Personnel Assignment
Decision Support System

A DISSERTATION
PRESENTED TO THE
NATIONAL UNIVERSITY OF IRELAND, DUBLIN
IN PARTIAL FULFILMENT OF THE
MASTER OF MANAGEMENT SCIENCE DEGREE

by
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Acknowledgements

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We would also like to thank Stan Blennerhassett and Paul O’Connor of SUDPT Ltd. for their constant assistance throughout the year.

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Finally we would like to thank our families for their support down though the years.
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Abstract

This dissertation describes the design and implementation of an online personnel placement Decision Support System. It provides a method whereby prospective jobseekers can log on and enter all their details including personal, education, extracurricular, skills and work experience details. Jobseekers also specify their preferred salary and work location. The system then allows recognised employers to log on and search the database of jobseekers under a number of different criteria namely skills, location, salary and degree grade. The system then returns the similarity matching for each jobseeker in the database and displays them on a results page.

The system has been designed to commercial specifications and has placed special emphasis on security and data integrity. The development of the project used the tried and tested Systems Development Lifecycle Methodology. Enclosed is a copy of the central repository containing all documentation generated during the systems development, this should greatly simplify matters for future projects in this area.
Introduction

Job Placement Agencies

Temporary staffing was conceived during World War II from a rise in demand for military supplies and a shortage of available male workers. While the men were away at war, women stepped in to help out in munitions factories. When the war ended, soldiers returned home to re-claim their jobs but industry had discovered a new source of labour with a cost-effective business model.

After the war, structured job placement firms emerged. One of the first firms established was Drake, which was formed in Milwaukee USA in 1948. From the early 1950s to the late 70s, the staffing industry had a “pink collar” reputation because it primarily matched female job seekers with temporary assignments, concentrated in clerical and secretarial areas. As the industry evolved, its demographics changed to incorporate its increasingly varied services, customers and employees. Since the early 1990s, the sectors served by the staffing industry have expanded and diversified along with the world’s workforce.

From the outset of the last decade job placement agencies have become more and more prominent in the personnel placement market. Up until then employers felt that all they needed to do to fill vacancies was to advertise in a relevant publication but as the market became more competitive and companies began to realise that in today's fiercely competitive business environment, it is good people that will give you a leg up. People who are team players, with the skills, the confidence and the desire to get the job done right can be your biggest asset.

This realisation among top management and the onset of the Celtic Tiger fuelled the growth in the job placement industry in Ireland in the early nineties. Like other
sectors since the mid-1990s the staffing industry has been redefining itself in pursuit of greater productivity. Some firms responded by expanding the scope of their businesses through mergers and acquisitions, while others have taken the opposite approach by specializing in niche markets, such as accounting or legal services.

While it is now widely recognised that recruitment professionals are highly skilled and often hold masters and doctorate degrees it is virtually impossible to stay up to date on the ever-evolving needs of the employer. To overcome this and in an attempt to streamline the whole recruitment process the development of software solutions for this area has had huge investment in recent years. The benefits of this approach are wide ranging and eliminate many of the overheads faced by the traditional placement agencies. With the downturn in the economy hitting this industry hard in recent years it has been for the most part the web based agencies that have kept their heads above water while many of the traditional job placement agencies have been unable to stay afloat.

Although the web based side of the industry has enjoyed unparalleled success in recent years it has not always been well received. Many traditional personnel placement consultants feel that these systems have failed to fully address the often complex issue of matching the right candidate with the right job. With this in mind this thesis aims to develop a system that utilises traditional management science techniques to offer a credible solution to this problem. To ensure the sustained success of personnel placement it is imperative that both the prospective candidate and employer receive a high quality of service, it is here that we feel our system can excel through the application of fundamental management science techniques to this yet unchartered area. The nucleus of this project will focus on matching the skills of the candidate with the needs of the employer while also incorporating auxiliary matching features such as location, salary and degree grade matching. These features incorporate numerous techniques, which will be discussed in greater detail in subsequent chapters. The combination of these matching features result in a comprehensive personnel placement decision support system (DSS), which will offer any prospective employer an accurate and consistent return of suitable candidates. It must be pointed out here however that this system is not meant to be all encompassing and is merely meant to be a first round selection tool for employers, it is also hoped
that this system will prove a valuable building block for future excursions into this area.

As up to 90% of information system projects run over time and over budget it is imperative that the development team have a clear understanding of how they foresee the project proceeding, with this in mind we decided to adopt the tried and tested systems development life cycle (SDLC) approach as our development methodology. This structured approach offers quantifiable deliverables at each stage of the development process while also facilitating constant feedback with the client. The remainder of this thesis will be discussed in the context of the SDLC model that comprises of the following chapters.

1. Planning
2. Analysis
3. Design
4. Implementation & Maintenance

In recent years the role of recruitment has extended beyond its traditional boundaries and no longer is just about “hiring”. Companies now have to strive harder to attract good staff. Organisations are constantly on the look out for systems that will give them a better chance of hiring the “right” person. With the constant evolvement of the employee market, systems that can adequately evolve and adapt to this changing climate are becoming ever more popular. This thesis aims to show that fundamental management science techniques can be used in the development of an efficient Personnel Placement Decision Support System.
Chapter 1

Project Planning & Selection

1.1 Introduction
For the purpose of this project the first stage of the SDLC that we are going to consider is the planning phase, this encompasses project identification, project initiation and project planning. This stage of the process aims to transform a vague system idea into a tangible project description clearly outlining the objectives, feasibility issues, benefits, costs and time schedules for the project. The tangible deliverables are a statement of work and a Baseline Project Plan (BPP), both of which are contained in the central repository. A BPP includes a high level description of the proposed system, an outline of the various feasibilities, and an overview of management issues specific to the project. Before the development of the system can begin the client and the development team must agree on this specification. The Statement of Work (SOW) is a document prepared for the customer during project initiation and planning that describes what the project will deliver and outlines generally at a high level all work required to complete the project, it is typically a high level summary of the BPP information. During the remainder of this chapter we aim to outline the many issues we considered in the planning phase to see what if any was our best course of action from here. For an in depth look at the issues discussed during the project selection and planning phase please consult the BPP contained in the repository.

1.2 Project Identification
In the latter half of 2001, the Students’ Union Data, Placement & Training (SUDPT) Ltd was established by the University of Limerick’s Student Union with the aim of
finding employment for students and graduates of the University. From the outset the company had three main objectives:

- To find students casual work during term time relevant to their course of study
- To find students summer employment whether it be at home or abroad
- To place graduates of the university in long-term employment relevant to their experience and interests.

Since its foundation this company has functioned under the sole guidance of its manager Paul O’Connor who came into the job with long standing contacts in many employment sectors. From these humble beginnings the company has been an untold success to such an extent that it was in danger of being consumed by its own growth.

Management felt that in order to guarantee the sustained success of the organisation it was necessary to develop a long-term strategic plan. To achieve this management approached Michael Phelan who had an in-depth knowledge of the Students’ Union and its IT infrastructure. After analysing the performance of the company and the critical growth factors it was evident that the SUDPT required a business development plan for the next three years. With this in mind an agreement was reached between the SUDPT Board of Directors, Master of Management Science (MMS) Course Director Dr. Peter Keenan and MMS students Conor McNamara & Michael Phelan to undertake this project as their dissertation.

It was apparent from the initial meeting that the IT infrastructure of the company was quite primitive so much so that a manual filing system was in place to record the details of each individual jobseeker. This set-up was adequate in the company’s infancy but had become infeasible to operate once word of the company spread among the student population and thousands of forms had been completed. The sole web resources of the company consisted of an information page outlining the history, objectives and contact details of the company. Having taken this into account it was decided that we would need to develop a complete web based system that would allow the manager more time to market and boost the company’s profile among jobseekers and employers alike. In conjunction with the system development, it was
also agreed that a business plan incorporating a marketing strategy would be an integral part of the project.

1.3 Project Objectives and Benefits
As stated above, if this company is to maintain its growth over the coming years its present IT infrastructure is simply inadequate. It is hoped a new system would help SUDPT Ltd achieve its primary objective of placing as many students and graduates of UL in employment as possible and freeing the manager to visit employers on a daily basis as opposed to having to stay in the office and organise paperwork. The provision of an online personnel placement system will in the short term increase customer loyalty as well as customer satisfaction, while in the long term it is hoped that it will generate revenue for the company by introducing a levy on employers who want access to the site. SUDPT Ltd also intends to seek a site sponsor for this new venture that again will offer a fixed income on a yearly basis.

SUDPT Ltd.’s primary objective of placing as many students and graduates of UL in employment as possible would also be achieved as the manager now would be free to visit employers on a daily basis as opposed to having to stay in the office and organise paperwork. The company will now also be able to keep track of where exactly its jobseekers are being placed and how they are performing. This new system supports SUDPT Ltd.’s mission statement because it will lead to increased profitability along with better innovation and cost effectiveness. With these points in mind a high level system description was developed.

1.4 System Description
Before we could come up with a system suitable for SUDPT Ltd. we first had to have a deep and thorough understanding of what exactly they expected from such a system. With this in mind we decided to set down a high level plan of the system so that any discrepancies between our perception of the proposed system and that of our employers could be ironed out at this early stage. A brief outline of the functionality of the complete system follows including all the different alternative ways the system
could be implemented and how we would go about tackling this project. Below is a summary of the main requirements and deliverables of the system.

1.5 System Requirements and Deliverables

1.5.1 Website functionality

• A welcome page that gives interested parties more information about the company and relevant contact details

• Graduate Section: a facility whereby students or graduates can register their personal details and receive an online login name and password. Once they have logged in they should then be able to fill out an online CV that would contain such elements as education details, work experience and extra curricular activities

• Employer Section: a facility where employers can register their details and receive a login name and password. They then will be allowed search the jobseekers in the system by predetermined criteria such as degree, skills, location, salary range and experience

• Administrator Section: a page where the manager of the company will be able to view, edit and delete specific parts of the system. Such options may include the deletion of inactive members, updating of existing skills

• A database that would be specifically designed for this application containing all the relevant information needed for the smooth operation of the system.

• Help files: as the manager of the company has negligible experience in the application of such software it is imperative that conclusive help files are written to allow him to overcome any minor problems that arise without having to contact the design team. Help files will also be needed to support the end users of the system, be they students or employers

• Training: the project will also incorporate initial training on the functionality of the system for the staff of SUDPT Ltd.

• Maintenance: The project will also consist of system support for an initial twelve-month period when the system first goes live
It is also of the utmost importance to the customer that security and data integrity are maintained at all times, it is the responsibility of the project development team that these requirements are met.

1.5.2 Database Technology

From our initial meetings with the management of SUDPT it became apparent to us that this project would involve an extensive database development aspect. From our initial research we felt that an MS Access database would be sufficient. The size and complexity of this technology should be more than competent for the foreseeable future but should the company grow considerably over time other options may need to be considered, one of which may be MySQL. This topic will be researched in greater detail in the analysis phase of the SDLC.

1.5.3 Hardware requirements

At this stage it is also important that we research the hardware resources that will be needed to make this proposed system a reality. These will involve the purchase of a computer that can act as a server, this PC will then be equipped with Windows 2000 server to host the site and maintain regular back ups of data. The manager of the company is currently equipped with his own PC so this will not be factored into the cost of the project.

1.5.4 Software Requirements

During this stage we foresaw a large amount of the development costs being spent on software. The software packages we considered using over the course of the system development life cycle were as follows:

- Macromedia Dreamweaver would be used for the development of the front end of the system, i.e. the website
- Macromedia Flash may also be used on the website for certain features
- On the server side there were numerous options available to us for example Coldfusion, ASP or JSP. This software will allow the website interact with the database.
• Licensing was not an issue as the company already had access to these products through the University’s onsite Microsoft warranty

1.5.5 Maintenance
As maintenance usually accounts for a large proportion of the overall lifetime cost of the system it is imperative that both the client and the development team come to an early agreement on this issue. Both the client and the project team have both settled on an initial two month maintenance deal after the system goes live with the internal IT support staff of the organisation undertaking maintenance following the conclusion of this period. Updates to the site data once the system goes live will also be the responsibility of the staff of SUDPT.

1.6 Feasibility Assessment
To insure that the overall implementation is viable it is crucial that the proposed system is analysed under a number of different feasibility factors. The feasibility of the proposed system depends on a number of different resource capabilities that have to be analysed at this stage. Below are some of the main factors we considered when developing the feasibility of this project.

1.6.1 Technical Feasibility
The technical feasibility of any project is to gain an understanding of the project teams ability to construct the proposed system. Given that the project team consists of two students there is a degree of risk involved on the part of the client. On the other hand as the cost is minimal, SUDPT Ltd. stand to lose very little even if the project fails. There will also be numerous checks in place to control and limit risk with the foremost of these being a policy of active involvement employed by the client where they are constantly aware of the projects progress. The fact that two lecturers with extensive experience in this area are supervising the project also reduces the level of technical risk involved.
1.6.2 Operational Feasibility
In investigating operational feasibility, we are endeavouring to understand the degree to which the proposed system will likely solve the business problems of the organisation. The business problems that are referred to here are the company’s inability to provide an efficient service to its ever-increasing number of clients together with the lack of revenue generation within the company will it is hoped be overcome by the implementation of this system. The effect of the system on organisational structures and procedures will initially be very limited. However, should the extent of the benefits from improvements in management control and planning envisaged accrue, savings on part-time labour could result in modest structural change. Any attempt to estimate this change is futile, given the uncertainty and significant number of factors involved.

1.6.3 Legal and Contractual Analysis
As this system will contain sensitive information on all its users it is vital that certain legislation and standards are adhered to in relation to data integrity and protection. For example the Data Protection Act of 1998 must be adhered to and any data contained in the database must only be used for the process agreed to by the user when registering. This is not seen as being a major obstacle to the development of the system.

1.6.4 Feasibility: Cost & Benefits
There are a number of different costs to consider when building this System. Obviously with the development of any system the client should be aware of the start up and recurring costs. As we will not be involved with the maintenance of the system we are only concerned with the initial set up costs. Below is a list of all the costs we foresee at this point to get the project up and running; the list indicates that we have also factored in initial advertising and stationery overheads that will be necessary to publicise the new system among the student population. We have not factored in any staff training costs as this will be undertaken free of charge by both team members in the preceding days before the system goes live.
To determine if the system is economically justifiable, it is necessary to carry out a Cost-Benefit Analysis. This is not really necessary in the context of this project as already outlined the costs are minimal and it is difficult to estimate what the long term tangible benefits will be. It should also be remembered here that SUDPT Ltd. is a non-profit making organisation and any money made by the company will be reinvested into the student population.

1.6.5 Project Start Up Costs Worksheet

1 Hardware Costs
- Dell Dimension €1600
- IDE Hard Drive €140
- Server Casing €120
- CD Writer €100

2 Software Costs
- Win 2003 Web Server Ed €200
- Norton antivirus software €70
- Win Office 2K (Access 2000) €200

3 Labour
- Database Input €1100

4 Miscellaneous
- Printing €1200
- Postage €100
- Advertising €200

Total €5030

1.7 Project Schedule

Another major deliverable of this phase of the SDLC is a workable project development schedule with deadlines associated with the completion of each phase of the SDLC. The timeline for this project was structured according to two deadlines, one is associated with the submission of the dissertation on the 29th of August and the other being the deadline set down by the clients. Fortunately both coincide fairly closely with one another and we were able to come up with a preliminary time frame that encompassed both. This is illustrated in the Project Schedule below. We foresee much of the work taking place on site to facilitate easy interaction with the management of SUDPT Ltd. The given schedule is subject to on going review by the team and any alterations made will be done so in such a way as not to affect the
agreed completion date. If this is not possible, meetings will take place in an endeavour to compromise with SUDPT management.

**Project Development Schedule**

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<tr>
<th>Project Steps:</th>
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<th>Qtr 2</th>
<th>Qtr 3</th>
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<td>Submission of Statement of Work to SUDPT</td>
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<td>Project Initiation and Planning</td>
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<td><strong>Project Analysis</strong></td>
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<td>Requirements Determination</td>
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<td>Requirements Structuring</td>
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<td>Alternative Generation and Selection</td>
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<td><strong>Project Design</strong></td>
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<td>Data Structure Design</td>
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<td>Web Page Design</td>
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<td>Database Design</td>
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<td><strong>Project Implementation</strong></td>
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<td>Full System goes live</td>
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<td>Initial staff training</td>
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<td>Submission of thesis &amp; completion of project</td>
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![Critical Path](image)

**Figure 1.1** Project Development Schedule

### 1.8 Communication Procedures

The existence of clear lines of communication between team members as well as between the project development team and the client are vital to the successful completion of any project. This ensures a shared understanding of the activities and goals of the project, which leads to a better coordination of activities.

#### 1.8.1 Communication Procedures between members of the project development team

Typically, communication between members of a project development team is done using the following computer-based mechanisms, which are already in place through the e-learning software available at UCD:
• A computer-based file exchange exists between members of a project development team, where reports, files, project documentation etc. can be added and made accessible to all members of the project development team
• An on-line discussion group facility is also available to team members.
• Team members to share ideas, make requests/suggestions to other team members etc also use internal e-mail

Both team members also use other forms of communication. These will typically include:
• Regular progress meetings involving both team members
• Minutes of each meeting in order to monitor progress of the project
• Status reports so that the status of the project is clarified as of the date of the report

1.8.2 Communication Procedures between the project development team and the clients

A clear communication line between the client and the project development team is essential. For this reason we suggest the following forms of communication to be used, in the development of the project, between the project development team and the SUDPT manager. It is suggested that informal communication is done mainly through telephone and e-mail. More formal means of communication, which would include:
• Regular progress meetings between the project team and the relevant SUDPT management
• Interim presentations to be given to BEC management approximately every three months

1.9 Project Standards and Procedures

The following set of standards and procedures will be used in this project. Such standards and procedures ensure the smooth operation of any project and ensure that both the project development team and the client are fully aware of the status of the project at any given time.
1.9.1 Evaluation Procedures

The deliverables of this project are largely in line with each phase of the SDLC. It is proposed by us that, on completion of each stage of the System Development Life Cycle (SDLC), a review is carried out on the deliverables of that stage with both team members of the project development team and with the client to ensure that they meet the satisfaction of both. Typically, a presentation will be given by the team to the client outlining in relevant detail such deliverables. Once the client has accepted the deliverable then the project can move on to the next stage in the SDLC with all concerns laid at rest.

1.9.2 Procedures for project change requests

At this stage it is vital that certain procedures are put in place to deal with change requests should the need arise. During the analysis stage and the initial part of the design stage consideration would be given to any changes the client wished to make. However the cut off point for change requests will be the completion of the data structure design phase, apart from extenuating circumstances change requests will not be entertained following this point.
Chapter 2 - Analysis

Requirements Determination & Structuring

2.1 Introduction

The analysis phase of the SDLC is only undertaken once the client has reviewed the Baseline Project Plan and has decided the project has merits and should be pursued further. This phase is usually divided into three main activities listed below

- Requirements determination & structuring
- Technology analysis & selection
- Alternative generation and selection

Requirements determination can be best described as a fact-finding exercise where the system developers use every option available to them to gather information on what the proposed system should do. This fact finding usually focuses on the current system if any exists, the organization that the new system will support and the expectations and requirements of the new system. Having come up with a comprehensive set of system requirements it is imperative that these requirements for the new system are organized. The organizing or structuring of system requirements results in diagrams and descriptions that can be analysed to show deficiencies, inefficiencies and missing elements of the proposed replacement system. The results of the requirements determination can then be structured three different ways: process modelling, logic & timing modelling, data modelling. The final part of the design phase determines how to choose between alternative design strategies. Following requirements determination and structuring the system developers may have come up with numerous different options for the provision of the desired system. Having documented the alternative strategies the team will then judge each on its merits and
determine the best strategy to proceed to the design phase with. The client is then briefed and if they are satisfied the project will proceed to the design phase.

2.2 Requirements Determination & Structuring

This part of the design phase is fundamental to the whole process and must not be underestimated. With this in mind we tried to make it as involved a process as possible, contacting any group we felt could make a positive impact on the process. Aside from this we also endeavoured to perform as much in depth research as possible through a number of different media ranging from the web to journal publications. The requirements determination process required the gathering of information on a number of different fronts. At a high level it involves investigation into the functionality of the system and what the expectations of this are in different quarters.

At a lower level we need to investigate the different system requirements. One of the main areas of requirements determination is coming up with a set of employment areas referred to as skill classes and as complete a set of skills for each area as possible. We must then investigate what criteria we are going to search by, following on from this we need to investigate what employer-jobseeker matching algorithms we are going to use. We also need to research the different technology options available to us and come up with a list of the most viable options. At the end of the requirements determination stage we should have a clear vision of the different options available to us to take on to the system design.

2.3 Online Research

As the proposed system is going to be a web based one a detailed study of what is out there at the moment is essential. If one is to type words like ‘recruitment’ or jobs’ into an internet search engine literally thousands of matches will be returned. Many of the matches returned will be online recruitment sites of some kind; these vary greatly in size, usability and projected target audience. To get a feel for what is out there at the moment we each endeavoured to come up with a list of twenty online recruitment sites and analyse them under the following headings.

- Target audience
• Site structure
• Marketing techniques

From our findings we were able to classify the sites researched into the following categories. Broadly speaking they fall into four main groups listed below.

2.3.1 Generic Online Recruitment Sites

Generic online recruitment sites carry jobs across a range of different industry sectors. They generally attract high levels of traffic from users with skills that can be applied to different industries – for example secretarial and administration or marketing. These sites can deal with Ireland only or can be part of an international network that could be useful for recruiters with international recruitment needs. Because of the levels of traffic attracted to these sites employers can expect to receive a high number of applications to their vacancies. This category can be further divided up into those sites that post vacancies on their sites and allow jobseekers apply to the company directly and those sites that allow the jobseeker complete an online CV that then can be reviewed by prospective employers who pay for the privilege of access to the sites database of jobseekers.

2.3.2 Specialist Online Recruitment Sites

Specialist online recruitment sites concentrate on carrying jobs from just one industry sector. These online recruitment sites tend to cater for industries that require specialist skills, such as the built environment or aviation. For employers wishing to recruit, specialist sites can provide a better quality of response from more targeted candidates. Specialist sites often have links with industry bodies and organizations within their sector, helping to attract traffic from qualified candidates.

2.3.3 Publication Related Sites
www.cwjobs.com or www.nursingtimes.net.

Trade magazines or newspapers that carry recruitment advertising usually also post advertised jobs on their equivalent internet sites. This can be useful as response
generated by advertisements in the magazine is added to by response to the vacancy posted online. However the audience of publication related sites comes largely from the related magazine and consequently advertising on such a site is not the best way for an employer to maximize exposure of a vacancy.

2.3.4 Portal Careers Sites

www.yahoo.co.uk, www.freeserve.com or www.msn.co.uk.

Portals or search engines frequently partner with job boards in order to offer their users recruitment areas within the portal featuring careers advice and vacancies. The content is usually replicated from existing sites and like generic online recruitment sites attracts traffic from non-specialist candidates.

2.4 Interviewing

Obviously there were a number of different methods available to us for collecting system requirements including interviews, questionnaires, interview groups and study of business documents. After careful deliberation we felt that in order to assure accuracy in our research it would be necessary to conduct interviews in person with the different groups who would have an impact on the system design. From the initial planning stage we had identified four different groups of people we needed to interview in order to get a balanced insight into what these constituent groups expected from the proposed system. The four groups interviewed were

- Experienced Recruitment Consultants
- Students and recent Graduates
- Academics
- The management of SUDPT Ltd

Interviewing is one of the most traditional forms of research and has proven to be very successful in the past, it is frequently suggested that a qualitative approach such as this provides a richness of data that is not possible with other less involved approaches (questionnaires etc.). It also must be stressed however that if the interview option is chosen then the benefit of the ‘richness’ only occurs if all the data is interpreted sensitively. Therefore to get the real benefits of interviewing detailed
planning is essential. With this in mind we came up with an Interview Outline for each group so that we are aware of the proposed structure of the interview, these outlines are all contained in the repository. Below is a summary of our approach to meeting each group, our subsequent findings and general conclusions.

2.4.1 Recruitment Consultant meetings

Planning
Before we could even consider designing a system such as this we felt that we needed to speak to professionals with years of experience in the field and so the first part of requirements determination involved arranging meetings with various recruitment consultants. The first part of this process involved sending out e-mails to the complete list of recruitment agencies in Ireland, a list of which we found on www.niceone.com. These mails were sent out in early March. The response was less than encouraging with the majority failing to reply, and those that did agree to fill out a questionnaire were all very reluctant to meet in person. Following this initial setback we were forced to reassess our approach and in early June we made contact with Christine Cross a lecturer in Personnel and Employee Relations at the University of Limerick with numerous years of commercial experience in the personnel placement industry. Having explained our predicament to Christine she arranged an initial meeting with Robert Graydon a senior recruitment consultant at Irish Recruitment Consultants (IRC). Robert then arranged subsequent meetings with Aidan Killian a colleague who specialises in the area of Banking and Finance and Dermot Foley of the Human Resources in UL. During this time we also made contact with Deirdre Galvin of the Accountants Panel.

Meeting Objectives
The main objectives from these meetings was to gather as much information as possible on the whole area of personnel placement. On first meeting the interviewee we gave a brief outline of the proposed system and how it would work form a fairly high level. Having completed this the interviewee would be asked to give their views on the system at this stage in the hope that they would highlight any major do’s and don’ts in the proposed system. The next stage of the interview involved seeking the interviewee’s input on the proposed different employment areas, i.e. how many
different employment areas we should have and what they should be called. The final objective of these interviews was to come up with a proposed set of skills for each of these employment areas. Many of the questions posed during these interviews were very open ended and the interviews had no set structure, this it was hoped would enable the interviewee to speak openly on the whole area.

Findings
In our meeting with Robert Graydon he stressed that IRC did not use software similar to what we hoped to design. Instead IRC reviewed CV’s sent in to them, arranged meetings with the job seeker and then if the jobseeker is suitable they aim to place him or her with one of their clients. Therefore he was not in a position to comment on our proposed design. He did say however that we should review online recruitment sites in business at the moment. On the topic of employment areas and skills he was very helpful and we focused on the areas that we were having trouble getting information on during our meetings with academics. He set out the main differences between sales and marketing and offered his opinion on a complete list of skills for both. In the area of tourism he again shed some light on the area and outlined the specific booking packages that employers use.

Our meeting with Aidan Killian of IRC mainly focused on the area of accounting and banking & finance. Here Aidan covered a wide range of topics. He stated that in order to be recruited into either of these areas a minimum of a 2.1 degree was needed and he also stressed that some employers may recruit on Leaving Cert results and this might be incorporated into our system. He also stated that many employers are now very reluctant to recruit graduates who have not taken a gap year as those that have taken a year out are generally in a position to begin their careers in earnest. On the area of the current graduate placement market he felt that the only area that is candidate driven at the moment is fund accountancy.

Through our contacts from our time in UL we were also able to arrange a meeting with Dermot Foley who works in the HR department of the university. Dermot has extensive experience in the area of personnel recruitment with over thirteen years industry experience. Again this interview was conducted in a pretty unstructured format with the interviewee being allowed to speak openly on issues he felt were relevant. Having given Dermot an initial outline of the system he suggested that we
research the Chartered Institute of Personnel and Development (CIPD) online resources. This organisation is a professional body for those involved in the management and development of people offering many certified qualifications. It also produces a fortnightly trade magazine focusing on topical issues in the HR industry. Archives of this magazine along with other CIPD publications can be found on the organisations at www.cipd.co.uk. During his career Dermot had also become aware of the growing trend of online recruitment sites and felt that while companies would be very reluctant to let us see the functionality of the site certain software houses that have developed computer based recruitment systems in the past may be willing to speak to us. The most prominent Irish companies in this area are Core Technologies Ltd. who have developed a fully integrated human resource management system (HRMS) incorporating a personnel selection and management element. On the area of the development of a comprehensive list of skills he advised us to consult a recent FAS study that researched this area in the hope of coming up with a complete list of skills employers look for. He cautioned however on the tendency for over reliance on this as much of the study was not aimed at the graduate market.

Conclusions
These interviews proved very productive in that the people interviewed were very knowledgeable on a wide range of employment areas and on the pulse of the industry. While they were aware of the graduate market, they were much more focused on the experienced market. Their primary aim is also to please the employer and not the jobseeker, this should not be overlooked in the design of this system as if this product is to be commercially viable it is imperative we cater for the employers needs as well as the needs of the jobseeker. In summation these meetings were very informative in that we got an insight into what recruitment agencies focus on and what are the critical success factors for our system.

2.4.2 Meetings with academics
Planning
As this system is primarily aimed at students and graduates of the University of Limerick we felt that in order to come up with a complete set of skills that would cover all graduates of the university we would need to speak to a representative of
each course in the university. Due to time constraints we decided to focus on the undergraduate programmes, again it must be stressed here that this system is not seen as the finished article but an initial building block for future systems.

The University of Limerick has five different colleges with each college having numerous different academic departments. From the middle of May we sent out e-mails to all the different departmental secretaries seeking a list of the course directors for all the undergraduate programmes within that department. This approach had mixed levels of success with about 50% of secretaries getting back to us within two weeks. Having compiled a preliminary list of course directors we put together an e-mail draft that would be sent to all course directors outlining who we were, what we were trying to do and how they could help us. A copy of this can be found in the repository. This had minimal success so we decided to go down to Limerick and approach these people in person. Before this could be done however we needed to come up with an interview format and a questionnaire. After our meetings with recruitment consultants and research into online recruitment sites we had come up with a set of employment areas that we felt encompassed every undergraduate course in UL, these are listed below.

- Accounting
- Arts, Media & Entertainment
- Banking & Finance
- Construction & Engineering
- Education
- HealthCare
- Human Resources
- Information Technology
- Insurance
- Languages
- Legal
- Marketing & Sales
- Production, Manufacturing & Materials
- Public Sector & Administration
- Science
Having come up with this set of employment areas we now needed to get a set of skills for each employment area. This would be done by asking academics to give us the skills for their course and place each skill under one of the seventeen headings listed above. Following initial meetings it became apparent that academics were having trouble coming up with a complete list of skills, to overcome this problem we decided to come up with a preliminary set of skills for each of the employment areas. We reviewed numerous different recruitment websites together with relevant publications on different courses (UL prospectus etc.) and extracted any skills we felt may be relevant. It was hoped these preliminary lists would trigger other skills and give a more accurate reflection of the course. It was decided that these skill lists would not be shown to the interviewee immediately, instead we decided to first give the interviewee the opportunity to come up with whatever skills they could without any prompts and then when we felt this avenue had been exhausted the preliminary skill lists would be shown in the hope that the interviewee would recall further skills. Having gotten a list of skills and their corresponding class from the academic we then would need to develop a relationship or correlation between these skills. In order to develop a process to make this possible we approached Sean Reidy, the Marketing Director at the University of Limerick. With his help we constructed a grid structure and developed a set of relationship parameters by which two skills could be related.

The relationship parameters developed are shown below.

- Totally unrelated
- Slightly related
- Moderately related
- Strongly related
- Completely related

The skills that academics had submitted would be entered into this grid structure and filled out with the aid of the academic to give us a correlation between all skills. The
completed meeting documentation from all meetings undertaken during the analysis phase would then be located in the central repository. As we were aware of the objectives of the interview beforehand they needed to have a structured approach, the development of an interview outline greatly facilitated this. This interview outline is again contained in the repository. Fundamental to the whole interviewing process is data collection; it is imperative that all interviews are documented within twenty-four hours of completion to ensure all data is recorded correctly.

Findings
The above approach worked well but, as was highlighted on a few occasions it was not fool proof. Our initial interviewing methodology was flawed in that it was unrealistic to expect one person to have an in-depth knowledge of undergraduate courses whose scope were quite broad. For courses such as Bachelor of Business Studies (BBS) which encompassed such wide-ranging topics as accounting and marketing it was decided that we would have to interview people knowledgeable in each of these areas. Therefore we decided to interview representatives from each major/minor option of such courses. This again stretched us even further especially when it became obvious that many potential interviewees were unavailable for a number of different reasons. While we were not able to meet the course director from every undergraduate course there were sufficiently knowledgeable staff to meet our requirements.

