	11	18%	C	19	14%	C	63	14%
		O	13	21%	O	19	15%	O	19	7%	O	22	18%	O	57	34%	O	129	21%
	Finance	C	5	6%	C	8	10%	C	8	9%	C	5	9%	C	4	3%	C	30	7%
		O	4	6%	O	18	24%	O	7	5%	O	5	5%	O	1	1%	O	35	6%
	Accounting	C	17	23%	C	5	7%	C	10	11%	C	6	10%	C	23	17%	C	61	14%
		O	8	13%	O	9	7%	O	8	6%	O	4	3%	O	8	5%	O	37	6%
	Marketing	C	3	4%	C	10	13%	C	22	24%	C	3	6%	C	22	17%	C	61	14%
		O	275	18%	O	25	20%	O	27	21%	O	21	18%	O	26	15%	O	117	19%
	Operational Management	C	3	5%	C	9	12%	C	2	2%	C	6	10%	C	11	8%	C	31	7%
		O	0	0%	O	7	5%	O	8	6%	O	6	5%	O	6	3%	O	26	4%
	Organisational Behaviour	C	1	2%	C	9	12%	C	9	9%	C	2	3%	C	11	8%	C	32	7%
		O	0	0%	O	5	4%	O	0	0%	O	5	4%	O	6	4%	O	16	3%
	Business Law	C	0	0%	C	2	3%	C	0	0%	C	0	0%	C	0	0%	C	2	0%
		O	3	4%	O	0	0%	O	3	3%	O	0	0%	O	7	4%	O	13	2%
	Globalisation	C	3	4%	C	3	4%	C	0	0%	C	1	2%	C	4	3%	C	11	2%
		O	3	4%	O	0	0%	O	7	5%	O	8	7%	O	9	5%	O	26	4%
	Management	C	11	15%	C	5	6%	C	9	10%	C	9	14%	C	23	17%	C	57	13%
		O	5	9%	O	11	9%	O	13	10%	O	6	15%	O	7	4%	O	43	7%
	HRM	C	5	7%	C	2	3%	C	7	7%	C	3	5%	C	5	4%	C	22	5%
		O	5	9%	O	10	8%	O	10	8%	O	10	8%	O	2	1%	O	37	6%
	Enterprise	C	11	15%	C	2	3%	C	1	1%	C	9	15%	C	1	1%	C	25	6%
		O	0	0%	O	13	10%	O	21	17%	O	22	19%	O	23	14%	O	79	13%
	Economics	C	1	2%	C	7	9%	C	2	2%	C	0	0%	C	7	6%	C	17	4%
		O	1	2%	O	3	2%	O	1	1%	O	1	1%	O	10	6%	O	16	3%
	Strategy	C	1	1%	C	3	4%	C	4	4%	C	2	3%	C	3	25	C	12	3%
		O	0	0%	O	3	2%	O	4	3%	O	2	2%	O	1	1%	O	10	2%
	Supply Chain Management	C	3	4%	C	2	3%	C	4	5%	C	3	4%	C	0	0%	C	12	3%
		O	1	2%	O	4	3%	O	0	0%	O	5	5%	O	5	3%	O	16	3%

CORE AND OPTION MODULES MAPPED TO DF (COMPUTING)

	Module Names	Russell Group			million+			1994 Group			University Alliance			No Affiliation			All		
COMPUTING DOMAIN	General Computing	C	11	74%	C	2	12%	C	6	40%	C	19	49%	C	31	40%	C	69	42%
		O	40	76%	O	14	16%	O	30	46%	O	21	20%	O	49	40%	O	154	35%
	Multimedia	C	3	19%	C	12	69%	C	0	0%	C	18	47%	C	13	17%	C	46	28%
		O	4	8%	O	35	41%	O	6	9%	O	28	26%	O	12	10%	O	85	19%
	Games	C	0	0%	C	1	8%	C	0	0%	C	1	4%	C	1	1%	C	4	2%
		O	0	0%	O	6	7%	O	3	5%	O	15	14%	O	8	7%	O	33	8%
	Graphics	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	2	3%	C	2	1%
		O	3	6%	O	8	9%	O	8	12%	O	18	16%	O	21	17%	O	58	13%
	AI	C	1	7%	C	2	12%	C	7	43%	C	0	0%	C	24	31%	C	34	21%
		O	4	8%	O	15	18%	O	16	23%	O	23	21%	O	21	17%	O	80	18%
	End User Computing	C	0	0%	C	0	0%	C	3	17%	C	0	0%	C	1	2%	C	4	2%
		O	0	0%	O	8	9%	O	0	0%	O	1	1%	O	0	0%	O	9	2%
	GIS	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	3	4%	C	3	2%
		O	0	0%	O	0	0%	O	2	3%	O	2	1%	O	2	2%	O	6	1%
	Bioinformatics	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	2	3%	C	2	1%
		O	1	2%	O	0	0%	O	0	0%	O	0	0%	O	10	8%	O	11	3%

