INVESTIGATING THE NEED FOR COSTING AND ESTIMATING IN INFORMATION TECHNOLOGY ACADEMIC PROGRAMS AT TECHNIKONS

By

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DECLARATION

The contents of this dissertation represent my own work, and the opinions contained therein are my own and not necessarily those of the Technikons. All references have been accurately reported.

Name: Gillian Khan

Signature: 

Date: February 2005

DEDICATION

This dissertation is dedicated to my beloved late mother Beatrice Valerie Thomas whose love and belief in me has guided my achievements.

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I wish to thank God for providing me with the physical, mental and emotional capacity to complete this dissertation. This arduous journey has included many situations where I have felt challenged to the extreme. Thankfully my supervisor Dr. Theodore (Theo) Conrad Haupt could always be counted on to assist and guide me through these barriers to completion. Your constant support, at times from remote locations, constructive criticism and total belief in my ability to succeed at this task has steadily assisted me towards completion. Matching your work ethic and high standards has been challenging, rewarding and enriching. For this I remain in your debt.

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This study was initiated to determine whether cost estimation is a necessary skill for an Information Technology (IT) consultant. The historic poor record in the software industry for delivering software projects within budget has highlighted a need for IT students to receive adequate preparation for future experiences in the world of work especially if they were to become self employed. The literature revealed that a variety of employability skills are required when preparing students for entrepreneurship. In IT there is a particular need for project management skills when the entrepreneur is responsible for all aspects of the software project. Cost estimation is a key function of project management.

The objectives of the study were :

1. To determine whether the IT industry and Technikons regard cost estimating as a necessary skill for an IT consultant.

2. To examine the course content of IT Skills – Entrepreneurship programs at Technikons to determine whether there is a module that specifically addresses cost estimation.
3. To gather feedback from the IT industry about the techniques commonly used to produce realistic cost estimates to inform the development of such a component in the IT Skills – Entrepreneurship subject.
4. To determine from IT consultants whether realistic accurate cost estimates contribute to sustaining and expanding an IT consultancy.

To fulfill the objectives data was gathered by means of various questionnaires completed by industry and IT Skills – Entrepreneurship lecturers. The results of the study revealed that the IT consultants reported a need for IT students who were potential consultants be taught to estimate costs for software projects accurately and competitively. The study further revealed that despite not teaching cost estimating in IT Skills – Entrepreneurship, the Technikon lecturers concurred with the finding. Bearing in mind the cooperative relationship to education that exists between Technikons and industry, these findings can be utilized as recommendations to inform a review of the preparation of students in the IT Skills – Entrepreneurship subject with reference to the cost estimating skills taught.

CHAPTER 1

INTRODUCTION

Awareness of the problem

In South Africa today there are three types of higher education institutions (HEI), namely universities, Technikons and colleges. South African Technikons offer career-oriented educational programmes designed to meet the needs of industry and commerce in a hi-tech global economic environment. Their approach to education is practical and outcomes-based, with the intent that graduates are immediately employable and productive. A key component that ensures this productivity is the inclusion of experiential learning in industry into technikon programmes (Haupt, 2003). This collaborative approach to education, also known as co-operative education, has 3 stakeholders namely, the institution, industry and students. Co-operative education includes periods of academic study alternating with a period of related work experience and prepares the student well for the class-to-work transition.

For this goal to be reached it is necessary that Technikons offer relevant training to adequately prepare their graduates for the world of work. To ensure that programmes offered at Technikons are responsive to the needs of industry, these institutions have advisory boards. These bodies consist jointly of representatives of industry, students, technikon academic staff and alumni. As one of the stakeholders in co-operative education, companies employ technikon students to provide them with experiential learning. Industry contributes to the development of technikon

programmes, by giving input via the advisory boards, and their evaluation of the performance of students they employ.

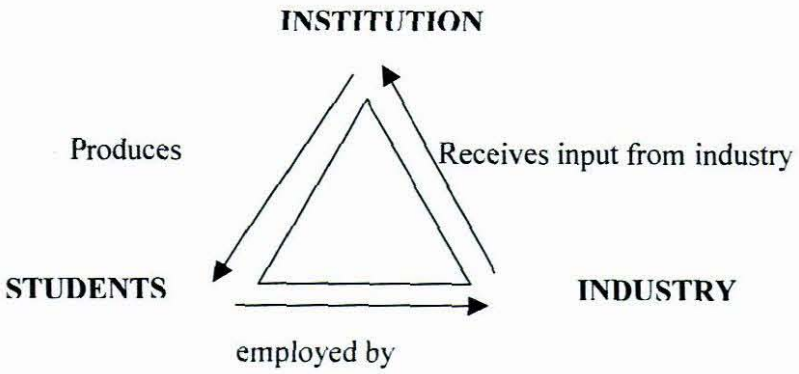

Figure1.1: Relationship between industry, institutions and students

Figure 1.1 represents the co-operative relationship between industry, institutions and students. In the case of Technikons (see figure 1.2 below), they offer programmes to students, which should adequately prepare them for the world of work. Industry contributes to the content of these programmes to ensure that there is a match between the skills that they need and those that the students possess.

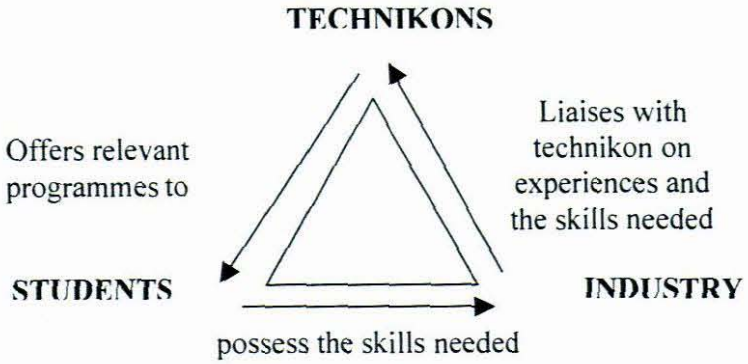

Figure 1.2: The co-operative relationship in the Technikon context.

While technikon trained students have technical skills much sought after in industry, other skills are also necessary for them to perform in a competitive and sometimes hostile environment with which they are unfamiliar (NWCET, 1999).

They are required to have knowledge about how organizations work and how people in them do their jobs (Frain, 1992). Since industry is a dynamic environment, the skills that industry requires from graduates are constantly changing (Fallows and Steven, 2000). It is no longer sufficient for students only to have technical skills. They are now expected to develop holistically requiring some business education (Jones-Evans, Williams and Deacon, 2000). It has become necessary for higher education institutions such as technikons to play a pivotal role in the preparation of graduates for entry into the workplace. It has also become important for students to be prepared for uncertain futures by emphasizing lifelong learning and developing generic skills (Fallows and Steven, 2000; Council on Higher Education, 2002). This preparation includes entrepreneurship education and training to enhance the managerial skills of students, especially those who might become small business owners or managers (Ibrahim and Soufani, 2000). To stay current and relevant Technikons need to continuously review their courseware so that they will provide industry with students who are able to make the transition from class to work with ease. In a study of the retrospective perceptions of alumni towards entrepreneurship education in HEIs financial management skills were highlighted as one of the key elements missing from undergraduate curriculums (Carter and Collinson, 1999).

The North West Center for Emerging Technologies (NWCET), which identified the skill standards for IT in the United States of America, has developed a core IT curriculum, which includes the development of these skills. Within the core skills for analytical skills and problem solving, estimation and cost/benefit analysis was defined as a key competency within an organization.

Presently at Peninsula Technikon there is a module in entrepreneurship, which is taught in the subject Information Technology Skills (IT Skills - Entrepreneurship) of the Information Technology Diploma. This subject was designed to equip students with skills for employment including self-employment. One of the key "new" core skills for employment is the ability of graduates to manage their own career development (Ibrahim and Soufani, 2000). In Information Technology (IT) students must be trained for the possibility of becoming small business owners and managers or consultants. Currently this subject focuses more on the process of creating and establishing a small business and less on the subsequent sustainability of the business. As IT managers or consultants the graduate will be responsible for all facets of the business, including sustainability. In IT this means they will be responsible for all the phases pertaining to the software product known as the systems development life cycle (SDLC) and not just its development. A manager or consultant will have to do the requisite planning prior to the development of the software. In any IT system, planning includes budgeting, which in turn includes the estimation of software development costs. This is a key function of an IT manager and it is executed early in the SDLC (see figure 1.3 below) when very little systems requirements information is available. A good estimate tendered at this stage has an increased possibility of securing the bid.

Currently, software estimation is not taught in the IT Skills - Entrepreneurship module. If graduates are, to compete successfully for projects against established businesses in the current competitive economic climate, they would need to be adequately skilled to provide realistic estimates. At the moment they are at a disadvantage, which is compounded by the difficulty they generally experience to

when attempting to develop competitive estimates of time and costs for software projects. While other subjects within the IT course will teach the cost estimation methodologies, the IT Skills - Entrepreneurship module should focus on developing expertise in generating estimates and pricing them to win a project.

Development of cost estimates

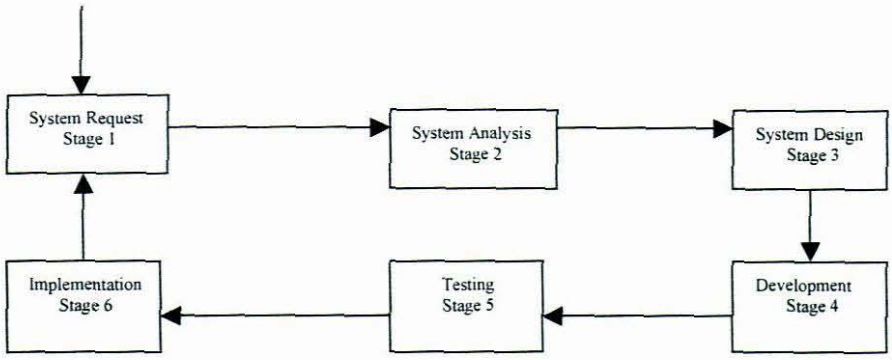

Figure 1.3: The early stage in the SDLC when cost estimates are developed.