While we had initially intended to meet with a representative of each course it became clear as time progressed that this would not be feasible due to a number of unforeseen difficulties that arose. The level of absence during the summer months among lecturers was somewhat unforeseen. This was due to sabbaticals, annual leave, seminars and conferences. Having said this we still met academic representatives from each academic department in the University and feel that even though we did not meet a representative from every undergraduate course the data collected is more than sufficient for the application of this system. For example we did not see the point in meeting a representative from all the B.Sc. in Education courses as they have broadly the same skill set with the only difference being the subject they are allowed to teach. Similarly there is very little benefit in meeting someone from Mechanical and
Aeronautical Engineering when 95% of the subjects studied throughout the four years being common to both disciplines.

It should also be stated that some academics we met failed to grasp the concept of the grid structure or felt that this technique could not be applied to their field for one reason or another. On this point the application of our correlation technique seemed to be much more successful in the more technical areas, for example the areas of IT, Engineering and Accounting were quite straightforward when it came to developing a correlation while in the less technical areas such as Arts Media and Entertainment we were unable to come up with a completed grid structure. All the professionals we met in these areas were adamant that this could not be applied to those areas and were quite hostile towards the idea.

Conclusions
While the more technical courses such as engineering give the student specific ‘hard’ skills, all the courses in the college of humanities find it much more difficult to quantify their skill set and furnish the student with a rounded education and a ‘soft’ skill set that is difficult to integrate into a system such as this. It also became apparent during our research that some undergraduate courses were not equipping students for any set career. In some undergraduate courses upwards of 90% of graduates pursue a postgraduate qualification after graduating. For example the Sports Science degree program had 95% of its graduates go into further education last year, in courses such as these it is very difficult for the course leader to come up with a quantifiable set of skills employers are looking for when they have little or no interaction with said employers. Secondary to this in the discipline of law for example you are not actually qualified to do anything on graduating and a graduate must pass the relevant professional exams to practice as a solicitor or barrister. If this system is being primarily aimed at graduates then its application will be fairly limited. Despite this we have come up with what we feel is a fairly comprehensive set of skills for each employment area and out of the seventeen employment areas we have developed a grid structure for ten of the more technically orientated areas. While we could have attained grid structures for all seventeen areas we felt there was no point in trying to fit a square peg into a round hole.
2.4.3 User Meetings

Planning
To get an accurate view of any system it is necessary to interview proposed users. Obviously over the last few years a number of online recruitment websites have emerged and disappeared. These have had varied levels of success and adopted numerous different formats. To get a good understanding of the positive and negative aspects of such sites we decided to interview final year undergraduate and postgraduate students who had experience with such sites. It was hoped that this would help us eliminate any aspects of previous sites that users found annoying or unclear while incorporating the features that users felt worked well.

Findings
The findings from this research were quite varied. Due to time constraints we only managed to interview five prospective users. A recurring trend emerging from the people we interviewed was the fact that of all the recruitment sites they have come across not one was focused on the graduate market. All commercial recruitment agencies in business at present place little or no emphasis on the graduate market as in the current environment there is no shortage of graduates looking for work and employers do not need recruitment agencies to fill these graduate positions. Of all the sites mentioned during these interviews www.monster.ie seemed to be the one generally regarded as the most user friendly. Most people we interviewed resented the fact that they had to enter their details online and much preferred the option of submitting a CV instead. Another common viewpoint was that many sites had just one big editable section that took an age to fill out instead of having numerous sub sections that could be saved on completion and returned to later. Interviewees also stressed that these sites were very impersonal and you often felt that filling out all these forms was a complete waste of time. For a more in depth review of the findings from these meetings again please refer to the repository.

Conclusions
Having conducted interviews with prospective users the user friendliness of the site coupled with the high possibility of getting that elusive job seem to be the primary priorities of the potential jobseeker. All job placement sites out there at the moment
are completely client (employer) focused and therefore the jobseeker often feels they are just a pawn in the whole process. This is where this system will be different as the primary aim of this company is the provision of a service to the students of the University. Another major turnoff for end users was what they termed the seemingly random assignment of a prospective employee to jobs they may not be suitable for. This focus on the jobseeker together with the logical matching of jobs to skills will hopefully separate SUDPT Ltd. from any other commercial personnel placement organisations out there at the moment. It’s all about maintaining the fine balance between achieving speed and efficiency for the recruiter whilst maintaining a positive experience for the candidate.

2.4.4 Client Meetings

Planning
From the previous stages of the SDLC we had built up quite a good relationship with Paul O’Connor manager of SUDPT Ltd, so our requirements determination meetings were quite informal. From the initiation and planning stage we had already stated that the company needed a web-based application accessible by both students and graduates that would adequately match jobseekers with employers. At this stage we needed to develop a high level plan of the system while also determining if there were any existing regulations by which the development team have to abide by.

Findings
As Paul had very little technical experience in this area and Michael had an in depth knowledge of the existing IT infrastructure of the organisation these meetings were very much a two way process with Paul outlining what he wanted in the system while we said if these proposals were feasible. Having listened to Paul’s requirements for the system functionality we then offered some ideas on extra features that we felt may add to the systems usability. By the end of these meetings we had come up with a much more structured view of what the end product would look like. The site will aim to cater for four different job markets, since the company’s inception it has catered in the most part for students seeking part time work during term time and students looking for either full time or part time summer work. In the last couple of years the SUDPT has established a partnership with Sayit Travel who provide student summer
visa’s for the USA and Canada and has since tried to place as many of these students as possible in employment in these countries. The final and most important market the company is trying to develop is the graduate market where users are placed in full time employment relevant to their qualifications.

There would be three different sections to the online site:

- Students & Graduates
- Employers
- Manager & Administrator

### 2.5 Student & Graduate Section

![Student & Graduate Section Diagram]

**Figure 2.1 - Student & Graduate High Level Plan**
The student/graduate section would comprise of the following. A new user would initially have to register with the system and would receive an email notification containing their username (email address), password and a link to activate their account. The reason for activating the account is to ensure only legitimate users are fully registered on the system and might also deter users from registering spurious information. Having activated their account they would then be able to login and complete an online CV that would contain personal details, education, skills, extra curricular and work experience sections along with an account administration section. Again the exact make up of these were in the most part left to the development team but Paul did have some features he felt needed to be incorporated. For example in the education section there needed to be a section where degree award could be entered.

- First Class Hons
- Second Class Hons (Grade I)
- Second Class Hons (Grade II)
- Pass
- Other

The extra curricular section also needed a feature where people could enter any information they felt may be relevant to their application. Paul also felt it was very important that both students, graduates and employers could suggest skills to be included on the database and for him to be able to post notices on the site, similar to the announcements in Blackboard.
2.6 Employer Section

The employer would also have to register initially but in this case the SUDPT manager would activate the employer account after confirming the legitimacy of the employer after which they would receive an e-mail notification containing their username (contact email) and password. The employer section will allow registered users enter their company details, administer their account and search the database of jobseekers by four different criteria agreed on by Paul and the development team.

Figure 2.2 - Employer High Level Plan
The criteria are:

- Location
- Salary
- Degree Award
- Skills

The criteria that are relevant will vary from search to search depending on whether a part time or full time employee is needed. How these are implemented was left up to the development team. The employer is also able to view the various employment classes and skills associated with each class and view the default weight profile (skill correlations) provided by the SUDPT. It was further suggested by Dr. Sean McGarraghy to provide employers with the ability to create their own weight profiles and search the database using their created profile. Again Paul felt that there should be a facility to post notices on the employer welcome page. It is also hoped in the future that the company can charge an annual fee for access to the database of jobseekers.
2.7 Manager & Administrator Section

The final part of the system is the administration section that will be operated by Paul. In brief this requires the ability to view, add, edit and delete all of the database tables. This would include the viewing and editing of both jobseeker and employer details, editing the various drop down menus that appear on the site, posting of notices on the welcome pages, emailing all registered users and maintenance of the weight profiles. We hope this structure will facilitate the improved functionality of the system over time with the performance of previous placements being incorporated into the system.

Figure 2.3 - Manager & Administrator High Level Plan
Apart from the functionality of the system we also discussed the strategic development of the company and how this new system would be marketed. Paul was very keen to increase the presence of the company on campus and felt that if this system were to be a success, a marketing campaign promoting it would be of utmost importance to the overall success of the project. To achieve this Paul has also asked us to design a brochure for the company along with a set of business cards, envelopes and compliment slips.

2.8 Conclusion

Following these client meetings we have a much more concrete set of system specifications outlined above. While we were given some instructions on the system make up Paul has given us creative control for the most part and it is up to us now to come up with the best method of implementing these system deliverables. To achieve this it is imperative that we look into the different software and hardware options available to us, analyse them on their respective merits and come up with the best option to proceed to the design stage with.
3.1 Technology Analysis
To implement the proposed system as efficiently as possible it was imperative that we use the right hardware and software while also keeping in mind the financial constraints of the company. From a hardware point of view we needed to purchase a server to host the system. From a software point of view there were four main software components needed for the system to function. It should also be pointed out that the SUDPT were covered under the UL Microsoft Site License Agreement, allowing the company access to any Microsoft product at low cost.

- Operating System & Web Server
- Database Technology
- Web Development Language

We will discuss each of these areas individually focusing on the different options available to us in each case. Before we begin discussing the above components it should be noted that all of them are available as open source products and as such a brief discussion on the advantages of open source is warranted.

3.2 Open Source software and its advantages
Open source software is an idea whose time has finally come. For twenty years it has been building momentum in the technical cultures that built the Internet and the World Wide Web. Now it's breaking out into the commercial world. The basic idea behind open source is very simple: when programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs and this can happen at a speed that is vastly
superior to the conventional software development process. Usually, the first perceived advantage of open source models is the fact that open source software is made available gratis or at a low cost. But this characteristic is not exclusive to open source software Microsoft’s Internet Explorer being a notable case. The advantages of open source are many and far ranging, below are the main reasons that the expected number of companies and organizations deploying open source software internationally will increase from 12 percent today to 18 percent by 2005 and 24 percent by 2007.

- The availability of the source code and the right to modify it is very important. It enables the unlimited tuning and improvement of a software product. It also makes it possible to export the code to new hardware, to adapt it to changing conditions, and to reach a detailed understanding of how the system works.
- The right to redistribute modifications and improvements to the code, and to reuse other open source code, permits all the advantages due to the modifiability of the software to be shared by large communities.
- The right to use the software in any way. This, combined with redistribution rights, ensures *(if the software is useful enough)*, a large population of users, which helps in turn to build up a market for support and customisation of the software, which can only attract more and more developers to work in the project.
- There is no single entity on which the future of the software depends. This is a very common concern with proprietary software. For example, let us say that a company uses a software product, and relies on the software manufacturer for upgrades and continued development. If the software manufacturer closes doors, or decides to discontinue development of the product, no one has the right to take the program and continue development on it, effectively killing its usability in the market.
- No per-copy fees can be asked for modified versions, and anyone can use the current code base to start new projects. As individuals and companies decide where to make improvements in the system, the collective desires of the community determine the overall direction of progress, and yet without compelling anyone.
3.3 Operating System

There were ever only two options available to us when choosing an operating system: the Microsoft option or the UNIX/Linux option. Here we give a brief summary of each highlighting the respective positive and negative aspects of each.

3.3.1 The Microsoft Option

When investigating what Microsoft was offering in terms of operating systems at this point in time we initially found that Windows 2000 Server with IIS 5.0 was the most up to date version on the market. We saw this as a viable option at the time but having reviewed the postings on various online user groups we became aware of certain faults in the system especially in the areas of security, reliability and performance. With this in mind we decided to reassess our options and decided to investigate when the next Microsoft offering was coming online. Thankfully Microsoft’s new 2003 server family was due for US release on the 24th of April with a UK and Irish shipping date of the 29th of April. As we did not intend beginning the implementation stage until early July it made sense to investigate the new OS further. Below is a review of the new software and it’s main advantages over any of its predecessors.

3.3.1.1 Windows Server 2003, Web Edition

The new family of Microsoft operating systems consisted of six different editions all catering for different sectors of the market. As Windows 2003, Web Edition was designed for dedicated Web serving and hosting it seemed ideal for our needs. Its limited functionality would even be of benefit to us in terms of security. Windows 2003, Web Edition, delivers a single-purpose solution for Internet service providers and application developers. Windows 2003, Web Edition, takes advantage of improvements in Internet Information Services (IIS) 6.0 to make it easier to build and host Web applications, Web pages, and XML Web services.

may be seen as a bad thing if you are looking to perform anything other than
dedicated web serving and hosting but in our case it greatly decreases the security risk
to the system as there is only one access point through which hackers can enter.
Integrated with the newly re-designed IIS 6.0, ASP.NET, and the .NET Framework,
Windows Server 2003, Web Edition, enables any organization to deploy Web pages,
Web sites, Web applications, and Web services rapidly.

The newly developed Internet Information Services (IIS) 6.0 also merits discussion in
greater detail. This is a powerful Web server, available in all versions of Microsoft
Windows Server 2003, which provides a highly reliable, manageable, scalable, and
secure Web application infrastructure. IIS 6.0 enables organizations of all sizes to
quickly and easily deploy Web sites and provides a high-performance platform for
applications built using Microsoft ASP.NET and the Microsoft .NET Framework.
Some of the new features include significantly improved security for Web servers. IIS
6.0 is locked down by default, limiting the attack surface area through aggressive
security defaults. In addition, authentication and authorization have been improved.
IIS 6.0 protects the server, and other applications, by automatically disabling Web
sites and applications that fail too often within a short amount of time.

3.3.2 The Open Source (Linux / UNIX) Option
Linux is developed under the GNU general public license and its source code is freely
available to everyone. Due to the very nature of Linux's functionality and availability,
it has become quite popular worldwide and it is estimated that its vast number of
software programmers now encompassing some eighteen million, have taken Linux's
source code and adapted it to meet their individual needs.

The limitations of commercial operating systems have exasperated many software
users for years. The slow release pattern and lack of source code availability coupled
with the planned obsolescence and monopolistic attitudes of the system providers
have made people look for an alternative to the ‘out of the box’ product. If we look at
an open source operating system such as Linux its advantages are immediately
obvious. For a start the source code is free while also outperforming its commercial
counterpart in such areas as reliability, network friendliness, backwards compatibility
and multi-user capability. Despite all this it is still fair to say that commercial operating systems most notably Microsoft’s Windows packages have a stranglehold on the market. The technical support and system information documentation are often much better when it comes to commercial systems. As commercial OS are tailored towards the home user market they are generally very user friendly with quite extensive interface technology as opposed to the open source options that seem to be quite lacking in that regard at the moment. The presence of various commercial applications such as the Office Suite also offers commercial OS a competitive advantage in the eye of the consumer. It is safe to say that until recently no viable substitutes for the Office suite exist in Linux although this is no longer the case.

An Apache Tomcat server could have been installed on either a Linux/UNIX or Microsoft OS and is suitable for running Java Server pages (JSP). It is also worth noting that a Tomcat server with an add on called “Chilli Soft” allows the running of ASP scripts, however this add on software is relatively expensive was not a viable option for the company.

### 3.4 Database Technology

As the database design is fundamental to the functionality of the entire system it is critical that we choose the most suitable database technology for our needs. Initially we decided to review six different database packages available at the moment and analyse each individually. Listed below are the packages that we initially researched.

- Microsoft Access 2000
- MySQL
- Microsoft SQL Server
- Oracle
- Postgres
- IBM DB2

Initially having reviewed the start up cost of each package we had to discount Microsoft SQL Server, DB2 and Oracle. Although these are world-renowned packages their capabilities far outweigh what we foresee as the initial demands on the
system. Secondary to that the company could simply not afford the initial outlay needed for the installation of such systems. Following this initial research we still had three options open to us so it was necessary to analyse each package in greater detail. As the licensing costs Microsoft Access 2000 are covered under the site license and MySQL and Postgres are both open source packages financial considerations were not really a factor in this decision making process. Below is an outline of the remaining options available to us for database construction.

- Relational
- Hierarchical
- Object Oriented

### 3.4.1 MySQL

The MySQL database server is the world's most popular open source database. Its architecture makes it extremely fast and easy to customize. Extensive reuse of code within the software and a minimalistic approach to producing functionally-rich features has resulted in a database management system that exhibits speed, compactness, stability and ease of deployment. The unique separation of the core server from the storage engine makes it possible to run with strict transaction control or with ultra-fast transactionless disk access. The MySQL database server is available without a license fee under the GNU General Public License (GPL). Commercial non-GP licenses are available for users who prefer not to be restricted by the terms of the GPL. To view the main features of MySQL please refer to [http://www.mysql.com/documentation/index.html](http://www.mysql.com/documentation/index.html)

### 3.4.2 Postgres

The PostgreSQL software itself had its beginnings in 1986 inside the University of California at Berkeley as a research prototype, and in the 16 years since has moved to its now globally distributed development model. It is now one of the worlds most advanced open source database software packages out there today. To view the main features of PostgreSQL please refer to [http://advocacy.postgresql.org/advantages/](http://advocacy.postgresql.org/advantages/)
3.4.3 Microsoft Access

Since its introduction in 1992, Microsoft Access has become one of the most versatile applications in the Office suite. This versatility is evidenced by the rich set of tools that even the most experienced database user can take advantage of, while offering the same level of simplicity as the other Office applications for first-time database users. Although this product may be limited in its capabilities compared to some of the more advanced database technology on the market today it has stood the test of time and continues to be a leader in the field. It should be stated here that Microsoft Access operates off a Jet engine but can be configured to operate with a MySQL engine with an Access front end. It is beyond the requirements of this thesis to go into the capabilities of this software and we would refer you to http://www.microsoft.com/office/access/evaluation/AccessPG.doc if you want to learn more about the functionality of Microsoft Access 2000.

3.5 Web Development Languages

The final development tool we had to decide on was what web development languages best suited our needs. Initially there were three options available to us

- JSP
- ASP
- PHP

3.5.1 ASP

Active Server Page (ASP) is part of Microsoft’s IIS server, it enables the embedding of either VBScript or JavaScript (please note this is different to client side JavaScript) within HTML files. There are many advantages of ASP, firstly if it runs off a Microsoft platform so if we choose Windows it will be easy to set up, it’s cheap and relatively easy to use. It has relatively fast execution and is equipped with ODBC links to any data source. Over the last year however ASP.NET, an updated version with new features has grown in stature. Its main advantages over its predecessor are garbage collection; this is similar to Java where when memory fills up it dumps all unused objects. ASP.NET compiles code the first time it’s run to the caching memory store, compiled code runs faster than interpreted code (ASP). It also offers extra
flexibility and freedom as well as having the ability to incorporate C# and C++ into pages.

### 3.5.2 JSP

Java Server Pages (JSP) like ASP is a technology that lets you mix regular, static HTML with dynamically generated HTML. The advantages of JSP are twofold. First, the dynamic part is written in Java, not Visual Basic or other MS-specific language, so it is more powerful and easier to use. Second, it is portable to other operating systems and non-Microsoft Web servers. JSP’s are also compiled to bytecode, then executed and not interpreted and so offering greater efficiency than traditional ASP. Because JSP however is based on Java, a strongly typed language, you have to declare the types of variables used and manually convert between types when necessary. This makes JSP the hardest of the scripting languages we tested for nonprogrammers to learn.

### 3.5.3 PHP

PHP is an established server-side scripting language for creating dynamic Web pages. As a language that has been designed expressly for the Web, it brings many features that commercial entities are looking for including exceptionally short learning curve, quick development time and very high performance. This is essential for companies who are faced with scarce skilled programming resources and ever-tighter time to market deadlines. In addition, PHP supports all major platforms (UNIX, Windows and even mainframes), and features native support for most popular databases. All these factors make it a very good choice for Web development. With PHP it is possible for non-programmers to be able to produce usable code within days. Programmers familiar with languages such as C, C++ or Java frequently find that they can begin programming in PHP within a few hours.

### 3.6 The Decision

Any one of these languages would have been sufficient to meet our needs and initially we did not favour ASP as the scripting language primarily due to the poor performance and security of IIS 5.0. Initially we had spent three weeks in May trying to come to terms with coding JSP on a Tomcat server, our original choice but
although we made some progress we felt that this dissertation was not overly concerned with what development language we used and so we decided to go with what we were used to and spend the time on other more pressing areas of the project.

The final decision really came down to what we felt most comfortable with. As we had previous experience in the area of ASP, coupled with the availability of IIS 6.0 this seemed an obvious choice. We also choose an Access 2000 database primarily for its impressive front-end which was a major factor for us as we were relatively inexperienced with database development at that time.

Due to the fact that ASP was the scripting language, we used a version of Microsoft Server 2003 Web Edition as it had the latest version of IIS (6.0) and was a far more secure OS than previous versions. For a more detailed review on this product, we would refer you to

http://www.microsoft.com/windowsserver2003/techinfo/overview/iis.mspx

Another factor in choosing an operating system was the fact that all our experience of operating systems was based on Microsoft products and to become proficient with an open source operating system would have taken considerable amount of time and many of the advantages of open source discussed above would not have been realised.

Although many large commercial systems have had problems with the multi user capabilities of MS Access we foresee that it will be more than sufficient initially to cater for the systems needs. However we do propose a review of the database technology within the first year with a possible view to a change over to MySQL depending on user numbers.
Chapter 4 - Analysis

Alternative Generation & Selection

4.1 Introduction

The main work involved in this stage of the Analysis phase involved the different techniques that could be used to match the employer’s requirements with the jobseekers in the database. Following on from a MMS dissertation “Personnel Assignment Using Case-Based Reasoning” [1] in 2000 it was reasonably apparent that the first theory we should look at would be Case-Based Reasoning. The CBR approach works on the theory that if someone with one set of skills, education and experience performs well in a job then another person with similar criteria will also perform well in that job. Another way to approach this problem is by developing a set of individual matching techniques that can adequately match the characteristics of the jobseeker with the needs of the employer. From the initiation and planning stage we had come up with four different (matching) criteria by which the employer could search.

- Degree Award
- Location
- Salary
- Skills

Once we settled on these we then had to develop techniques whereby we could match the needs of the employer with the details of the jobseeker and thereby returning the most suitable candidates for the job.
4.2 Case Based Reasoning

Case-Based Reasoning is a relatively new approach to the whole area of Artificial Intelligence that can be traced back to the work of Roger Schank and his students in the late 1970’s. It is based on the principle that situations often reoccur and that using the knowledge gained from solving similar problems in the past provides a good basis for solving a similar one today. With CBR the task of implementation is reduced to deciding which features are used to describe a case and should be stored. Another trait of CBR is that routine everyday cases are merged into generalised or composite cases while unusual cases that deviate from the norm are remembered as specific composite cases.

4.2.1 The CBR Operational Cycle

There are four main components of the CBR system with each one vitally important to the whole process. Each stage is individually described below.

![Figure 4.1 CBR Operational Cycle](image-url)
A) The Case Base
The case-base is where all previous experiences, cases and problems are stored for reference and retrieval. The most important basic component of any Case Based system are the cases. Without suitable cases or past experiences the system is useless, the three major components of most cases are the problem description, the solution description and the outcome. The organisation of cases is vital, without the assigning of useful indices to appropriate cases making them easily retrievable the system would be completely inefficient.

B) The Retriever Process
The next part of the process involves retrieving the most applicable cases from the Case-Base. This process relies on the indexing scheme to guide the search and insure the most applicable cases are found as efficiently as possible.

C) The Adapter
Adaptation is the process of modifying the retrieved case to fit the constraints and specifications of the input case. The two types of adaptation most widely used are structural and derivational adaptation.

D) The Learner
Learning occurs in a CBR system through integration of new cases into the system. Failures are also a very important learning tool in CBR. Failure driven learning involves the representation, indexing and storage of failures along with their explanations and repairs.

4.2.2 CBR And This Project
Although CBR is undoubtedly a revolutionary approach and time may prove that it can be applied to the area of personnel placement we fail to see how it can be applied in its truest sense to this project. If we look at the ‘help desk’ scenario where this approach has traditionally been applied, the development of the case base has been fundamental to the systems success. If we relate this to our proposed system there will initially be a non-existent case base that will only develop when users are placed in
employment. Therefore the placement of users initially will be unable to rely on the CBR approach.

However, we do envisage incorporating certain aspects of a CBR application, in that once users have been placed in employment for a set period of time we will ask their employer to assess their performance with the results of this employer assessment being incorporated into the matching techniques currently used in the placement process. This aims to incorporate a continuous self-improvement mechanism into the site and so improving the functionality of the system over time much like a traditional CBR application.

4.3 Comparative Evaluation Strategies

Having settled on the matching criteria we then had to decide what matching or decision rules we were going to use. The major ones considered are described in detail below. These can be split up into compensatory and non-compensatory evaluation techniques as shown in figure 2.4. The non-compensatory strategies can then be split up into candidate and attribute evaluation strategies.

![Figure 4.2 - Comparative Evaluation Strategies](image)

Figure 4.2 - Comparative Evaluation Strategies
4.3.1 Candidate Evaluation Strategies

Conjunctive
This involves selecting all candidates that surpass a certain level, for example select every candidate that has a 2.2 degree AND lives in Limerick. This involves picking all (or any) candidates that surpass a minimum level on each evaluative criterion. This is a valid but simplistic approach. If no candidate meets the required level then the system will fail to return anyone.

Disjunctive
The next matching technique researched was the disjunctive approach, this involves selecting all or any candidates that surpass a satisfactory level, pick all (or any) brands that surpass a satisfactory level on any relevant criterion. For example select anyone who has a 2.2 degree OR is living in Limerick.

4.3.2 Attribute Evaluation Strategies

Elimination-by-aspects
The first attribute based evaluation strategy we will look at is the elimination by aspects strategy. This involves selecting which criteria or attribute is most important and then eliminating all candidates that do not meet the satisfactory level. You would then continue this process through all the criteria or until only one candidate remained.

If the employer thinks degree level is most important and they are looking for a 2.2 then anyone with a degree award less than this will be eliminated. The remaining candidates will then proceed to the criterion valued second most important by the employer and again if they do not meet the desired level they will be eliminated. This process continues until only one candidate remains or all the searchable criteria have been gone through.

4.3.3 Lexicographic (Similarity Matching)
This involves ranking the criteria in terms of importance. The user then starts with the most important criterion and select the candidate that scores highest on that
dimension. If two or more candidates tie, continue through the attributes until one of the remaining candidates outperforms the others.

If the employer again thinks degree grade is most important then the person with the highest degree grade will be chosen, if there is a tie then the people with the joint highest degree grade will be retained, if the employer thinks skills are the next most important criteria then only the people with the exact skills will be retained, if no one has the exact skill then the jobseeker with the most closely related skill will be selected. This is again carried on until one candidate remains or all the criteria have been gone through.

4.3.4 Compensatory
This approach differs slightly from anything discussed earlier in that the employer evaluates the candidates on all relevant attributes and then selects the candidate with the highest summed score of all the attributes, \( i.e. \) select the candidate that provides the highest overall score when the performance ratings for all the relevant attributes are added together.

4.3.5 Affect Referral Decision Rule
This is an approach that is neither compensatory nor non compensatory and although a little simplistic it is very common in everyday decision-making. It basically works on the basis that if something worked well in the past the chances are it will work well in the future. For example if an employer has long standing links with UCD and the graduates in the past have been top class they will probably continue to hire graduates from UCD in the future.

Having reviewed the various comparative evaluation strategies we decided to go with the compensatory approach as we felt it best suited our needs, we felt that the non-compensatory approaches although valid may not have always given the truest reflection of the jobseekers in the database. We feel that the compensatory approach coupled with the incorporation of a weighting system on the employer page allowing employers weight the different criteria according to importance is the best approach for this application.
4.4 The Skill Feature
Having ruled out CBR we then had to come up with an alternative approach. We decided to approach each searching criteria individually and develop some sort of matching technique for each. As the skill feature was likely to be the most complicated we decided to start with that.

4.4.1 Topological Tree Structure Approach
The first approach we looked at was a fundamental graph theory approach. Let us first state some basic graph theory principles so that we have a good understanding of some underlying graph theory principles.

Trees, as special graphs, consist of nodes and edges and are best-defined recursively. For every tree one node is singled out and is called the root. One node constitutes a tree and, naturally, is that tree's root. A collection of more than one node is a tree if by removing the root the remaining nodes fall into disjoint trees. Nodes connected to a tree root are called siblings. A shorter way is to define the tree as a connected graph with no circuits. The absence of circuits means that there is always exactly one way to get from one vertex of the tree to any other. A topological tree is a tree where all nodes have degree other than one. The degree of a node is the number of edges at that node, for example no node allows a single edge to 'pass through'. It was proposed to use a topological tree structure together with subsumption matching to develop a matching technique for the skills feature. This would involve setting up skills according to different levels of abstraction. If an employer is looking for someone proficient in OOP (Object Oriented Programming) then anyone proficient in a skill that is a direct descendant of OOP in the topological tree structure is seen to be an exact match. For example anyone with Java or C++ experience would be an exact match for employers looking for OOP experience. This technique can also determine skill similarity due to their proximity in the tree structure. In other words the closer two skills are in the tree the closer they are seen to be. Distance is measured in the number of arcs or edges between the respective skills. An interclass relationship value also needed to be developed between the different classes (i.e. class OOP) to allow skills that were not in the same tree structure to be assigned some sort of a similarity score. For example if you wanted to relate C++ to bookkeeping you would count the
number of arcs between the two skills and then add the relevant interclass relationship value. By definition there is no weighting applied to the arcs of a tree. The figures below illustrate the basic concepts of the topological tree structure and how the similarity matching would be performed.

Figure 4.3 Similarity Tree
This tree shows the domain knowledge available for skill.

Figure 4.4 Subsumption Matching
Descendants of a node are taken as exact matches for that node.

Figure 4.5 Proximity Matching
Chapter 4 – Alternative Generation & Selection

The skills of C++ and Java are taken to be conceptually quite similar.

![Figure 4.6 Inter-class similarity](image)

The classes of IMP and OOP are deemed not to be very similar.

4.4.2 Limitations With This Approach

Although this approach is definitely applicable in certain fields where a hierarchical structure of skills and proficiencies can be developed its application in the personnel placement industry in general would be fairly limited. We simply do not feel that it is feasible to apply a topological tree structure when the data present does not conform to such a structure. In practice we found it very difficult to develop any sort a hierarchical tree structure in any area other than IT. We also had serious reservations about the construction of the tree structure, again concentrating on the area of IT one could argue that C is more closely related to C++ than Java is to C++ yet the way the tree structure is set up the distance between Java and C++ is two while the distance between C and C++ is four plus the interclass relationship. This highlights a serious flaw with this approach, to overcome this we decided to investigate using a weighted interconnected graph to represent our skills.

4.4.3 Graph Theory

4.4.3.1 Weighted Interconnected Graph Approach

As we didn’t think the tree structure was feasible we decided to look into the possibility of using a weighted connected graph to represent the skills feature. Each skill would be represented by a node on the graph with the weight on the interconnected edges representing the relationships between the skills. To determine the correlation between two skills we felt that the application of a shortest path algorithm may be necessary. This approach originated from the algorithms and Data
Structures module given by Dr. Sean McGarragh. During this course we studied the functionality of Dijkstra’s algorithm while also implementing it in Java. It is beyond the scope of this thesis to delve into this again here but we felt that this algorithm could be adapted to find the relationship between any two skills contained in the graph structure. We had intended on joining two skills together if we felt they were related with the weight on that arc representing the closeness of the relationship. No arc would exist between the two skills if we felt that they were totally unrelated.

4.4.3.2 Complete Graph

Following our research into using a weighted connected graph together with a shortest path algorithm for solving the skills feature we realised after collecting all of the correlation data we had in fact built up a complete graph structure for all the skills and it would not be necessary to apply a shortest path algorithm to calculate the relationship between two skills.