CORE AND OPTION MODULES MAPPED TO DF (OTHER)

	Module Names	Russell Group			million+			1994 Group			University Alliance			No Affiliation			All		
VARIOUS	Foreign Language	C	0	0%	C	0	0	C	0	0%	C	0	0%	C	0	0%	C	0	0%
		O	11	62%	O	29	82%	O	3	100%	O	27	84%	O	3	25%	O	73	72%
	Research Methods	C	4	100%	C	20	100%	C	1	100%	C	13	100%	C	13	48%	C	52	79%
		O	4	23%	O	1	4%	O	0	0%	O	5	16%	O	0	0%	O	10	10%
	Law	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	1	2%	C	1	1%
		O	3	15%	O	0	0%	O	0	0%	O	0	0%	O	2	13%	O	5	5%
	Other	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	13	49%	C	13	20%
		O	0	0%	O	5	14%	O	0	0%	O	0	0%	O	8	60%	O	13	13%

CORE AND OPTION MODULES MAPPED TO FKS

	Module Names	Russell Group			million+			1994 Group			University Alliance			No Affiliation			All		
SKILLS	Collaboration / Teamwork	C	3	23%	C	11	12%	C	4	8%	C	4	8%	C	9	12%	C	31	11%
		O	2	15%	O	6	8%	O	5	22%	O	32	52%	O	31	48%	O	75	32%
	Communications Skills	C	6	43%	C	54	59%	C	12	24%	C	30	55%	C	27	38%	C	129	46%
		O	1	8%	O	23	32%	O	1	6%	O	19	31%	O	19	30%	O	64	27%
	Negotiation	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	0	0%	C	0	0%
		O	0	0%	O	0	0%	O	0	0%	O	3	4%	O	0	0%	O	3	1%
	Analytical Thinking	C	1	9%	C	20	22%	C	7	14%	C	7	12%	C	6	9%	C	42	15%
		O	6	38%	O	40	56%	O	7	34%	O	1	2%	O	7	11%	O	61	26%
	Maths	C	4	25%	C	7	7%	C	26	53%	C	13	25%	C	29	41%	C	79	28%
		O	6	40%	O	3	4%	O	8	38%	O	7	11%	O	7	11%	O	111	13%

APPENDIX B

List of universities included in the First Stage and Second Stage Mapping Surveys.

University	Country	Region	Website
Birkbeck UoL	England	Greater London	http://www.bbk.ac.uk
Brunel University	England	Greater London	http://www.brunel.ac.uk
City University	England	Greater London	http://www.city.ac.uk
Goldsmiths UoL	England	Greater London	http://www.gold.ac.uk
Kingston University	England	Greater London	http://www.kingston.ac.uk
London Metropolitan University	England	Greater London	http://www.londonmet.ac.uk
London South Bank University	England	Greater London	http://www.lsbu.ac.uk
Middlesex University	England	Greater London	http://www.mdx.ac.uk
Queen Mary UoL	England	Greater London	http://www.qmul.ac.uk
Thames Valley University	England	Greater London	http://www.tvu.ac.uk
University of East London	England	Greater London	http://www.uel.ac.uk
University of Greenwich	England	Greater London	http://www.gre.ac.uk
University of Westminster	England	Greater London	http://www.westminster.ac.uk
Anglia Ruskin University	England	South East	http://www.anglia.ac.uk
Aston University	England	West Midlands	http://www1.aston.ac.uk
University of Bath	England	South West	http://www.bath.ac.uk
University of Bedfordshire	England	East of England	http://www.beds.ac.uk
Birmingham City University	England	West Midlands	http://www.bcu.ac.uk
University of Bolton	England	North West	http://www2.bolton.ac.uk
Bournemouth University	England	South West	http://www.bournemouth.ac.uk
University of Bradford	England	Yorkshire and the Humber	http://www.brad.ac.uk
University of Brighton	England	South East	http://www.brighton.ac.uk
Buckinghamshire New University	England	South East	http://bucks.ac.uk
Canterbury Christ Church University	England	South East	http://www.canterbury.ac.uk
University of Central Lancashire	England	North West	http://www.uclan.ac.uk
University of Chester	England	North West	http://www.chester.ac.uk
University of Chichester	England	South East	http://www.chi.ac.uk
Coventry University	England	West Midlands	http://www.coventry.ac.uk
De Montfort University	England	East Midlands	http://www.dmu.ac.uk
University of Derby	England	East Midlands	http://www.derby.ac.uk
University of East Anglia	England	East of England	http://www.uea.ac.uk
Edge Hill University	England	North West	http://www.edgehill.ac.uk
University of Exeter	England	South West	https://www.exeter.ac.uk
University of Gloucestershire	England	South West	http://www.glos.ac.uk
University of Hertfordshire	England	East of England	http://www.herts.ac.uk
University of Huddersfield	England	Yorkshire and the Humber	http://www2.hud.ac.uk
University of Hull	England	Yorkshire and the Humber	http://www2.hull.ac.uk
Keele University	England	West Midlands	http://www.keele.ac.uk