The problems of projects falling behind schedule or not meeting the specifications, costs and other requirements is well known amongst software project developers and managers (Cheung, Willis and Milne, 1999). Despite the number of estimating methods that have been developed and used by software developers since 1960, projects are still being reported as being either overdue or over budget (Court, 1999). A key element in estimating is that it implies the difficult task of predicting the future. While one cannot predict all the factors that may arise and delay a software development project, estimating is not a guessing exercise. There are a number of methodologies available that take into account modern software development practices such as object orientation, code generation and re-use of code, while still providing acceptable levels of accuracy. Achieving these levels of

accuracy are important as both underestimation and overestimation can generate serious problems (Fleck, 1998). One of these problems would be the management of scarce resources such as time and money. The second is the software consultant's or small business manager's reputation and future existence. The ability to generate a realistic estimate is often responsible for securing the project in the first place.

Since realistic cost estimating is a challenge even for large companies with expert resources and large budgets at their disposal, this difficulty is multiplied for the entrepreneur for whom the results of inaccurate estimates could mean the loss of reputation as well as the loss of income. The use of estimation tools and practices in the development of software projects aids with project planning and management and in increasing client's confidence (Cheung, Willis and Milne, 1999).

Statement of the Problem

Considering that the costs of software projects frequently overrun their initial cost estimates as a result of factors such as poor estimation and predictive skills, and that Technikon IT programs do not focus on the development of these skills, the IT industry requires graduates from Technikons who become software development consultants to be able to estimate the costs of the software projects that they bid for realistically and comprehensively.

Hypothesis

Hypothesis 1

Cost estimation is important for an IT graduate to become a consultant.

Hypothesis 2

Current IT programs at Technikons do not prepare students to produce realistic cost estimates.

Hypothesis 3

A focused cost estimating and pricing module is not included in IT Skills – Entrepreneurship subject.

Hypothesis 4

The IT Skills – Entrepreneurship subject includes techniques to enable graduates to develop estimates using costing and estimating first principles.

Hypothesis 5

Realistic cost estimating results in a positive reputation and return business for an IT consultant.

Objectives

The primary aim of this study is to "add value" to the entrepreneurship module in the IT Skills curriculum by teaching students a vital managerial skill that will enable them to bid more competitively for projects against established businesses and complete projects within budget, on time and to specification. To achieve this aim the following objectives will have to be realized.

The first objective is to determine whether the IT industry and Technikons regard cost estimating as a necessary skill to be an IT consultant.

The second objective examines the course content of IT Skills – Entrepreneurship programs at Technikons to determine whether there is a module that specifically addresses cost estimation.

The third objective is to gather feedback from the IT industry about the techniques commonly used to produce realistic cost estimates to inform the development of such a component in the IT Skills – Entrepreneurship subject.

The last objective determines from IT consultants whether realistic accurate cost estimates contribute to sustaining and expanding an IT consultancy.

Research Methodology

To achieve the objectives of the research the following research methodology process will be used. The relevant literature will be reviewed on entrepreneurial skills, project management, and estimation of software costs. The research methodology will utilize both qualitative and quantitative approaches to achieve the objectives of the study. Data will be gathered from multiple samples (Carter and Collinson, 1999) to:

1. Establish whether the IT industry and Technikons consider cost estimation to be a necessary skill for an IT consultant.
2. Establish from Technikon IT Skills lecturers whether there is a need for a module in the IT Skills – Entrepreneurship subject that focuses on the development of the estimating skills of students who might enter the IT market as consultants.
3. Determine from lecturers at Technikons the content of the IT Skills – Entrepreneurship subject to inform the development of guidelines for the "Estimating for consultants" module.
4. Identify from the IT industry the most commonly used techniques to estimate costs.

5 Determine from consultants whether accurate and realistic cost estimates are necessary to develop a positive reputation and generate return business for an IT consultant.

The data collected will be statistically analyzed using the Statistical Package for Social Sciences (SPSS). From the analysis conclusions will be drawn and recommendations formulated relative to an effective estimating module.

Limitations

1. This study is limited to sampling the 3rd year offering of Entrepreneurship in the subject IT Skills in the National Diploma in Information Technology.

Assumptions

It is assumed that industry participants will provide meaningful information that will inform the design of an effective estimation module. It is further assumed that other institutions will respond positively to requests for information on their programs.

Structure of the Dissertation

This dissertation will be structured as follows:

CHAPTER 1. This introductory chapter outlines the research problem which this study addresses. It identifies the hypotheses to be tested, the project objectives and the methodologies to be used to gather data.

CHAPTER 2. Literature Review. This chapter will review entrepreneurial

skills, the importance of project management and software estimation to consultants and the difficulties facing consultants when estimating in the dynamic world of IT.

CHAPTER 3. This chapter discusses the research design and methodology used, to achieve the objectives of the study.

CHAPTER 4. The analysis of the data will be described in this chapter.

CHAPTER 5. In this chapter the results of the research are discussed. The key findings are summarized and recommendations are made for the IT Skills - Entrepreneurship course.

Ethical Statement

To comply with internationally accepted ethical standards, no names of individuals will be recorded on research instruments. In this way, no individual will be linked to a particular completed instrument, thus assuring anonymity. No compensation will be paid to any of the respondents for participation in the study. As with other studies, quality assurance will be done with respect to the following aspects:

- General conduct and competence of interviewers;
- Correctness and completeness of research instruments, especially where open ended questions are concerned;
- Quality of data capturing done by encoders; and
- Frequency distributions run to check that all variables contain only values in the accepted range and variable labels.

CHAPTER 2

LITERATURE REVIEW

Introduction

The purpose of this chapter is to review the relevant literature on cooperative education, entrepreneurial skills, project management and estimation of software costs to determine the need for entrepreneurial skills, in career management, to establish a need for accurate and competitive cost estimates, to understand the importance of project management in software development and to establish what difficulties are facing consultants when estimating the costs involved in software development or maintenance in the dynamic world of IT.

Cooperative education at South African Technikons

The South African employment market is following trends in the international labour market, which have necessitated closer interaction between the labour market and education. In South Africa there is a mismatch between the supply and demand of labour (Oosthuizen, 2003). The government is supportive of partnership initiatives between industry and education, which address this mismatch and has passed enabling legislation such as the Skills Development Act (no 97 of 1998) to encourage appropriate skills development in the country.

Industry stakeholders and education providers play key roles in addressing the development of appropriate skills with industry requiring suitably trained graduates and education providers having to produce these graduates (Haupt, 2003; Lundall, 2003). This situation implies a quick response to this need. Instead it is aggravated by the delays encountered while waiting for students to graduate. To ensure a continuous supply of adequately trained graduates, industry needs to continuously inform academic institutions of trends and industry requirements. In turn, academic institutions need to be responsive and design and offer programmes that address these trends and requirements.

In South Africa, Technikons have addressed this difficulty by developing educational policies, which encourage linkages with industry (Haupt, 2003; Lundall, 2003). This inclusive approach to education is known as cooperative education. There are three key stakeholders in this educational approach namely, the Technikon, industry and the student. Each stakeholder has a vested interest in the adequate preparation of the student for the world of work and benefits from this symbiotic relationship. The education institution liaises with industry to update their academic courses. Industry in turn provides mentored work opportunities for semi-skilled students to expose them to the world of work and improve their employability skills. Cooperative education requires the student to alternate academic study with periods of work experience in appropriate fields of study and career. This shared responsibility in the education of Technikon students ensures that these students are suitably equipped for the world of work on completion of their studies.

As future employers of Technikon graduates industry gives input to inform the programmes that Technikons offer. To ensure that these programmes are relevant to the employment market, Technikons have established advisory boards for each

programme that they offer. Advisory board members are representative of industry, professional bodies, academic staff and students. To ensure that these boards are not prescriptive, they make recommendations on a consultative basis rather than impose ill-founded syllabus changes on the academic departments (Lundall, 2003). Academic staff are expected to implement these recommendations into the programmes that they offer. This process ensures that

- Technikon students receive relevant and adequate preparation for the industry they enter as well as appropriate work experience;
- Industry receives experienced and knowledgeable graduates from Technikons; and
- Technikons are able to deliver up to date education and training in their programmes.

In their quest to adequately prepare students for future employment, Technikons need to ensure that their academic programmes include employability skills such as those that enable students to go into business for themselves should they choose to do so.

Entrepreneurial Skills for Career Management

The need for students to be taught transferable skills in addition to their technical skills has been identified and discussed by several authors (Dearing, 1997; Stewart and Knowles, 2000). Transferable skills are generic skills and are required by most jobs. These skills include basic literacy and numeracy, basic IT skills, communication skills, the ability to work well with others, self motivation and the ability to organize one's own work. Of the skills defined, analytical and problem solving skills, self-motivation, the ability to organize one's own work and communication skills are four of the key skills needed by small business owners and managers and consultants. The North West Center for Emerging Technologies

(NWCET), developed skills standards for IT in America in 1999. The Curriculum Research and Development Group listed analytical and problem-solving skills as a core skill for employability and this skill includes estimation and cost/benefit analysis (NWCET, 1999). Other authors have similarly identified problem-solving and analytical skills as key employability skills (Fallows and Steven, 2000; Jones-Evans et al., 2000).

It has also been determined that transferable skills and qualities play an important role in the potential employability of graduates (Stewart and Knowles, 2000). Higher Educational Institutions (HEIs) have to play the increasingly important role of producing "lifelong learners" and supporting and encouraging "lifelong learning". To play this role, HEIs need to teach their students skills for effective learning and career management (Stewart and Knowles, 2000).

While students generally expect their diploma or degree as well as their development in their studies to enhance their employability, they also have to prepare for the changes taking place in the employment arena in general. In the past it was possible to simply expect to be employed by an organization on completion of a diploma or a degree. Globally, life long stable employment is no longer the norm for many countries' work force. This trend is also reflected in IT in South Africa (SAITIS Report, 2000). These new employment and economic realities (James, 1996; SAITIS Report, 2000) have created a need for additional skills to be developed in students so that they can choose from the various job opportunities available to them.

South Africa (SAITIS Report, 2000). This report highlighted, as two of the major priority areas the needs to develop an appropriate skills base for the IT sector and a stronger entrepreneurial base in the IT industry in South Africa. It further recommended that training programs be instituted at HEIs in South Africa to address the lack of entrepreneurial training in IT.

There are opportunities for South African entrepreneurs to become the remote developers for large organizations. Other countries such as India, Ireland and Singapore, which also have highly educated software developers, have set up offshore software development agencies that develop software at prices, which are attractive to both the developer and the more affluent client (Yang, 2001). Considering that local graduates are highly skilled, South African graduates, especially those who are potential entrepreneurs could realize similar opportunities locally. For these graduates to compete equitably in an aggressive global market, they need to be able to cost their products competitively.