![Sample Complete Graph](image)

**Figure 4.7** Sample Complete Graph \((K_5)\)

4.4.4 Investigation of Feasibility of Clustering for Skills Matching

We also felt that grouping or clustering skills that were closely related may be an option in solving the skills dilemma. Performance of a database can be greatly impacted by the manner in which data is loaded. Data density is defined as the proportion of objects within a given storage block that are accessed by a client during some scope of activation. Clustering is a technique to achieve high data density. In order to achieve these goals, the working set of the application should be optimal. The
way to achieve an optimal working set is via data clustering. With good data clustering more data can be accessed in fewer pages; thus a high data density rate is obtained. It was following a meeting with Dr. Timothy Hall of the Department of Computer and Electronic Engineering at the University of Limerick that we were first encouraged to investigate this approach. During the interview Dr. Hall felt that we should consider grouping the IT sector into the following areas.

- Archival (Fortran, Algol, Cobol)
- Fundamental (Pascal, C)
- Structural (Delphi, Java, C++)
- Web Languages (ASP, PHP, JSP, Flash)
- Database technology (Oracle, MySQL)
- Engineering Packages (RSL etc)

All the data within the different groups would be related to varying extents while there would be no relation between skills in different groups, this structure could theoretically greatly increase the efficiency by which the database could be searched. Clustering techniques have long been used in information retrieval to improve the performance of search engines, both in terms of timing and quality of results [e.g. Jardine and Van Rijsbergen 1971, Van Rijsbergen and Croft 1979 and Griffiths, Luckhurst and Willett 1986]. This work follows from the observation, known as the cluster hypothesis, that relevant skills are more like one another than they are to non-relevant skills [Van Rijsbergen & Sparck Jones 1973]. We investigated three main clustering techniques that may be used to improve the performance of skill matching:

- Balanced Clustering
- Single Link Clustering
- Group Average Clustering

All these clustering algorithms are hierarchic agglomerative algorithms, meaning a hierarchical structure of clusters and sub-clusters is created by starting with small clusters and adding skills and merging clusters until a single cluster remains. The clustering techniques were used to produce a hierarchical clustering of the skills that, hopefully, has similar skills grouped together on the lower levels of the hierarchy.
First we give a brief overview of what an agglomerative algorithm exactly is and then we review different types of agglomerative algorithms.

### 4.4.5 Agglomerative Clustering

In Agglomerative Clustering, each object is initially placed into its own group. Therefore, if we have N objects to cluster, we start with N groups. Each of these groups contains only a single object, and is known as a singleton. Before we start the clustering, we need to decide on a threshold distance. Once this is done, the procedure is as follows: Compare all pairs of groups and mark the pair that is closest. The distance between this closest pair of groups is compared to the threshold value. If the distance between this closest pair is less than the threshold distance, these groups become linked and are merged into a single group. Return to Step 1 to continue the clustering. If the distance between the closest pair is greater than the threshold, the clustering stops. If the threshold value is too small, there will still be many groups present at the end, and many of them will be singletons. Conversely, if the threshold is too large, objects that are not very similar may end up in the same cluster. To run an agglomerative clustering, you need to decide upon a method of measuring the distance between two objects. In addition, you need a measure to determine which groups should be linked.

### 4.4.6 Balanced Clustering

In the balanced clustering approach each skill is grouped with another one or two skills based on the similarity between the nodes (as defined by the same IR engine and indexing approaches used in the baseline searching method). These pairs or triples are then grouped together with the most similar other group based on the average vector for the groupings (this is essentially a balanced variation of group average clustering discussed later). These groupings are further grouped into pairs or triples until the second top level where a pair is forced.

### 4.4.7 Single Link Clustering

Single link clustering is based on creating a hierarchical tree by continually inserting an additional node that satisfies the following criteria:

- The new node is currently outside the hierarchy
• Of all similarities between nodes inside and outside the hierarchy, the new node is selected that has the strongest similarity. It is then added to the hierarchy at a level based on how strong the similarity is. This approach is fairly fast and results in hierarchies where the closest nearest neighbours are at lower levels of the hierarchy. However, it leads to non-balanced clusters and does not yield a binary hierarchy – many node-node comparisons can have the same strength of similarity thus many skills can be linked at the same level in the hierarchy.

4.4.8 Group Average Clustering

Group average link clustering is based on creating a hierarchical tree by initially creating a singleton cluster for each skill and marking these as “active”. The clustering then repeats the following until only one cluster remains active: merge the two clusters with most similar cluster representatives. Where the cluster representative is the mean vector of all skill vectors in the cluster (with singleton clusters being self representing); make the new pairing active and the two clusters which formed the pair non-active.

4.5 Location Feature

With location being one of the four criteria an employer can search by it is imperative that we come up with an accurate way of calculating the similarity between the employers location and the candidates preferred location. At this point of the analysis stage we considered a number of different ways to calculate the distance between two locations.

4.5.1 Location Grid

One option involves coming up with a set number of towns that give a good geographical spread around the country (no town should be more than thirty miles away from any other town). This would then involve coming up with the distances from each town to every other town and hard coding them into the system. While this method seems fine in theory it may however create problems down the line from an administration point of view. If some time in the future the administrator felt the need to add in a new town or city they would then have the time consuming task of trying
to find the distance from this new town or city to every other location already contained in the database.

### 4.5.2 Surface Distance

A more usable and maintenance friendly option however would be to store the Latitude & Longitude coordinates of these towns and cities in the system and then use a mathematical formula to find the surface distance between all these towns. The formula used to calculate the radian distance between two points on the earth’s surface is:

\[
\cos D = \sin (q_1) \sin (q_2) + \cos (q_1) \cos (q_2) \cos (D_1) \quad (4.1)
\]

where \(q_1\) and \(q_2\) must be expressed as + (north) and - (south). Once the distance of the arc in radians is obtained, we can convert to real world distances by multiplying by 111km (the length of a degree on a great circle). This route on a map is referred to as a loxodrome or rhumb line. On the Mercator projection such a line was approximated as a series of straight lines of constant compass bearing. However the use of this formula is of no additional benefit over a geographical area as small as Ireland.

### 4.5.3 Linear Distance

To shed some light on this we approached Dr. Gerald Mills a lecturer in the Geography Department at UCD. Having made initial contact by email he agreed to meet us. Having explained our problem to him he advised us to use the grid coordinates for Ireland as the formula 4.1 is only used for distances greater than 500 KM. If we take the country of Ireland as being flat and discard the earth’s natural curvature we can use the grid references offered in most maps of Ireland. Then simply use the basic Pythagoras formula to calculate the distance between any two points.

\[
\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad (4.2)
\]

where \(x\) & \(y\) represent the latitudinal and longitudinal coordinates of the two locations. We then set about coming up with a satisfactory list of towns that ensured a
good geographic spread. We obtained a list of towns with population greater than 15,000 people from the Central Statistics Office. Having reviewed these towns we felt that this would be more than adequate for the calculation of location similarity for Ireland. In the future we feel that this feature may need to be extended to incorporate Europe and North America. With this in mind some of the techniques mentioned above may need to be incorporated.

The location function will be calculated using a linear scale. We propose dividing a three hundred mile radius into twenty intervals of fifteen miles. With anyone whose preferred place of work is within fifteen miles of the employer being assigned a 100% match, anyone whose preferred place of work is between fifteen and thirty miles of the employer being assigned a 95% match and so on. This will result in anyone greater than three hundred miles from the employer’s location being assigned a 0% match for this criterion.

### 4.6 The Experience Feature

When trying to accurately represent the acquisition of knowledge on a certain subject or the gaining of proficiency in a certain skill one has to understand how the learning process actually works. From a very early stage in the research into this area it became obvious to us that a linear approach was not an option. Let us first look at a simple mathematical model used to represent the learning process by noting that it involves two conflicting processes: needing to have knowledge in order to acquire more, and slowing down in the acquisition as there is less and less left to acquire. This can be approximated to the first order as a systemic process in which the rate of growth is related to: the amount already accumulated; and also to the amount remaining to accumulate. The differential equation of such processes is dominated by a term of the form:

$$\frac{dx}{dt} = \alpha x \frac{(\beta - x)}{\beta}$$

(4.3)

where $\alpha$ is a rate constant and $\beta$ is the peak attainable. Integrating this gives:

$$x = \frac{\beta e^{\alpha t}}{\chi + e^{\alpha t}}$$

(4.4)
where $\chi$ is a constant of integration, which is the standard symmetric S-shaped logistic curve. The logistic curve has been found to be a useful phenomenological model of the introduction of any new knowledge, technology or product that follows a "learning curve" in which growth takes off slowly, begins to climb rapidly and then slows down as all the information has been assimilated. Such curves arise in many different disciplines such as education, ecology, economics, marketing and technological forecasting (Van Dujin 1983, Stoneman 1983). It has also been noted in many disciplines that the qualitative phenomena during the growth of the logistic curve vary from stage to stage in a similar sequence to the BRETAM analysed below (Crane 1972, De Mey 1982).

From equation 4.4 if we take the amount of knowledge necessary for a total familiarity to be 1, then the 0.1, 0.25, 0.5, 0.75 and 0.9 points are equally spaced in time along the logistic curve. These points can be roughly correlated with the significant phases in knowledge acquisition where the BRETAM sequence is superimposed on the logistic learning curve. When less than 0.1 of the knowledge is available little can be achieved and we are in a breakthrough period where you are still unaware of the skill. However, at around the 0.1 level some form of recognizable breakthrough becomes possible and we move into a phase of replication in which the breakthrough activity is noted and mimicked widely with little understanding. This leads to increasing experience and knowledge based upon it and when the 0.25 level is reached sufficient information is available for a phase of empiricism in which design rules are formulated based on experience. At the 0.5 level sufficient information has been accumulated for deeper patterns to be discerned, and a phase of theory commences in which casual rules are derived that allow further experience to be predicted and design rules to be derived. At the 0.75 level the theories have become accepted as the normative basis for further progress and an automation phase commences in which they are used for design and to search out the residual knowledge. Above the 0.9 level a phase of maturity is entered when the knowledge is expected to be available and used routinely. Following on from research done by Murpy & Welsh where they categorised the Bretam curve intervals as follows:

\[ \begin{array}{|c|c|}
\hline
0.1 & Graduate \\
\hline
\end{array} \]
Chapter 4 – Alternative Generation & Selection

<table>
<thead>
<tr>
<th>0.25</th>
<th>One Years Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>Two years Experience</td>
</tr>
<tr>
<td>0.75</td>
<td>Three Years Experience</td>
</tr>
<tr>
<td>0.9</td>
<td>Four Years Experience</td>
</tr>
<tr>
<td>1</td>
<td>Five Years Experience</td>
</tr>
</tbody>
</table>

**Figure 4.8** Qualitative changes along a technological learning curve

**Breakthrough:** Problem solving attempts/failures, leading to creative advance/breakthrough.

**Replicator:** Breakthrough is organised and mimicked to increasing experience.

**Empiric:** Lessons are drawn from experience and formulated as empirical design

**Theory:** Hypothesis are formed about the casual systems underlying experience and developed

**Automation:** Theories accepted to predict experience and generate design rules

**Maturity:** Theories have been developed assimilated and are used routinely without question

Whereas Murphy & Welsh used a single experience feature we feel that the matching process will be further enhanced if the experience level is specific to each skill. We feel that a common skill feature is too arbitrary in that the employer may want someone with five years experience in C++ while the jobseeker may have had five years experience working in a newsagent. To eliminate this possible problem we propose to allow the jobseeker select their level of proficiency in each skill they select with the employer being afforded the same option when they select skills they want to
search by. The drop down menus will also be worded differently even though the same BRETAM curve approach will be used. Listed below are the proposed options that will appear in the drop down menus detailing levels of proficiency. Extensive online help files will also be included to allow the user gain a deeper understanding of what each term actually means.

4.7 The Salary & Degree Features

Having reviewed the findings of Murphy & Welsh we felt that the model they used for the salary feature would be more than adequate again in this case. The similarity was calculated under two criteria.

If the required salary of the jobseeker was less than the amount the employer was willing to pay he or she automatically got a similarity value of one 1.

If on the other hand the salary desired by the jobseeker was greater than the salary offered by the employer a linear scale was adopted with the salary range being broken into intervals of £2000 and then calculating the interval difference between the two salaries.

The salary equation used was:

\[ \text{Score} = 1 - \frac{(q - c)}{(Max - Min)} \]  \hspace{1cm} (4.5)

Where

C: the salary to be offered by the employer

Q: The salary requested by the jobseeker

Max: The maximum value of the salary feature

Min: The minimum value of the salary feature

The £2000 range used previously is no longer relevant so we set about researching different industries in order to come with a scale of salaries that we felt would cover every scenario. Having researched numerous different online recruitment sites we came up with a scale that we felt was more than sufficient. During our research into the salary feature it became apparent to us that the same linear scale could also be
applied to the degree feature. Any jobseeker with a degree grade greater than the degree grade requested by the employer receiving a value of one while the jobseekers who fall below the requested degree grade being matched using the same linear model used above for the salary feature.

4.8 MCDM In This Project

In order to add another level of functionality to this system we decided to investigate the idea of incorporating a weighting structure into the employer search page. As the system offers four different criteria by which an employer can search the database it would be very unrealistic to assume that each employer would weight these criteria equally. With this in mind we felt that for an accurate matching process it would be necessary to allow the employer weight the different criteria in order of importance. Fortunately we had some experience in this area following Dr. Brugha’s multi criteria decision-making course we took in the first semester. Basically there were two options open to us when setting up this weighting system. The first one being the Direct Interactive Structured Criteria Utility Scoring (DISCUSS) technique, this is usually termed as weighting the criteria on its ‘own merits’. Here the user is asked to rate each criterion out of a set score usually one hundred, if the user feels that this criteria is vitally important then they assign that criterion a score of one hundred, the user can if he or she so wishes assign all the criteria a weight of one hundred. The second option is the Direct Interactive Structured Criteria Relative Scoring (DISCRIM) technique; this approach is slightly different in that all the criteria weights must add up to a set score usually one (one hundred). This necessitates the user to weight the criteria relative to each other. Whereas with the DISCUSS technique it is possible to give all the criteria maximum weighting the DISCRIM technique necessitates the user to come up with some sort of compromise. During numerous studies undertaken by Brugha et al. it has been shown that the DISCRIM approach is most effective with three or less criteria. To come up with the most effective and user friendly technique we felt that we needed to develop a system prototype and perform some end user testing. This would involve offering the candidate both options and letting them chose which approach they were most comfortable with. Having performed this test on a suitable number of users and recorded their observations a well informed decision will be made.
Chapter 5 - Design

Data Design

5.1 Introduction to Design phase

In the next phase of the SDLC we will focus on the design phase, here we hope to develop a concrete functionality of the system eliminating any unwanted anomalies that may make the system susceptible to errors and inefficiencies. For the purpose of this thesis we will split the design phase into two main sections.

- Data design
- Web site functionality and interaction
- Search feature design and functionality

In the data design section we will use the conceptual modelling technique of entity relationship diagrams (ERD) to represent how the database is to be structured. This technique gives the reader a snapshot representation of the database and shows how the entities interact statically with each other. In the next part of the design phase an overall system representation will be developed showing how the user interacts with the system and how navigation between constituent parts of the system is handled. All the individual pages of the site will be discussed here focusing on the algorithms used to perform the internal functions of the page. It must also be stressed here that the different sections of the design phase do not occur sequentially: each individual part is undertaken in parallel or at least with serious overlap in the hope that all the elements of the design phase will be consistent with each other and thus ensuring that a comprehensive system specification is carried onto the implementation stage.
5.2 Conceptual Data Modelling

A Conceptual Data Model is a representation of organizational data. There are many reasons for creating a model and for using a modelling and design tool rather than just jumping in and directly programming a database and application code. Modelling can help bridge the gaps between business concepts (conceptual models), database designs (logical models), and physical database implementations (physical models or schemas). The purpose of a conceptual data model is to show as many rules about the meaning and inter-relationships among the data as are possible. Since data rather than the processes are the most complex aspects of our system it is imperative that the structuring of this data is given a central role in the design stage. The most common format used for data modelling is entity relationship (E-R) diagramming. A data model using E-R notation explains the characteristics and structure of data independent of how this data may be stored in computer memory. A logical model created with a design tool is insulated from DBMS specifics, allowing (in theory) a single design to be implemented in different DBMSs. Unlike logical models; schemas are tied to specific DBMS server products. For many years, modelling tools have had both reverse-engineering capabilities (deriving logical models from existing databases) and forward-engineering capabilities (generating database schemas from logical models). The complete set of E-R diagram documentation will be stored in the central repository giving a detailed insight into the overall functionality of the system, this will hopefully decrease the maintenance costs of the system in the future.

Chen developed the basic entity-relationship modelling notation in 1976. The E-R model notation has subsequently been extended to include additional constructs, see Teorey et al. (1986) and Storey (1991). For the purpose of this thesis we have adopted one common notation that we had already studied during the year in the Systems Analysis and Design course taken in the first semester of this program, the so-called crow’s foot notation. The E-R diagrams develop a cardinality specifying how many instances of an entity relate to one instance of another entity. Below is a brief description of the relationship notation used to describe the cardinality between two entities used with this approach.
Although ERD’s are traditionally used to allow the developers to design the overall functionality of the relational structure before the constraints of the implementation stage are taken into consideration, however due to our relative inexperience in database design we proceeded straight to the implementation stage without using ERD’s. In hindsight this approach was not a good one and if a similar project were to be undertaken again we would strongly advise the development team to use ERD’s before proceeding to the implementation stage. Although we did not use ERD’s in the traditional way we still feel that they add greatly to the readers understanding of this thesis and will greatly reduce the third party maintenance costs associated with the system in the long term.

During the course of this project we investigated three different case tools for the use in the area of ERD design. The first one we looked at was Case Studio 2, this is an extensive database design tool supporting a comprehensive range of database technology and facilitating the building of ER diagrams in minutes while also supporting reverse engineering. Unfortunately the trial version available to us was limited to the use of six entities and we were unable to gain access to a licensed version. Following this we turned our attention to Microsoft Visio, this was developed as an addition to the Office Suite and again supports ERD design and reverse engineering. Having obtained a trial version of this we performed reverse engineering on our database but unfortunately it did not support the crow’s foot technique mentioned above and we felt the readability of the completed ERD was very poor. After these initial two setbacks we decided to investigate the possibility of using SmartDraw Professional, a package we had previously used in the Initiation and
Planning phase of the project when developing Gantt charts. This software worked well as it catered for different ERD notation one of which was the crow’s foot notation. While this software did not support reverse engineering we were able to graphically represent our ERD’s in a matter of minutes. The completed ERD’s are contained on the following pages followed by a brief description of each relationship. The complete diagram contains thirty-one different entities and in order to adequately display this ERD it was necessary that we split it over two pages. As you can see, one page deals with the entities associated with the student while the other deals with the ones associated with the employer, there is a certain amount of overlap between the two diagrams as some entities are common to both the student/graduate and the employer. As you can see we have also numbered the relationships between the different entities, these numbers correspond to the brief description of the cardinality associated with each relationship contained on the following pages. For a complete ERD of the data shown below on a single A3 page please refer to the system repository.
Figure 5.1 Database Design Entity Relationship Diagram (1 of 2)
Figure 5.2 Database Design Entity Relationship Diagram (2 of 2)
5.3 Defining Entity Relationship Cardinality

1. StuGrad_Details has an Admin_Salary: Each student graduate has exactly one requested salary bracket. Each salary bracket belongs to zero or more students.

2. StuGrad_Details has StuGrad_Skill: Each student graduate has zero or more skills. Each student skill belongs to exactly one set of student details.

3. StuGrad_Details has Admin_Userstatus: Each student/graduate has exactly one user status. Each user status belongs to zero or more student/graduates.

4. StuGrad_Details has Admin_CareerLevel: Each jobseeker has exactly one career level (Student, Entry Level, Management etc.). A career level can belong to zero or many jobseekers

5. StuGrad_Details has Admin_Year: Each jobseeker has selected exactly one year from Admin_Year seven different times while completing their details. Each individual Admin_Year has been selected by zero or many jobseekers (not all years in the drop down may have been selected by a jobseeker).

6. StuGrad_Details has Admin_JobType: A jobseeker is looking for exactly one type of job (full time, part time etc.). A job type belongs to either zero or many jobseekers.

7. StuGrad_Details has Admin_Month: Each jobseeker has selected exactly one month from Admin_Month seven different times while completing their details. Each individual Admin_Month has been selected by zero or many jobseekers.

8. StuGrad_Details has Admin_DegreeAward: A student has exactly one undergraduate degree award, an undergraduate degree award belongs to zero or many students. A student has zero or one postgraduate degree award. A postgraduate degree award belongs to zero or many students.

9. StuGrad_Details has Admin_Day: A student selects exactly one day (date of birth) An Admin_Day belongs to zero or many students.

10. StuGrad_Details has Admin_County: students select exactly one county when giving their permanent address. Each Admin_County belongs to zero or many students. If the students term address is different from their permanent address they again select exactly one county, in this instance each student again selects
zero or one counties and each Admin_County again belongs to zero or many students.

11. StudentGrad_Details has Admin_Country: A student has exactly one nationality; an Admin_Country belongs to zero or many students. When giving a permanent address a student selects exactly one country while the different countries may belong to zero or more students. Again when giving a term address a student has zero or one country (As their term address may also be their permanent address) while the different countries may belong to zero or more students.

12. StuGrad_Details has StuGrad_Location: Each student has to select one and can select many preferred work locations. Each location contained in the StuGrad_Location corresponds to exactly one student.

13. StuGrad_Details has StuGrad_SecSubject: Each student can enter zero or many secondary subjects studied, each secondary subject corresponds to exactly one student.

14. StuGrad_Details has StuGrad_UgSubject: Each student can enter zero or many undergraduate subjects studied, each undergraduate subject entered corresponds to exactly one student.

15. StuGrad_Location has Admin_Location: Each entry in the StuGrad_Location table belongs to exactly one entry in the Admin_Location table. Conversely each entry in the Admin_Location table may have zero or many entries in the StuGrad_Location table.

16. StuGrad_Skill has Admin_Skill: Each entry in the StuGrad_Skill table corresponds to exactly one entry in the Admin_Skill table. Each entry in the Admin_Skill table has zero or more corresponding entries in the StuGrad_Skill table.

17. StuGrad_Skill has Admin_SkillLevel: When a student enters a skill they must enter one and only one skill level for that skill, therefore each StuGrad_Skill has exactly one Admin_SkillLevel. Conversely each Admin_SkillLevel has zero or many StuGrad_Skill entries corresponding to it.
18. Admin_SkillClass has Admin_Skill: Each skill class has zero or more skills (class IT has fifty two skills) while each skill belongs to exactly one skill class (C++ is contained in the class IT and no other class).

19. StuGrad_WorkExperience has Admin_Year: When a student enters an instance of their work experience they select exactly one year from the drop down menu on two separate occasions. One year representing the start date and one representing the end date. As a student can enter as many different work experience placements as they like there is no upper limit on how many years the students selects. On the other hand each year in the Admin_Year table corresponds to zero or many StuGrad_WorkExperience table entries.

20. StuGrad_WorkExperience has Admin_Month: This is identical to the above relationship, again when a student enters an instance of their work experience they select exactly one month from the drop down menu on two separate occasions. One month representing the start date and one representing the end date. As a student can enter as many different work experience placements as they like there is no upper limit on how many months the student selects. On the other hand each month in the Admin_Month table corresponds to zero or many StuGrad_WorkExperience table entries.

21. Employer_SkillSet has Admin_Skill: Each Employer can select zero or one skills from the Admin_Skill table multiple times depending on how many skills they want to search by, they can search by an upper limit of six skills. Alternatively each skill in the Admin_Skill table belongs to zero or many entries in the employer_SkillSet table.

22. Employer_SkillSet has Admin_Skilllevel: When an employer selects a skill they want to search by they then must select the level of proficiency they want in that skill (graduate, one year, two years etc.), therefore each entry in the Employer_SkillSet table has exactly one corresponding entry in the Admin_Skilllevel table. Each entry in the Admin_Skilllevel table belongs to zero or many entries in the Employer_SkillSet table.

23. Employer_SkillSet has Admin_SkillImportance: When an employer selects a skill to search by they must also select how important that skill is (of slight importance, important, very important), therefore each entry in the
Employer_SkillSet table has exactly one corresponding entry in the Admin_SkillImportance table. Each entry in the Admin_SkillImportance page belongs to zero or more entries in the Employer_SkillSet page.

24. Employer_Details has Employer_Query: Each individual employer can make an infinite number of queries (searches of the database of jobseekers) while each query is unique to that employer. Therefore each entry in the Employer_Details table has zero or many corresponding entries in the Employers_Query table while each entry in the Employers_Query table belongs to exactly one entry in the Employer_Details table.

25. Employer_Details has Employer_Profile: Each individual employer can create as many different skill correlation profiles as they like while each employer profile created is distinct to that employer. Each entry in the Employer_Details table has zero or many entries in the Employer_Profile table. Each entry in the Employer_Profile table belongs to exactly one entry in the Employer_Details table.

26. Employer_Details has Admin_UserStatus: Each employer is assigned a user status (Administrator, Graduate, Employer) that gives them certain rights and privileges within the site. Each employer has exactly one user status while each entry in the Admin_UserStatus table belongs to zero or many entries in the Employer_Details table.

27. Employer_Profile has Skill_Correlation: Each distinct skill correlation profile created by an employer has exactly one skill correlation table associated with it. Each skill correlation table entry belongs to zero or many employer (one skill correlation table will be the default table and won't belong to any employer).

28. Skill_Correlation has Skill_CorrelationValue: A correlation between any two skills in the Skill_Correlation table has exactly one value associated with it in the Skill_CorrelationValue table (If two skills are strongly correlated in the skill_correlation table and receive a correlation ID of three they receive a value of 0.75 from the Skill_CorrelationValue table). The different entries in the skill_correlationValue table correspond to zero or many entries in the Skill_Correlation table.
Chapter 5 – Data Design

29. Master_Login has Admin_UserStatus: An entry in the Master_Login table has exactly one user status (Administrator) in the Admin_UserStatus table. Alternatively an entry in the Admin_UserStatus table belongs to zero or many entries in the Master_Login table.

It must be stressed here that an ERD is not a complete picture of the system and is only one of many ways to represent it. As stated above the ERD’s are limited in that they only give the static relationships between entities and would need to be studied in conjunction with the remaining documentation from the systems design phase in order to gain a complete understanding of the functionality of the system.
Chapter 6 - Design

Website Functionality & Interaction

Following on from the analysis section of the SDLC where we proposed to partition the system into three constituent parts namely:

- Students & Graduates Section
- Employers Section
- Manager & Administration Section

We will now take a closer look at how each of these sections interact within the system and discuss various design issues that were encountered. Firstly we will examine some techniques and structures that are common to all sections of the system and outline any algorithms developed.

6.1 Account Login

The login procedure for all three sections is the same with the only difference being different sections will access different tables in the database to authenticate the users details.

The user is requested to enter their username (Email) and password to access their account details. A series of checks must be performed to authenticate the user:
Figure 6.1 User Authentication

6.1.1 Login Function

Function userLogin (username, password)

username = LowerCase( username)

If (username Not In Table) Then
    Return error = incorrect username or account not created
Else
    If (password <> password in table corresponding to username) Then
        Return error = incorrect password
    Else
        If (account not activated) Then
            Return error = account not activated
        Else
            Update visits counter in database
            Update last visit date database field with current system date
            redirect user to welcome page
6.2 Form Validation

Due to the nature of this system, users - students & graduates in particular are required to enter substantial amounts of data. In general users don't like filling out forms, and will rush them to finish as quickly as possibly ignoring the instructions placed on each page of the site with regards to the information required.

Since this data is vital to the effectiveness of the system, it is incumbent on the developers of similar systems to ensure as much as possible that the data stored in the database is as accurate as possible. To achieve this accurate data storage we will consider two methods of data validation, client side validation and server side validation.

6.2.1 Client Side Validation

Client-side scripting, as the name implies, is executed scripting code that occurs on the client (web browser) checking that the values entered into the form are valid before the form is submitted to the server. If there are errors in the data, the user cannot save the information on that page until all of the errors are corrected. Client-side scripting can be achieved using VB Script or JavaScript as the scripting language, but since Netscape Navigator only accepts JavaScript as a legal, client-side scripting language, this system uses JavaScript. The main advantages of client side validation are as follows:

- Quick, users are immediately aware of any errors in the data submitted
- Relatively straightforward to code
- Extremely versatile language

However these advantages compromise security. Anyone visiting a website can view the source code for a page and look at the validation script informing them of the checks being performed on the data. One could if they were so inclined save this page
to their computer, edit or delete the validation code and then submit the form repeatedly.

### 6.2.2 Server Side Validation

The way to avoid this problem is to perform server-side validation. To implement server-side validation ASP scripts are written to validate the form data submitted to the server, returning and displaying any errors on the form page. This method of form validation can be more complicated to implement and in some situations can amount to overkill.

For the purposes of this system, a combination of client and server side validation was employed. Virtually all of the pages on the website that request the user to enter some information have an element of validation. This information is categorised into mandatory *(requiring validation)* and non-mandatory *(no validation)* information. As outlined above most of this validation is implemented on the client side using JavaScript.

### 6.2.3 Validations

#### 6.2.3.1 Blank Text Fields

All mandatory fields are checked to ensure the user has entered some value.

#### 6.2.3.2 Unselected Drop Down Menus

All mandatory drop down menus are checked to ensure the user has selected a menu item.

#### 6.2.3.3 Unchecked Check Box

All mandatory check boxes are checked to ensure the user has ticked the appropriate box.

#### 6.2.3.4 Invalid Emails

All email fields are checked to ensure that a user has entered a valid email address, with no illegal characters, spaces, contains the characters “@ and .” and has the correct structure *i.e. someone@somewhere.com*
6.2.3.5 Invalid Password

All password fields are checked to ensure that they are of the correct form, that is they contain only alphabetical characters and numbers. A password must also contain at least one number, one alphabetical character and must be between 6 and 20 characters in size.

6.2.3.6 Invalid Date

When a user is requested to select their date of birth from the drop down menus, the final value is checked to ensure it is a valid date, *i.e. it has the correct number of days in the month and also there is a complete leap year function to test possible 29th February dates.*

6.2.3.7 Weight Counter

In the employer and Administrator search section, the user is required to relatively weight their search criteria; this function ensures the sum of the weight totals exactly one hundred.

All of the validation functions are listed in Appendix 4.

6.3 Passing Data Between Pages

When a user registers with the site they are assigned a unique user ID in the relevant database table. On all subsequent visits to the site the user retrieves their user ID at login and the system requires that this unique user identifier be passed between pages in order to display the relevant information for that user from the appropriate database tables. Two methods of passing data between pages were investigated, below is a brief discussion of these methods outlining the positive and negative aspects of each and reasons for the preference of one method for the purpose of this system.

6.3.1 Sessions

HTTP is stateless by nature, which means that the data contained on one page will not be stored when you navigate to the next page. For example, when you enter a URL in your browser it will request the corresponding page from the Web server. Once the page has been served all communications will cease until another request is made.
This is an inherent problem with HTTP in that there is no built-in mechanism to retain data in between page requests. If you fill in a form online and forget to click the Submit button everything you typed in will be lost. Sessions states were developed as a way of tracking every unique user that visits a website by providing detailed user information on server logs and allowing the site administrator to programmatically monitor and control individual users on a website.

Sessions work by generating a unique ID for each user (called a session identifier), which is usually placed in a cookie in the client browser. When a user accesses the website, the server will retrieve the cookie and then make note of the user’s session identifier. However, as useful as Sessions are they are not always available. For example, what happens if your Web application is viewed through a wireless device that doesn’t support cookies or is viewed through a pre-HTML 2.0 or text-based browser? Another possibility is that your audience may be using cookie-blocking technology to protect privacy. To reach the widest audience possible, we decided to avoid using Sessions as a method of passing information between pages.

### 6.3.2 Query Strings

Although more difficult to implement, the query string approach was chose over that of Sessions. Using this method the cookie value is stored in the URL and can be retrieved by both the server and the browser.