University of Kent	England	South East	http://www.kent.ac.uk
Lancaster University	England	North West	http://www.lancs.ac.uk
University of Leeds	England	Yorkshire and the Humber	http://www.leeds.ac.uk
University of Leicester	England	East Midlands	http://www.le.ac.uk
University of Lincoln	England	East Midlands	http://www.lincoln.ac.uk
University of Liverpool	England	North West	http://www.liv.ac.uk
Liverpool John Moores University	England	North West	http://www.ljmu.ac.uk
Loughborough University	England	East Midlands	http://www.lboro.ac.uk
University of Manchester	England	North West	http://www.mbs.ac.uk
Manchester Metropolitan University	England	North West	http://www.mmu.ac.uk
Newcastle University	England	North East	http://www.ncl.ac.uk
University of Northampton	England	East Midlands	http://www.northampton.ac.uk
Northumbria University	England	North East	http://www.northumbria.ac.uk
Nottingham Trent University	England	East Midlands	http://www.ntu.ac.uk
The Open University	England	South East	http://www.open.ac.uk
Oxford Brooks University	England	South East	http://www.brookes.ac.uk
University of Plymouth	England	South West	http://www.plymouth.ac.uk
University of Portsmouth	England	South East	http://www.port.ac.uk/
University of Reading	England	South East	http://www.reading.ac.uk
University of Sheffield	England	Yorkshire and the Humber	http://www.shef.ac.uk
Sheffield Hallam University	England	Yorkshire and the Humber	http://www.shu.ac.uk
University of Southampton	England	South East	http://www.soton.ac.uk
Southampton Solent University	England	South East	http://www.solent.ac.uk
Staffordshire University	England	West Midlands	http://www.staffs.ac.uk
University of Sunderland	England	North East	http://www.sunderland.ac.uk
University of Surrey	England	South East	http://www.surrey.ac.uk
Teesside University	England	North East	http://www.tees.ac.uk
University of the West of England	England	South West	http://uwe.ac.uk
University of Wolverhampton	England	West Midlands	http://www.wlv.ac.uk
University of Worcester	England	West Midlands	http://www.worc.ac.uk
University of Aberdeen	Scotland	Scotland	http://www.abdn.ac.uk
Edinburgh Napier University	Scotland	Scotland	http://www.napier.ac.uk
Glasgow Caledonian University	Scotland	Scotland	http://www.gcal.ac.uk
Heriot-Watt University	Scotland	Scotland	http://www.hw.ac.uk
Robert Gordon University	Scotland	Scotland	http://www.rgu.ac.uk
University of Stirling	Scotland	Scotland	http://www.stir.ac.uk
University of Strathclyde	Scotland	Scotland	http://www.strath.ac.uk
Queen's University Belfast	NI	Northern Ireland	http://www.qub.ac.uk
University of Glamorgan	Wales	Wales	http://www.glam.ac.uk

Aberystwyth University	Wales	Wales	http://www.aber.ac.uk
Bangor University	Wales	Wales	http://www.bangor.ac.uk
Cardiff University	Wales	Wales	http://www.cs.cf.ac.uk
University of Wales, Lampeter	Wales	Wales	http://www.lamp.ac.uk
University of Wales Institute, Cardiff	Wales	Wales	http://www.uwic.ac.uk
University of Wales, Newport	Wales	Wales	http://www.newport.ac.uk
Swansea Metropolitan University	Wales	Wales	http://www.smu.ac.uk
Swansea Metropolitan University	Wales	Wales	http://www.smu.ac.uk