Not meeting the deadlines and budget

The general skills shortage in the Software Development domain indicated above is aggravated by the global lack of skills (Schwalbe, 2000; Yang, 2001) in certain areas of responsibility in software development and project management. Two responsibilities of concern, in particular in software development are time management and budget management (SAITIS Report, 2000; The CHAOS Report, 1995). Despite the progress made in software development methodologies, software projects still have a poor track record for meeting schedules and when they are

completed they have a poor track record for coming in within budget (Jiang et al.; 1997; Fleck, 1998; Schwalbe, 2000; Boyd, 2001; Yang, 2001).

Boyd (2001) has noted that it is "not uncommon for software development projects to be delivered late and over budget by a factor of 50% to 100%". This is an extremely high failure rate and it is unacceptable to business. While other studies places the cost overrun factor at 30 to 40 % (Moløkken and Jørgensen, 2004) this is still a significant rate of failure. For a small business this could be devastating. Small businesses do not have the resources or the steady supply of projects waiting to be developed, which can be used to offset such failures. For a small business each project must be tendered for in an aggressive market (Fagan ,1997).

Tendering in Small IT business

Service providers, such as IT consultants, depend on the market and the economy for their success. Since these external influences are beyond the control of the small business owner and manager it is imperative that effective control is exercised over the factors within their command. In order to operate profitably under the prevailing economic pressures it is necessary for the IT consultant to utilize a number of different skills to achieve a strategic advantage. Strategic decision-making is needed to achieve a profit and in the case of tendering, this objective is obtained via an optimum combination of costs and price. Traditionally tendering is viewed as a complex task and beyond the reach of small business owners or managers. The proliferation in the creating of small businesses has created a need to equip the

entrepreneur with the skills and confidence required to compete equitably with established businesses, when tendering for projects.

Prospective customers consider a number of factors when making a purchase. These factors include the comparative price, the after sales service and the reputation of the seller or service provider. A decision is then made to procure the product or service based on the perceived best quality received at a fair price (Park and Chapin, 1989; Fagan, 1997). The buying market requires the right product or service to be provided at the desired place, time and price from a provider with an acceptable reputation. The abovementioned factors for successful sales provide a major challenge for the small business owner or manager when securing new business (Fagan, 1997, NWCET, 1999).

Bearing these factors in mind, the consultant needs to overcome a few barriers to the success of the tender. It is vital to view the resources at its disposal critically when tendering for projects. Over-committing limited resources to a project can, adversely affect the small business. At the same time the development of the tender is a cost to the business (Park and Chapin, 1989; Fagan, 1997). Estimating the costs and pricing for tenders require knowledge, time and experience. As the consultant becomes more experienced at developing estimates for tender, the accuracy of those tenders will improve (Park and Chapin, 1989; Fagan, 1997). The accuracy of the estimate is important for several reasons including contractual obligations, financial implications and loss of reputation as a consequence of not complying with the contract (Fagan, 1997).

Knowing when to tender is an important factor to consider when developing cost estimates for tender. Consultants are faced with the difficult choice of selecting between missing out on an opportunity for work and incurring the cost of an estimate for tenders, which are unlikely to be successful. Consultants continuously need to determine why their tenders were unsuccessful and to compare their pricing to those of competitors. It is important that records of past tenders are kept in a database, which will allow the consultants to critically assess the resources required to respond effectively to tender opportunities. Constant review of the competition provides insight as to the "right price" for a project.

Costing, Estimating and Pricing for Tender

Determining the price of a project requires the costs to be determined first. This is a difficult situation for the consultant. By pricing the project too high, the consultant increases the chances of the tender being rejected. Similarly, by pricing the project too low, the consultant risks financial loss as well as the possibility of the tender being rejected. Determining the optimum price for a project necessitates an understanding of costing. The consultant needs to know what is being invested by the business in order to determine a price that will be considered fair by prospective customers (Fagan, 1997; Rwigema and Venter, 2004). To enable the entrepreneur to develop accurate, profitable and successful tenders, the entrepreneur needs to be taught to cost for projects.

There are a variety of costs which impact on the price of a tender and these include fixed and variable costs. Fixed costs or overheads are costs, which remain the

same despite the level of sales or production. Variable costs refer to those costs, which are incurred directly as a result of a particular project and will differ from project to project.

Added to these costs will be estimates for aspects of the project, which reflect the use of certain resources. A further addition to the costs when determining a price is the inclusion of a suitable markup on the costs. An important component of costing is the accuracy of the estimates. While the term estimating implies a degree of inaccuracy, the historical records kept in a database for reference when determining the price, will improve the accuracy of the cost estimate and contribute towards a realistic and fair price. Costing, estimating and pricing require the consultant to have arithmetic and financial skills to produce an accurate, realistic and competitive tender.

Jones and Tilley (2003), cites costing as a "strategic contract" which contributes to competitive advantage. Competitor research is vital for consultants when tendering for projects, since this information will inform the tender predictions being produced (Fagan, 1997). These market conditions assist the entrepreneur with their strategic development. To develop or maintain a competitive advantage the entrepreneur constantly needs to update its strategic plan so that the business will continue to grow and sustain itself. This challenge to improve competitiveness is compounded by the constant need to overcome the problems associated with a small business.

Objective decision-making is required for management problems that traditionally would have been solved through intuitive judgment. In certain scenarios

past experience may best guide a consultant's actions while in other situations theoretical or managerial treatment is required. There are a number of decision-making tools available to supplement the personal experience and skill of the entrepreneur. These tools include operations research, statistics, probability theory and game theory (Park and Chapin, 1989). They allow the consultant to utilize both their experience and skills to a maximum advantage when facing difficult decisions for the business. Since future profits depend on present decisions it is important that these decisions are based on sound management judgment. Business should not solely be conducted on a trial and error business experience, since this is expensive for the business (Park and Chapin, 1989). Effective management of the small business requires a variety of skills to enable successful tendering. These skills include technical skills, sales and marketing skills, legal awareness, financial and managerial skills (Park and Chapin, 1989; Fagan, 1997; Jones and Tilley, 2003).

Need for Project Management

Once the tender is won, it is vital for the future existence of the IT business that the project is finished and it is successful. The CHAOS Report defines a successful software development project as being one that is completed on time and on budget with all features and functions originally specified. A failed software development project is one that does not meet customer expectations. These expectations include time frame, budget and functionality expectations. Improving the project management process will potentially reduce the risk of a project failing (CHAOS Report, 1995; Schwalbe, 2000; Kippenberger, 2000; Boyd, 2001). These

authors highlight the need for software development projects to be delivered in the timeframe and at a fair price that the customer desires.

Achieving a balance of high quality, cost effectiveness and on time delivery is a challenge especially since the degree of emphasis required by each of these key areas varies from project to project. Evidently, poor project management results in the high rate of project failures (CHAOS Report, 1995; Whittaker, 1999; Kippenberger, 2000; Boyd 2001). Since software development projects need to be managed from inception to implementation it spans the full software development lifecycle (SDLC). Management of projects is generally a team effort but in a small IT business all these tasks have to be done by the small business owner or manager skills (Jones and Tilley, 2003).

The functions of project management involve planning, execution and control of resources, tasks and the activities needed to complete a project. Detailed and thorough planning activities early in the lifecycle will enable a smoother execution phase later and will also require less time to be spent on control throughout the SDLC. In a small IT business the owner or manager will be both the project manager and the software developer.

In the early stages when the focus should be on the planning of a project, there is a tendency to rush into the design and development stages of the project. Software developers are usually keen to get started on the new project especially if they are required to learn new programming skills. These challenges illustrate the need for small IT business owners or managers to have multifunctional skills to enable them to

successfully manage their software development projects. A key function of the project manager is to develop good cost and time estimates.

The need for controlling software development costs is not new. In 1994, Morgan highlighted the urgency for addressing this problem by referring to it as a "runaway train". In 1997, in a survey of 239 IT companies conducted by Jiang et al. (1997) six criteria were used for assessing the effectiveness of projects, of which two were adherence to budget and schedule. Both these criteria were found to be major contributors in a project's success. A recent study (Bacarini et al., 2004) found "unreasonable project schedule and budget" to be the second highest risks factors in the management of IT projects.

It is therefore important for the project manager to respond to these threats to the projects' success via effective risk management and stringent project cost management. Project risk management is a tool, which enables the project manager to identify, analyze and respond to risks throughout the life of a project. This aspect of project management involves the continuous assessment of the factors that can affect a project negatively and the impact of these factors. Several strategies are then developed to minimize and deal with the risk. Anticipating and preparing suitable responses for threats to a project's success will have a positive impact on the development of realistic cost and time estimates. Effective risk management will potentially minimize the anticipated risks of a project, improve the realization of potential opportunities and assist project managers who are constantly working towards improved service delivery and better management through informed decision-making.

Despite knowing that software development projects need cost control, many IT professionals still do not understand the importance of knowing basic accounting and finance principles (Schwalbe, 2000). They need to liase with members of an executive board, accountants and others who decide on the granting of projects and are more interested in financial terms than IT terms. The resulting tension requires IT professionals to be trained to create good cost estimates that can be understood by both themselves and the accountants and management who will be evaluating them (Suwardy et al., 2003). When working towards achieving good cost estimates for their projects, IT professionals need to incorporate project cost management processes into the development of that estimate. Project cost management includes resource planning, cost estimation, cost budgeting and cost control, these cost management processes necessitates an understanding of the basic principles of cost management (Schwalbe, 2000).

While the accountants and management might essentially be interested in a "bottom line" amount as the cost to be considered for the project, it is important for the IT professional to motivate the project's costs in terms of worth and value to the company. Concepts such as life cycle costing (LCC) should be included to enable the development of more accurate projections of a project's potential financial benefits (Schwalbe, 2000; NASA, 2002). Life cycle costing allows the project manager to provide a conceptual view of the costs of a project over its life span. It provides management with an improved awareness of the factors, which influence costs and resources required by a project. Life cycle costing techniques allow for the full cost associated with a project to be estimated more accurately and this leads to improved decision-making and allows for more accurate forecasting of future expenditure. LCC

assists with the project management goals of improved service delivery and informed decision-making.

Preparing good cost estimates is a "very demanding, important skill that all IT project managers need to acquire" (Schwalbe, 2000). IT project management need to be able to present and discuss project information in financial terms as well as technical terms. Besides developing good cost and time estimates consultants need to have good leadership and negotiating skills to assist them with the motivation that may be required to stand by those estimates.