Here is an example of a users ID embedded in an Active Server Pages URL:

```
http://www.sudpt.ul.ie/yourpage.asp?userID=666
```

However exposing the user ID is generally not a good idea from a security standpoint. If a hacker can obtain your ID and you are logged in, the hacker may be able to hijack your session. A solution to this problem is to encrypt the user ID in the URL. In order to encrypt the user ID we examined various encryption methods and below is a brief summary of three encryption techniques.
6.3.3 MD5 (Message Digest Algorithm)
The message digest algorithm was developed by Professor Ronald L. Rivest of MIT. The algorithm takes as input a message of arbitrary length and produces as output a 128-bit "fingerprint" or "message digest" of the input. It is conjectured that it is computationally infeasible to produce two messages having the same message digest, or to produce any message having a given pre-specified target message digest. The MD5 algorithm is intended for digital signature applications, where a large file must be “compressed” in a secure manner before being encrypted with a private (secret) key under a public-key cryptosystem such as RSA. The MD5 algorithm is designed to be quite fast on 32-bit machines. In addition, the MD5 algorithm does not require any large substitution tables allowing the relatively compact coding of the algorithm.

6.3.4 RSA
RSA is a public-key cryptosystem developed by MIT professors: Ronald L. Rivest, Adi Shamir, and Leonard M. Adleman in 1977 in an effort to help ensure Internet security. Simply put, a cryptosystem is an algorithm that can convert input data into something unrecognisable (encryption), and convert the unrecognisable data back to its original form (decryption).

In a public-key cryptosystem, the sender encrypts a message with a private key. The sender's public key is posted (usually in a table). The recipient looks up the sender’s public key and uses it and her/his own private key to unlock the message. Private and public keys are associated by a function. In the RSA cryptosystem, the private and public keys are linked by the factorisation of prime numbers. The challenge of public-key cryptography is developing a system in which it is impossible to determine the private key. This is accomplished through the use of a one-way function. With a one-way function, it is relatively easy to compute a result given some input values. However, it is extremely difficult, nearly impossible, to determine the original values if you start with the result. In mathematical terms, given x, computing f(x) is easy, but given f(x), computing x is nearly impossible. The one-way function used in RSA is multiplication of prime numbers. It is easy to multiply two big prime numbers, but for most very large primes, it is extremely time-
consuming to factor them. Public-key cryptography uses this function by building a cryptosystem which uses two large primes to build the private key and the product of those primes to build the public key.

Since its introduction the RSA algorithm has been employed in the most widely-used Internet electronic communications encryption program, Pretty Good Privacy (PGP). It is also employed in both the Netscape Navigator and Microsoft Explorer web browsing programs in their implementations of the Secure Sockets Layer (SSL), and by Mastercard and VISA in the Secure Electronic Transactions (SET) protocol for credit card transactions.

6.3.5 RC4

RC4 is a stream cipher symmetric key algorithm. It was developed in 1987 by Ronald Rivest and kept as a trade secret by RSA Data Security. On September 9, 1994, the RC4 algorithm was anonymously posted on the Internet on the Cyperpunks’ “anonymous remailers” list.


RC4 uses a variable length key from 1 to 256 bytes to initialise a 256-byte state table. The state table is used for subsequent generation of pseudo-random bytes and then to generate a pseudo-random stream which is XORed with the plaintext to give the ciphertext. Each element in the state table is swapped at least once.

The RC4 key is often limited to 40 bits, because of export restrictions (certain kinds of heavy encryption are illegal to export out of the US. They are actually classified as "munitions", i.e. weapons.) but it is sometimes used as a 128 bit key. It has the capability of using keys between 1 and 2048 bits. RC4 is used in many commercial software packages such as Lotus Notes and Oracle Secure SQL.

6.3.6 The Decision

We choose the RC4 algorithm to encrypt the user ID in the URL as it is generally regarded as being "strong", and has no known attacks (although a relatively weak class of keys has been identified).
Other strengths of this algorithm include decent encryption/decryption speed and relative ease of coding in ASP. Due to the symmetrical nature of the RC4 algorithm, i.e. to encrypt data simply pass the data and the password you choose to the routine in order to receive encrypted data. To decrypt, pass the encrypted data and the same password. (Note: It is possible to encrypt the data multiple times, with different passwords on each iteration. To decrypt, simply reverse the steps you followed during encryption).

### 6.3.7 RC4 Algorithm

The RC4 algorithm works in two phases, key setup and ciphering. Key setup is the first phase of the algorithm.

During a N-bit key setup (N being the key length, *SUDPT uses up to 24 as the key length*), the encryption key is used to generate an encrypting variable using two arrays, ASCIIarray and KEYarray, and 256 mixing operations. These mixing operations consist of swapping bytes, modulo operations, and other formulae. Once the encrypting variable is produced from the key setup, it enters the ciphering phase, where it is XORed with the plain text message to create an encrypted message. The receiver on getting the encrypted message decrypts it by XORing the encrypted message with the same encrypting variable.

```plaintext
Function RC4 (userInput, userKEY)
    If (Length (userKEY) = 0) Then Exit Function
    If (Length (userInput) = 0) Then Exit Function

    //Calculate the length of the key
    userKEY_Length = Length (userKEY)

    //Create a 256 byte state array, Si, consisting of the numbers 0 thru 255
    For i = 0 To 255
        Si = i
    End For

    //Create a 256 byte key array, fi, consisting of the key repeating as often as necessary to
    //fill the whole array
    For i = 0 To 255
        Ki = ANSI value of Key (repeating)
    End For
    For i = 0 To 255
        f = ((f + Si + Ki ) mod 256)
        Swap (Si, Sf)
    End For
```

Personnel Placement Decision Support System
End For

//Generate a random byte for encryption.
i, f = 0
i = (i + 1) mod 256
f = (f + Si) mod 256
Swap (Si, Sf)
t = (Si + Sf) mod 256
St = Random byte for encryption

RC4 = (St XOR userInput)
Return RC4

End Function

6.3.8 RC4 In Action

Below is the explanation of RC4 algorithm; a four-bit key is used for simplification of the process.

Create a 4 byte state array, Si, consisting of the numbers 0 thru 3

Si =  0     1    2      3
    S0   S1   S2    S3

Create a 4 byte key array, Ki, consisting of the key repeating as often as necessary to fill the entire array. (We chose 1 and 7)

Ki =   1          7         1         7
    K0       K1      K2      K3

For the following mixing operations we will use the variables i and f to index the arrays Si and Ki. First we initialise both i and f to 0. The mixing operations are iterations of the formula (f + Si + Ki ) mod 4 followed by swapping Si with Sf.

First iteration

For i = 0 (  0    +    0    +    1   ) mod 4 = 1 = f
    f          S0        K0
Swap S0 with S1
Si =    1    0      2      3
    S0   S1  S2    S3

Second iteration

For i = 1 (   1    +    0   +    7    ) mod 4 = 0 = f
    f          S1       K1
Swap S1 with S0

\[
\begin{array}{cccc}
S0 & S1 & S2 & S3 \\
0 & 1 & 2 & 3 \\
\end{array}
\]

**Third iteration**

For \( i = 2 \) \( (0 + 2 + 1) \) mod 4 = 3 = f

\[
\begin{array}{ccc}
f & S2 & K2 \\
\end{array}
\]

Swap S2 with S3

\[
\begin{array}{cccc}
S0 & S1 & S2 & S3 \\
0 & 1 & 3 & 2 \\
\end{array}
\]

**Fourth iteration**

For \( i = 3 \) \( (3 + 0 + 7) \) mod 4 = 2 = f

\[
\begin{array}{ccc}
f & S3 & K3 \\
\end{array}
\]

Swap S3 with S2

\[
\begin{array}{cccc}
S0 & S1 & S2 & S3 \\
0 & 1 & 2 & 3 \\
\end{array}
\]

Generate a random byte for encryption. Reinitialise i and f to 0 and then set i equal to \((i + 1) \) mod 4 and set f equal to \((f + Si) \) mod 4. Then swap Si and Sf. Set t equal to \((Si + Sf) \) mod 4 the random byte for encryption is equal to St

\[
(0 + 1) \mod 4 = 1 = i
\]

\[
i
\]

\[
(0 + 2) \mod 4 = 2 = f
\]

\[
f & Si
\]

Now swap S1 with S2,

\[
\begin{array}{cccc}
S0 & S1 & S2 & S3 \\
1 & 0 & 2 & 3 \\
\end{array}
\]

\[
t = (0 + 2) \mod 4 = 2
\]

\[
S1 & S2 \\
S2 = 2
\]

Two \(00000010\) in binary, our encrypting variable is XORed with our plain text to produce ciphertext.

The example below uses plain text “HI”. 

Personnel Placement Decision Support System
6.4 Date Function

6.4.1 Background

Julian dates are simply a continuous count of days and fractions since noon Universal Time on January 1st 4713 BCE (on the Julian calendar). Almost 2.5 million days have transpired since this date. Julian dates are widely used as time variables within astronomical and mainframe software.

It was in 46 B.C. that Julius Caesar ordered adoption of the Egyptian Solar Calendar of 365 days and taking cognisance of the additional fraction. Assuming that this fraction is 0.25 day, the Julian Calendar provided for the regular intercalation of one day after every 4th year. But, there was a source of error in the estimate of the odd fraction as 0.25 day rather than .2422 day per year. By the year 16th Century the accumulated error had amounted 10 days.

In 1582, Pope Gregory XIII ordered the so-called Georgian reform omitting 10 days of that year (the day following October 4 was declared October 15) to put the calendar and sun into correspondence again. The Georgian reform also prescribed that in future the additional day may be omitted from all years divisible by 100 expect those by 400. Thus 1700, 1800 and 1900 were 365-day years while 1600 was a leap year and 2000 will also be a leap year. This adjustment also is not free from error. It covers intercalary or accumulation of days up to 3rd decimal while the error in the 4th decimal will amount to a full day in about 3,300 years. In short the Solar Calendar needs adjustment after every four years and still it will accumulate one-day difference.
in 3,300 years. In fact, due to relativistic effects the duration of the earths revolution about the sun \textit{(i.e. a year)} is slowly increasing and occasionally “leap seconds” are added to standard GMT.

\textbf{6.4.2 Application}

For the purposes of the Announcements feature in the Administration section of the site, it was necessary to schedule announcements, \textit{i.e. the period of time for which they were to be displayed}. Employing a quasi - Julian type calendar function we were able to overcome this. The administrator is required to enter a display from date and a display to date; this date is then converted to its Julian representation and is saved along with the announcement in the database. When a student or employer logs onto their account and is redirected to their respective welcome pages the following check is performed:

- Get the local system date in the format (mm/dd/yyyy) and convert it to its Julian value.
- Looping through the Announcements table, checking if the current Julian date is between any of the Announcements display dates.
- If they are, those announcements are displayed on the welcome page.

\textbf{6.4.3 Julian Date Function}

//Convert the present Date (mm/dd/yyyy) into an integer value
Function ToJulian (Date)

//If the date entered is not a valid system date, then return the error string “0000000”
If (Date in not a valid date) Then
ToJulian = “0000000”
Else
//Result is set to be the year part of the date entered
String JulainYear = Convert to String (Year part of date)

//Days is set to be the difference between the 1\textsuperscript{st} of January on the year of the date that the user entered and the date that the user entered plus one (this includes the 1\textsuperscript{st} of January)
String Days = Date Difference in days (1/1/ JulainYear, Date) + 1

//If the Days string is less than three characters, add one or two zeros to the start of the value, this ensures all day values are three characters in length i.e. (003 = 3\textsuperscript{rd} January)
While (Length (Days) < 3)
  Days = “0” + Days
End While
//The value returned is a string comprised of the year and the variable Days
  ToJulian = JulainYear + Days
  End If
  Return ToJulian
End Function

A similar function called ToGregorian is also required to convert a seven character
Julian string into a system date.

6.4.3.1 Example 1: User enters 29/11/2003 for the date
  Year = 2003
  Days = 333
  Julian Date returned is 2003333

6.4.3.2 Example 2: User enters 29/02/2003 for the date
  Julian Date returned is 0000000
Chapter 6 – Website Functionality & Interaction

Julian Date Function

Reads in the System date

Check to see if the date is a valid system date

Yes

Converts the year part of the date to a string (Julian Year)

Days is set to be the difference between the 1st of January of the year entered and the date that the user entered + 1

If the day’s string consists of one digit add two zeros to the front of the value
If the day’s string consists of two digits add one zero to the front of the value (this ensures the day string consistently has three characters)

ToJulian

Julian Year + days

Return ToJulian

Gregorian Date Function

Reads in the Julian date

Check to see that a valid Julian date has been entered

Yes

Gregorian Year = Year part of the Julian date string

GregorianDay = Day part of the Julian date string

Gregorian Result = (GregorianDay -1) + (January 1st of Gregorian Year)

ToGregorian = Gregorian Result

Return ToGregorian

No

ToJulian = "0000000"

Yes

Return ToJulian

No

ToGregorian = "Invalid Date"

Figure 6.2 Julian & Gregorian Date Functions
6.5 Students & Graduates Section

6.5.1 Registration

Any prospective jobseeker must first complete a registration form, furnishing their name, email address, email format preference (*i.e. HTML or text based emails*), a password, password hint and contact number. This form is validated on the client side to ensure all mandatory fields have been filled in and a correctly structured email address and password have been entered. The user must also tick a Data Protection box to enable the submit button and proceed with registration. If client side validation is successful, a check is performed on the stuGrad_details table to see if the email address entered has already been registered. If it has, an error message will be displayed to the user and their information will not be saved. Otherwise the information is stored in the stuGrad_details table and the user is returned to a thank you page, a confirmation email is automatically sent to the specified email address. Assuming the user has given a valid email address they can click on a link in the email to activate their account. It is envisaged that this activation process will curtail the amount of bogus information entered into the various database tables. It should also be noted that the email address is also the users’ username as it is a unique identifier of a person and saves the need of generating unique usernames. It is also an easy way for the user to remember his/her username.
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Figure 6.3 Student & Graduate Registration & Account Activation

6.5.2 Welcome Page
The user receives a personal greeting (Welcome Joe Bloggs), taken from the stuGrad_details table and can also view any announcements posted by the SUDPT manager.

6.5.3 Personal Details
The user is required to enter their personal information such as name, address and contact details some of which is validated on the client side. Once validated the information is then stored in the stuGrad_details table and can be viewed by the user.
6.5.4 Educational Details

The user is required to enter their educational information such as secondary school (or equivalent), undergraduate and postgraduate (if applicable) information, some of which is validated on the client side. In order for a user to add secondary school or undergraduate subjects, they must repeatedly add a subject and fill in the required fields that are generated. Once validated the information is then stored in the stuGrad_details, stuGrad_secSubject and stuGrad_ugSubject tables and can be viewed by the user.
Chapter 6 – Website Functionality & Interaction

Data saved to StuGrad_Details, StuGrad_SecSubject & StuGrad_UgSubject database tables

Form validation, check all mandatory fields have been completed

User forwards to education view page

Figure 6.5 Student & Graduate Education Details

6.5.5 Skill Details

The user is required to enter their skills information such as expected salary, preferred location, degree award, list of their skills from the SUDPT skills list, IT experience, any languages spoken and any other information they feel may be relevant to prospective employers. Again the mandatory information is validated on the client side and is stored in the stuGrad_details, stuGrad_skill and stuGrad_location tables, the user can then view these tables.
6.5.6 Extra Curricular Details

The user is required to enter information such as interests, pastimes, awards, achievements, driver's license status and any other extra curricular details they feel we have not addressed. Once validated the information is then stored in the stuGrad_details table and can be viewed by the user.
### 6.5.7 Work Experience Details

The user is required to include all instances of work experience they feel may be relevant to their application, detailing the dates in employment, employers name and address and their main duties and responsibilities. This information is then stored in the `stuGrad_workExperience` table and can be viewed by the user.

---

**Figure 6.7** Student & Graduate Extra Curricular Details

**Figure 6.8** Student & Graduate Work Experience Details
6.5.8 Account Administration

The user has the ability to change their email address and password. In the case of changing the email address, the user will be sent a change of email activation mail similar to the registration section. Firstly the stuGrad_details table is checked to see if the new email address is in use by another user, if it is the email cannot be changed and the user is informed of this. If the email is not in use, the new email address will not take effect until the user clicks on the link to activate the new email address. In the case of a password change, the new password is validated to ensure a valid password is entered; again this is the same as the registration process.

![Diagram of Student/Graduate Account administration](image)

Figure 6.9 Student & Graduate Account Administration

6.5.9 Logout

This page simply clears the cache of the users visit and ends any sessions that were invoked, in our case none as we used the method of query strings.

6.6 Employers Section

6.6.1 Registration

The same process as for the students & graduates section with the notable exception being, that only the SUDPT manager can activate the employers account and then an email is sent to the employer with their username (contact persons email address) and password.
Chapter 6 – Website Functionality & Interaction

6.6.2 Welcome Page

The employer is greeted by their name, taken from the employer_details table and can also view any announcements posted by the SUDPT manager.

6.6.3 Company Details

The employer is required to enter their company information such as company name and contact details, contact person name and contact details. Once validated the information is then stored in the employer_details table and can be viewed by the
employer. The company name and web address will then be displayed on the associates page.

![Diagram]

**Figure 6.11** Company & Employer Contact Details

### 6.6.4 View Employment Classes

The employer can view the list of employment areas (classes) that the SUDPT cater for.

### 6.6.5 View Employment Skills

The employer can view the list of employment skills associated with each of the classes that the SUDPT cater for.

### 6.6.6 Create Weight Profile

The employer can create multiple weight profiles and also edit and delete previously created profiles.
Create weight profile

User enters the name of the profile to be created

*Form validation*, checks that the field 'new profile name' has been created

Finds next available profile ID for this employer and inserts new profile into employer_profile table in database

Pop up message prompts the user to enter a profile name

Figure 6.12 Employer Weight Profile

6.6.7 Edit Skill Weights

The employer selects a skill that they want to correlate to another skill or set of skills (class) using one of their created profiles. They can also view all of the default skill correlations provided by the SUDPT. If the employer creates a new weight profile, this results in an insertion into the skill_correlation table to reflect the change. *(Employer ID, Employer Profile ID, Skill1 ID Skill2 ID and the skill correlation)*. On subsequent visits the employer can edit the weight again, this will only result in an update to the skill_correlation table.
Edit Skill weights

User selects a skill and/or associated class for that skill as well as a skill weight profile.

Check to see if default profile or created employer profile selected

Default Profile

User selects a class by which they want to correlate the selected skill to.

Allow the user to view the skill weights

New skill weight saved in skill_correlation table in database

User allowed edit skill weights

Check to see if selected skill exists with above profile and employer ID in skill_correlation table.

Yes

No

Inserts new skill correlation for above profile and employer ID into skill_correlation table in database

Figure 6.13 Employer Edit Skill Weights

6.6.8 Search

This section of the website will be discussed in chapter 7.

6.6.9 Account Administration

See Students & Graduates section.

6.6.10 Logout

See Students & Graduates section.
6.7 Manager & Administration Section

6.7.1 Edit Menus

The manager needs the ability to edit the entire set of drop down menus that appear on the website. This includes adding new menu items, editing and deleting existing items. The design of these tables is similar to the create profile table in figure 6.10.

6.7.2 Edit Skills Section

The manager has the ability to add, edit and delete skill classes similar to the methods described in 6.7.1. In the case of adding a new skill to the table a new skill is added to the admin_skill using the methods described in 6.7.1. When a new skill is added the skill_correlation table must also insert new rows to reflect the new skills’ correlation to all other skills that exist in the table which by default are set to zero (uncorrelated).

This will create a skill correlation table with \( \frac{n(n-1)}{2} \) entries where \( n \) is the number of skills. It is also vital that in the case of a class or skill deletion, that all instances of the class/skill to be deleted are removed from all tables.

The manager can also edit the SUDPT master weight profile; this will be the default weight profile for employers to search the database.

![Diagram](image.png)

Figure 6.14 Manager Add Skill
6.7.3 View System Users
The manager can create, edit, delete and view all of the students/graduates and employers registered on the database. The manager can also activate the employer’s account.

6.7.4 Send Email
The manager can send email to registered users on the system. This is discussed in more detail in chapter 8.

6.7.5 Announcements
The manager can post announcements that will be displayed on student/graduates and employers welcome pages. The date function described in 6.4 is used on this page.

6.7.6 Search Database
This section of the website will be discussed in chapter 7.

6.7.7 Account Administration
See Students & Graduates section.
When an employer enters the search page, they must choose a job type to search for.

### 7.1 Part Time
An employer can search for the database for one part-time job at a time whereas any students registering for part time jobs have to specify five from the same drop down menu.

#### 7.1.1 Part Time Algorithm
Function PartTime (EmployerPartTimeJob)

\[
\text{PartTimeJobSearch} = 0 \\
\text{StudentPartTimeJob = Get part time jobs associated with each student from the database} \\
\text{For } i = 1 \text{ to Number of students in database} \\
\hspace{1cm} \text{If (EmployerPartTimeJob = StudentPartTimeJob) Then} \\
\hspace{1.5cm} \text{PartTimeJobSearch} = 1 \\
\hspace{1cm} \text{End If} \\
\hspace{1cm} \text{Update employerQuery table where studentID (i) = PartTimeJobSearch} \\
\hspace{1cm} \text{End For} \\
\text{End Function}
\]
Chapter 7 – Search Function

**Figure 7.1 Employer Part Time Search**

Employer Part time Search

Part time or Full time

Part Time

Employer selects from the drop down what part time employment they are recruiting for

Checks for ‘active’ students in the database looking for part time employment

Yes

No

Returns the user to a blank results page

No

Yes

Checks if ‘active’ students looking for part time work have the skill specified by employer

Yes

Student receives a similarity matching of 1

No

Student gets a similarity matching of 0

Returns list of candidates in order of percentage match to the results page

For Full Time representation please consult figure 7.2
7.2 Full Time

If the employer selects the full time option to search for students they are required to specify the following search criteria and also weight the importance of each of the categories (2 – 5) using the DISCRIM approach, outlined in section 4.8.

7.2.1 Criteria

1. **Profile**: Select the skill weighting system, this can be the default profile provided by the SUDPT or one that the employer has created. This weighting system provides the correlations between skills.

2. **Skills to search**: The employer must specify the skills, level of experience a user has with that skill and how important that skill is to their search.

3. **Salary Range**: Select the level of remuneration that an employer is willing to pay.

4. **Degree**: Select the Degree Award that an employer requires from a student (expected degree award) or graduate (obtained degree award).

5. **Location**: Specify where a prospective employee could be expected to relocate.

Once all of the employers search criteria have been entered and validated, the search can be performed using the following algorithm.

7.2.2 Full Time Algorithm

Function FullTime (employerID, employerProfileID, employerSalary, salaryWeight, employerLocation, locationWeight, employerDegree, degreeWeight, skillWeight)

StudentsRecordSet = Set of all students who are active and interested in full time work
StudentSkillsRecordSet = List of skills student has
StudentLocationRecordSet = List of locations a student has chosen
EmployerSkillsRecordSet = List of skills employer wants to search for

If Count (EmployerSkillsRecordSet = 0) Then
    Return to search page, with error message “No skills chosen to search”
Else

    If Count (StudentsRecordSet <> 0) Then
        While Not StudentsRecordSet End Of File
            While Not EmployerSkillsRecordSet End Of File
                totalSkillSimilarity = 0
            End While
        End While
    Else
If Count (StudentSkillsRecordSet <> 0) Then
    While Not StudentSkillsRecordSet End Of File
        maxSkillSimilarity = 0
        If (EmployerSkillID > StudentSkillID) Then
            MaxSkill = EmployerSkillID
            MinSkill = StudentSkillID
        Else
            MaxSkill = StudentSkillID
            MinSkill = EmployerSkillID
        End If
        skillCorrelation = get skill Correlation value from database where employer ID = EmployerID and profile ID = employerProfileID and skill1 = MaxSkill and skill2 = MinSkill and EmployerID
        temp = skillCorrelation * skillExperience * skillImportance
        If (temp > maxSkillSimilarity) Then
            maxSkillSimilarity = temp
        End If
    End While
End If
End While
totalSkillSimilarity = totalSkillSimilarity + maxSkillSimilarity
skillSimilarity = skillWeight * (totalSkillSimilarity / Count (EmployerSkillsRecordSet))
salarySimilarity = salary (employerSalary, studentSalary, salaryWeight)
If (employerLocation = 9999) Then
    locationSimilarity = 1
Else
    If (Count (StudentLocationRecordSet) <> 0) Then
        While Not StudentLocationRecordSet End Of File
            locationSimilarity = location (employerLocation_X, employerLocation_Y, studentLocation_X, studentLocation_Y, locationWeight)
        End While
    End If
End If
degreeSimilarity = degree (employerDegree, studentDegree, degreeWeight)
totalSimilarity = (skillSimilarity + salarySimilarity + locationSimilarity + degreeSimilarity)
Insert current search into employer_query table
Chapter 7 – Search Function

Figure 7.2 Employer Full Time Search
Chapter 7 – Search Function

Skill similarity calculation

Check database contains students looking for full time jobs

Yes

Check each individual student entry in database for entered skills

No

Returns a skill similarity match of zero for that student

Yes

Check Employee ID

No

Min Skill = StuSkill_ID

Yes

Max Skill = EmpSkill_ID

Max Skill = EmpSkill_ID

Min Skill = StuSkill_ID

Calculates skill correlation from Skill Correlation table

Calculates skill correlation value from Correlation Value table

Skill Similarity = Correlation_Value * Importance * Experience

If Skill Similarity > Max Skill Similarity, Max Skill Similarity = temp

Total Skill Similarity = Total Skill Similarity + temp

Skill Similarity = Skill Weight * Total Skill Similarity/Number of skills in query

Figure 7.3 Employer Full Time Search – Skill Similarity
Chapter 7 – Search Function

7.2.3 Experience Algorithm

Function experience (experienceEmployer, experienceStudent)

    If (experienceEmployer <= experienceStudent)
        experienceSimilarity = 1
    Else
        get employer Bretam experience value from database table admin_skillLevel
        get student Bretam experience value from database table admin_skillLevel
        experienceRange = (upper bound - lower bound) / 100
        experienceSimilarity = BretamEmployer
                                BretamStudent
    End If
Return experienceSimilarity
End Function

Figure 7.4 Employer Full Time Search – Skill Experience
Chapter 7 – Search Function

7.2.4 Salary Algorithm

Function salary (salaryEmployer, salaryStudent, salaryWeight)

If (salaryStudent <= salaryEmployer)
    salarySimilarity = 1
Else
    get lower bound salary from database table admin_salary
    get upper bound salary from database table admin_salary
    salaryRange = (upper bound - lower bound) / 100
    salarySimilarity = 1 - \[1 - \frac{\text{salaryEmployer} - \text{salaryStudent}}{\text{salaryRange}}\]
End If

weightedSalarySimilarity = salarySimilarity * salaryWeight
Return weightedSalarySimilarity
End Function

Figure 7.5 Employer Full Time Search – Salary Similarity
Chapter 7 – Search Function

Figure 7.6 Employer Full Time Search – Degree Similarity

7.2.5 Degree Algorithm

Function degree (degreeEmployer, degreeStudent, degreeWeight)
    If (degreeStudent <= degreeEmployer)
        degreeSimilarity = 1
    Else
        degreeCounter = number of degree categories in database table admin_degreeAward
        degreeSimilarity = 1 - \frac{\text{degreeEmployer} - \text{degreeStudent}}{\text{degreeCounter}}
    End If
    weightedDegreeSimilarity = degreeSimilarity * degreeWeight
End Function
Chapter 7 – Search Function

Read in X & Y coordinates of the location chosen by the employer.

Check if employer selects all Ireland as preferred location.

Location similarity = 1

No

Check if student in question has entered all Ireland as preferred location.

Location similarity = 1

No

Check if student in question has entered multiple preferred locations.

No

Calculate distance between each individual student location and the employer's location.

Location similarity

Yes

Select highest location similarity value for each individual student.

Weighted location similarity = location similarity * location weight

Location similarity

Return weighted location similarity.

Figure 7.7 Employer Full Time Search – Location Similarity
7.2.6 Location Algorithm

Calculate Location Function

Function calculateLocation (X₁, Y₁, X₂, Y₂)

    calculateLocation = sqrt(((X₁ - X₂) * (X₁ - X₂)) + ((Y₁ - Y₂) * (Y₁ - Y₂)))

    Return calculateLocation

End Function

Location Function

Function location (locationEmployer X co-ord, locationEmployer Y co-ord, locationStudent X co-ord, locationStudent Y co-ord)

    // Constant Values
    limit = 300  // Longest distance in Ireland
    interval = 15

    // Initialise Temporary Variables
    tempLocation, minTempLocation = 0

    locationRange = Int (limit / interval)  // Return an integer value

    locationDistance = calculateLocation (locationEmployer X co-ord, locationEmployer Y co-ord, locationStudent X co-ord, locationStudent Y co-ord)

    For intervalCounter = 1 to locationRange Do

        If (locationDistance <= (intervalCounter * interval))
            tempLocation = (100 – (intervalCounter*5)) / 100
        End If

        If (minTempLocation < tempLocation)
            minTempLocation = tempLocation
        End If

    End For

    locationSimilarity = minTempLocation

    Return locationSimilarity

End Function
Chapter 8 – Implementation & Maintenance

Installation & Coding

8.1 Introduction

On completion of the design phase we had achieved quite a concrete system specification. At a high level the purpose of implementation is to convert this physical system specification into working reliable software and hardware, document the work that has been done and provide help for current and future users and caretakers of the system. During the implementation phase the system specification is transformed into a fully functional system equipped with relevant support documentation, the project team also has responsibility for the development of a comprehensive test plan. As the development team were also charged with the responsibility of integrating this system into the organisation a certain amount of client training needs to be conducted. Another auxiliary part of the implementation phase involves developing an initial marketing plan for the system to ensure its arrival does not go unnoticed among prospective users. Following the successful completion of the implementation phase the project team have also agreed to maintain the system for an initial two month period to remove any initial problems that may occur that were not detected during testing. Broadly speaking the implementation phase can be discussed under the following headings.

- Installation
- Coding
- Testing
- Documentation
- User training
Chapter 8 – Installation & Coding

On the completion of each of these and with the consent of the client the project proceeds to the maintenance phase of the SDLC, this is the final phase of the SDLC methodology and the procedures for system maintenance will be discussed briefly.

8.2 Installation

Installation is the process during which the current system is replaced by the new system. For the successful integration of the proposed system it is necessary to incorporate the existing data of the organisation into the new system. This “Data Conversion” is of fundamental importance in the case of this project as the abandonment of the existing client base would be disastrous for the company, with this in mind the integration of the old and the new is discussed below. Another fundamental part of the installation stage is the configuration of the server, it is beyond the scope of this thesis to delve too far into the complexities of the installation process but the major points of interest are summarised below.

8.3 System Integration

From our meetings with the SUDPT manager, we were aware of the need to integrate the current paper based forms onto the database. When we had finalised the database design for the students & graduates section we hired a student to input all of the forms into the database using an Access designed form. It took the month of July to complete this process and it is our recommendation to the SUDPT to contact all of the people on the database and inform them of this new system, encouraging them to access the site and complete their details. This can be done by email, phone and post depending on the information supplied on the paper based form.

8.4 Server Installation Walkthrough

A Dell Dimension, (Pentium 4, 2.4GHz, 512Mb RAM, 40 GB HD) was purchased to act as the server and Windows 2003 Server Web edition was installed with limited options. In order to test and deploy the site, we installed Terminal Services manager on the server and also a remote desktop connection on Michael’s laptop. This afforded us full access of the server in Limerick for testing and deployment from our apartment.
in Dublin. For more information on Windows Terminal Services technology we refer
the reader to:

http://www.microsoft.com/windowsserver2003/techinfo/overview/termserv.mspx

The server’s hard drive was partitioned into C, D and E drives. All system software
and program files were placed on the C, a virtual web directory was set-up on the D
drive and the database was run off the E drive. We will now discuss two major
considerations taken into account during server installation, security and database
backup.

8.4.1 Security

It is vital when hosting a website to ensure that the server is secure especially when
you are expecting users to submit sensitive information. The following is a
recommended list of security tips when trying to make a web server more robust, not
all of these apply in our case due to the fact that we upgraded from Windows 2000

- Be up to date with all operating system and database security patches, this was
  achieved by scheduling Windows Update to run at 3am every morning. It is
  also important that the system administrator keeps up to date with all new
  security issues & definitions.
- Use NTFS on all partitions.
- Install 128-bit security.
- Turn on security event logging for all audit failures and selected success
  events.
- Have a password policy that requires strong passwords and regular password
  changes.
- Disable the Guest account (Pre Windows Server 2003 editions).
- Disable directory browsing (Pre Windows Server 2003 editions).
- Disable parent paths. (This was not possible for the SUDPT system due to the
  fact that Server Side Includes were used)
- IIS should run with a specially created restricted account. Don't use an
  administrator's account.
• Have a virus checking solution with automated updates. *(A copy of Norton Internet Security was purchased which includes anti virus software and a firewall).*

For more information visit [http://www.symantec.com/sabu/nis/nis_pe](http://www.symantec.com/sabu/nis/nis_pe)

• Limit use of administrator access.

• Web and database servers should be physically secure.

• Ensure various files & directories on the system have nonsense file names primarily due to the fact that they give no information about what the file or directory may contain. In some cases files are embedded in multiple directories, all with nonsense naming structures, *i.e. name = “va#;da*pe75%$_)”*

• Ensure there is no link to the Administrator / Manager section of the system on the website.

For more information on Windows and IIS security we refer the reader to the following pages:


### 8.4.2 Database Backup

Due to the nature of the system it is imperative that backups of the database are kept in case anything goes wrong. To achieve this we took the following steps

• Schedule a daily back up of the database at an unusual time *(i.e. 3:24am)*

• Installation of a secondary 40GB Western Digital Hard drive for backups

• Installation of a CD writer for weekly backups that can be stored off site

If the need should arise for a recovery of the database for any reason, i.e. primary hard drive fails; the last backup can be retrieved from the secondary hard drive. If this secondary drive should also fail which is highly unlikely, the CD backup of the previous weeks database that is stored on a CD offsite can be used.
8.5 Coding Implementation techniques
In the last chapter we gave a detailed plan of what was the purpose of each section of the website and how the pages interacted with each other. It is true to say that a good design plan and structure will facilitate the relatively straightforward coding of the system. In this section we will discuss the various validations performed in pages and also a number of coding techniques that were prominent in the implementation of the system. These include:

- Option Explicit
- Server Side Includes
- SQL
- ADO
- ADO Recordset
- Default cursor and lock types
- ADOVBS.INC
- Browser Detection
- Website Statistics
- Email
  - CDONTS
  - AspEmail

8.5.1 Option Explicit
At the top of your ASP page, you can insert the statement "Option Explicit". By inserting this code, you are telling the ASP parsing engine that you want to explicitly declare all your variables (via a Dim statement). Using Option Explicit allows you to easily catch misspelled variable names and makes code more readable. Rather, all variables in the code will have been declared before they are used which is standard in any good language.

8.5.2 Server Side Includes
Server Side Includes (SSI) allows developers to place the contents of a file into another file. The benefit of including files is that you can group common functions and code into a file, and then just make a reference to that file in all of your ASP
scripts that need to use those functions. Using server-side includes allow you to modularise your code; rather than having to rewrite functions, you can write them once and access them easily from all the ASP pages that need them. Server Side Includes are used throughout the site and it should also be noted that by default they are turned off in Windows Server 2003 and need to be activated by ticking the “Enable parent paths” for the site to function.

![Application Configuration](image)

**Figure 8.1** IIS Application Configuration

Any Server Side Includes are declared at the top of each page after the option explicit tag as follows `<!--#include file="scripts/asp/adovbs.inc" -->`. Notice the file extension “.inc”, this stands for include and other pages that are SSI’s containing only ASP functions have the file extension “.asp” instead of .inc.
8.5.3 Site menus

One significant application of Server Side Includes in the SUDPT site was used to implement the menus. Associated with each user there is a user status column in their respective tables.

<table>
<thead>
<tr>
<th>Table name</th>
<th>User status value</th>
<th>User status description</th>
</tr>
</thead>
<tbody>
<tr>
<td>stuGrad_details</td>
<td>3</td>
<td>Students &amp; graduates</td>
</tr>
<tr>
<td>employers_details</td>
<td>2</td>
<td>Employers</td>
</tr>
<tr>
<td>master_login</td>
<td>1</td>
<td>Administrator</td>
</tr>
<tr>
<td>master_login</td>
<td>4</td>
<td>Manager</td>
</tr>
</tbody>
</table>

Table 8.1 User Status Table

In any of the sections that require a login to access, the user status is retrieved from the relevant table and passed into a JavaScript function which loads the appropriate menu to a SSI page. Depending on the user status value, a menu SSI page is displayed by the browser.

```% If (Cint(userRS.fields("USER_STATUS")) = 1) Then %>
    <!--#include file="../../scripts/javascript/menu/menus/menu_ADMIN.inc" -->
<% ElseIf (Cint(userRS.fields("USER_STATUS")) = 2) Then %>
    <!--#include file="../../scripts/javascript/menu/menus/menu_EMP.inc" -->
<% ElseIf (Cint(userRS.fields("USER_STATUS")) = 3) Then %>
    <!--#include file="../../scripts/javascript/menu/menus/menu_SG.inc" -->
<%End If%>
```

8.5.4 SQL

There was a considerable amount of SQL employed in the implementation due to the fact the system is database driven. The majority of SQL statements were the standard INSERT, UPDATE and DELETE statements and were combined with ActiveX Data Objects to interact with the database tables. For primer in basic SQL we refer the reader to [http://www.w3schools.com/sql](http://www.w3schools.com/sql)
8.5.5 ADO

ActiveX Data Objects (ADO) is a Microsoft technology that is automatically installed with Microsoft IIS and is a programming interface to access data in a database. A common way to access a database from inside an ASP page is to:

- Create an ADO connection to a database
- Open the database connection
- Create an ADO recordset & open it
- Extract the data you need from the recordset
- Close the recordset & connection

8.5.6 Accessing the database

The two main ways to create a connection with the database are

- A (Data Source Name) DSN - Less connection where the file path of the database is specified in the ASP code.

  Example

  ```vbscript
  set conn=Server.CreateObject("ADODB.Connection")
  conn.Provider="Microsoft.Jet.OLEDB.4.0"
  conn.Open "c:/Database/sudpt.mdb"
  ```

- Create an Open Database Connection (ODBC) as follows:

  Start Menu ➔ Settings ➔ Control Panel ➔ Administrative Tools ➔ Data Sources (ODBC)

  In the ODBC data source administrator select the System DSN tab
Chapter 8 – Installation & Coding

Figure 8.2 ODBC Data Source Administrator

Click on Add…

Figure 8.3 Create New Data Source

Select the Microsoft Access Driver (*.mdb)
Enter the relevant details as shown in figure 8.4, and select the relevant database on your machine that correspond to the DSN. Finally open the connection using the following code:

```vba
Set oConn = Server.CreateObject("ADODB.Connection")
oConn.ConnectionString = "DSN=SUDPTdb"
oConn.Open
```

Coding Tip: The above code for database connection was placed in a separate file on the server and is included on every page that requires a database connection using Server Side Includes as discussed above.

### 8.5.7 Creating an ADO recordset

To be able to read data from a database, the data must first be loaded into a recordset while the database connection is open. Below is an example of how information contained in the admin_degreeAward table can be accessed combining ADO and SQL statements.

```vba
degreeSQL = "SELECT * FROM admin_degreeAward"
Set degreeRS = Server.CreateObject("ADODB.Connection")
```

//open the recordset
```vba
degreeRS.Open oConn
degreeRS.Open oConn
```

```vba
exampleRS.Execute updateEmpSearchSQL, adExecuteNoRecords
```
While ASP should automatically close and free up all object instantiations, it is always a good idea to **explicitly** close and free up object references in your code. Another good reason to do this arises when using connection pooling, here you want to close and free your ADO objects as soon as possible, if you do this explicitly once you're done with the ADO object it dumps the connection back into the pool sooner than if you wait until the page terminates, letting the terminating page implicitly close and freeing the ADO object.

Recordset objects can be created implicitly or explicitly. Many developers use code similar to this:

```vbs
Dim objConn
Set objConn = Server.CreateObject("ADODB.Connection")
objConn.Open "DSN=SomeDSN"
Dim objRS
Set objRS = objConn.Execute("SELECT * FROM MyTable")
```

### 8.5.8 Cursors and Locking

In the above scenario, objRS is the Recordset object. It was created *implicitly* by ADO. When a Recordset is created implicitly, the default cursor and locktypes are assigned to the recordset. When you execute a query, you are returned a set of rows. The cursor determines how the rows in the set are iterated through, and if the rows accurately reflect the real-time state of the database. The locktype determines how to lock the records when you try to update a row in your resultset. We will now discuss the four types of cursors and locking.
Cursors

- **adOpenForwardOnly** - this is the default cursor if no other is specified. This cursor allows only forward movement through a recordset.
- **adOpenKeyset** - this cursor supports forwards as well as backwards navigation. It also allows you to update a recordset and all changes will be reflected in other users recordsets. The cursor also supports bookmarking.
- **adOpenDynamic** - this cursor supports forward and backward navigation but bookmarks may not be supported (*i.e.* Access). Any changes made to data are immediately visible with no need to resynchronise the cursor with the database.
- **adOpenStatic** - this cursor uses a static copy of data from the database and therefore no changes to the data are visible and supports forward and backward navigation.

Since multiple users could have sets of data that overlap, the question exists, "How does the database handle individual updates to these sets of data, which may overlap?"

There are also four types of locking:

**Locking**

- **adLockReadOnly** - default type used when no locktype is specified.
- **adLockPessimistic** - forces the database to lock the entire record when editing first starts.
- **adLockOptimistic** - locks records only after you call the UPDATE method of the recordset object.
- **adLockBatchOptimistic** - allows batch updating instead of updating each record individually.

You cannot set a recordset object's locktype and cursor type when you create it implicitly. To set its locktype and cursor, you must create the recordset explicitly. To do this, you can use the following code:

```vba
Dim objConn
Set objConn = Server.CreateObject("ADODB.Connection")
objConn.Open "DSN=SomeDSN"

//EXPLICITLY Create a recordset object
```
Dim objRS
Set objRS = Server.CreateObject("ADODB.Recordset")

//Now you can play with the locktype
objRS.LockType = adLockReadOnly

//Now set the cursor
objRS.CursorType = adOpenForwardOnly

The above code assumes you have included ADOVBS.inc (an SSI file) at the top of your page. Notice the two constants adLockReadOnly and adOpenForwardOnly, these map to numeric values in ADOVBS.inc. Below we give a brief description of ADOVBS.inc

8.5.9 ADOVBS.inc
ADOVBS is an abbreviation for ActiveX Data Objects (ADO) for Visual Basic Script (VBS or VBScript). The reason for the Adovbs file is to allow developers’ write more readable and easier to follow ASP code, this file can be thought of as a dictionary which converts pseudo-English words into numeric values. The ADOVBS.inc file contains a list of all the named ADO constants and their numerical equivalents. When included in your ASP code it defines them as constants so you have access to them in your code. There is a vast number of these constants and most code you will see only uses a very small subset of them.

For more information on ADO and ODBC data sources we refer the reader to
- http://www.w3schools.com/ado/default.asp

8.6 Browser Detection
Due to the fact that this site is heavily reliant on JavaScript functions it is imperative that any prospective users have JavaScript enabled browsers. To go one step further we have recommend to prospective users that they have Microsoft Internet Explorer 5 or higher or Netscape 6 or greater to view the SUDPT site. This browser check is implemented when the user attempts to register their details with the site. If they do not have JavaScript enabled (this will be displayed on screen), they are not given the
registration link or if they have an older version of the browsers mentioned above, they will be prompted to upgrade the relevant system. This only works for Internet Explorer and Netscape browsers.

### 8.7 Website Statistics

At any given time the administrator may want to have SUDPT website statistics at hand. This feature is provided on the administrator’s welcome page where they can view the following:

- Number of users currently logged in
- Number of active & inactive users registered including dates of their last visit
- Number of database searches per employer

It is anticipated that the array of statistics will increase in time.

### 8.8 Email

From our analysis phase it was evident for the need to send emails to all system users at regular intervals. With this in mind we set about reviewing methods of sending emails to users in a database table-using Asp. Our findings led us to three possible options:

- CDONTS
- AspEmail

#### 8.8.1 CDONTS

CDONTS stands for Collaboration Data Objects for Windows NT Server and the component is a part of IIS 5. Although the component will run on Windows Server 2003, Microsoft has removed the component from IIS 5.1 on Windows XP and IIS 6.0. This component is used in connection with the SMTP server in IIS to send emails that can be coded in ASP. For more information on CDONTS we refer the reader to [http://msdn.microsoft.com/library/default.asp?url=/library/en-us/cdo/html/_denali_cdo_for_nts_library.asp](http://msdn.microsoft.com/library/default.asp?url=/library/en-us/cdo/html/_denali_cdo_for_nts_library.asp)
8.8.2 AspEmail
AspEmail 5.0 is an active server component for sending e-mail messages using an external SMTP server in an ASP or VB environment. AspEmail 5.0 supports multiple recipients, multiple file attachments, HTML format, embedded images and sounds, non-US ASCII character sets, secure mail, and high-performance message queuing.

8.8.3 The Decision
We choose AspEmail primarily due to the fact that the basic package was free and allowed the user the ability to specify the SMTP server that would send the emails. This SMTP server address is located in the admin_MISC table. The reason for this is to allow the administrator the ability to specify the SMTP server from which all emails will be sent i.e. in the case of UCD the address is “smtp.ucd.ie”. It also allows for the sending of attachments and HTML formatted emails. The following are a list of emails that the system currently has implemented in both text and HTML format.

- **Students & Graduates Section**
  - Forgot password
  - Account activation
  - Activate change of email

- **Employers Section**
  - Forgot password
  - Account activation
  - Activate change of email

- **Manager & Administrator Section**
  - Send general emails to all users or a selection of users
  - Send confirmation of employers account activation

In the following chapter we will discuss the remaining functions of the installation process.
Chapter 9 – Implementation & Maintenance

Testing & Roll Out

9.1 Introduction
Having discussed the installation and testing in the previous chapter we will now deal with the remaining aspects of the implementation phase namely testing, documentation, marketing and user training. Having finished discussing implementation we will then briefly outline the maintenance procedures at the end of this chapter. We will first focus on testing, which is further broken down into the discussion areas of system performance, sample test data and user prototype testing.

9.2 System Performance
Having implemented and tested the site, it became apparent that by minimising the size of various database tables especially the more dynamic ones, there was a direct correlation to system performance. Below we outline some methods to achieve this.

9.2.1 Data Integrity
In any relational database data integrity between tables is vital for the smooth and accurate performance of the system. A prime example of maintaining data integrity in the SUDPT database is the deletion of a class or a skill. If the administrator deletes a skill from the admin_skill (parent) table, this skill must also be removed from any (child) tables such as stuGrad_skill table to maintain the integrity of the system.

Example Delete Class
- Delete any instances of that class ID in the admin_skill and skill_correlation
• Delete the a class from admin_skillClass

Note: Always delete the children before the parent

9.2.2 Timestamp
After an employer has completed a query, and has ended their web session any instances of this query need to be removed from the employer_query table. However if there are multiple users of this system in any organisation searching the database at the same time there is a need to differentiate between users so their searches are not affected. This is overcome using a timestamp technique. When an employer logs onto the system a timestamp is created for that instance of that employer ID login. This timestamp is an integer value representing the time difference in seconds between the current system date and January 1st the following year:

\[ CDate("January 1, " \& (Year(Now())+1)) \]

This timestamp is then passed between all the employers’ pages and used as part of the composite key in the employer_query table. This query can then be deleted when the employer logs out without affecting any other session that may be using the same employer ID.

This query table will also be wiped clean nightly using a batch file.

9.2.3 Script Time Out
Having comprehensively reviewed the site, all of the ASP scripts employed with the exception of the add skill, skills correlation and search features executed within the default script time out period of 90 seconds (see figure 8.1). To overcome this the following code was inserted at the top of the pages searchSGDB.asp (asp script that performs the search), view_weight.asp (asp script to edit the correlations between skills) and add_skill.asp.

\[ Server.ScriptTimeout = 4000 \]

This code overwrites the default time out period and allows the server 4000 seconds to execute the code before an error is returned. Let us now take a closer look at the performance of these pages in an attempt to understand the reason for this protracted execution time.
9.2.4 Add Skill

When the administrator adds a new skill to the admin_skill table this skill is also correlated to all other skills in the skill_correlation table (containing the correlation between all skills or in graph theory terms contains the weights on all the arcs of the complete graph of skills) maintaining the relationship that all skills in the SKILL1 column are greater than their corresponding skills in the SKILL2 column. At any time the size of the skill_correlation table is

\[
\frac{n(n-1)}{2}
\]

(9.1)

where \( n \) is the number of skills in the admin_skill table. At the roll out stage of this project the number of skills in the database numbered 350 (see Appendix 3 for a list of all SUDPT skills) giving 61,075 correlations in the skill_correlation table representing a \( K_{350} \) graph. As can be seen the larger the number of skills the more time it will take to create all the correlations. The time taken to add a new skill is of the order \( n^2 \) and below is the code used to implement

```
//Create a recordset of all skills in the admin_skill table minus the new skill entered
//The new skill' ID will be greater than any other skill in the admin_skill table
skillCorrelationSQL = "SELECT * FROM admin_skill WHERE ID <> " & maxSkillID & " ORDER
BY SKILL_CLASS ASC"
Set skillCorrelationRS = oConn.Execute(skillCorrelationSQL)

//Loop down through the recordset inserting the new skill into the SKILL1 column in the
//skill_correlation table (n – 1) times and each skill in the recordset into the SKILL2 column.
//The default correlation (arc weight) is set to zero.

skillCorrelationRS.moveFirst
Do While Not skillCorrelationRS.EOF
    updateSkillCorrelationSQL = "INSERT INTO skill_correlation (PROFILE_ID, EMP_ID,
CLASS1, SKILL1, SKILL2, CLASS2, CORRELATION_ID) VALUES (0, 0, " & maxSkillClass & ", " & maxSkillID & ", " & Cint(skillCorrelationRS.fields("ID")) & ", " &
Cint(skillCorrelationRS.fields("SKILL_CLASS")) & ", 0)"
    Set updateSkillCorrelationRS = oConn.execute(updateSkillCorrelationSQL)
    skillCorrelationRS.moveNext
Loop
```

9.2.5 Viewing & editing Skill Weights

When a user requests the correlation between a particular skill and all the skills in a certain class the execution time of this process is quite slow for the simple fact that
the SQL statement employed to perform this query on the skill_correlation table is quite complicated and will take time anyway.

In the case of an employer who has created a weight profile and wants to create new weights in the skill_correlation table, only the skill correlations they require new weights for are inserted into the skill_correlation table to avoid inserting unnecessary data into the skill_correlation table. This process of minimising the table size comes at the price of a more complicated SQL statement that we had not managed to implement fully at the time of going to print.

In essence the SQL statement should display:

- Skill correlations between selected skills where the employer has created a weight profile for all skills to be displayed.
- Skill correlations between selected skills where the employer has created a weight profile for some skills and display the default correlation for the others.
- Display all default correlations if the employer has not selected a weight profile.

We are currently working on two SQL statements to implement this.

9.2.6 Search Feature

Looking at the search algorithm in chapter 7, we will now analyse its complexity in an attempt to explain its execution time.

Loop through the active students in the database \( (N_{sg}) \)

   Loop through the employer’s skills \( (S_{emp}) \)

      Loop through the current students skills \( (S_{sg}) \)

    End Loop

   End Loop

   Loop through students preferred locations \( (L_{sg}) \)

End Loop

Total complexity of search is or order \( N_{sg}S_{emp}S_{sg} + N_{sg}L_{sg} \)

Search Algorithm – O \( (N_{sg}S_{emp}S_{sg}) \)
Example
Number of active students = 200 ($N_{sg}$)
Number of employers skills specified = 5 ($S_{emp}$)
Average number of skills per student = 8 ($S_{sg}$)
Complexity = Number of rows visited in various database tables = 8000
As can be seen this provides an insight into the speed of the search feature and would require further investigation and refinement of the above algorithm to reduce the complexity.

Having discussed the performance of the system we now observe the performance of the system under different conditions. As discussed in chapter 6 most of the web pages collect data from the users and require data validation. Below is a summary of the performance of various system features under different entry conditions read in from the user.

9.3 Sample Test Data

In the following tables the Pass/Fail column refers to the expected test outcome.

### Test Data General Validation

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blank mandatory field</td>
<td>Prompt</td>
<td>Fail</td>
</tr>
<tr>
<td>2</td>
<td>Completed mandatory field</td>
<td>Save data to database</td>
<td>Pass</td>
</tr>
<tr>
<td>3</td>
<td>Unselected mandatory Drop down menu</td>
<td>Prompt</td>
<td>Fail</td>
</tr>
<tr>
<td>4</td>
<td>Selected mandatory Drop down menu</td>
<td>Save data to database</td>
<td>Pass</td>
</tr>
<tr>
<td>5</td>
<td>Unchecked mandatory check box</td>
<td>Prompt</td>
<td>Fail</td>
</tr>
<tr>
<td>6</td>
<td>Checked mandatory check box</td>
<td>Save data to database</td>
<td>Pass</td>
</tr>
</tbody>
</table>

### Test Data Login

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Incorrect username &amp; incorrect password</td>
<td>Error Message – Incorrect Username</td>
<td>Fail</td>
</tr>
<tr>
<td>2</td>
<td>Incorrect username &amp; correct password</td>
<td>Error Message – Incorrect Username</td>
<td>Fail</td>
</tr>
<tr>
<td>3</td>
<td>Correct username &amp; incorrect password</td>
<td>Error Message – Incorrect Password</td>
<td>Fail</td>
</tr>
<tr>
<td>4</td>
<td>Correct username &amp; correct password</td>
<td>Forward to welcome page</td>
<td>Pass</td>
</tr>
</tbody>
</table>
## Test Data Registration

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Existing Email Address</td>
<td>Error Message – Already Registered</td>
<td>Fail</td>
</tr>
<tr>
<td>2</td>
<td>New Email Address</td>
<td>Save details to database</td>
<td>Pass</td>
</tr>
</tbody>
</table>

## Test Data Date Function (ToJulian)

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11/29/2003</td>
<td>2003333</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>02/29/2003</td>
<td>0000000</td>
<td>Fail</td>
</tr>
<tr>
<td>3</td>
<td>11/33/2003</td>
<td>0000000</td>
<td>Fail</td>
</tr>
<tr>
<td>4</td>
<td>01/31/2003</td>
<td>2003031</td>
<td>Pass</td>
</tr>
<tr>
<td>5</td>
<td>09/31/2003</td>
<td>0000000</td>
<td>Fail</td>
</tr>
<tr>
<td>6</td>
<td>02/29/2004</td>
<td>2004060</td>
<td>Pass</td>
</tr>
<tr>
<td>7</td>
<td>02/29/1900</td>
<td>0000000</td>
<td>Fail</td>
</tr>
</tbody>
</table>

## Test Data Date Function (ToGregorian)

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0000000</td>
<td>Invalid Date</td>
<td>Fail</td>
</tr>
<tr>
<td>2</td>
<td>2004060</td>
<td>02/29/2003</td>
<td>Pass</td>
</tr>
<tr>
<td>3</td>
<td>2003333</td>
<td>11/33/2003</td>
<td>Pass</td>
</tr>
<tr>
<td>4</td>
<td>Hello</td>
<td>Invalid Date</td>
<td>Fail</td>
</tr>
<tr>
<td>5</td>
<td>2003333</td>
<td>Invalid Date</td>
<td>Fail</td>
</tr>
</tbody>
</table>

## Test Data Email Validation

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><a href="mailto:mms@ucd.ie">mms@ucd.ie</a></td>
<td>Validation pass</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>mms%@ucd.com</td>
<td>Prompt – Illegal Character</td>
<td>Fail</td>
</tr>
<tr>
<td>3</td>
<td><a href="mailto:mms@ucd.coms">mms@ucd.coms</a></td>
<td>Prompt – invalid email address (&gt;3 character after .)</td>
<td>Fail</td>
</tr>
<tr>
<td>4</td>
<td>mmsucd.ie</td>
<td>Prompt – invalid email address (no @ )</td>
<td>Fail</td>
</tr>
<tr>
<td>5</td>
<td>mm <a href="mailto:s@ucd.ie">s@ucd.ie</a></td>
<td>Prompt – invalid email address (no spaces allowed )</td>
<td>Fail</td>
</tr>
</tbody>
</table>

## Test Data Date of Birth Validation

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29/11/1977</td>
<td>Validation pass</td>
<td>Pass</td>
</tr>
<tr>
<td>2</td>
<td>29/02/2003</td>
<td>Prompt – Illegal Date (not leap year)</td>
<td>Fail</td>
</tr>
<tr>
<td>3</td>
<td>29/02/1900</td>
<td>Prompt – Illegal Date (not leap year)</td>
<td>Fail</td>
</tr>
<tr>
<td>4</td>
<td>31/09/2003</td>
<td>Prompt – Illegal Date (too many days on month)</td>
<td>Fail</td>
</tr>
<tr>
<td>5</td>
<td>45/12/2003</td>
<td>Prompt – Illegal Year (too many days on month)</td>
<td>Fail</td>
</tr>
<tr>
<td>6</td>
<td>12/122/2003</td>
<td>Prompt – Illegal Year</td>
<td>Fail</td>
</tr>
<tr>
<td>7</td>
<td>29/02/2000</td>
<td>Validation pass</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Chapter 9 – Testing & Roll Out

### Test Data

<table>
<thead>
<tr>
<th>Number</th>
<th>Test Data</th>
<th>Expected Result</th>
<th>Pass / Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MMS</td>
<td>Prompt – Illegal password <em>(too few characters)</em></td>
<td>Fail</td>
</tr>
<tr>
<td>2</td>
<td>MMS2</td>
<td>Prompt – Illegal password <em>(too few characters)</em></td>
<td>Fail</td>
</tr>
<tr>
<td>3</td>
<td>MMS2003</td>
<td>Validation pass</td>
<td>Pass</td>
</tr>
<tr>
<td>4</td>
<td>MMS&amp;</td>
<td>Prompt – Illegal password <em>(illegal characters)</em></td>
<td>Fail</td>
</tr>
<tr>
<td>5</td>
<td>2003</td>
<td>Prompt – Illegal password <em>(too few characters)</em></td>
<td>Fail</td>
</tr>
<tr>
<td>6</td>
<td>MMS2003*</td>
<td>Prompt – Illegal password <em>(illegal characters)</em></td>
<td>Fail</td>
</tr>
<tr>
<td>7</td>
<td>MMS2003MMS2003MMS2003</td>
<td>Prompt – Illegal password <em>(too many characters)</em></td>
<td>Fail</td>
</tr>
<tr>
<td>9</td>
<td>MMS 2003</td>
<td>Prompt – Illegal password <em>(no spaces allowed)</em></td>
<td>Fail</td>
</tr>
</tbody>
</table>

### 9.4 End user prototype testing

One important testing technique used was that of end user prototype testing, this was employed in the hope of eliminating any obvious design faults while also seeking the users opinion on the preliminary website layout. Having coded a first draft of the system we decided to send out questionnaires to prospective end users who had agreed to take part in this testing process asking them to proceed through the site as normal filling out all the relevant fields and then completing a questionnaire on the process. This proved a very beneficial approach as it not only highlighted any faults of the system but users also gave their opinion on the overall functionality along with any recommendations they had on future improvements to the site. Following the initial success of this approach we also decided to try the same approach for the employers section. Unfortunately it was more difficult to get recruitment consultants, we did however manage to get Peter Brennan of Star Retail Placement to review the site. For a full-unedited version of these returned questionnaires please consult the repository.

To test the system in terms of grammatical correctness we recruited the help of an American master’s student studying English literature who reviewed each individual page along with their constituent help files making amendments to the spelling and grammar whenever she saw fit. She also vetted the site from an international standpoint and rephrased some of the questions to make them more comprehensible to
Chapter 9 – Testing & Roll Out

the international student. Again an unedited summary of this meeting is contained in the central repository.

9.5 Documentation

Having reached this point in the SDLC the system documentation is already quite extensive and should be stored safely in the central repository. In this part of the system the main documentation is the online system documentation, i.e. help files. As stated above these were first written by the development team and subsequently reviewed by a masters student in English Literature, these help files were also reviewed by people with little or no experience in the area of online recruitment to ensure they are sufficient. Apart from the development of help files there was obviously extensive code to be commented during this phase and saved for future reference, however as a security precaution much of the online code was not commented.

9.6 System Marketing

As stated earlier another auxiliary part of the implementation stage is the design of marketing material for the company. We were given an initial budget of €1000 in this area; we felt that for the system to be a success the company had to be seen as a professional entity in the eyes of the student and employer. With this in mind we set about designing brochures advertising the company and focusing on the new system. We also set about designing business cards, letter heads, envelopes and compliment slips to be used by the manager in any SUDPT business. All these were designed using Quark Express, which we found to be very user friendly.

9.7 User Training

To ensure the successful integration of this system into SUDPT Ltd. it is vital that the manager and sole employee of the company is comfortable with every aspect of the new system. As Paul commissioned this project the barriers to change for the introduction of this system were minimal and once the system was functional he was given a brief tutorial on every aspect of the system with special emphasis on the administrator section and the privileges available to him when logged in as an
administrator. It is hoped that Paul will then be able to train any new employee of the company on the system functionality. It is also hoped that Paul will be able to guide prospective employers on the functionality of the system in the event of insufficient help files.

### 9.8 Maintenance

As this project concludes with the submission of this thesis it is impractical for the project development to maintain the system in the long term. During the planning stage the client and development team agreed on an initial two month maintenance period, following this the onus is on SUDPT to maintain the system or get a third party to do so. It should also be stated here that the skills feature would need to be assessed and upgraded on a regular basis to ensure that new skills coming online are catered for. For example the addition of a new course at the University of Limerick may offer a new set of skills that need to be incorporated into the system, secondly the continuous evolution of skills in the IT field necessitates constant reassessment.

### 9.9 Sample Full Time Search

Finally we will give a worked example of the search feature in operation. For this example there are two students registered in the database with the following skills

#### Students Information

<table>
<thead>
<tr>
<th>Student Number</th>
<th>Salary</th>
<th>Location</th>
<th>Degree</th>
<th>Skill</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>€35,000 – €38,000</td>
<td>Dublin</td>
<td>UG – 2.2</td>
<td>C++</td>
<td>1 Year</td>
</tr>
<tr>
<td>Student 1</td>
<td>€35,000 – €38,000</td>
<td>Cork</td>
<td>PC – 2.1</td>
<td>IC Design</td>
<td>Graduate</td>
</tr>
<tr>
<td>Student 2</td>
<td>€26,000 – €29,000</td>
<td>All Ireland</td>
<td>UG – 2.1</td>
<td>Calibration</td>
<td>5 Years</td>
</tr>
<tr>
<td>Student 2</td>
<td>€26,000 – €29,000</td>
<td>All Ireland</td>
<td>UG – 2.1</td>
<td>HACCP</td>
<td>3 Years</td>
</tr>
</tbody>
</table>
When an employer logs and searches the database, the following search criteria are specified.