Like most skills, cost estimating is one, which the project manager will improve at over time (Park and Chapin, 1989; Fagan, 1997). The time constrained small business owner or manager who needs to be productive immediately needs this skill prior to taking on any project. IT projects are sought after and secured based on a perceived financial return to the business (Currie, 1995). Scarce resources such as time, effort and money are invested in projects based on cost estimates. When these estimates are exceeded, losses of current and future business occur.

Alternatively, estimating and costing skills may be acquired in a controlled and mentored situation such as within an IT curriculum. In this tolerant environment students can be taught to cost existing projects and learn by matching the actual costs with the estimated costs. Without the real loss of reputation and finances that could result from over or under estimating projects students can learn from their mistakes and modify their approach. By nature, estimating is a learning process that one refines with experience and develops expert judgment to base future estimates on. A

recent study of 10 surveys on cost estimation conducted internationally (Moløkken and Jørgensen, 2004), found that expert estimation is the most frequently used method for developing cost estimates. In the simulated environment of a classroom students could gain experience in generating the estimates and in the negotiating skills required to motivate for those estimates.

The difficulties for consultants

Software development is a risky undertaking where a number of decisions must be made, usually without complete information (Park and Chapin, 1989). Project leaders or managers need to learn to make the best decisions for the organization based on the information at their disposal. Developing an estimate is a complex task requiring a significant amount of effort (Shwalbe, 2000; Bacarini et al., 2004). In practice, many estimates must be done quickly and before clear system requirements have been produced. Figure 2.4 below, depicts the early stage at which the cost and time estimates must be produced. At this stage there often is also not enough accurate reliable project data available on which to base the estimates. The constraints of having a lack of the historical data to work from and insufficient estimating experience, makes it extremely challenging for consultants or entrepreneurs to generate realistic cost estimates.

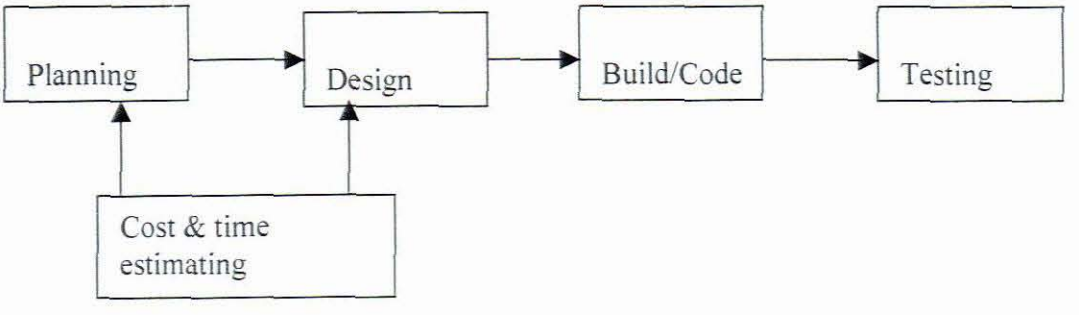

Figure 2.4: The stages in software development

Since humans have the tendency to under estimate (Kippenberger, 2000; Schwalbe, 2000; Boyd, 2001), good continuous monitoring and control of the real and estimated costs and outputs are also required throughout the development lifecycle of the project. This reviewing will create a frame of reference for future, similar projects that may need to be developed and it will also act as an early warning system allowing for corrective action where possible before large amounts of time, money and effort have been poorly spent.

Chapter Summary

The need for entrepreneurial training in South Africa HEIs has been identified in the SAITIS Report. This finding is consistent with worldwide educational trends that seek to prepare graduates more realistically for the world of work. HEIs such as Technikons can utilize their cooperative educational policies, which foster close linkages with industry to inform their programmes to meet this need. The report also identified the need for project management skills to be taught to IT students especially those who will become small business owners or managers. These IT consultants need to be *multi skilled to manage effectively. Financial and managerial skills are* key contributors to the development of accurate and competitive tender. These core skills for tendering need to be provided when developing entrepreneurial training for IT students. This should include the first principles of arithmetic and accounting on which tendering is based.

Software development generally includes risk and it is desirable to minimize this risk. Managers of software projects need to constantly review a project's

progress and risk to address those threats timeously. Project management highlights the need for realistic estimates to be developed and the recording of real and estimated costs and outputs to form a baseline that enables easier costing for future projects. In IT cost estimating is a skill that one learns and improves at over time, usually with some mentoring. For IT entrepreneurs, especially those with very little or no cost estimating skills, this need becomes vital. The situation is exacerbated by the fact that the business world is competitive and with current trends of downsizing and outsourcing in IT, the desire for quality, fair priced software must constantly be matched to the client's budget of time and money.

The key to any organization's survival and growth is to make a profit and achieve maximum results. For the entrepreneur it is also vital to create a good reputation for delivering products or services as promised. This will in turn result in return business and more opportunities for making a profit. When IT consultants or small business owners or managers are looking at ways to achieve maximum results then a key concern would be to deliver the products on time and within budget. The difficulty lies firstly in creating accurate and profitable cost estimates for tender followed by a schedule and a budget that are achievable but still competitive enough to secure the project in the first place. These factors highlight the need for HEIs who are teaching entrepreneurial studies to IT students to include cost estimating training into their curricula.

CHAPTER 3

METHODOLOGY

Introduction

This chapter discusses the methodology and the approach used to gather data from a variety of sources to test the hypotheses.

Over the years a number of methods have been developed to acquire data. Different methods offer different benefits and are best suited to certain situations. Since a single problem can result in different types of research questions being asked, there are a number of approaches to answering these questions. For example, a little boy is learning to swim. This situation could raise questions on the speeds that a young swimmer can reach or how far such a young novice can swim. These are scientific questions requiring precise answers and are more suited to a quantitative approach. Alternately, the same situation could result in questions like "What it felt like to be immersed in water?" or "What it is like to view things under water?" These questions focus on the child's experiences and its perceptions of that experience and are more suited to a qualitative approach. Both types of questions are valuable and both provide more understanding of the experience of learning to swim for a young child, but they differ in what they want to know. Different people would recount the experience differently and neither account would be wrong or better (Leedy, 1997). The type of questions asked would determine which approach would be more or less appropriate in that particular case (Leedy, 1997, Sarantakos, 1998). The approaches to answering research questions are either qualitative or quantitative.

Qualitative approaches

This approach is also referred to as being interpretive, naturalistic, constructivist or post-positivist (Leedy, 1997). The qualitative approach answers questions about the "nature of a phenomenon, with the intent of describing and understanding the phenomena from the participants' point of view" (Leedy, 1997). It permits the researcher to study selected issues in depth and in detail without being constrained by predefined categories of analysis. It places emphasis on the individual cases and seeks human understanding of those cases. Special attention is given to the subjective. It is not as precise as the quantitative approach and rather than attempting to prove or disprove a hypothesis it aims for "a pretty good idea" (Leedy, 1997). From this knowledge and understanding the researcher will build theory from a ground of experience or practice. This is known as grounded theory. To find out more about a phenomenon the researcher will ask people or observe the people. Hence the key techniques used here are interviewing and observation. According to Patton (1990) the researcher is the instrument in a qualitative inquiry since most of their data collection depends on their personal involvement. Validity in these methods requires the person doing the fieldwork to be a good listener, competent in the data gathering technique and thorough. The interviewer should be able to clarify areas where necessary without bringing in any bias. It is always necessary to minimize the impact of the intervention.

Quantitative approaches

This approach typically answers questions "about the relationships among measured variables with the purpose of explaining, predicting and controlling phenomena" (Leedy, 1997). This approach is also referred to by many names such as

the traditional or positivist or experimental or empiricist approach. It requires the use of standardized measures, which allow for the varying responses of people to be "fit into a number of predetermined response categories"(Patton, 1990). Attempts are usually made to remove the individual, the particular and the subjective from these responses. This approach starts off by testing a theory composed of variables, it measures with numbers and uses statistical procedures to analyze the findings to determine if theory holds true. It focuses on the precise. The benefits of a quantitative approach are that it makes it possible to measure the reactions of a large number of people to a limited number of questions. This facilitates comparison and statistical aggregation of the data (Leedy, 1997; Sarantakos, 1998). It provides a broad generalized set of findings. The study usually ends with the hypothesis being confirmed or proved false. The quantitative researcher seeks to understand and relate the subjective understandings and actions of those being studied and provides an insider's view. Due to this direct contact the relationship between the researcher and the researched in quantitative studies is usually very close (Patton, 1990). Qualitative data may be presented singularly, or combined with quantitative findings (Leedy, 1997; Sarantakos, 1998). A key element that shapes the steps in both the qualitative and quantitative research process is measurement.

Measurement

Measurement is a tool, which enables the researcher to assign values to objects to facilitate data analysis and interpretation. It includes the categorizing and/or assigning of values to the objects to represent quantities of attributes. This categorizing will enable the information gathered to be more specific and precise.

One objective of this study is to determine whether industry considers it to be necessary for IT students to be taught to cost for software development projects prior to them becoming consultants. To measure the degree to which industry valued this skill a questionnaire was developed based on numeric responses. Numerous questions in the questionnaire were rated on a scale of 1 to 5 and respondents were required to select the most appropriate rating on the scale.

Measurement occurs in both quantitative and qualitative research but the different methodologies treat the measurement process differently (Neuman, 2000). Table 3.1 below illustrates the different approaches to measurement in the two research methodologies.

Table 3.1 Measurement approaches in the research methodologies

Measurement approach	Quantitative research	Qualitative research
Stage when it occurs	During the planning stages prior to data collection	During data collection stage
Data and techniques	Since quantitative data are required, techniques are used to provide precise numerical information	Data can be in the form of numbers, written or spoken words, visual images to provide data in a variety of shapes or forms.
Process	Specific measurement techniques define what the data will be and provide directions for gathering data.	Researcher starts to gather data and create ways to measure based on what they encounter. On reflection new ideas are developed and these ideas may suggest new ways to measure the data. An interactive and continuing process is formed resulting in further measurement.

Despite these differences both methodologies require the measurement to be reliable and valid.

Reliability and Validity

Reliability refers to the ability of an instrument to repeatedly produce the same results (Sarantakos, 1998). This dependability is desired to ensure research studies are transportable to different contexts. The two main types of reliability are internal reliability and external reliability. In the case of internal reliability, the results generated within a site are consistent. In external reliability the results generated across sites are consistent and replicable.