**Employers Information**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Employer Selection</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary</td>
<td>€29,000 - €32,000</td>
<td>20</td>
</tr>
<tr>
<td>Location</td>
<td>Nass</td>
<td>20</td>
</tr>
<tr>
<td>Degree</td>
<td>2.1 Hons – Both UG Only</td>
<td>20</td>
</tr>
<tr>
<td>Skill 1</td>
<td>Java</td>
<td>40</td>
</tr>
<tr>
<td>Experience Skill 1</td>
<td>2 Years</td>
<td></td>
</tr>
<tr>
<td>Importance Skill 1</td>
<td>Important</td>
<td></td>
</tr>
<tr>
<td>Skill 2</td>
<td>HACCP</td>
<td>40</td>
</tr>
<tr>
<td>Experience Skill 2</td>
<td>5 Years</td>
<td></td>
</tr>
<tr>
<td>Importance Skill 2</td>
<td>Of slight Important</td>
<td></td>
</tr>
<tr>
<td>Skill 3</td>
<td>IC Design</td>
<td>40</td>
</tr>
<tr>
<td>Experience Skill 3</td>
<td>Graduate</td>
<td></td>
</tr>
<tr>
<td>Importance Skill 3</td>
<td>Very Important</td>
<td></td>
</tr>
</tbody>
</table>

**9.9.1 Similarity Calculations**

**Location**

<table>
<thead>
<tr>
<th>Student Number</th>
<th>Location Student</th>
<th>Location Employer</th>
<th>Similarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dublin</td>
<td>Nass</td>
<td>0.85</td>
</tr>
<tr>
<td>1</td>
<td>Cork</td>
<td>Nass</td>
<td>0.35</td>
</tr>
<tr>
<td>2</td>
<td>All Ireland</td>
<td>Nass</td>
<td>1</td>
</tr>
</tbody>
</table>

**Salary**

<table>
<thead>
<tr>
<th>Student Number</th>
<th>Location Student</th>
<th>Location Employer</th>
<th>Similarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>€35,000 – €38,000</td>
<td>€29,000 - €32,000</td>
<td>0.972</td>
</tr>
<tr>
<td>2</td>
<td>€26,000 – €29,000</td>
<td>€29,000 - €32,000</td>
<td>1</td>
</tr>
</tbody>
</table>

**Degree**

<table>
<thead>
<tr>
<th>Student Number</th>
<th>Degree Student</th>
<th>Degree Employer</th>
<th>Similarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UG – 2.2</td>
<td>2.1 Hons UG</td>
<td>0.8</td>
</tr>
<tr>
<td>2</td>
<td>UG – 2.1</td>
<td>2.1 Hons UG</td>
<td>1</td>
</tr>
</tbody>
</table>
## Skill

<table>
<thead>
<tr>
<th>Student Number</th>
<th>Skill Student</th>
<th>Skill Employer</th>
<th>Skill Similarity</th>
<th>Experience Similarity</th>
<th>Importance Factor</th>
<th>Total Skill Similarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C++</td>
<td>Java</td>
<td>0.25</td>
<td>0.5</td>
<td>0.66</td>
<td>0.0825</td>
</tr>
<tr>
<td>1</td>
<td>IC Design</td>
<td>Java</td>
<td>0</td>
<td>0</td>
<td>0.66</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Best Similarity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>0.0825</strong></td>
</tr>
<tr>
<td>1</td>
<td>C++</td>
<td>IC Design</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>IC Design</td>
<td>IC Design</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Best Similarity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>1</td>
<td>C++</td>
<td>HACCP</td>
<td>0</td>
<td>0</td>
<td>0.33</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>IC Design</td>
<td>HACCP</td>
<td>0</td>
<td>1</td>
<td>0.33</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Best Similarity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Total Similarity</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Average Similarity</strong></td>
</tr>
<tr>
<td>2</td>
<td>Calibration</td>
<td>Java</td>
<td>0</td>
<td>0</td>
<td>0.66</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>HACCP</td>
<td>Java</td>
<td>0</td>
<td>0</td>
<td>0.66</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Best Similarity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td>2</td>
<td>Calibration</td>
<td>IC Design</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>HACCP</td>
<td>IC Design</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Best Similarity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>0</strong></td>
</tr>
<tr>
<td>2</td>
<td>Calibration</td>
<td>HACCP</td>
<td>0.5</td>
<td>1</td>
<td>0.33</td>
<td>0.165</td>
</tr>
<tr>
<td>2</td>
<td>HACCP</td>
<td>HACCP</td>
<td>1</td>
<td>0.75</td>
<td>0.33</td>
<td>0.2475</td>
</tr>
<tr>
<td></td>
<td><strong>Best Similarity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>0.2475</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Total Similarity</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Average Similarity</strong></td>
</tr>
</tbody>
</table>
Weighted Similarity

<table>
<thead>
<tr>
<th></th>
<th>Student 1</th>
<th>Student 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill</td>
<td>0.360833</td>
<td>0.0825</td>
</tr>
<tr>
<td>Weight</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>0.1443332</td>
<td>0.033</td>
</tr>
<tr>
<td>Location</td>
<td>0.85</td>
<td>1.0</td>
</tr>
<tr>
<td>Weight</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>0.17</td>
<td>0.2</td>
</tr>
<tr>
<td>Salary</td>
<td>0.972</td>
<td>1.0</td>
</tr>
<tr>
<td>Weight</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>0.1944</td>
<td>0.2</td>
</tr>
<tr>
<td>Degree</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Weight</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>0.16</td>
<td>0.2</td>
</tr>
</tbody>
</table>

9.9.2 Similarity Results

Total Similarity

Student 1  0.6687
Student 2  0.633

These results will be displayed in order of similarity

Student 1  66.87%
Student 2  63.3%
Recommendations

Here we set out some recommendations on where we feel this project could be developed in the future.

**Technical recommendations**
We feel that the current utilisation of an Access database may be unable to cope with the amount of traffic on the site in years to come if the company reaches its target of registered users this year. This may warrant the upgrade of the database technology to MySQL.
We would also recommend that the server scripting language be upgraded from ASP to ASP.NET. This is object orientated and offers all the benefits of such over the procedural ASP. It will also offer faster execution time.
The development of the user interface may also be redesigned to use Flash.
At present we have a very basic spellchecker in operation for the addition of a new skill. This uses the ‘like’ function in SQL. The implementation of a more sophisticated spellchecker may be something that future projects may investigate.

**Usability and Functionality recommendations**
We also feel that six months after placing an employee in a job a follow up should be made enquiring on the performance of the candidate in question. Depending on the candidates’ performance the skills matrix could then be reassessed to incorporate this new information, this essentially introduces a self-improvement mechanism into the system, it is hoped the system will then improve its performance and accuracy over time.
The application of a Geographical Information System to more accurately calculate the location feature in the search. At present the distance is simply the straight-line distance and does not take into account the road structure or projected travel time. The application of a location feature for Europe and North America would also improve the overall usability of the system.
Conclusion

During the course of this project a number of different areas studied throughout the year were investigated with a view to incorporating them into the system. Initially Case Based Reasoning was researched to determine its suitability for the proposed system. Having been unable to see how this approach could be applied we decided to investigate the possibility of using a graph theory approach to represent and manipulate our data. Numerous different approaches were considered including Shortest Path Algorithms, Clustering techniques, Topological tree structures and finally a complete graph representation. This project also investigated the different comparative evaluation strategies out there with a view to adopting one for the purpose of this project. Following meetings with marketing personnel the compensatory evaluation strategy was adopted here. Multi Criteria decision Making was also incorporated into this project with a relative intensity measurement technique being used when allowing employers to wait search criteria available to them. This research stage was very important as it ensured all avenues had been explored before progressing to the design phase.

From a data collection point of view extensive research was conducted through the mediums of interviews and questionnaires. All groups who were seen as having an input into the system design were contacted and asked for their views on the proposed system. A high proportion of meetings were conducted with lecturers from different areas to develop a comprehensive skill set and skill correlation. Recruitment consultants were also interviewed to get their opinions on the proposed system, together these two groups impacted greatly on the overall system design and

Personnel Placement Decision Support System
functionality. This comprehensive research again added greatly to the validity of the completed system as the performance of any system can only ever be as good as the data it is based on.

Throughout the project development Computer Aided Software Engineering (CASE) tools were used to help the development team understand and clearly represent different aspects of the project. All the documentation developed during the SDLC is contained in the central repository contained at the rear of this thesis. This repository will prove invaluable assistance to students who wish to develop this area further. Having conducted extensive analysis the design phase focused primarily on the database and web page design. The sequential development of this phase was central to the completion of this project on time. The implementation stage offered another unique set of challenges to the development team with any unforeseen design issues arising in the system coding being overcome here. As with any Information System, testing was an integral part of the implementation phase. The development team adopted two testing approaches namely, end user prototype testing together with sample input data testing. Other parts of the implementation process included user training, documentation, marketing of system and installation. Procedures for future system maintenance were also established here.

As stated previously this system is not seen as the complete personnel placement solution but merely as a valuable tool to be used in the first stage of the development process. We do not claim that the best match returned from the system is unquestionably the right person for the job, we do however think that this person may warrant further investigation to see if they are in fact suitable for the job in question. What needs to be understood is that while technology, such as Internet recruitment, while providing a valuable service, should not preclude the human element. This means knowing when to draw the line. It would be naive to state that all employers are interested in is a quantifiable skill set, the truth is that employers are looking for a certain skill set coupled with a blend of confidence, sense of humour, team spirit and other attributes that match, in a perfect synergy, the company’s culture. With this in mind it is unrealistic to think that any IS system would have the capability of finding Personnel Placement Decision Support System
this perfect synergy, however we feel that this system can have a valuable input into
the recruitment process while also acting as a building block for future excursions into
this area.
Review of System

Paul O’Connor (Manager SUDPT Ltd.)

“When I first discussed the proposed new system with Michael and Conor I was very impressed by the extra options available and it would more than meet my needs. The finished product exceeded all expectations being both user friendly and accessible. Their suggested Business Development Plan ensures a bright and secure future for the Students’ Union Job Placement Agency”

William Ryan (PhD student of statistics at the University of Limerick)

“It is an excellent website that provides a very important service for the students of the University of Limerick. It is a very well structured site and easy to navigate. Obviously the designers have done a lot work in establishing a comprehensive list of skills to help match students to their desired jobs”

Shane Clifford (Masters student of Engineering at the University of Limerick)

“I was impressed with the overall appearance of the site. Navigation of the site is very intuitive, and the amount of information the user is prompted and permitted to enter is very comprehensive. The site’s interface will make it very easy for users to maintain and update their details”

Personnel Placement Decision Support System
**Norah Power (Computer Systems Course Leader, Department of Computer Science and Information Systems)**

“When Conor first came to me with this proposal I thought it was a very good idea to have a search engine that would match students and graduates with skills to employers. It is a good idea, the website is extremely easy to use. I think that the idea of using email as your username, it is quite easy to create accounts especially student accounts and employer accounts. There are a few things that need to be changed, but it has pretty good potential. Students will use it and I hope employers will use it. I think that Mick and Conor have done a very good job on this”

**Jim Kidd (Head of Direct Banking, Allied Irish Banks)**

“We were impressed with the work that had gone into it and felt it was an imaginative solution to a real business issue - we are all tied down with paperwork from time to time. Your solution was sound in its strategy, well executed and the business issues well thought through. We will be speaking to you further about how an input from AIB might benefit both UL and ourselves in Direct Banking.”
Word of Thanks

We would like to thank the following people for their invaluable assistance in the completion of this project:

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All the staff of UL Students’ Union
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Dermot (Slick) Hartigan
Dr Gerry Higgins
Dr Peter Williams
Dr. Andy Niven
Dr. Christine Cross
Dr. Derek Fitzgerald
Dr. Elaine Hutson
Dr. Frank McGourty
Dr. George O’Donnell
Dr. George O’Dwyer
Dr. Gerald Mills
Dr. JJ Leahy
Dr. Norah Power
Dr. Peter Keenan
Dr. PJ Smyth
Dr. Sean McGarraghy
Dr. Tim Hall
Eamonn O’Flynn
Eavan Coakley

Emma Tierney
Helena Lenihan
Jerry Cronin
Jim Dalton
Jim Kidd
Joe Wallace
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Mary Wallace
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Patricia Moriarity
Paudric Gallagher
Paul O’Connor
Peter Brennan
Prof. David J. Fegan
Robert Graydon
Roger Gough
Ross Davis
Sarah Wagner Mcoy
Seamus Dolan
Sean Reidy
Shane Clifford
Stan Blennerhassett
Tony Brabazon
William Ryan

Personnel Placement Decision Support System
1. Hobrough, John E: *Progression of skills and competencies from the university gateway to employment*, University of Surrey
3. Sides, Charles H: *How to write and present technical information*

**Personnel Placement Decision Support System**
21. http://www.seul.org/docs/whylinux.html#section5.1
25. UL undergraduate degree course prospectus
26. *Clustering Paper* :
   http://www.cs.strath.ac.uk/~mdd/research/publications/00dunlop_b.pdf
27. Grimes, Seth : *Modelling Object/Relational Databases*
   http://www.dbmsmag.com/9804d13.html
30. http://www.w3schools.com/sql
32. http://www.w3schools.com/vbscript/vbscript_ref_functions.asp
34. http://www.sloppycode.net/asp-components/
Appendix 1

Interview Documentation

- Interview Outline when interviewing academics
- Interview Outline when interviewing end users
- Letter of Introduction
- **Skills Data Collection Interviews**
  - Meeting Information
  - Skill List
  - Skill Correlation Table
  - SUDPT Employment Areas
  - Skill Correlation Definitions

- Feedback Questionnaire - Industry.doc
- Feedback Questionnaire – End User.doc
SUDPT – INTERVIEWS
Interview Outline when interviewing academics

Objectives:
1. Get a list of skills for their course
2. Fill out the grid structure containing those skills
3. Get their opinion on the system
4. Ask if we can contact them at a later date for further information

Agenda
1. Introduction
2. Background to project
3. Overview of interview
   Topics to be covered
4. Topic 1: ask for skills for that course and record them
   Topic 2: Show them a preliminary skills list and record any additions
   Topic 3: Obtain a complete skills list
   Topic 4: Fill out grid structure containing above skills
5. Summary of major points
6. Ask interviewee if they have anything further to add
7. Ask interviewee if it would be possible to approach them in the future if needed
8. Closing

Follow Up Work
1. Record General Observations on completion of meeting
2. Note unresolved issues, topics not covered
3. Store meeting documentation in central repository
4. Write up summary of meeting within 24 hours of completion of meeting
5. Organise follow up meeting if needed
SUDPT – INTERVIEWS
Interview Outline when interviewing end users

Objectives:
1. Ask for their opinion on online recruitment sites in general
2. Get a list of the online recruitment sites they have used and their preferred ones
3. Ask them what they see as the pros and cons of each site
4. Get their opinion on our proposed system and ask for any suggestions.
5. Ask if we can contact them at a later date for further information

Agenda
1. Introduction
2. Background to project
3. Overview of interview
   - Topics to be covered
4. Topic 1: ask for their opinion on recruitment sites in general
   - Topic 2: Get a list of the online sites they have used and their preferred ones.
   - Topic 3: Ask them what they see as the pros and cons of each site
   - Topic 4: Give a brief overview of our proposed system
   - Topic 5: Get a brief feedback on the proposed system
   - Topic 6: Ask them if they would be willing to review the online prototype
5. Summary of major points
6. Ask interviewee if they have anything further to add
7. Ask interviewee if it would be possible to approach them in the future if needed
8. Closing

Follow Up Work
1. Record General Observations on completion of meeting
2. Note unresolved issues, topics not covered
3. Store meeting documentation in central repository
4. Write up summary of meeting within 24 hours of completion of meeting
5. Organise follow up meeting if needed
Dear

I am a recent graduate of the University of Limerick, currently pursuing a Masters in Management Science at UCD. A major part of my masters is a research thesis “Design & Implementation of a Human Resource Management System” for a UL job placement agency SUDPT Ltd. based in the Student Centre.

SUDPT Ltd. was established in 2001 to cater for both present students and graduates. The agency served students by providing employment opportunities for those who needed money during the academic year and by establishing a client base that would provide employment to UL graduates for years to come.

To date this company has found employment for over two thousand students in a wide variety of jobs, both nationally and internationally. To maintain this growth we will install a fully functional Human Resources Management System that can adequately match the skills of the students and graduates with the needs of the employer and allow the manager of the company forge more links with potential employers.

To make this system as efficient as possible we will construct a complete set of skill categories based on input from course leaders for the university so that graduates can be presented in the best possible light to employers. In addition, we will explore the relationships between the skills within and between the categories; your feedback on the interplay and necessity of specific skills in your field will prove indispensable.

To achieve this we would be most grateful if you could afford us a small amount of your time as we feel that you are an expert in your field and are well placed to offer an informed view on the skills in your chosen field and the relationships and correlation between these skills. We know that you are probably very busy but we feel that this will be time well spent as your input will help to place students from this university in employment for years to come.

Yours Sincerely

Conor McNamara

E-mail: Conor.McNamara.2@student.ucd.ie
Mobile: 087-7758586
### SUDPT – HRMS INTERVIEWS

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SUDPT Employment Areas

1. Accounting
2. Arts, Media & Entertainment
3. Banking & Finance
4. Construction & Engineering
5. Education
6. HealthCare
7. Human Resources
8. Information Technology
9. Insurance
10. Languages
11. Legal
12. Marketing & Sales
13. Production, Manufacturing & Materials
14. Public Sector & Administration
15. Science
16. Telecommunications & Electronics
17. Tourism, Sport & Leisure
SUDPT Skill Correlations

- Unrelated
- Slightly Related
- Moderately Related
- Strongly Related
- Completely Related
1. Please comment on the overall usability of the site highlighting any positive and negative points you can think of.

2. What changes would you make to improve the usability of the site?

3. How did you find the employer section of the site, was it easy to navigate?

4. How user friendly did you think the employer search mechanism was, would you make any changes?

5. Did you use any help files while using the site, if so did you find them helpful?

6. Overall what do you think of the concept of the site, do you think it is commercially viable?

7. What marketing tools would you use to promote the site?

8. Do you have any recommendations for future additions to the site that would make it more appealing to the jobseeker or employer?

9. Please state anything other comments you think may be relevant.
SUDPT Questionnaire - End User

1. Have you used online recruitment sites in the past, if so which ones?

2. What do you think is the best online recruitment site out there at the moment?

3. Please state what you see as the major positive and negative aspects of such sites

4. What do you think makes up a good online recruitment site?

5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?

6. Having reviewed the SUDPT online recruitment site what do you think are it’s worst features?

7. What changes would you make to improve the usability of the site?

8. Do you have any recommendations for future additions to the site?

9. What marketing tools would you use to promote the site?
Appendix 2

Meeting Summaries

Paudric Gallagher - Career Advisor University of Limerick

Joe Wallace - Head of Human Resources, Department of Personnel and Employee Relations, University of Limerick

Helena Lenihan - Course Leader Bachelor of Business Studies Degree University of Limerick

Jerry Cronin - Careers and Cooperative Education Department, University of Limerick

Norah Power - Computer Systems Course Leader, Department of Computer Science and Information Systems

Dr. Tim Hall - Senior Lecturer, Department of Computer and Electronic Engineering, University of Limerick

Brian Greenford - Senior Lecturer in Insurance and Risk Management, Department of Accounting and Finance, University of Limerick

Christine Cross - Lecturer Department of Personnel and Employee Relations, College of Business, University of Limerick

Mary Sweeney - Head of Careers, Careers Department, University of Limerick

Norah Power - Computer Systems Course Leader, Department of Computer Science and Information Systems

Dermot Foley - Department of Human Resources, University of Limerick

Robert Graydon - Senior Recruitment Consultant, Irish Recruitment Consultants, Limerick Office

Dr. JJ Leahy - Course Director Industrial Chemistry, University of Limerick

Personnel Placement Decision Support System
Appendix 2 – Meeting Summaries

Dr. Tim Hall - Senior Lecturer, department of Computer and Electronic Engineering, University of Limerick

Dr. PJ Smyth - Course Leader BSc. Sport Science, Department of Physical Education and Sport Science, University of Limerick

Jim Dalton - Senior Marketing Lecturer, Department of Management and Marketing, College of Business, University of Limerick

Frank McGourty - Course Director of Equine Science and B.Sc (Education) Biological Science with Physics or Chemistry, Department of Life sciences, College of Science, University of Limerick

Tony Brabazon - Senior Lecturer, Department of Accountancy, Faculty of Commerce, University College Dublin

Dr. Elaine Hutson - Senior Lecturer, Department of Banking and Finance, Smurfit School of Business UCD

Mary Wallace - Course Leader of the Masters of International Tourism Degree Programme.

Dr. Andy Niven - Course Leader of the B.Eng. in Aeronautical Engineering, Department of Mechanical and Aeronautical Engineering, College of Engineering, University of Limerick

Dr. Peter Williams - Course Leader of the B.Tech in Production Management, Department of Manufacturing and Operations Engineering, College of Engineering, University of Limerick

Dr. Gerry Higgins - Course Leader of the B.Sc. in Material Science, Department of Chemical and Environmental Science, College of Science, University of Limerick

Dr. George O’Dwyer - Course Leader of the B.Sc. in Food Science, Department of Life Sciences, College of Science, University of Limerick

Patricia Moriarty - Arts Officer, University of Limerick

Aidan Killian - Senior Consultant, Irish Recruitment Consultants, 11 Ely Place, Dublin 2

Dr. George O’Donnell - Lecturer in Mechanical Engineering, Department of Mechanical Engineering, Faculty of Engineering, University College Dublin

Dr. Gerald Mills - Faculty of Geography, University college Dublin

Personnel Placement Decision Support System
Appendix 2 – Meeting Summaries

Prof. David J. Fegan - MSc, PhD, associate Professor of Experimental Physics, Department of Experimental Physics, Faculty of Science, University College Dublin

Mr. Jim Kidd - Sales Development Manager for AIB’s Direct Banking Division, AIB Head Offices, Ballsbridge, Dublin

Personnel Placement Decision Support System
Appendix 2

Meeting Summaries

11.30 A.M Friday 13th of June 2003
Meeting with Paudric Gallagher Career Advisor University of Limerick

The main purpose of this meeting was to see if Paudric could recommend any literature to me or point me towards someone who had a broad knowledge of the job placement industry. Again Paudric was very upbeat about the thesis and felt that this approach may be widely used in the future, although he did feel that this system may be more suited to skilled job seekers with a number of years experience rather than graduates who may not necessarily be skilled in one particular area but whose knowledge may encompass a wide range of skills, he also stressed that the so called soft skills such as communication and leadership skills often were of more importance to graduate employers rather than a vast technical knowledge of a particular area.

11.00 A.M. Wednesday 18th of June 2003
Meeting with Joe Wallace Head of Human Resources, Department of Personnel and Employee Relations, University of Limerick

Having read my initial email Joe felt that our data gathering methodology was fundamentally flawed in that by interviewing course leaders we would be unable the get enough in depth knowledge of large courses such as BBS which has a number of different streams and no one person within the department would be able to give us a broad view of all these streams. Joe then gave me the names of faculty members from the different streams within the course so that I could conduct more in depth research.
I began the meeting by outlining to Joe the way I intended to approach the data gathering part of the project. He then looked over the seventeen classes of skills we had come up with and was of the opinion that these were more than satisfactory. I then showed Joe the corresponding skills we had come up for each class and asked him for his views on these. Having reviewed the first skill class of Accountancy Joe felt that many of the skills needed to be rephrased and that some of the skills were not in fact skills at all but financial packages. Here Joe also felt that the idea of an employer recruiting solely on the basis of what packages the job seeker knew was again flawed as many companies want employees to have a broad range of skills rather than one specific skill. He also felt that some of the so called skills needed to be refined more clearly and took particular exception to the term computer literate which he felt need to be redefined.

Having reviewed the different skill classes and corresponding skills I then presented to Joe the method by which we hope to correlate the skills, initially he was quite impressed with this novel concept but he did express slight reservations about the weighting system he was of the opinion that some employers may be more interested in a candidate with a little knowledge of many areas than a candidate with an in depth knowledge of one particular area. This may need to be addressed further down the line in the system with an either/or option for employers.

Having reviewed the system as a whole we then concentrated on Joe’s specific area of Expertise and he gave me the following skills which he felt would accurately cover the area of human resources.

1. Interviewing
2. Knowledge of Labour Law
3. Knowledge of negotiations
4. Knowledge of Computer Systems
5. Management
6. Administration
7. Teaching

Having thanked Joe for his help the meeting concluded at 11.45AM.
1.30 P.M Thursday the 19th of June 2003

Meeting with Helena Lenihan, Course Leader Bachelor of Business Studies Degree University of Limerick

Again the meeting began with the outline of what we propose to do and initial feedback from the interviewee. Helena was very interested in the concept initially but as BBS is such a broad degree program she felt it necessary that we speak with one academic from each major option on the program, as Helena’s area of expertise lies in the area of economics we decided to focus on this for the remainder of the interview. Helena then submitted what she saw as a list of skills for this area.

1. Quantitative
2. Analytical
3. Logical Reasoning
4. Management
5. Teaching

Having entered these skills into the grid format Helena then offered her expert opinion on the correlation between the skills. Having completed this Helena then gave me contacts within the other majors in BBS who could help me.

Jim Dalton – Marketing
Siobhan Tiernan – Management
Brian Greenford – Insurance and Risk Management
Antoinette Flynn - Accounting

3.30 P.M Thursday the 19th of June

Meeting with Jerry Cronin, Careers and Cooperative Education Department, University of Limerick

Following my meeting with Paudric Gallagher last Friday he arranged for me to meet with Jerry who has been involved in numerous projects on what skills employers look for from graduates. Having explained what we hope to accomplish Jerry presented me with a few journals which outlined his research findings. The main conclusions from his research showed the differing skills employers from different countries focus on, although these terms were quite generic and may not be of direct use in the Personnel Placement Decision Support System.
implementation of the system they offer a valuable insight into the range of skills our systems should cater for so that all organisations are catered for. The meeting concluded after Jerry had made copies of the journals for me.

12.00 P.M Friday the 20th of June
Meeting with Norah Power, Computer Systems Course Leader, Department of Computer Science and Information Systems

Following our initial meeting last week Norah was already aware of what I needed from her. Having searched numerous recruitment websites I had come with a set of skills which consistently fell under the employment area IT/Computing. The approach I had to the meeting was to offer Norah this list of skills and let her select the ones that were relevant to her course with her also having the option of adding skills as she saw fit. This was quite a successful approach as it speeded up the whole process quite considerably. Having reviewed skills for three different employment areas (IT, Telecomms & Electronics and Engineering) we had come up with quite a substantial number of skills (somewhere in the region of sixty skills). The fact that we had come up with such a large skill set we decided to arrange a subsequent meeting for early next week where the correlation between the skills could be established. It was agreed that I would mail Norah to arrange a suitable time on Monday.

1.15 P.M Friday the 20th of June
Meeting with Dr. Tim Hall, Senior Lecturer, department of Computer and Electronic Engineering, University of Limerick

Having initially met with Dr. Elfed Lewis Head of Computer and Electronic Engineering last week, he advised me to meet with Tim who has experience in a number of different areas and is well placed to offer me a balanced insight into the skills that graduates form this Department would poses on entering the jobs market.
The three undergrad courses which we covered during the course of this interview was B.Eng Electronic Engineering
  B.Eng Computer Engineering
  B.Sc Electronic Systems

Personnel Placement Decision Support System
Appendix 2 – Meeting Summaries

Again the meeting began with me outlining the project scope and what we hope to accomplish. I then offered Tim the preliminary sheets of skills which I had come up with for three of the employment areas. Having progressed down through the three skills we again had come up with quite a substantial set of skills. As with Norah I thought it would be best if I arranged for another appointment at a later date when I had arranged the skills in the grid structure. Tim then suggested that it may be of some use to arrange the skills into smaller groups. For example programming could be split up into five areas as follows.

1. Archival (Fortran, Algol, Cobol)
2. Fundamental (Pascal, C)
3. Structural (Delphi, Java, C++)
4. Web Languages (ASP, PHP, JSP, Flash)
5. Database technology (Oracle, MySQL)
6. Engineering Packages (RSL etc)

He also suggested that areas such as Management, Technical Writing and Production could also be arranged in the same way. The meeting concluded with the agreement that I would call him early next week to arrange a further meeting.

**10.30 A.M Monday the 23rd of June**

Meeting with Brian Greenford, Senior Lecturer in Insurance and Risk Management, Department of Accounting and Finance, University of Limerick

There are two undergraduate courses that study the area of insurance and risk management, Bachelor of Business Studies with a major in Insurance and Risk Management and the Bachelor of Arts degree in insurance and European studies. As Brian is involved in both these programs he was an ideal person to talk to. Having first outlined what we are doing in a little more detail I then asked Brian if he could tell me the skills a graduate from these courses should be equipped with on leaving the university. Below is a list of the skills we ended up with

1. Assess/Establish/ Quantify Risk
2. Draw up safety Statements
3. Written Communication
4. Verbal Communication
5. Advise on life/non life policies
6. Computer Literate
7. Underwriting
8. Management of Claims
9. MS Excel

Having come up with this list of skills Brian then offered his opinion on the correlation between the skills. This was achieved quite quickly and what is notable is the consistently strong correlation between the skills All the documentation for this meeting is stored in the central repository Having thanked Brian for his input the meeting concluded at 11.05 A.M

10.30 A.M Tuesday the 24th of June
Meeting with Christine Cross, Lecturer Department of Personnel and Employee Relations, College of Business, University of Limerick

Mick had already made contact with Christine on his last visit to UL but due to time constraints was not able to meet her. Following this it was agreed that I would meet with her to see if she could offer me any extra resources to help us in our data collection phase of the project. Christine is a past student of The Smurfit Graduate School of Business where she undertook an MBS in HR. With this in mind she was quite aware of the nature of our thesis and what we want to achieve. Having outlined the whole project to her she felt that the research methodology was quite good. She did express a slight concern that there was no employment area entitled Economics as she felt it was quite a broad and important area. Having reviewed the skills given by Joe Wallace for the area of HR she felt that they were quite sparse and did not adequately describe the skills of a HR graduate from the university. She then agreed to come with her own set of skills for the area. As Christine had spent a large amount of her working life in industry she seemed to be much more in touch with the needs of employers than most academics. She proposed that I go and speak to Robert Graydon of Irish Recruitment Consultants who she feels may have an interest in this area. He is
also highly involved in the CIPD (Chartered Institute of Personnel and Development). The CIPD has more than 110,000 members and is the professional body for all those specialising in the management and development of people. On concluding the meeting Christine offered her help again in the future if needed. The meeting concluded at 11.10 A.M.

3.00 P.M Tuesday the 24th of June
Meeting with Mary Sweeney, Head of Careers, Careers Department, University of Limerick

Having come in contact with Mary during my undergraduate studies at UL I felt that with her years of experience in the area of placing graduates that she would be a knowledgeable person in the area of graduate skills and skill correlation. Having explained what we hoped to achieve and how we were going about it I asked Mary if she had ever been involved in such a project or if she had heard of anyone who had attempted something similar. Unfortunately Mary had never come across such a concept and the whole thing seemed quite alien to her. She issued me with a hard copy of the prospectus covering every undergraduate course in the college which she felt may contain some skills. Unfortunately under further investigation this proved not to be the case. The meeting concluded at 3.25 P.M.

3.30 P.M Tuesday the 24th of June
Meeting with Norah Power, Computer Systems Course Leader, Department of Computer Science and Information Systems

Following on from our last meeting where Norah selected in the region of sixty skills which she felt students from the Bachelor of Science in Computer Systems would be equipped with on graduating. These sixty ‘skills’ mostly encompassed software packages and programming languages. Having gone away and put together a grid structure of sixty skills we spent an hour and fifteen minutes filling it out. Norah’s cooperation and enthusiasm in this was invaluable. Having completed the grid structure Norah stressed that I should also perform this procedure with another member of her faculty so that I could get more balanced data. Having thanked Norah...
sincerely for her help the meeting concluded at 4.45 P.M. A full list of the skills from this meeting can be found in the central repository along with the completed grid structure.

12.00 P.M Wednesday the 25th of June
Meeting with Dermot Foley, Department of Human Resources, University of Limerick

Following Mick’s brief meeting with Dermot on his last visit to UL I arranged to meet him to see if he could offer us anymore assistance. Dermot is an experienced HR professional having worked in industry for thirteen years before moving to UL. Having given a brief synopsis of the system to familiarise Dermot we reviewed each employment area. Dermot stressed the importance of the different ways to approach each area. While the IT area may be focused on certain specific skills areas such as accountancy may need to be approached differently. Dermot feels that employers would not only be looking for specific skills but the path they have taken may also be very important. In accountancy for example one might take the professional route or the industry route.

Following on from this Dermot then gave me the name of a site maintained by UK universities which may be of use to us. This site www.jobs.ac.uk recruits people to academic institutions and has quite extensive skill menus. Dermot was also of the opinion that an extra text box titled ‘Additional information which you think is relevant’ would also be beneficial to employers as they may get a brief insight into the character of the individual before the interview stage. On the issue of extra resources that may help us he felt recent issues of Chartered Institute of Personnel and Development (CIPD) magazines may be of interest. The Chartered Institute of Personnel and Development (CIPD) is the professional body for those involved in the management and development of people. It offers numerous resources on the area of personnel including a fortnightly magazine People Management. He also mentioned that certain software houses specialise in such systems and companies such as Wiztek and CORE (www.core2000.ie) that incidentally produces the software used by the HR department in UCD may be worth looking up. Finally Dermot also said that FAS had done some work with is area and had come up with a list of skills for different job Personnel Placement Decision Support System
Having said this Dermot felt that recruitment agencies and these software houses would be very reluctant to speak to us. Having thanked Dermot for his help the meeting concluded at 12.45 P.M.

4.00 P.M Thursday the 26th of June
Meeting with Robert Graydon, Senior Recruitment Consultant, Irish Recruitment Consultants, Limerick Office

Following my meeting with Christine Cross I arranged to meet with Robert at his office. Initially I gave him a brief outline of the thesis content and how we were going to implement these ideas. I then explained to Robert the problems we were having in getting skills for some employment areas. First of all I asked him what he felt employers look for when recruiting in the area of accountancy. Robert felt that when employers are recruiting graduate accountants they will look for a commerce graduates with a major in accountancy. When recruiting experienced accountants he said that while the list of skills were valid most employers primary concern was which institutes exams they had completed, secondary to this where they did their training was also an important factor. Many employers according to Robert have a preference for people with big four experience as they would have had exposure to all areas of accounting. However this is not a hard and fast rule accountants who have done their training in industry may be more adept in the areas of cost and management accountancy.

We then moved onto the next area that was proving to be a little difficult to get a concise set of skills for. Although IRC have little experience in this area Robert felt that most companies recruit graduates on the basis of their degree and results achieved, Robert also felt that employers may have a preference for those who took the BCL(Bachelor of Civil Law) route. When recruiting qualified solicitors he said that a very small minority of firms use recruitment agencies and prefer to promote from within. Again the next area that was proving troublesome was not catered for by IRC, Education Robert felt would centre on the degree and the relevant postgraduate qualification completed. From the skills point of view he felt a list of second level subjects should cover skills searched for by employers when recruiting second level teachers. On the area of banking and finance, Robert referred me to a colleague of his
Aiden Kileen (01-6114315) from their Dublin office who specialises in that area. Robert offered to call him and arrange for him to take a call from me over the coming week.

I then asked Robert what skills a person involved in sales should be equipped with. In this area the number one priority for recruiters is experience and a proven track record. When pushed to sum up their skills he came up with communication, presentation and the ability to manage a database whether it be a specialist software package or a manual filing system. Although we have grouped the areas of sales and marketing into one employment for the purpose our system Robert was of the opinion that the two are fundamentally different areas. In Robert’s experience a prerequisite to get into the area of marketing is a recognised qualification in the area preferably a degree. Following on from this there are a number of core skills which any person involved in marketing should possess.

1. Development of promotional material
2. Mail Shooting
3. Mail Tracking
4. Statistics
5. Research a Market
6. Communication
7. Presentation (Powerpoint)
8. Computer Literate
9. Budget Management
10. Market Share estimation
11. Campaign Management
12. Questionnaire Development

Following on from this another major factor for employers is recent successful campaigns the job seeker was involved in.

In the area of tourism Robert said that it is now becoming the norm for all hotels to look for some sort of formal training whether it be Certificates Diplomas or Degrees when recruiting. Knowledge in the widely used online booking systems such as GALIO and Fidelio is another major factor when recruiting hotel receptionists. From the Sport and Leisure point of view a recognised qualification is again a must.
but again Irish Recruitment Consultants have little or no experience in this area. The final employment area I asked Robert about was the area of languages. IRC have extensive experience in this area as they help to man any of the call centres located in the mid west. When recruiting telesales or technical support people they will only recruit native or fluent speakers with a preference for native speakers due to their ability to adapt to the different dialects that exist within certain countries. Anyone with less than fluent language skills will not even be considered. When recruiting technical support people with a foreign language they will usually divide them into three levels. Broadly speaking this is done along the level of qualification they possess. A person with a certificate may be assigned to level one, a person with a diploma may be assigned to level two and a person with a degree will be assigned to level three. Having thanked Robert for his very informative thoughts we concluded the meeting at 5.05 P.M.

10.00 A.M Monday the 30th of June
Meeting with Dr. JJ Leahy, Course Director Industrial Chemistry, University of Limerick

Having come up with an initial set of skills for the employment area of Science I explained to JJ what was involved in this research and asked him if he could list the skills graduates from this course are equipped with on leaving the university. Initially JJ came up with a list of ten skills and on reviewing my preliminary list this swelled to twenty-three. As this list was quite extensive JJ felt that he would not have the time to fill it out immediately so I agreed to drop back a completed grid section, which JJ would fill out over the next couple of days. On conclusion of the meeting we arranged for me to call in again tomorrow evening to collect the completed grid section. Having thanked JJ for his help the meeting concluded at 10.35 A.M.

11.30 A.M Monday the 30th of June
Meeting with Dr. Tim Hall, Senior Lecturer, department of Computer and Electronic Engineering, University of Limerick

Personnel Placement Decision Support System
Following our initial meeting last week where Tim had come up with a number of skills covering the degree courses in Computer & Electronic Engineering and Electronic Systems, I had constructed two different grids one containing all the skills that fall under the employment area telecoms and electronics and the other falling under the area IT. The IT skill set was split into the following areas.

1. Archival Languages
2. Fundamental Languages.
3. Structured Languages
4. Web Based Packages
5. Database Technology
6. Operating Systems

This classification of skills made the completion of the grid like structure much easier. Areas 1,4,5 and 6 were seen as having interclass relationships but no cross class relationships while areas 2 and 3 were seen as having a strong cross class relationship. On completion of the two grid like structures I thanked Tim for his invaluable assistance and the meeting concluded at 12.35 P.M

9.00 A.M Tuesday the 1st of July
Meeting with Dr. PJ Smyth, Course Leader BSc. Sport Science, Department of Physical Education and Sport Science, University of Limerick

In our quest to produce as comprehensive a system as possible we decided to speak to someone in the area of PE and sport science. Initially PJ outlined the main aims and objectives of the course which basically are to provide graduates with an in-depth knowledge and understanding of the key elements of Sport and Exercise Sciences. When I asked PJ what areas of employment students enter on completion of the course he was keen to stress that upwards of 80% of graduates go on to pursue some sort of future study be it as a research student or further taught programs. Below is a list of careers that graduates who have completed this course have gone into in the past.

- Sports science consultants with National Sports Agencies.
Appendix 2 – Meeting Summaries

- Sports science advisors with policy making boards in the areas pertaining to health, exercise and fitness.
- Development officers/coaches/administrators with national sports agencies.
- Sport and exercise research and development
- Leisure, recreation and tourism based on sport and exercise activities
- Health and fitness advisors, including fitness testing, exercise prescription, fitness consulting, exercise rehabilitation for specific populations, management of sport and fitness centres and corporate fitness programmes.
- Sport journalism and Radio/TV sport production
- Research and marketing with sport and exercise manufacturing and other commercial industries (e.g. equipment, clothing, footwear, food, drink etc).

The main areas of expertise that graduates from this course are equipped with would be in the following areas.

- Physiology
- Biomechanics
- Psychology

Over their four years each student would undertake at least six different modules in each of these areas. From a computer literacy point of view students have recently began using specialist statistical software called SPSS which is an invaluable tool for those pursuing a career in research. Along with this a basic knowledge of the Microsoft packages such as Word and Excel is also attained. Apart from what is listed above there seems to very few other ‘hard’ skills an employer would look for when recruiting from this course and further study seems to be the option taken by the vast majority of Sport Science graduates. Having thanked PJ for his help the meeting concluded at 9.40 A.M

11.00 A.M Tuesday the 1st of July
Meeting with Jim Dalton, Senior Marketing Lecturer, Department of Management and Marketing, College of Business, University of Limerick

Personnel Placement Decision Support System
Having spoken briefly to Jim last week he already had a brief understanding of what I needed from him and what I was trying to implement. He first outlined what he saw as necessary ‘soft’ skills for someone to succeed in the field of marketing. The following attributes are a must for any individual hoping to be successful in the field.

- Presentation Skills
- Report writing
- Ability to research a project
- Understand the relationships between the micro and macro environments
- Be energetic

I then showed Jim the list of preliminary hard skills I had come up with through online research. Having reviewed these Jim came up with fourteen skills that he felt were relevant to the BBS students with a major in marketing. We then proceeded to fill out the grid structure which was accomplished quite efficiently. Having agreed to send Jim a report on completion of the thesis we concluded our meeting at 11.40 A.M

9.00 A.M Thursday the 3rd of July
Meeting with Frank McGourty, Course Director of Equine Science and B.Sc (Education) Biological Science with Physics or Chemistry, Department of Life sciences, College of Science, University of Limerick

As Frank is course director of two different undergraduate programs at the University of Limerick we were very keen to talk to him. He is course director for both the B.Sc. in Equine Science and the B.Sc. (Education) in Biological Science. We began the interview with a brief outline of what the project consisted of and what the main objectives of the meeting were. We began by concentrating on the B.Sc. (Education) in Biological Science. Frank felt that the skills accumulated by graduates of this course could be grouped under the following headings.

- Teaching Professional Skills
  - Junior science
  - Senior Biology
Appendix 2 – Meeting Summaries

- Chemistry and/or Physics
  - Generic Skills
    - Communication
    - Learning
      - Hinting
      - Doing
      - Attitudinal Skills
  - Scientific Skills
    - Knowledge of subject area
    - Practical laboratory skills
  - Professional Education Skills
    - Psychology
    - Human sociology
    - Curriculum Development
    - Assessment
  - IT Skills
    - Application Software

Frank was also very keen to stress that graduates from this course were not tied to a career in teaching with many using the wide variety of skills learned to branch out in different areas. For example many have undertaken positions as laboratory researchers. Frank also highlighted the fact that due to the strong psychology element in the course many had made careers for themselves in the software development field as they were able to understand the rationale of the human brain. Having come up with a concrete list of skills for his area we then proceeded to complete a corresponding grid structure.

We then turned our attention to the B.Sc. in Equine Science degree program that Frank also directed. This was again quite a broad course with the aim of giving the student a broad understanding of a number of different areas with an obvious strong focus on the equine business. Again Frank tried to categorise the skills acquired by a graduate of this course into main areas listed below before expanding on each individual category.

- IT

Personnel Placement Decision Support System
Appendix 2 – Meeting Summaries

- Communication & Presentation
- Languages
- Scientific
- Business
- Facility Management
- Horse Interaction skills

These areas were then broken down further to give us a complete skill set of fourteen. Having achieved this we then proceeded to fill out a grid structure for this area. For the completed grid structures and other documentation accompanying this meeting please consult the repository.

2.00 P.M Friday the 4th of July
Meeting with Tony Brabazon, Senior Lecturer, Department of Accountancy, Faculty of Commerce, University College Dublin

As I had already met Tony when he presented some possible theses topics for the MMS class I decided to seek his help in coming up with a set of skills for the field of Accounting. I again gave a brief explanation of what the thesis entailed and offered him a list of possible skills/tasks that I had come up with from various recruitment sites. Tony felt that twelve of these were relevant to commerce graduates who had majored in accounting. Having attained these skills we then filled out the grid structure to incorporate the correlations between these skills. This whole procedure took approximately twenty minutes, when we had concluded filing out this structure Tony was keen to stress that none of these skills were any good to you unless you have good interpersonal skills and he felt there may be a case for incorporating a set of ‘soft’ skills into the system. He also was keen to stress that although employers may look for similar skills their levels of importance may differ from employer to employer. Although we will take Tony’s comments into account we feel at this time that incorporating soft skills may make the system overly complex and reduce it’s efficiency and as the system is only designed to act as the first stage in the recruitment process we feel that a conclusive set of hard skills will weed out the unsuitable candidates with the ‘soft’ skills being assessed at interview stage.

Personnel Placement Decision Support System
11.00 A.M Friday the 11th of July
Meeting with Dr. Elaine Hutson, Senior Lecturer, Department of Banking and Finance, Smurfit School of Business UCD

Although there is no specific course in the area of Banking and Finance at the University of Limerick we felt still felt it was worthy of a major heading as a major employment area due to the huge number of graduates that gain employment in this area each year. To adequately determine the skills that employers look for when recruiting in this area we felt that speaking to someone with in depth experience in this area would be of benefit. To this end we decided to speak with Dr. Elaine Hutson who is a senior lecturer in Banking and Finance at the Smurfit School of Business.

Having explained to Elaine what we were trying to do and offering her a preliminary list of skills got from numerous recruitment websites she came up with seventeen different skills/tasks/areas of expertise that she felt an employer may look for when recruiting graduates. I then explained the grid structure to Elaine and we proceeded to fill it out. The completed grid structure and the remaining meeting documentation was then placed in the central repository. Having thanked Elaine for her help the meeting concluded at 11.30 A.M

10.00 A.M Tuesday the 15th of July
Meeting with Mary Wallace, Course Leader of the Masters of International Tourism Degree Programme.

As the Tourist Industry is one of the largest employment sectors in the country we felt that to make this commercially viable we would have no option but to incorporate a tourism element to our system. Although UL has no undergrad program which directly caters for the Tourist Industry, many graduates pursue careers in this area. The only program that is solely dedicated to providing workers for the tourist industry is the Masters in International Tourism Degree Program. To begin our data collection for this employment area we decided to speak with Mary Wallace.

Mary began by giving me a brief description of the program which consists of two semesters taught with the final one spent undertaking a research thesis. The class size
ranges from twenty to twenty five with the profile of students varying greatly. The present class consists of students with backgrounds ranging from arts and business to mature students who have worked in the industry for years. Each year there is also a number of international students who undertake this well respected program. From the outset of this interview Mary was keen to stress that this program is not concerned with the hands on aspect or the “spoons and forks” aspect of the industry but instead the course aims to focus on the bigger picture of how the industry ticks and how it interacts with local national and global issues. Below is a list of areas of expertise that a graduate from this course would possess.

- Focus on Policy and Planning at a local, national and international level
- Languages
- Policy and Planning implications
- Research Skills
- Report Writing
- Knowledge of Institutional Structures for planning of Irish Tourism
- Customer Service
- Analysis of International Trends
- Statistics
- SPSS (Software Package)
- ECDL Qualification
- Tourism Policy Management
- Knowledge of EU tourism Policy
- Knowledge of Airline deregulation and Airport Structures

Having got an understanding of what the course involves I then asked Mary where graduates have been placed in the past Below is a list of organisations that typically recruit graduates.

- Regional Tourism Operators
- Airlines/Airports
- Hotels and Marketing offices

Personnel Placement Decision Support System
Having gained a deep insight into the only dedicated tourism course Mary suggested that I speak to someone in the Shannon College of Hotel Management who would be able to give me some information on the more hands on side of the industry. Having thanked Mary for her time the meeting concluded at 10.45 A.M

11.30 A.M Tuesday the 15th of July 2003,
Meeting with Dr. Andy Niven, Course Leader of the B.Eng. in Aeronautical Engineering, Department of Mechanical and Aeronautical Engineering, College of Engineering, University of Limerick

As UL started out primarily as a technical college and still puts great emphasis on its strong engineering faculty it is imperative that we adequately represent graduates from the college of engineering to make the system a success in the long term. Dr. Nevin was the first member of this department that I managed to track down. Having explained the goal of the project Andy agreed to fill out the relevant documentation but due to time constraints on his part he was unable to fill them out there and then so having explained what I needed to be done in great detail he agreed to fill out the form later that evening and post it on to me.

2.00 P.M Tuesday the 15th of July 2003
Meeting with Dr Peter Williams, Course Leader of the B.Tech in Production Management, Department of Manufacturing and Operations Engineering, College of Engineering, University of Limerick

This course is unique in that it is offered by the College of Engineering in conjunction with the College of Business. This course has been designed to incorporate a broad base of engineering, science and business subjects, thereby educating graduates who have an understanding of the technical, social and business aspects of Industrial Production. In view of this the career choice of graduates leaving this program is quite Personnel Placement Decision Support System
Appendix 2 – Meeting Summaries

varied with graduates going on to work in fields as far reaching as accounting and manufacturing engineering. After speaking to Peter for a couple of minutes that this course had a lot of similarities with the MMS. When I initially asked Peter to describe what students take form the course he said a ‘broad but shallow education’ and by the end of the meeting I understood exactly what he meant. When asked to describe the profile of a typical student from this course he said they would be qualitative as opposed to quantitative, forward looking with good numeric and team working skills. When asked for a list of skills Peter was quite forthcoming which again reinforced the fact that this course offered quite a broad education and we finally came up with twenty-one skills. These are listed in the central repository.

12.00 P.M Wednesday the 16th of July 2003

Meeting with Dr. Gerry Higgins, Course Leader of the B.Sc. in Material Science, Department of Chemical and Environmental Science, College of Science, University of Limerick

Mick originally made contact with a friend of his who works as a technician in the department of Environmental Science who in turn organised a meeting with Dr. Gerry Higgins. As the area of science is quite broad it was necessary to get input from people with very varied backgrounds. To that end we spoke with Dr. Gerry Higgins Course Leader for the B.Sc. in Material Science. Again Gerry was quite sceptical originally but following a little persuasion he agreed to facilitate us in our information gathering. The Material Science course again proved a perfect area to apply our chosen techniques to as it offered a set of easily quantifiable skills. The corresponding grid structure was also quite easily developed. In the end we came up with a list of thirteen specific skills that a graduate of Material Science would be expected to be competent in. Having thanked Gerry for his input we concluded the meeting at 12.30 P.M.

2.00 P.M Wednesday the 16th of July 2003

Meeting with Dr. George O’Dwyer, Course Leader of the B.Sc. in Food Science, Department of Life Sciences, College of Science, University of Limerick

Personnel Placement Decision Support System
Having covered all the other major science courses in UL all that remained was the area of Food Science that has grown considerably in recent years. Again in order to come up with a definitive set of skills for this course I built up a preliminary set from various recruitment websites and the course prospectus, I then asked George to select all the skills that were relevant to this particular course. After selecting the ones form the list he felt were relevant and adding a few extra we were left with a total of twenty-three skills. Having explained how the correlation grid would function we set about filling out the upper triangular grid matrix. This proved quite time consuming but due to the unwavering cooperation of George we managed to complete the entire grid in one sitting. Having thanked George sincerely for his help the meeting concluded at 2.45 P.M.

2.00 P.M Monday the 21st of July 2003
Meeting with Patricia Moriarty, Arts Officer, University of Limerick

In our quest to find a complete set of skills for the area of arts Media and Entertainment Mick made contact with the Arts Officer at UL. The duties of the Arts Officer are quite varied. From a broad point of view she has the responsibility of promoting the whole Arts movement within the University. This involves the organising of various events from a weekly movie showing to the organising of SOUL week. Having explained to Patricia what we were doing and explaining what I needed she was more than willing to help. She initially found it quite difficult to quantify the skills of an Arts student. Their area of study can encompass many areas from philosophy to English to politics and trying to extract quantifiable skills from these areas is quite difficult. Again when I asked Patricia to outline the career paths of arts graduates in the past she was at a loss to do so, this is down to the wide scope these courses offer for future careers. She also stressed that many graduates from Arts go on to pursue postgraduate qualifications either in their own area or in a different subject area all together. It is common for those who specialise in different areas of arts to pursue as a career as an academic; those who pursue a postgraduate qualification in a completely different area have many different career options. Having said this when reviewing the area as a whole we were able to come up with
Appendix 2 – Meeting Summaries

certain career paths that an arts graduate was likely to have. Unfortunately the development of a grid structure was not feasible for this employment area but in keeping with the aims of the project we have managed to obtain a list of skills for yet another employment area. Having thanked Patricia for her help the meeting concluded at 2.40 PM.

10.00 A.M Tuesday the 22nd of July 2003
Meeting with Aidan Killian, Senior Consultant, Irish Recruitment Consultants, 11 Ely Place, Dublin 2

Following my meeting with Robert Graydon of IRC in Limerick he suggested I meet with Aidan who caters specifically for the Banking and Finance employment area. Basically I asked Aidan to give me an overall view of where graduates coming into the industry end up and what attributes employers look for in these graduates. Although IRC do not traditionally place graduates Aidan has had experience of placing graduates in the banking and finance area in the past. From the outset Aidan was very keen to stress that employers look very unfavourably on graduates who have not taken a gap year as they feel that graduates will try to get a couple of years experience and then leave to travel. As the cost of recruiting a graduate is quite substantial companies do not start to recoup this initial outlay until a year after the start date. It should also be mentioned here that employers have a preference for EU nationals even though they may not be allowed to say this in writing.

For a graduate to gain employment in the banking and finance industry it is expected that they have at least a 2.1 honours degree as-well as a good Leaving Cert. Having explained the search criteria our system will operate by Aidan recommended that we include Leaving Cert results as some companies will not recruit without a certain number of honours in the Leaving Cert and this is not negotiable. Another point that Aidan was keen to make was that even good honours student with a relevant masters degree will still enter the field at an entry level position as they will not have any real experience.

Most graduates who enter the Banking and Finance fields are expected to go on and pursue an ACCA qualification. If they are not interested in this the very least they will have to do is an IATA qualification which will give them a good understanding of Personnel Placement Decision Support System
accounting practice but will not allow them to act as a certified accountant. The two main areas that recruit graduates at the moment are corporate finance and treasury. The major financial institutions through their online recruitment sites usually offer these positions. Employers seeking treasury employees will usually look for someone who is good with figures and has an entrepreneurial flair, psychometric testing is usually used to determine these skills. The one area which is currently candidate driven is fund accountancy. Large institutions such as CityBank, AIB, BOI and JP Morgan Chase are currently recruiting graduates in this area. As all the front office work is done in either London or New York all the work on offer in Dublin is in the back office. The typical career path of a trainee fund accountant is an initial six months as a junior with people of promise then graduating to a senior role, if at that stage you decide to undertake an ACCA qualification you would be in line for an supervisory role within three to four years with salaries of €60,000 on offer.

Knowledge of HTML and VB coupled with a Banking and Finance degree would also make a graduate very marketable in today’s market.

2.00 P.M Tuesday the 29th of July 2003
Meeting with Dr. George O’Donnell, Lecturer in Mechanical Engineering, Department of Mechanical Engineering, Faculty of Engineering, University College Dublin

Having been unable to meet the necessary people at the University of Limerick due to a variety of reasons we decided that the differences between the engineering courses offered at each institution was quite minimal and lecturers from UCD would be equally knowledgeable in the relevant areas. With this in mind we made contact with the Mechanical Engineering Department at UCD who kindly put us in touch with George O’Donnell who lectures to undergraduates in this area.

Having explained to George what exactly we were undertaking and how he could help we came up with a preliminary list of twelve skills that we proceeded to correlate with each other. Throughout this interview we only concentrated on the specific skills that graduates would take from the course and not on the broader range of skills which the graduate ay or may not learn on the job. Having conducted a twenty-five minute interview we concluded at 2.25 P.M.
2.00 P.M Tuesday the 5\textsuperscript{th} of August 2003
Meeting with Dr. Gerald Mills, Faculty of Geography, University college Dublin

With location being one of the five criteria an employer can search by it is imperative that we come up with an accurate way of calculating the correlation between the employers location and the candidates preferred location. Over the last week we have considered a number of different ways to calculate the distance between the two locations. One option involves coming up with a set number of towns that give a good geographical spread around the country (no town should be more than thirty miles away from any other town). This would then involve coming up with the distances from each town to every other town and hard coding them into the system. This however would prove be very difficult for the administrator to update as to add a town the administrator would have to calculate the distance from that town to every other town. Another option would again involve coming up with a spread of towns with a good geographical spread and storing their coordinates in the system. We then tried to use the following formula to calculate the degree distance between the two locations.

$$
\cos D = \sin (q1) \sin (q2) + \cos (q1) \cos (q2) \cos (Dl)
$$

where q1 and q2 must be expressed as + (north) and - (south). Once the length of the arc in degrees is obtained, we can convert to real world distances by multiplying by 111km (the length of a degree on a great circle). This route on a map is referred to as a loxodrome or rhumb line. On the Mercator projection such a line was approximated as a series of straight lines of constant compass bearing. Unfortunately we were having considerable trouble in coming up with an accurate distance between to locations using the above formula.

To this end we approached Dr. Mills who agreed to meet us. Having explained our problem to him he advised us to use the grid coordinates for Ireland as the above formula is only used for distances greater than 500 KM. If we take the country of Ireland as being flat and discard the earth’s natural curvature we can use the grid references offered in most maps of Ireland. We can then use the Pythagoras formula to calculate the distance between two points.
Distance = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Where x & y represent the x and y coordinates of the two points.

**11.00 A.M Friday the 15th of August 2003**
Meeting with Prof. David J. Fegan, MSc, PhD, associate Professor of Experimental Physics, Department of Experimental Physics, Faculty of Science, University College Dublin
Again we had serious difficulty in meeting the relevant people in the area of physics at the university of Limerick and after a little research into the physics courses on offer at UCD it became apparent to us that the differences among the undergraduate courses offered was again negligible. Therefore we decided to approach the departmental coordinator who put us in touch with Prof. David Fegan, Prof. Fegan is one of the most senior lecturers in the department and is a past departmental head. When we explained to Prof. Fegan what we were trying to accomplish he was very forthcoming and produced copies of all the most recent documentation he had at hand on the area of physics in general and the specifics of the Physics courses taught at UCD. From this literature Prof. Fegan felt that we should be able to generate a comprehensive list of skills, unfortunately due to time constraints on his part we were unable to proceed to the completing of the grid correlation structure. Having thanked Prof. Fegan for all his help the meeting concluded at 11.20 A.M.

Physics is the study of the laws that govern the construction and foundation of the universe. These find expression in the everyday world, together with the micro and astronomical worlds that are studied with powerful instruments. Careers for physicists are in the manufacturing industry, electronics, telecommunications, astrophysics, computers meteorology and medical physics.

**11.00 A.M Wednesday the 20th of August 2003**
Meeting with Mr. Jim Kidd, Sales Development Manager for AIB’s Direct Banking Division, AIB Head Offices, Ballsbridge, Dublin

Personnel Placement Decision Support System
As outlined in the planning stage this project is not only concerned with the development of a web based application it is also the responsibility of the development team to ensure that this system is exploited to its full potential and made commercially viable. An obvious method of making the system viable is the bringing on board of a site sponsor. This company would have the right to advertise on the site aswell as send e-mails to registered users of the system. With this in mind the manager of SUDPT Ltd. Paul O’Connor arranged a meeting with the head of AIB’s Direct Banking division, Jim Kidd. Jim has responsibility for exploring and developing new potential business ventures for the bank, recent projects he has been involved in include the development of 24 hour banking, an online banking facility offered by AIB. As the project development team we have in depth knowledge of the system functionality and were asked to present the system to Jim while also fielding any questions he may have on the system. As Jim had started his career as a technology analyst the presentation was aimed at quite a high technical level with emphasis being placed on the matching approaches taken in the system and how it differs from the vast majority of recruitment sites out there today. Following our technical presentation Paul then gave an overview of the company outlining the relevant statistics of the company such as number of job placements to date, projected member figures and projected hits on the new site. Having gotten a very positive initial response from Jim the meeting concluded at 12.15 PM.
## Appendix 3

### SUDPT Skills

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<th>Class – Accounting</th>
<th>Class – Insurance</th>
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<td>Bookkeeping</td>
<td>Advise on Life / Non-Life Policies</td>
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<td>Cost Accounting</td>
<td>Assess / Establish / Quantify Risk</td>
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<td>Financial Analysis</td>
<td>Draw up Safety Statements</td>
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<td>Financial Reporting</td>
<td>Management of Claims</td>
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<td>General Ledger Reconciliation’s</td>
<td>Underwriting</td>
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<td>Product Costing</td>
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<th>Class – Legal</th>
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<td>Editing Skills</td>
<td>Constitutional Law</td>
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<td>Creative Department</td>
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<td>Journalism</td>
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<td>Document Drafting</td>
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<td>English - Romantics</td>
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<td>English - Renaissance</td>
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Personnel Placement Decision Support System
Appendix 3 – SUDPT Skills

English - Pre Modern
English - 19th Century (Victorian)
Philosophy - Classical
Philosophy - Empirical
Philosophy - Scholastics
Philosophy - Modern
Art History
Ancient Egypt
Greco Roman
Asian
Baroque

Class - Marketing & Sales
Business Development
Category Management/ Analysis
Creation of Press Releases
Customer Relationship Management
Direct Marketing
E-Commerce
FMCG (Fast Moving Consumer Goods)
Media Relations
Project Management
Research & Analysis of Markets
Sales Coordinator
Telemarketing
Telesales Representative

Class - Banking & Finance
Bond Trading
Credit Control
Credit / Market Risk
Derivatives Trading
Equity Broker
Financial Analysis
Fixed Interest Trading
Fund Management
FX Trading
Portfolio Management
Risk Management
Stock Analysis
Stock Trading
Treasury

Class - Construction & Engineering
AutoCAD
Calibration
Computational Fluid Dynamics Software
Draughtsman
Finite Element Analysis
HVAC
Hydraulics
Industrial Aerodynamics
Industrial Engineering
Instrumentation
Manufacturing Engineering

Class - Production, Manufacturing & Materials
Auditing
Health & Safety
Material Characterisation
Material Processing
Material Selection
Materials Safety
Microscopy
Process Product Development
Production
Quality Assurance
Technical Writing
Vendor Qualification

Class - Public Sector & Administration
Audio Typing
Bookkeeping
Goldmine
IGS

Personnel Placement Decision Support System
## Appendix 3 – SUDPT Skills

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<td>Matlab</td>
<td>ISO (Quality Control)</td>
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<tr>
<td>Mechanical Design</td>
<td>Meridian</td>
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<td>PLC’s</td>
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<td>Structural Design</td>
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<td>Thermal Analysis</td>
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<td>Switchboard</td>
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<td>Tas Books</td>
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<td>Food Supply Company</td>
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<td>Communication – Verbal</td>
<td>Horse Analysis</td>
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<td>Horse Care</td>
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<td>Horse Handling</td>
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<td>Horse Riding</td>
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<td>Race Track</td>
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<td>MS Office – PowerPoint</td>
<td>Racing Yard</td>
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<td>MS Office – Publisher</td>
<td>Stud Farm</td>
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<td>MS Office – Word</td>
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<th>Class - Science - Food &amp; General</th>
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<td>Psychiatry</td>
<td>Analytical Development Chemistry</td>
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<td>Midwifery</td>
<td>Atomic Physics</td>
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<td>Paediatrics</td>
<td>Bulk Pharmaceutical</td>
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<td>Calibration</td>
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<td>Coronary Care</td>
<td>Chemical Unit Operation</td>
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<td>Accident &amp; Emergency</td>
<td>Computational Physics</td>
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<td>Electromagnetism</td>
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<td>Orthopaedic</td>
<td>Environmental Analysis</td>
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<tr>
<td>Peri - Operative</td>
<td>Food Science - Documentation</td>
</tr>
</tbody>
</table>

Personnel Placement Decision Support System
| Anaesthetics and Recovery Room | Food Science - Formulation |
| Pain Management Nursing       | Food Science - Legislation |
| Oncology                     | GAS Chromatography |
| Palliative Care              | HACCP |
| Cardio-thoracic              | Health & Safety |
| Ophthalmic Surgery           | Heat & Mass Transfer |
| Ear, Nose & Throat Surgery   | HPLC |

**Class - Human Resources**

- Administration
- Compensation & Benefits
- Interviewing
- Knowledge of Employment Legislation
- Knowledge of Health and Safety Legislation
- Knowledge of Labour Law
- Knowledge of Negotiations
- Knowledge of Psychometric Testing
- Policy Implementation
- Teaching
- Training and Development
- Union Negotiation

- Materials Safety
- MathCad
- Microbiology
- New Drug Application Preparation
- Nuclear Physics
- Occupational Hygiene
- Optics
- Organic Chemistry
- Particle Physics
- Polymer Technology
- Process Control
- Process Development
- Product Development
- Product Preservation
- Production
- Quality Assurance
- Quality Control
- Quantum Mechanics
- Reaction Engineering Kinetics
- Regulatory Compliance
- Relativity
- Solid State Physics / Lasers
- Sound Engineering
- Supervisory Skills
- Technical Writing
- Testing
- Thermal Mapping
- Thermodynamics
- UV
- Validation
- HAZOP