Validity refers to the ability to produce accurate results. A valid measure will produce accurate results and a true reflection of a situation (Sarantakos, 1998). It relates to the acquisition of data and how well the research instrument was designed. A close fit is desired between the conceptual and operational definitions. When this is achieved it will signify greater measurement validity (Neuman, 2000). The four types of measurement validity are face validity, content validity, criterion validity and construct validity.

Reliability is required if validity is to be achieved. While these concepts are complementary, reliability does not guarantee that a measure is valid. A researcher aims to achieve a high degree of both reliability and validity in the research instrument. To increase the reliability and validity a researcher will use specialized measures to condense and simplify the data that is collected (Neuman, 2000).

Specialized measures

Scales and indexes are examples of specialized measures used by researchers to improve reliability and validity. These techniques are employed in the area of attitude measurement and are used when reducing the data collected. An index is created when the researcher combines several distinct indicators of a construct into a single score. Scales are used when a number of questions or statements are posed and a set of response categories, are supplied with a related score. This allows the researcher to measure complex issues more easily. The most popular scales are the Likert, Thurstone and Guttman scales.

In this study the research instruments used the Likert format question with five responses based on the scale provided. Respondents were requested to select a numeric response of between one and five to each question. This scales provided the respondent with sufficient choice to enable the selection of an appropriate and accurate response based on their experience or understanding. Scales allow for high coverage of all the important aspects of the study. They provide the benefits of a high degree of precision, reliability and comparability while simplifying the data capturing and analysis processes (Sarantakos, 1998).

Sampling

Sampling is a process of choosing units of the targeted population which are to be included in the study. Sarantakos (1998) defines sampling as "a way that enables the researcher to study a relatively small number of units in place of the target population, to obtain data that are representative of the whole target population". While not all data lends itself to sampling, this process is appropriate whenever large

homogeneous populations need to be investigated. The two main categories of sampling are probability sampling and non-probability sampling (Leedy, 1997).

Probability sampling

Probability sampling is used by many researchers due to its high degree of reliability, representativeness and its generalisability of results (Sarantakos, 1998). It is however, an expensive, complicated and time-consuming method to employ. Strict rules of probability are employed when selecting the sample. In this type of sampling the researcher can specify in advance that each part of the population will be represented in the sample. This process of selecting components of the sample from the larger population is known as randomization and the sample is called a random sample. Random sampling achieves probability sampling best, and is used to avoid bias in a sample.

There are many different random sampling techniques available and the researcher needs to consider the total population carefully to enable the selection of the most appropriate sampling technique (Leedy, 1997). Examples of standard random sampling techniques include simple random sampling, stratified random sampling, proportional random sampling, cluster sampling and systematic sampling (Leedy, 1997).

Non-probability sampling

This approach is used when the researcher has no way of forecasting or guaranteeing that each element in the population will be represented in the sample. It is employed in exploratory research, observational research and qualitative research.

One example of non-probability sampling is accidental sampling, which takes the units "as they arrive on the scene or as they are presented to the researcher by mere happenstance," (Leedy, 1997). In this type of sampling, no attempt is made to control any bias and it is suited to situations where representativeness is not essential. This sampling technique is also known as convenience sampling and is easy to construct and evaluate (Sarantakos, 1998).

Quota sampling is a variant of convenience sampling where respondents are selected in the same ratio "as they are found in the general population" (Leedy, 1997). This type of sampling is not regulated and the only limitation is the size of the category.

A sampling technique where the researcher purposely chooses subjects who in their opinion are thought to be relevant to the research topic is know as purposive or judgmental sampling. In this instance, the judgment of the investigator is more important than obtaining a probability sample. This type of sampling will involve the identification of informants and the arrangement times for meeting them (Neuman, 2000).

This study focuses on two samples namely a sample of IT consultants and a sample of IT Skills - Entrepreneurship lecturers at the Technikons nationally. A purposive sample is used for each questionnaire. To probe IT consultants in the questionnaire for IT consultants, the researcher chose subjects who were IT consultants and who were familiar with the IT education program at Peninsula Technikon. The sample consisted of

- Alumni from Peninsula Technikon's IT department who had become consultants;
- Lecturers in Peninsula Technikon's IT department who are consultants; and
- Members of the advisory board of the IT department at Peninsula Technikon who were consultants.

The second questionnaire was directed at the 9 Technikons nationally. A saturation survey was selected for this sample population and consisted of the IT Skills - Entrepreneurship lecturer at each institution. The next step in the research model was the collection of the data.

Data collection

Data can be collected from a variety of sources to secure information about the research question (Sarantakos, 1998). Factors such as the research methodology used, personal preference and ideological convictions influence the choice of the method. Some data collection methods are more suited to quantitative studies and others to qualitative studies and some are used by both methodologies. In such instances, the methods will be adjusted to meet the principles and standards of these methodologies. Examples of methods used by both types of research are experiments, document analysis, observation and surveys (Sarantakos, 1998). Surveys include interviewing and questionnaires. In this study data were collected via mail questionnaires. This commonly used survey method was chosen since it

- Was easy to read and understand
- Was quick to complete (Leedy, 1997)
- Allowed for a geographically dispersed group to be accessed speedily and economically (Frazer and Lawley, 2004).

Since questionnaires are considered to be remote and impersonal and are often ignored, an introductory cover letter was mailed to participants to inform them of the purpose of the study and to assure them of their confidentiality (Sarantakos, 1998).

To overcome the constraint of not being able to prompt or ask clarifying questions, the following guidelines were adhered to, to facilitate the accurate completion of the questions,

- The use of clear language and instructions were supplied on the questionnaire on how to complete it (Leedy 1997, Sarantakos, 1998).
- The inclusion of open-ended questions to provide opportunities for clarification and additional information to be collected (Sarantakos, 1998).

There are different forms of questions that can be posed in a questionnaire that includes primary, secondary and tertiary questions, direct and indirect questions and fixed alternative and open-ended questions. This questionnaire primarily used fixed alternative questions and they were supplemented with open ended questions.

The background to this research problem

This research resides in the area of small businesses and entrepreneurship education with a focus on IT. This area of study has only recently become one of academic interest (Shaw,1999). It involves the study of human action and experience and is concerned with the social world. According to Shaw (1999), human beings "have the ability to think for themselves, comprehend their own behavior and have an opinion about the social world of which they are a part". This personal aspect requires researchers to use approaches that will enable them to gain the confidence of the participants. It is also desirable to develop a rapport with the participant so that this can lead to the participant not only assisting the researcher but volunteering information as well.

It is the intention of this researcher to gain information from this emerging area of research and to learn from the real life experiences of small business owners

or managers in IT and from other institutions, which may be offering entrepreneurship education. These factors suggest that a qualitative approach is appropriate. It is intended to determine the main issues that IT consultants or small business owners and managers encountered when developing costs for estimates in the initial stage of their businesses. This study does not seek to find the "best", most popular or most important costing methodology around. By surveying the participants it is hoped to penetrate their realities for developing their reputations and to interpret the perceptions of software development consultants or small business owners or managers with regard to the need for estimating skills to be taught in an entrepreneurship course for IT students. This research seeks to determine the importance of creating realistic estimates when trying to sustain a business in the competitive field of IT.

Objectives and the Research design

The objectives of this phase are firstly, to establish the need for a module in the Information Technology Skills – Entrepreneurship subject that focuses on the development of cost estimating skills of students who may enter the IT market as consultants. To achieve this objective IT consultants and small business owners and managers were sent a questionnaire to determine their qualifications, their level of estimating skills at the start of their consulting career and what their initial experiences were when estimating the costs of software projects.

The second objective seeks to determine from the experience of IT consultants

- whether cost estimating as a skill would be beneficial in starting up and sustaining an IT business;
- whether generating good cost estimates will help create a reputation that renders return business; and
- which topics the content of the proposed module should focus on to adequately prepare students to cost competitively for software development projects.

A questionnaire which addressed the above two objectives was developed and administered to the selected IT consultants.

The last objective of this study was to determine whether the IT Skills - Entrepreneurship lecturers at the Technikons perceived a need for a cost estimating module within the subject.

IT Consultants Questionnaire

Sample and Administration

This questionnaire was distributed to a sample of 22 IT consultants as previously discussed who were small business owners or managers in Cape Town. Two copies were hand delivered to consultants while they were visiting Peninsula Technikon and the remaining 20 were e-mailed. The purpose of this questionnaire was to determine from industry if cost estimation was a necessary skill for an IT consultant. It also sought to determine the need for IT students to be taught this skill prior to becoming a consultant.

This method was chosen for data collection since it allowed for quick data collection, it did not require any training of administrators, and it was affordable. It also provided for uniform data collection, a higher response rate and it was possible to execute with ease within the small radius from the researcher (Frazer and Lawley, 2004).

Questionnaire Design

To establish the degree to which industry considered cost estimation as being a necessary skill for an IT consultant, the questionnaire was designed to return quantitative responses. To enable effective measurement at a later stage, data relating to the consultants experiences encountered when costing estimates for software development projects were rated on a five point Likert scale. A numeric response of between one and five was required to be selected from the response categories indicating the level of agreement or disagreement. This approach allowed for simple data capturing and analysis of results.

The questionnaire consisted of an introduction and three sections. Section A of the questionnaire covered personal information such as the consultant or manager's contact details. This information was only used for follow up if the questionnaire was returned incomplete or if the respondent did not save the responses before returning it via e-mail.

Section B covered the qualifications of the consultant, whether they had entrepreneurial training in their formal education, how much if any cost estimating was done in their qualifications and whether this was sufficient preparation for their initial costing experiences.

Section C covered the cost estimation process itself and includes questions determining the need for the skill, the features and criteria that impact on an estimate, and whether any metrics are used. Some of these questions were informed from the literature.

Response Rate

Of the 22 consultants targeted 20 completed the questionnaire giving a response rate of 91%.

IT Skills -Entrepreneurship Lecturers Questionnaire

Sample and Administration

This questionnaire was conducted via email and had an introduction and 3 sections. It was sent to the IT Skills -Entrepreneurship lecturer in the IT departments at the 9 Technikons in the country. This sample represented the entire current population of Technikons in South Africa. The emailed self-administered questionnaire method was chosen since it was a low budget approach and required no supervision. This approach enabled the researcher to quickly reach a small group of geographically dispersed respondents. To avoid the very low response rate this method is usually known for (Frazer and Lawley, 2004) the researcher followed up on this small sample with reminder e-mails as well as telephonic reminders (Sarantakos, 1998).