**Class - Information Technology**

- .NET
- Active X
- ASP
- Assembly
- ATM
- C
- C#
- C++
- CMM
- Cobol
- ColdFusion
- COMM
- Crystal Reports
- DCOM
- DNS
- Flash
- Fortran
- GUI Design
- HTML

- Quality Assurance
- Quality Control
- Quantum Mechanics
- Reaction Engineering Kinetics
- Regulatory Compliance
- Relativity
- Solid State Physics / Lasers
- Sound Engineering
- Supervisory Skills
- Technical Writing
- Testing
- Thermal Mapping
- Thermodynamics
- UV
- Validation
- HAZOP

**Class - Telecommunications & Electronics**

- Analog Design

Personnel Placement Decision Support System
### Appendix 3 – SUDPT Skills

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<th>ASIC's</th>
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<td>Java</td>
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<td>Soldering</td>
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<td>Temperature Measurement</td>
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<td>PERL</td>
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<td>Photoshop</td>
<td>VHDL</td>
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<tr>
<td>PHP</td>
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</table>

**Process Improvement**

**Project Management**

**RDBMS**

**Shell Scripting**

**SQL**

**SQL Server**

**TCP/IP**

**Technical Support**

**Technical Writing**

**UML**

**UNIX**

**VB Script**

**Visual Basic**

**White Box Testing**

**Win 2000**

**Win 95/98**

**XDSL**

**XML**

**EJB**

**Class - Tourism, Sport & Leisure**

<table>
<thead>
<tr>
<th>Aremis</th>
<th>Chef de Partie</th>
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<tbody>
<tr>
<td>Chef de Rang</td>
<td>Commie Chef</td>
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<tr>
<td>Conference and Banqueting Coordinator</td>
<td>Day Porter</td>
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<tr>
<td>Executive Head Chef</td>
<td>Fidelio Reservations</td>
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<td>Fine Dining Waiting</td>
<td>Head Chef</td>
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<td>Hotel Receptionist</td>
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<td>Maître d’Hotel</td>
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<td>Pastry Chef</td>
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<td>Tourism Policy Management</td>
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Personnel Placement Decision Support System
Appendix 4

JavaScript Functions

/*

SUDPT Form validation Javascript functions
Developed : Michael Phelan
Date : June - August 2003
*/

//SUDPT FORM VALIDATION

function email (type, strng)
{
    var error="";
    var emailFilter=/^[^@.]+@[^\]^\d\d[/i; 
    var illegalChars= /[(()\]<\:\;\,\:\\\"\[\]\];/ 
    var typeName = ""
    if (type == 2)
    {
        typeName = " New "
    }
    else
    {
        typeName = " "
    }
    if (strng == "")
    {
        error = " - Please Enter Your" + typeName + "Email Address\n\n";
    }
    else
    {
        if (!(emailFilter.test(strng)))
        {
            error = " - Please Enter A Valid" + typeName + "Email Address\n\n";
        }
    }
    return error;
}

Personnel Placement Decision Support System


Appendix 4 – JavaScript Functions

```javascript
//test email for illegal characters
if (strng.match(illegalChars))
{
    error = " - The" + typeName + "Email Address Contains Illegal
    Characters.\n\n";
}
if (testForSpaces(strng) != 0)
{
    error = " - The" + typeName + "Email Address Contains
    Spaces.\n\n";
}
}

return error;
}

//Confirm Email
function emailConfirm (type, ConfirmEmail, Email)
{
    var error = "";
    var typeName = ""

    if (type == 2)
    {
        typeName = " New 
    }
    else
    {
        typeName = " 
    }

    if (ConfirmEmail == "")
    {
        error = " - Please Confirm Your" + typeName + "Email.\n\n";
    }
    else
    {
        //Checks Password = Confirm Password
        if (Email == ConfirmEmail)
        {
        }
        else
        {
            error = " - Please Ensure Your" + typeName + "Emails Match.\n\n";
        }
    }

    return error;
}
```

Persons Placement Decision Support System
function testForSpaces(strng)
{
    var i, space, containsSpace;
    containsSpace = 0;
    space = " ";
    for (i = 0; i < strng.length; i++)
    {
        if (strng.charAt(i) == space)
        {
            containsSpace = containsSpace + 1;
        }
    }
    return containsSpace;
}

//Password - between 6 - 20 chars and at least one numeral
function password (type, strng)
{
    var error = "";
    var typeName = "";
    if (type == 2)
    {
        typeName = " New ";
    }
    else
    {
        typeName = " "
    }
    var illegalChars = /[\W_]/; // allow only letters and numbers
    var digitArray = new Array('0','1','2','3','4','5','6','7','8','9');
    var i, j, containsDigit;
    containsDigit = 0;
    for (i = 0; i < strng.length; i++)
    {
        for (j = 0; j < digitArray.length; j++)
        {
            if (strng.charAt(i) == digitArray[j])
            {
                containsDigit = containsDigit + 1;
            }
        }
    }
    if (strng == "")
    {
        error = " - Please Enter A" + typeName + "Password.\n\n";
    }
    else
    {
        if ((strng.length < 6) || (strng.length > 20))
        {
            error = " - Password length must be between 6 and 20 characters.\n\n";
        }
    }
    return error;
}
Appendix 4 – JavaScript Functions

```javascript
error = " - The" + typeName + "Password Must Be Between 6 & 20 Characters.

if (containsDigit == 0)
{
    error = " - The" + typeName + "Password Must Contain At Least One Numeral.

} if (strng.length == containsDigit)
{
    error = " - The" + typeName + "Password Must Contain At Least One Letter.

} if (testForSpaces(strng) != 0)
{
    error = " - The" + typeName + "Password Must Not Contain Any Spaces.

} if (illegalChars.test(strng))
{
    error = " - The" + typeName + "Password Contains Illegal Characters, Only Letters & Numbers Permitted.

}

return error;

//Confirm Password
function passwordConfirm (type, ConfirmPassword, Password)
{
    var error = "";
    var typeName = 

    if (type == 2)
    {
        typeName = " New 
    }
    else
    {
        typeName = " 
    }

    if (ConfirmPassword == "")
    {
        error = " - Please Confirm Your" + typeName + "Password.
    }
    else
    {
        //Checks Password = Confirm Password
        if (Password == ConfirmPassword)
        {
        }
        else
        {
            error = " - Please Ensure Your" + typeName + "Passwords Match.
        }
    }
}
```

Personnel Placement Decision Support System
return error;

//Password Hint
function passwordHint (type, strng)
{
    var error = "",
    var typeName = ""

    if (type == 2)
    {
        typeName = " New 
    }
    else
    {
        typeName = " "
    }

    if (strng == "")
    {
        error = " - Please Enter Your" + typeName + "Password Hint.\n\n";
    }
    else
    {
        if (strng.length > 100)
        {
            error = " - The" + typeName + "Password Hint Must Be Less Than 100 Characters (incl Spaces).\n\n";
        }
    }

    return error;
}

//Generic Form Validation
// Generic Form Validation

function validateField (name, strng)
{
    var error = "",
    if (strng == "")
    {
        error = " - Please Complete The Field : " + name + ".\n\n";
    }

    return error;
}

function validateDDMenu (name, number)
{
    var error = "",
    if (number == 0)
    {
        error = " - Please Select An Item From The Menu : " + name + ".\n\n";
    }

    return error;
}
function validateDDMenuMultiple (name, number, limit) {
    var error = "";
    if (number == 0) {
        error = " - Please Select Up To " + limit + " Items From The Menu : " + name + 
"\n\n";
    }
    if (number > limit) {
        error = " - You Can Only Select A Maximum Of " + limit + " Items From The Menu 
: " + name + "\n\n";
    }
    return error;
}

function DDMenuMultipleCount(sel) {
    var i=-1, c=0;
    while (sel.options[++i])
        if (sel.options[i].selected) c++;
    return c;
}

function validateCheckBox(name, checkvalue) {
    var error = "";
    if (!(checkvalue)) {
        error = " - Please Tick The Appropriate Box For : " + name + "\n\n";
    }
    return error;
}

function validateAttendance (name, monthFrom, monthTo, yearFrom, yearTo) {
    var error = "";
    if (monthFrom == 0) {
        error += " - Please Select An Item From The Attendance Month Menu (From) : " + 
name + "\n\n";
    }
    if (monthTo == 0) {
        error += " - Please Select An Item From The Attendance Month Menu (To) : " + 
name + "\n\n";
    }
    return error;
}
Appendix 4 – JavaScript Functions

if (yearFrom === 0) {
    error += " - Please Select An Item From The Attendance Year Menu (From) : " + name + ".\n\n";
}

if (yearTo === 0) {
    error += " - Please Select An Item From The Attendance Year Menu (To) : " + name + ".\n\n";
}
return error;

function validateCharCount (name, number, limit) {
var error = "";
if (number > limit) {
    error = " - " + name + " Cannot Exceed " + limit + " Characters (incl spaces).\n\n";
}
return error;
}

//Nationality
function Nationality (number, strng) {
var error = "";
if (number === 0) {
    error = " - Please Select A Nationality.\n\n";
}
if (((number === 156) && (strng === ""))) {
    error = " - Please Specify A Nationality.\n\n";
}
return error;
}

//Permenant & Term Address
function Address (type, Line1, CityTown, Country, Specify, County) {
var error = "";
if (Line1 === "") {
    error = " - Please Specifiy A Permanent Address.\n\n";
}

Personnel Placement Decision Support System
error = " - Please Enter " + type + " Address : Line 1.

};

if (CityTown == "")
{
    error += " - Please Enter " + type + " Address : City / Town.

};

if (Country == 0)
{
    error += " - Please Select A " + type + " Address : Country.

};

if (((Country == 156) && (Specify == ""))
{
    error += " - Please Specify A " + type + " Address : Country.

};

if (((Country == 99) && (County == 0))
{
    error += " - Please Select A " + type + " Address : County.

};

return error;

} // end validateAddress

function validateDOB(day, month, year)
{
    var error = "";

    if (day == 0)
    {
        error += " - Please Select A DOB : Day.

    }

    if (month == 0)
    {
        error += " - Please Select A DOB : Month.

    }

    if (year == 0)
    {
        error += " - Please Select A DOB : Year.

    }

    if (((month == 4) || (month == 6) || (month == 9) || (month == 11)) && (day > 30))
    {
        error += " - Please Select A Valid DOB : Year.

    }

    if (((month == 2) && (day > 29)) || ((month == 2) && (day > 28) && (leapYear(year) != 1))
    {
        error += " - Please Select A Valid DOB : Year.

    }

    return error;

} // end validateDOB

Personnel Placement Decision Support System
function leapYear(year)
{
    var leapYear;
    if ((year%4) != 0)
    {
        leapYear = 0;
    }
    else
    {
        if ((year%100) != 0)
        {
            leapYear = 1;
        }
        else
        {
            if ((year%400) != 0)
            {
                leapYear = 0;
            }
            else
            {
                leapYear = 1;
            }
        }
    }

    return leapYear;
}

//Students - Education Edit Page

// Undergraduate & Postgraduate Awards
function collegeAward (name, number, strng)
{
    var error = "";
    if (number == 0)
    {
        error = " - Please Select An " + name + " Degree Award.";
    }
    else
    {
        if (((number == 5) && (strng == ""))
            {
                error = " - Please Specify The " + name + " Degree Award.";
            }
        return error;
    }

Personnel Placement Decision Support System
function checkWeight(name, strng)
{
    var error = "";
    if (strng == "")
    {
        error = " - Please Enter A Weight For " + name + ".\n\n";
    }
    else
    {
        if (isValidDigit(strng) == false)
        {
            error = " - Please Enter A Valid Integer (1-100) Value For " + name + " Weight.\n\n";
        }
    }
    return error;
}

function calcWeight (salary, degree, location, skill)
{
    var error = "";
    var weightTot;
    weightTot = (parseInt(salary) + parseInt(degree) + parseInt(location) + parseInt(skill));
    document.searchStuGradDB.weightTotal.value = weightTot;
    if (weightTot != 100)
    {
        error = " - Please Ensure That The Weights Add Up To 100.\n\n";
    }
    return error;
}

function isValidDigit(input)
{
    var digitArray = new Array('0','1','2','3','4','5','6','7','8','9');
    var i, j, isValid;
    isValid = 0;
    var theData = new String(input);

for (i = 0; i < theData.length; i++)
{
    for (j = 0; j < digitArray.length; j++)
    {
        if (theData.charAt(i) == digitArray[j])
            isValid = isValid + 1;
    }
}

if ((input <= 100) && (input >= 0))
{
    isValid = isValid + 1;
}

if (isValid != theData.length + 1)
{
    return false
}
else
{
    return true
}

return false
Appendix 5 – SUDPT Website Structure

SUDPT Website Structure

Site - www.sudpt.ul.ie

- admin
  - announcements
  - email
  - skills
  - table_admin
    - announcement.asp
    - email.asp
    - welcome.asp
- employers
  - ac_admin
  - details
  - registration
  - search
  - skills
  - welcome.asp
- images

- scripts
  - asp
    - admin
    - cache
    - crypt
    - date
    - dbConnect
    - employer
    - search
    - stuGrad
    - adovbs.inc
  - javascript
    - formValidation
    - help
    - menu
    - nrl
    - sudptFNS.js
    - sudpt.css
- students_graduates
  - ac_admin
  - education
  - extra_circular
  - personal
  - registration
  - skills
  - template
  - work.asp
    - welcome.asp
  - about_us.html
  - admin.asp
  - associates.html
  - browserDetect35.html
  - employers.asp
  - index.html
  - logout.asp
  - students_graduates.asp
  - suggest_skill.asp

Personnel Placement Decision Support System
Appendix 6

End User Questionnaire

Daire Cronin - *PhD. Student in Mechanical engineering at UL*

Eavan Coakley - *Recent graduate of the University of Limerick*

Emma Tierney - *Masters student of the University of Limerick*

Roger Gough - *Masters student of Engineering at the University of Limerick*

Shane Clifford - *Masters student of Engineering at the University of Limerick*

Peter Brennan - *Recruitment consultant with Star Retail Placement*

William Ryan - *PhD Student in Statistics at the University of Limerick*
Appendix 6 – End User Questionnaire

SUDPT Ltd. end user online recruitment questionnaire

Name: Daire Cronin
Title: PhD. Student in Mechanical engineering at UL
Date Completed: 21st August 2003

1. Have you used online recruitment sites in the past, if so which ones?
Yes, just monster.ie.

2. What do you think is the best online recruitment site out there at the moment?
I haven’t used any in about a year and a half – only one used is monster.ie

3. Please state what you see as the major positive and negative aspects of such sites
They get your info out to a large number of employers if there are capabilities for the employer to access this. It also gives you a large list of possible job opportunities as well but sometimes the search topics are too broad so it returns jobs that aren’t suitable

4. What do you think makes up a good online recruitment site?
Must be promoted well so that it has a large database for both employees and employers, giving a better chance of finding the right job or potential employer. It should also be easy to sign up to and also remove your profile from the list if you manage to get a job so that you don’t keep receiving info you don’t need. Security would also be important so that you don’t get large spam e-mails from a group or sponsor that manages to access the contact details of the people signed up to the site.

5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?
I like the amount of detail asked for in all sections and also the fact that you can specify the job type – most sites are only useful for full time jobs and even at that, you can’t specify whether it’s permanent or contract type jobs that you require. The help

Personnel Placement Decision Support System
on the menu when editing is good for explanation and stops the webpage getting cluttered.

6. Having reviewed the SUDPT online recruitment site what do you think are it’s worst features?
I think that there should probably be a way for the user to disable his a/c easily if he has a job or make it inactive, and maybe reactivate it later on if the person needs to look for another job. This should be available online. Some of the commas and sentence layout in the about us section

7. What changes would you make to improve the usability of the site?
When you’re logged in and then you click on the about us section, you have to log back in again to get to your personal details. It would be easier if you didn’t have to log back in again every time you looked at one of the other sections

8. Do you have any recommendations for future additions to the site?
Once you have a list of potential employers, you could have a link to the company’s website so that somebody going for an interview would have a source to research info about the company. It could also be worth combining with student services who have some similar ideas in their student profile and an on-line cv for co-op. Many co-op students wouldn’t take the time to fill out two separate c.v’s so maybe these two could possibly be combined for the skills, personal details, and work experience sections.

9. What marketing tools would you use to promote the site?
College e-mail, an info booklet and regular reminders and updates to personnel departments of companies, an info presentation for students a few times a year, a stall at the recruitment drive in the arena, alumni association newsletter, An Focal
Appendix 6 – End User Questionnaire

SUDPT Ltd. end user online recruitment questionnaire

Name: Eavan Coakley
Title: Recent graduate of the University of Limerick
Date Completed: 16th August 2003

1. Have you used online recruitment sites in the past, if so which ones?

Yes.

- monster.ie
- reed.co.uk
- jobsfinancial.com
- thislondon.co.uk/jobs
- prospects.ac.uk
- yahoo.com/jobs
- roc.co.uk
- hudsonresourcing.com (I got temporary work in London through this one.)
- secretariesplus.co.uk
- morganmckinley.co.uk
- headwayrecruitment.com
- rec.uk.com (for all finance/banking recruitment agencies in the UK)

2. What do you think is the best online recruitment site out there at the moment?

- I thought Monster.ie was quite good as once you had saved your CV and cover letter, it made applying for jobs much quicker. Also, I was able to set up ‘Agents’, which notified me of vacancies in my chosen job categories. And it covered a broad range of countries.
- Reed.co.uk and jobsfinancial.com also had these capabilities but mostly advertised UK jobs.
3. Please state what you see as the major positive and negative aspects of such sites

**Positive:**

- The ability to set up these ‘Agents’/email notifications was very helpful.
- Also, being able to search sites for specific sectors/types of contracts (permanent/part time/full time/temporary) helped minimise unsuitable positions.
- When applying for jobs, a specific contact name and number should be provided to make following-up easier.
- Also, one site specifically stressed that I should follow-up on each job applied for. (I think this was Morgan McKinley.) Before that, it had taken me a while to realise how important that is in securing an interview/job.

**Negative:**

- I think that more information on the type of applicant that the company itself requires minimises applying for unsuitable jobs.
- Online recruitment sites need to be as easy to navigate as possible, looking for work is time-consuming and exasperating enough!
- All online recruitment sites should allow you to apply online. Some only give email addresses/phone numbers. In this day and age…

4. What do you think makes up a good online recruitment site?

- One that has search capabilities;
- One that sends email notification of new positions if requested (of specified sectors/job types only);
- One on which you can apply online.
- One that covers a broad range of sectors and countries.
- One that is easy to read/navigate;

5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?

I thought it was an excellent site:
It appears as if the jobs available are broad ranging, with something to suit everyone’s needs, i.e. work at home/abroad/J1s; part-time/full-time; etc.

It seems ‘friendly’, in that it welcomes students to call to their office, which may be important as some people find looking for a new job quite daunting.

You can register online. Many recruitment agencies require you to physically call in, in order to register basic personal details.

It is encouraging and optimistic, i.e. “Despite the downturn in the global economy, The Graduate Placement Programme has been buoyant and we have had many successful placements to date.” And “Plans for the future include providing training courses…”

It is aimed at past and present UL students making it very accessible and more personal.

6. Having reviewed the SUDPT online recruitment site what do you think are its worst features?
   - Not having a search capability!
   - Not having an email notification capability!
   - When I logged in for the first time, it was not clear enough that any password required letters AND numerals. When I corrected this and clicked ‘Register’ again, the message “That email is already registered” appeared at the bottom of the page (where it wasn’t very obvious). I tried clicking on the ‘Reset’ button but it didn’t work. It took me a while to figure out that I could retrieve my password using the ‘Forgot Password’ button on a different page. (It sent my details to the email address initially given and had automatically assigned my first name as my password.)

7. What changes would you make to improve the usability of the site?
   - See Question 6 above, otherwise I thought it was excellent.

8. Do you have any recommendations for future additions to the site?
   - Again, see Question 6 above.
Appendix 6 – End User Questionnaire

9. What marketing tools would you use to promote the site?

- Posters around campus;
- Emails to every Undergraduate at different stages throughout the academic year;
- ‘Open Days’ encouraging people to call to the offices to register details/ask any questions/etc.;
- A link on the UL homepage and post-graduate web page;
- Letters to graduates and alumni;
- Letters to those graduates who have applied to receive the ‘Jobfile’ publication sent by the Careers Dept.;
- Announcements made by Mary Sweeney & Co. during their many talks
- Word of Mouth! Everything I have heard about this facility so far has been very positive.
Appendix 6 – End User Questionnaire

SUDPT Ltd. end user online recruitment questionnaire

Name: Emma Tierney
Title: Masters student of the University of Limerick
Date Completed: 9th August 2003

1. Have you used online recruitment sites in the past, if so which ones?

Yes.
- monster.ie
- prospects.ac.uk
- yahoo.com/jobs
- irishjobs.ie
- jobs.ie
- myjob.ie
- headwayrecruitment.com
- rec.uk.com (for all finance/banking recruitment agencies in the UK)

2. What do you think is the best online recruitment site out there at the moment?

- I thought Monster.ie was quite good as once you had saved your CV and cover letter, it made applying for jobs much quicker. Also, I was able to set up ‘Agents’, which notified me of vacancies in my chosen job categories. And it covered a broad range of countries.

3. Please state what you see as the major positive and negative aspects of such sites

Positive:
- (permanent/part time/full time/temporary) helped minimise unsuitable positions.
- When applying for jobs, a specific contact name and number should be provided to make following-up easier.

Personnel Placement Decision Support System
Also, one site specifically stressed that I should follow-up on each job applied for. (I think this was Morgan McKinley.) Before that, it had taken me a while to realise how important that is in securing an interview/job.

Negative:

- Online recruitment sites need to be as easy to navigate as possible, looking for work is time-consuming and exasperating enough!
- All online recruitment sites should allow you to apply online. Some only give email addresses/phone numbers. In this day and age…

4. What do you think makes up a good online recruitment site?

- One that has search capabilities;
- One that sends email notification of new positions if requested (of specified sectors/job types only);
- One on which you can apply online.
- One that covers a broad range of sectors and countries.
- One that is easy to read/navigate;

5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?

I thought it was an excellent site:

- It seems ‘friendly’, in that it welcomes students to call to their office, which may be important as some people find looking for a new job quite daunting.
- It is aimed at past and present UL students making it very accessible and more personal.

6. Having reviewed the SUDPT online recruitment site what do you think are it’s worst features?

- Not having a search capability

7. What changes would you make to improve the usability of the site?
- Yee could put in an explanation once you get onto each of the login pages (similar to what comes up when you mouseover the links to get into them) just to remind the person why they are there and what information they can get!
- Once the person has logged in yee have a welcome message...yee could just put in (for the more stupid person that is using it) that they can use the menu on the left to edit their details, which are going to be seen by the employers. By the way "curricular" is spelt incorrectly.

8. Do you have any recommendations for future additions to the site?
- When logged in as a student, once you enter each of the menu pages....it would be nice to have an explanation of what those pages are looking for too....like "account admin". I wasn't too sure before i read what info yee were looking for what the page was actually going to do for me.
- Don't want to sound negative but I'm only looking at it from a dumb persons point of view.(no smart comments) Otherwise I really like the layout and the data entry is very straight forward and quick to use.

9. What marketing tools would you use to promote the site?
- Posters around campus;
- Emails to every Undergraduate at different stages throughout the academic year;
- ‘Open Days’ encouraging people to call to the offices to register details/ask any questions/etc.;
- Letters to graduates and alumni;
Appendix 6 – End User Questionnaire

SUDPT Ltd. end user online recruitment questionnaire

Name: Roger Gough
Title: Masters student of Engineering at the University of Limerick
Date Completed: 19th August 2003

1. Have you used online recruitment sites in the past, if so which ones?
   - prospects.ac.uk
   - yahoo.com/jobs
   - roc.co.uk
   - www.monster.ie

2. What do you think is the best online recruitment site out there at the moment?
   - www.monster.ie

3. Please state what you see as the major positive and negative aspects of such sites

   Negative
   - Spam mail is a real pain
   - Impersonal

   Positive
   - Easy access
   - Free

4. What do you think makes up a good online recruitment site?
   - One that has search capabilities;
   - One that sends email notification of new positions if requested (of specified sectors/job types only);
   - One on which you can apply online.

Personnel Placement Decision Support System
5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?

Good Points

- Very easy to navigate around this site.
- Page is not full of adverts. I think adverts only distract you from your core objective.
- Good use of colour / graphics etc.
- Going through the application, one can click on a question to expand on its meaning, very impressive.
- It is very easy to save your data and then view your details. Compare this to Accentures online recruitment, there process is very complicated, and it never seems to save the data correctly.

6. Having reviewed the SUDPT online recruitment site what do you think are it’s worst features?

6. Worst Features

- I found the section where you add your results quite confusing. Are you expected to add all your results (could tell students to copy and paste their results from the sigma.ul.ie page)
- I am presently doing a post grad and I will finish in may 2004, I was not given this option from the drop down menu.
- Also I am doing a research masters. This is pass/fail as far as I am aware, are u supposed to just say this in the ‘other’ box. I have had this problem with all the online recruitment forms so I suppose you need not worry about that.
- I got the following error when I went to choose ‘all ireland’ option from the drop down menu

    ADODB.Field error ‘80020009’

    Either BOF or EOF is True, or the current record has been deleted. Requested operation requires a current record.
• When you choose Telecommunications and Electronics from the ‘class’ menu it does not give you an option in the ‘skill’ menu

• You don’t get to choose locations outside of Ireland either.

• On the personal page, if you do something wrong it does not tell you which field it is (I don’t think too many sites do however)

7. What changes would you make to improve the usability of the site?
• Not too many really, maybe try and modify some of the stuff mentioned above

• In ‘Work Experience’ have a field for “Title”

8. Do you have any recommendations for future additions to the site?
• I would have ‘Extra Curricular’ link below skills on MENU.

• Maybe have a sample one done out, to give students some ideas

9. What marketing tools would you use to promote the site?
• Email it to all undergraduate students and ITD mailing list. Give a prize for the first 100 students to apply

• Set up some stands at the career fair and post graduate fair.

• Posters around the college.

• Email the link to all the companies in the Career service database. If the career guidance give it their blessing, it will market itself. It would surely reduce their workload, not sure if they would consider that a good thing or a bad thing.
Appendix 6 – End User Questionnaire

SUDPT Ltd. end user online recruitment questionnaire

Name: Shane Clifford
Title: Masters student of Engineering at the University of Limerick
Date Completed: 10th August 2003

1. Have you used online recruitment sites in the past, if so which ones?
   - Yes, although not extensively. Monster.ie; Irishjobs.ie

2. What do you think is the best online recruitment site out there at the moment?
   - Monster.ie appears fairly comprehensive.

3. Please state what you see as the major positive and negative aspects of such sites
   - A positive feature would be the large network of employee/employer resources.
   - A negative aspect would be inappropriate job allocation, in regards to individuals skills.

4. What do you think makes up a good online recruitment site?
   - Feedback. Or preferably, fast and accurate assignment of jobs.

5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?
   - The interface and the entering of information are very intuitive. Plenty of space is allowed for entering detailed information.

6. Having reviewed the SUDPT online recruitment site what do you think are it’s worst features?
   - Under ‘Dates From/To’ there is no option for presently or ongoing education or employment, nor for ‘Dates To’ in 2004, to indicate end of education or employment.

Personnel Placement Decision Support System
7. What changes would you make to improve the usability of the site?
   - I find the site as it is very easy to use.

8. Do you have any recommendations for future additions to the site?
   - I would recommend perhaps some indication of participating employers.

9. What marketing tools would you use to promote the site?
   - I think it would work well with the cooperative education department in UL, or the UL alumni association.
SUDPT Ltd. Industry online recruitment questionnaire

Name: Peter Brennan
Title: Recruitment consultant with Star Retail Placement
Date Completed: 22nd August 2003

1. Please comment on the overall usability of the site highlighting any positive and negative points you can think of.
   - I found the site very user friendly, I liked the use of graphics and the simple number of choices at each stage in the process

2. What changes would you make to improve the usability of the site?
   - I would expand the site to explore career options outside limerick.

3. How did you find the employer section of the site, was it easy to navigate?
   - Very user friendly and easy to get around

4. How user friendly did you think the employer search mechanism was, would you make any changes?
   - Very user friendly –I would ‘nt change a thing

5. Did you use any help files while using the site, if so did you find them helpful?
   - No I didnt

6. Overall what do you think of the concept of the site, do you think it is commercially viable?
   - Overall I think recruitment web-sites only work for certain sectors of employment. Areas of employment such as sales and retail, for example that rely more on the intangible skills of their employees may find it harder to source suitable candidates.
   - I do however think it is commercially viable

Personnel Placement Decision Support System
7. What marketing tools would you use to promote the site?
   • Advertising in local and national recruitment sections of papers

8. Do you have any recommendations for future additions to the site that would make it more appealing to the jobseeker or employer?
   • A higher profile and a list of preferred clients always makes a site more attractive

9. Please state anything other comments you think may be relevant.
Appendix 6 – End User Questionnaire

SUDPT Ltd. end user online recruitment questionnaire

Name: William Ryan
Title: PhD Student (Statistics) of the University of Limerick
Date Completed: 20th August 2003

1. Have you used online recruitment sites in the past, if so which ones?
Yes

- www.irishjobs.ie
- www.myjob.ie
- www.monster.ie

I’ve only been searching for Irish based jobs

2. What do you think is the best online recruitment site out there at the moment?
- www.irishjobs.ie

3. Please state what you see as the major positive and negative aspects of such sites

Positive:
- List of jobs in all areas of employment usually with detailed job description and applicant requirements readily available for browsing
- Office hours is not an obstacle, they can be accessed at any time
- Provide email service to update the user on available jobs that suit his/her qualifications
- Provide online CV service, which can be made available to potential employers at users request

Negative:
- Structures/ Skill set options available can be too rigid
- No human contact involved

Personnel Placement Decision Support System
4. What do you think makes up a good online recruitment site?

- Large database of employers
- Professional look, if it looks good and looks like a lot of effort went into the site encourages people to continue using the site (First Impressions…)
- Easy to use
- Shouldn’t be too restrictive when matching user skills to available jobs. It’s difficult to pinpoint exactly what type of job the user would like with online site because there is no human interaction, points/interests aren’t developed. It’s a good idea to list jobs even if the skill match is low (say 30%)
- CV builder service
- Daily email service for matching jobs

5. Having reviewed the SUDPT online recruitment site what do you think are it’s best features?

- I like the layout, looks good, easy to use, nothing over complicated
- Easy to navigate, everything explained clearly

6. Having reviewed the SUDPT online recruitment site what do you think are it’s worst features?

- No job search option

7. What changes would you make to improve the usability of the site?

- When filling in info (registration and personal details) one press of the tab button should bring you to the next entry box, it takes two.
- Replace “Country of Nationality” with “Nationality”?
- Add box for “Country of Residence” straight after Nationality. It’s a small bit confusing that you fill in your address then your country and then a county box appears, normally other way around. I think most people would fill in the county in the address fields before country cos u don’t know that box is going to appear.
• When filling in Leaving cert results, there should be six fields there by default and then the option to add more, it’s slightly annoying to have to add a field for every subject. Maybe the same for the college subjects
• For Undergrad/Post grad qualifications you only have the grade i.e. first class, 2.1, pass, so on you don’t have a field to fill in whether its Degree/Diploma/Cert and for post grad whether its Masters (taught or research) or PhD
• I’m not sure if employers want to know if you have a provisional licence or not. If they do there’s no option there.

8. Do you have any recommendations for future additions to the site?
• Search facility
• Email facility, probably weekly is sufficient if only aimed at UL people, not the high volume that national recruitment sites would have

9. What marketing tools would you use to promote the site?
• Leaflets distributed every year to students with their timetables
• Leaflets distributed every year to 4th year students with their grad ball info
• Ads in local papers. Limerick Leader, Limerick Post
Appendix 7

SUDPT Stationary

- Students Brochure
- Graduates Brochure
- Business Card
- Letterhead
- Envelope
- Compliments Slip