Questionnaire Design

This questionnaire similarly measured the lecturer responses on a five point Likert scale for the previously discussed reasons.

There was an introduction and three sections in this questionnaire. Section A of the questionnaire covered personal information such as the lecturer contact details. This information was only used for follow up if the questionnaire was returned incomplete or if the respondent did not save the responses before returning it via e-mail.

Since each Technikon has the ability to choose what to teach within each course section B was designed to establish which topics were included in the module Information Technology Skills –Entrepreneurship at the different institutions.

Section C tried to determine whether the lecturers felt that students were being adequately prepared to compete for software projects successfully and if cost estimation needed to be taught in IT Skills - Entrepreneurship.

Response Rate

Of the 9 lecturers targeted at each of the Technikons 4 completed the questionnaire giving a response rate of 44%.

Analysis of data

The collected data was captured, encoded and statistically analyzed using the statistical package "Statistical Program for Social Sciences" (SPSS).

Chapter Summary

The methods used to gather data from IT consultants in industry and IT Skills - Entrepreneurship lecturers at the Technikons nationally, were outlined in this chapter. The sample selection, questionnaire design and administration and the

response rates were discussed. In the next chapter, the data will be analyzed and the findings will be discussed.

CHAPTER 4

DATA ANALYSIS

Introduction

The findings of the analysis of the data are presented in this chapter. The relationships between the variables represented by the data were investigated as well as the strength of these relationships. The software package SPSS (Statistical Program for Social Sciences) was used to analyze the data collected from the two questionnaires.

IT Consultants Questionnaire Analysis

This questionnaire was developed to determine whether IT consultants perceived it necessary for IT students who wished become consultants, to be taught how to cost competitively for software development projects.

The IT consultants were asked several questions about their formal, other professional and entrepreneurship qualifications. The distribution of the qualifications of IT consultants is shown in Table 4.1. This finding suggests that most IT consultants are generally well qualified with 90% of them reporting to have a minimum of three year tertiary education as their formal qualification and 65% reporting to have additional professional qualifications.

Table 4.1. IT consultants' formal qualifications

Formal Qualification	Technikon	University	Other
High school	-	-	10%
3 year qualification	20%	20%	-
4 year qualification	20%	10%	-
5 year qualification	-	15%	-
> 5 year qualification	-	5%	-

Few consultants (10%) reported having any entrepreneurial training that took the form of short courses such as privately offered Business Finance, Starting your own business in South Africa and Proposal Writing. However, 65% reported having at least one additional professional IT qualification. These findings are summarized in Table 4.2. Examples of these qualifications include X certified Novelle Admistrator, Oracle Professional Developer, A+ and CCNA .

Table 4.2. Types of IT qualifications.

Qualification	Percentage
Formal tertiary qualification	90%
Additional professional IT qualification	65%
Entrepreneurship education	10%

The responses of the consultants to how important their qualifications were in assisting them in establishing their business, suggest that the formal qualification is the foundation for the lifelong learning required by IT. They were presented with 3 statements referring to their qualifications and the role that each played in assisting them to establish their businesses.

On a 5-point Likert scale[1] of importance consultants were required to indicate how important these qualifications were. The ranking by the mean of their responses is shown in Table 4.3.

Table 4.3. The role of qualifications in business establishment

	1 %	2 %	3 %	4 %	5 %	Mean	Std Dev.
Other IT qualification	13.3	6.7	33.3	33.3	13.3	3.27	1.22
Formal qualification	10.0	10.0	45.0	15.0	20.0	3.25	1.21
Entrepreneurship qualification	33.3	-	16.7	33.3	16.7	3.00	1.67

Respondents ranked their other IT qualifications as most important relative to the establishment of their businesses. They ranked qualifications or training in entrepreneurship as the least important.

Table 4.4. Perceptions of the impact of qualifications on costing experiences

	1 %	2 %	3 %	4 %	5 %	Mean	Std Dev.
Formal qualification	42.1	42.1	5.3	5.3	5.3	1.89	1.10
Other IT qualification	46.2	15.4	30.8	-	7.7	2.07	1.26
Entrepreneurship qualification	40.0	-	20.0	40.0	-	2.60	1.51

On a 5-point Likert scale of preparedness (1 = did not prepare at all, 2 = slightly prepared, 3 = well prepared, 4 = moderately well prepared, 5 = extremely well prepared), consultants were required to indicate how well these qualifications prepared them for costing. The ranking by the mean of their responses is shown in

[1] On the 5-point Likert scale of importance, 1 = not at all important, 2 = little importance, 3 = moderately important, 4 = very important, 5 = extremely important.

Table 4.4. Respondents ranked their qualifications or training in entrepreneurship as providing the most preparation for costing than the other forms of education. However, all the means of the responses were less than 3 indicating that none of the forms of education provided adequate preparation and training in costing.

Most consultants (55.6%) reported that their formal IT qualifications did not include any modules or subjects on cost estimation.

Table 4.5. Perceptions on the importance of costing activities

	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
Documenting data for future use	-	5.0	15.0	40.0	40.0	4.15	0.88
Improving company estimation process	5.6	5.6	5.6	44.4	38.9	4.05	1.08
Developing own estimates	5	-	25.0	35.0	35.0	3.95	1.05
Re estimating the project	5.0	10.0	15.0	50.0	20.0	3.70	1.08
Standardized estimation	-	10.0	40.0	25.0	25.0	3.65	0.99
Creating multiple estimates	-	27.8	33.3	33.3	5.6	3.17	0.92
Using software estimation tools	5.0	25.0	40.0	30.0	-	2.95	0.89

Consultants were presented with seven activities or approaches used when costing for software development projects and required to rate them on the 5-point Likert scale of importance. After ranking the means of their responses, documenting costing data for use on similar projects was ranked as most important (mean=4.15), followed by improvements to the estimation process of their companies (mean=4.05).

The use of software estimating tools ranked as the least important to producing cost estimates with a mean less than 3, namely 2.95. These results are shown in Table 4.5.

The consultants were presented with five factors which typically contribute to cost overruns of software projects and were required to indicate how important each factor was in influencing cost overruns in software development projects. After ranking the means of their responses, the lack of the understanding of the users of their own requirements was rated as the most important factor in cost overruns emphasizing the need for the consultant to be skilled to interpret the users needs. The second highest factor listed was the tasks that were overlooked in the estimating process, which similarly referred to the need for consultants to be skilled in the cost estimation process.

Table 4.6. Factors influencing cost estimate overruns

	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
Users lack of understanding own requirements *	-	5.3	15.8	31.6	47.4	4.21	0.92
Overlooked tasks *	-	10.5	15.8	42.1	31.6	3.95	0.97
Over optimistic estimating	-	10.5	21.1	31.6	36.8	3.94	1.03
Inadequate information available	-	-	31.6	52.6	15.8	3.84	0.69
Frequent requests for changes by users *	5.3	-	26.3	42.1	26.3	3.84	1.01

Frequent requests for changes by users was rated as the least important relative to influencing cost overruns with a mean of 3.84. Since all means were

* Adapted from Lederer and Prasad, 1992

greater than 3, all factors were considered to be important influences on cost overruns. These results are shown in Table 4.6.

Consultants were asked to indicate which methods were used for developing cost estimates and the frequency with which they were used. Table 4.7 suggests that most respondents ranked the use of simple arithmetic formulas (94.7%) and the use of own intuition highly (83.3%). Both these methods required the consultant to have experience and skills. The method reported by the least number of respondents was the use of estimating software packages (26.3%). Relative to other methods not mentioned, one respondent reported adjustment of the costs themselves to gain the contract depending on how badly the consultant needed the business at that time.

Table 4.7 Estimating methods used

Method	Yes (%)	No (%)
Use of simple arithmetic formula *	94.7	5.3
Use of own intuition *	83.3	16.7
Comparison to similar, past projects based on documented facts *	76.5	23.5
Comparison to similar, past projects based on memory *	66.7	33.3
Use of market estimates	58.8	41.2
Guessing *	47.1	52.9
Use of established standards *	33.3	66.7
Use of a software package *	26.3	73.7

The results in Table 4.8 indicate that where the various methods were used, the frequency with which they were used by the respondents. By ranking the means of the responses, the use of software packages was most frequently used by respondents who possessed them. Anecdotal evidence suggests that these consultants themselves developed these software packages. The next most frequent method used

* Adapted from Lederer and Prasad, 1992

was the use of arithmetic formulas to generate cost estimates followed by comparison to similar, past projects based on documented facts. Guessing was the least frequently used option. Of the eight methods, the frequency of use of 62.5% (5) were less than 3 indicating that these methods were seldom used by the consultants.

Table 4.8. Frequency of the use of estimating methods

Method	Rarely %	Sometimes %	Often %	Very often %	Mean	Std dev.
Use of a software package *	-	-	60.0	40.0	3.40	0.55
Use of simple arithmetic formula *	-	-	63.2	36.8	3.39	0.50
Comparison to similar, past projects based on documented facts *	6.3	12.5	43.8	37.5	3.12	0.89
Comparison to similar, past projects based on memory *	7.1	35.7	42.9	14.3	2.64	0.84
Use of own intuition *	22.2	38.9	33.3	5.6	2.22	0.88
Use of market estimates	33.3	26.7	26.7	13.3	2.20	1.08
Use of established standards *	33.3	33.3	33.3	-	2.00	0.87
Guessing *	25.0	58.3	16.7	-	1.91	0.67

The consultants were presented with ten statements relative to the importance of various aspects of costing to becoming IT consultants and were required to rate the level of importance of each of these on the 5-point Likert scale of importance. By ranking the means of the responses, realistic costing of estimates for software projects was the most important aspect followed by cost estimating as a vital skill; and realistic cost estimation for repeat business.

* Adapted from Lederer and Prasad, 1992

The least important was the ability of graduates to compete for software projects offshore. Most of the means of the responses (7) were above 4, which on the 5-point scale was "very important." These results are shown in Table 4.9.

Table 4.9. Importance of costing aspects in preparation for becoming IT consultants

Statement	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
Realistic costing of estimates for software projects contribute to the development of a positive reputation for IT consultants (1)	-	-	15.0	35.0	50.0	4.35	0.75
Cost estimation is a vital skill for graduates who wish to become IT consultants (2)	-	-	15.0	55.5	30.0	4.15	0.67
Realistic cost estimation for software projects result in return business for an IT consultant (3)	-	-	15.0	60.0	25.0	4.10	0.64
It is preferable for graduates who wish to become IT consultants to learn to cost effectively in a simulated mentored environment (3)	-	-	15.0	60.0	25.0	4.10	0.64
It is preferable for IT graduates to improve their cost estimation skills on becoming consultants (5)	-	-	25.0	45.0	30.0	4.05	0.76
IT graduates should be able to cost competitively for software projects (6)	-	-	30.0	35.0	35.0	4.05	0.83
Technikon IT graduates should be able to cost for software projects (7)	-	5.0	25.0	35.0	35.0	4.00	0.92
It is possible for IT graduates to acquire cost estimating skills for software projects in the workplace (8)	-	-	30.0	50.0	20.0	3.90	0.71
It is preferable for IT graduates to acquire the ability to cost for software projects prior to becoming consultants (9)	-	-	40.0	45.0	15.0	3.75	0.72
IT graduates should be able to compete for software projects as offshore developers (10)	-	-	55.0	25.0	20.0	3.65	0.81

The consultants were presented with four statements relative to the costing requirements of industry from IT consultants. The consultants were required to rate the level of importance of each of these on the 5-point Likert scale of importance. By

ranking the means of the responses, the requirement by the software industry of accurate cost estimates was the most important followed by the problems associated with achieving accurate cost estimates. The least important issue to industry was the objective of pricing software to secure a contract. The means of 50% (2) of the responses were above 4, which on the 5-point scale was "very important." These results are shown in Table 4.10.

Table 4.10. Software industry costing issues

Statement	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
The software industry requires accurate cost estimates	-	-	5.0	50.0	45.0	4.40	0.60
Accurate cost estimates are a problem in the software industry	-	10.0	15.0	25.0	50.0	4.15	1.04
Software functionality should be adjusted to the price of an estimate	15.0	5.0	25.0	40.0	15.0	3.40	1.47
Software should be priced to gain a contract	15.0	15.0	15.0	25.0	30.0	3.35	1.27

IT Skills – Entrepreneurship Lecturers Questionnaire Analysis

This questionnaire was developed to determine whether the lecturers of the subject, *IT Skills – Entrepreneurship*, at Technikons in South Africa perceived it necessary for IT students who wished to become consultants to be taught how to cost competitively for software development projects. It sought to determine the content of the subject at the other Technikons. Not all Technikons teach this particular subject, selecting autonomously which subjects they wish to teach from a list of possible subjects. Each subject selected is then curriculated to suit the needs of each Technikon in consultation with industry stakeholders, usually using academic advisory boards for this purpose.

Of the institutions that offered the subject IT Skills – Entrepreneurship, 44.4% responded to the survey. After attempting to increase this rate of response through acceptable follow up methods, this response rate was deemed to be acceptable for the study.

Respondents were asked to indicate the level of study at their institution that the subject IT Skills –Entrepreneurship was taught. Their responses are shown in Table 4.11. Evidently, there is no consensus relative to when the subject is taught with equal numbers of respondents reporting offering the subject at each academic level.

Table 4.11. Academic level at which IT Skills - Entrepreneurship is taught

Level	Percentage
First year	33.3%
Second year	33.3%
Third year	33.3%

Academic staff were presented with a list of 11 subject areas or topics that could be covered in the subject and requested to indicate which they included in their course. The distribution of their responses relative to each of the subject areas is shown in Table 4.12. Forms of business, Purchasing, Finance and financial plans, Marketing and advertising, Types of business and Business Plans were the subject areas taught by most of the institutions (75%). This finding confirms the autonomy of institutions to curriculate the program to suit their individual requirements. The remaining subjects appear to be electives around the core subjects.

Table 4.12. Summary of topics offered in the entrepreneurship module

Topic	Proportion of institutions offering topic
Forms of business	75%
Purchasing	75%
Finance and financial plans	75%
Marketing & advertising	75%
Types of business	75%
Business plan	75%
Human resources	50%
Cost estimating & pricing	50%
Stock control	33.3%
Insurance	33.3%
Taxation	33.3%

Opportunity was provided for respondents to include topics they taught that were not reflected in the list of subject areas presented to them. These topics included Legal aspects of a business, Entrepreneurship & small business management and Business concepts. It is possible that while the topics might have different names they might in fact be the same as those in the list in Table 4.12.

The lecturers were required to rate the topics on a 5-point Likert scale of importance each of the topics in Table 4.12. Their responses ranked by the means are shown in Table 4.13. The extremely important topics were evidently Types of business, Business plans and Finance and financial plans with means of 5. The next important topics were Cost estimating and pricing, Forms of business and Marketing & advertising, each reporting a mean of 4.67. All topics reported a mean greater than 4, indicating that they were regarded as very important.

Table 4.13. Ranked list of topics in the entrepreneurship module

Topic	1 %	2 %	3 %	4 %	5 %	Mean	Std dev
Types of business	-	-	-	-	100	5.00	-
Business plan	-	-	-	-	100	5.00	-
Finance and financial plans	-	-	-	-	100	5.00	-
Cost estimating & pricing	-	-	-	33.3	66.7	4.67	0.58
Forms of business	-	-	-	33.3	66.7	4.67	0.58
Marketing & advertising	-	-	-	33.3	66.7	4.67	0.58
Stock control	-	-	-	50	50	4.50	0.71
Taxation	-	-	-	50	50	4.50	0.71
Insurance	-	-	-	50	50	4.50	0.71
Human resources	-	-	33.3	-	66.7	4.33	1.15
Purchasing	-	-	33.3	-	66.7	4.33	1.15

In response to whether a module on cost estimation should be taught in IT Skills - Entrepreneurship, all the respondents reported that it should. Reasons given for the respective responses included

- Consulting is very important in IT;
- Students need to have basic knowledge about costing to enable Continuous Professional Development (CPD); and
- Final year students need to be prepared for the field of IT.

Lecturers were asked whether cost estimation was taught as a topic in any other subject in the diploma and were required to select one of the supplied options or include any option not mentioned. In Information Systems II, 66.7% of respondents included cost estimation as a topic.

Table 4.14 provides a list of options relative to the topics that should be included in the "Cost estimating for consultants" module. These include areas of Project Management such as defining your project, Project Risk and Sensitivity Analysis and Resource Scheduling. The predominant reasons given for including these topics were

- These are the main components for estimating costs to consultants;

- Improved risk analysis; and
- Preparation of consultants for the survival and growth of the business as well as its employees.

Table 4.14. Suggested topics for the "Cost estimating for consultants" module

Fundamentals of Software Cost Estimation
Defining your project
Measuring program volume
Adjusting for the environment
"What if " analysis
Scheduling and project constraints
Project Risk and Sensitivity analysis
Case studies/class demonstrations
Resource management

Academic staff were asked to respond to five statements about the preparation of current students to become consultants and required to rate on a 5-point Likert scale of importance each of the statements. The results are shown in Table 4.15.

Table 4.15. Preparation of current students to become consultants

	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
Cost estimation is a vital skill for students who wish to become IT consultants	-	-	25	25	50	4.25	0.95
IT Skills (Entreprenuership) should be taught to start up a business.	-	-	25	25	50	4.25	0.95
IT Skills (Entreprenuership) should be taught to sustain a business.	-	-	25	25	50	4.25	0.95
It is preferable for IT students who are potential consultants to learn to competitively cost for projects in a simulated mentored environment.	-	-	25	25	50	4.25	0.95
IT Skills (Entreprenuership) students are adequately prepare to become IT consultants.	25	25	25	25	-	2.5	1.29

All statements except one (mean=2.50) were regarded equally as extremely important.

Similarly, academic staff were asked to respond to seven statements on various aspects of IT consulting relative to IT graduates and requested to rate on a 5-point Likert scale of importance each of the statements. The results are shown in Table 4.16. The requirement by the software industry for accurate estimates produced by IT graduates was ranked as the most important aspect, followed by the prospect of realistic estimates for repeat business.

Table 4.16. Aspects of IT consulting relative to IT graduates

Aspect	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
The software industry requires accurate cost estimates	-	-	25	25	50	4.25	0.96
Realistic costing of estimates for software development projects result in return business for an IT consultant.	-	33.3	-	-	66.7	4.00	1.73
IT graduates are able to estimate costs for software projects.	-	25	-	25	50	3.75	1.26
IT graduates are able to develop competitive cost estimate for software projects.	-	25	-	50	25	3.75	1.26
Realistic costing of estimates for software development projects contribute to the development of a positive reputation for IT consultants.	-	25	25	25	25	3.50	1.29
IT graduates are able to compete for software projects as offshore developers.	-	-	75	25	-	3.25	0.50
IT graduates would be productive in industry as consultants	-	25	25	50	-	3.25	0.95

All statements had means greater than 3 indicating that each statement was regarded as an important aspect of IT consulting relative to IT graduates as potential consultants.

Academic staff were presented with 4 stages commonly associated with the development of an IT business and asked to rate their level of importance using a 5-point Likert scale. Their responses are shown in table 4.17. While the means of all the responses were greater than 3, the most important stage of business development was the start up phase where costing skills are initially needed followed equally by establishing a reputation and sustaining the business.

Table 4.17. Stages associated with the development of a business.

Stage of business development	1 %	2 %	3 %	4 %	5 %	Mean	Std dev.
Business start up	-	-	25	25	50	4.25	0.96
Establishing a reputation	-	-	50	-	50	4.00	1.15
Sustaining a business	-	-	50	-	50	4.00	1.15
Expansion .	-	-	50	25	25	3.75	0.96

Chapter Summary

The responses to the IT consultants and IT Skills - Entrepreneurship Lecturers questionnaires were analyzed. The findings suggest that cost estimation is a necessary skill for IT consultants considering that the software industry required accurate cost estimation. Both the IT consultants and the academic staff at the Technikons, who were surveyed, confirmed this need. Despite a disparity in when the subject IT Skills –Entrepreneurship should be taught in the National Diploma in IT program, there was consensus on most of the topics that should be taught in it. While cost estimation was being taught as a topic within another subject such as (Information Systems II) there was a need for it to be taught in IT Skills – Entrepreneurship subject in a simulated mentored environment.

The IT consultant questionnaire aimed to determine if cost estimation is a necessary skill for an IT consultant. Consultants reported an need for this skill and that the industry required both realistic and accurate cost estimates for software projects. While few consultants reported to having entrepreneurship training, they reported this training to be beneficial in the establishment of a business. They reported that none of their qualifications provided adequate preparation and training in cost estimation for potential consultants. They indicated that entrepreneurship training or qualifications would better prepare students for future costing experiences and that this training should take place in a simulated mentored environment.

In the next chapter the findings of the study are summarized and compared against the literature reviewed, the study is concluded and suggestions offered for further research.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study as stated in the chapter entitled, Awareness of the problem, was to determine if cost estimation was a necessary skill for IT students who wanted to become consultants. The study was designed to test the following hypotheses:

- H1:Cost estimation is important for an IT graduate to become a consultant.
- H2:Current IT programs at Technikons do not prepare students to produce realistic cost estimates.
- H3:A focused cost estimating and pricing module is not included in the IT Skills – Entrepreneurship subject.
- H4:The IT Skills – Entrepreneurship subject includes techniques to enable graduates to develop estimates using costing and estimating first principles.
- H5:Realistic cost estimating results in a positive reputation and return business for an IT consultant.

The study was also directed at achieving the following objectives:

1. The first objective is to determine whether the IT industry and Technikons regard cost estimating as a necessary skill to be an IT consultant.

2. The second objective examines the course content of IT Skills – Entrepreneurship programs at Technikons to determine whether there is a module that specifically addresses cost estimation.

3. The third objective is to gather feedback from the IT industry about the techniques commonly used to produce realistic cost estimates to inform the development of such a component in the IT Skills – Entrepreneurship subject.

4. The last objective determines from IT consultants whether realistic accurate cost estimates contribute to sustaining and expanding an IT consultancy.

The study reviewed the available literature to support the objectives. Questionnaires were designed to return quantitative responses. The resulting data were recorded and analyzed using SPSS software and the findings were recorded. This chapter reviews and summarizes the findings relative to each of the hypotheses and objectives.

H1: Cost estimation is important for an IT graduate to become a consultant.

The study revealed that both Technikon lecturers and IT consultants considered cost estimation to be an important skill. From the literature reviewed the employability skills identified by several authors, listed analytical and problem solving skills as core employability skills (NWCET, 1999; Fallows and Steven, 2000; Jones-Evans et al. 2000). These employability skills include estimation and cost/benefit analysis. In South Africa, time and budget management were identified as two areas of concern in software development (SAITIS Report, 2000). These areas of concern in the management of projects are consistent with an international study by the Standish Group and published in the CHAOS Report of 1995. While these studies do not specifically address IT consultants it does report this need in IT in general.

The hypothesis that cost estimation is an important skill for an IT graduate to become a consultant cannot be rejected.

H2: Current IT programmes at Technikons do not prepare students to produce realistic cost estimates.

The study revealed that most consultants are well qualified and possessed both formal and other professional IT qualifications. While these qualifications assisted them in establishing their businesses, they did not adequately prepare them for their initial costing experiences. While current IT courses according to the academics surveyed included reference to cost estimating in their course offerings, this exposure was insufficient and inadequate to equip graduates to satisfactorily prepare cost estimates that are realistic and yet competitive.

The hypothesis that current IT programmes at Technikons do not prepare students to produce realistic cost estimates is, therefore, not rejected.

H3: A focused cost estimation and pricing module is not included in the subject IT Skills – Entrepreneurship.

The study revealed that not all Technikons included a module on cost estimation and pricing in their offering of the subject IT Skills – Entrepreneurship. Considering that all respondents regarded this topic as a very important component of the subject, all Technikons need to be persuaded to include such a module in IT Skills – Entrepreneurship.

The hypothesis that a focused, cost estimation and pricing module is not included in the subject IT Skills – Entrepreneurship is, therefore, not rejected.

H4: The IT Skills – Entrepreneurship subject includes techniques to enable graduates to develop estimates using costing and estimating first principles.

The study revealed that the most popular estimating method utilized by IT consultants was the use of simple arithmetic formula. Schwalbe (2000) highlighted a need for IT project managers to be able to present and discuss project information in financial terms. While all Technikons reported to offer basic finance and financial concepts in the subject IT Skills – Entrepreneurship, it is important that students be taught specific financial and arithmetic techniques based on costing and estimating first principles to enable them to produce good estimates that can be understood by both themselves and the accountants or management who will be evaluating the estimates (Park and Chapin, 1989; Fagan, 1997; Suwardy et al., 2003).

The hypothesis that the IT Skills – Entrepreneurship subject includes techniques to enable graduates to develop estimates using costing and estimating first principles is, therefore, rejected.

H5: Realistic cost estimates result in a positive reputation and return business for an IT consultant.

The study revealed that realistic cost estimates are extremely important, and potentially result in return business. Several authors have attested that improving this project management skill will potentially contribute to the success of a project (CHAOS Report, 1995; Whittaker, 1999; Schwalbe, 2000; Kippenberger, 2000; Boyd, 2001). Currie (1995) concurs with this finding, reporting that projects are sought after

and secured based on a perceived financial return to the business. This emphasizes the need for realistic cost estimates by the IT industry.

The hypothesis that realistic cost estimates result in a positive reputation and return business for an IT consultant is, therefore, not rejected.

Conclusion

Based on the results of the study the objectives have been achieved with four of the five of the hypothesis not being rejected. There is consensus amongst IT consultants and Technikon lecturers regarding the need for cost estimating to be taught to IT students to adequately prepare them for becoming IT consultants. This challenge is echoed in the national survey commissioned by the South African government (SAITIS Report, 2000), which highlighted the needs for the development of a stronger entrepreneurial base in the IT industry as well as an appropriate skills base in the country. It is imperative that HEIs prepare students for both the changing world of work as well as the dynamic world of IT. Continuous revision of the programmes offered is required to keep abreast in the IT sector and to keep the training provided in the programmes relevant. Cooperative education policy at Technikons encourages input from industry to ensure that the training these institutions offer remain relevant. The IT industry has indicated a need for students to be taught do to cost estimating realistically and competitively to address this historic need for improved budget and time management (CHAOS Report, 1995; Schwalbe, 2000; Kippenberger, 2000; Boyd, 2001). The improvement of their cost estimating skills to enable realistic cost estimates has been identified by the IT industry as a

means for producing return business and a positive reputation (Park and Chapin, 1989; Fagan, 1997). This improved ability will aid graduates who are potential IT consultant to progress from starting up a business to sustaining and growing their business through the procurement of more software development projects as a result of more realistic cost estimates.

Future Research

This research has established the importance of the cost estimation skill and the need for cost estimating to be taught at Technikons. There is, however, a need for an in-depth study to determine precisely what the content of a cost estimation module should be. This further research will require greater consultation with IT consultants nationally to provide a broader insight from the IT sector.

APPENDIX A - IT CONSULTANT QUESTIONNAIRE

PENINSULA TECHNIKON

COST ESTIMATING FOR CONSULTANTS QUESTIONNAIRE CONSULTANTS

This research aims to determine whether IT graduates wishing to become entrepreneurs, should be taught to do competitive costing for software development projects.

Please answer **all** the questions by filling in the blanks and marking your selection with an **X** as applicable and return this questionnaire to khang@.pentech.ac.za by **13:00 on 10/11/04.**

SECTION A (Consultant information)

Name		**Company**	
Contact No		**Position**	
Email address			

SECTION B

- What is your highest formal qualification and where did you receive this qualification?

	***Qualification* (discipline)**	**University**	**Technikon**	**Other College**
High school				
Matric (Std 10 / Grade 12)				
2 year Diploma				
3 year Diploma/degree				
Higher Diploma/ Honours Degree				
Masters Diploma/Degree				
Doctorate Diploma/Degree				

- Do you have any additional IT specific training?

Note: Should you have more than one qualification in a category add it under Other

	Qualification name e.g. MCSE	**Institution e.g. Damelin**
Microsoft certified		

Novel certified		
Cisco certified		
Oracle certified		
Other:		
Other:		

- Do you have any formal entrepreneurship training e.g. short courses, modules in other courses, etc?

	University	**Technikon**	**College**	**Private institution**
Short course				
Module / part of another programme				
Programme in entrepreneurship				
Other (describe below)				

- Use the following scale of 1 to 5 where to indicate how much your qualifications (listed in 1, 2 and 3) assisted you in establishing your business.

(1=not at all important; 2 = little importance; 3 = moderately important; 4 =very important; 5 = extremely important)

	1	**2**	**3**	**4**	**5**
Formal qualification					
Other IT qualification					
Entrepreneurship qualification					

- Use the following scale of 1 to 5 to indicate the extent to which the **above qualifications** prepared you for your initial costing experiences?

(1 = did not prepare at all; 2 = slightly prepared; 3 = well prepared; 4 = moderately well prepared; 5 = extremely well prepared)

	1	**2**	**3**	**4**	**5**
Formal qualification					
Other IT qualification					
Entrepreneurship qualification					

- Did your formal diploma/degree include any cost estimation? ***(Only include what you answered under question 1)***

Yes		**No**	

SECTION C (Cost estimation process)

- Use the following scale of 1 to 5 to rate the following questions. How important are these activities when costing for software development projects.

(1=not at all important; 2 = little importance; 3 = moderately important; 4 =very important; 5 = extremely important)

		1	2	3	4	5
1.	Developing their own estimates					
2.	Using software estimation tools to generate estimates					
3.	Creating multiple estimates using different estimation techniques					
4.	Re-estimating the project through its lifecycle					
5.	Documenting data for future use on similar projects					
6.	Using a standardized estimation procedure for all projects					
7.	Improving company's estimation process for software projects					

- To what degree of importance do the following factors influence the cost overruns of software projects?

(1=not at all important; 2 = little importance; 3 = moderately important; 4 =very important; 5 = extremely important)

		1	2	3	4	5
1.	Overlooked tasks					
2.	Over optimistic estimating					
3.	Users lack of understanding of own requirements					
4.	Frequent requests for changes by users					
5.	Inadequate information available					

- Which method for developing cost estimates do you use and how often do you use it?

(1= rarely, 2 sometimes; 3=often, 4=very often)

		Yes	No	1	2	3	4
1.	Use of a software package						
2.	Use of simple arithmetic formula (e.g. summing task durations)						
3.	Comparison to similar, past projects based on documented facts						
4.	Comparison to similar, past projects based on memory						
5.	Use of established standards (e.g. standard deviations, averages, etc.)						
6.	Guessing						
7.	Use of own intuition						
8.	Use of market estimates from other companies						
9.	Other: (describe below)						

- The following statements that relate to the preparation of IT students to become consultant and what the industry requires. Read them carefully before responding and mark your response in the relevant box with an **X** using the scale below.

(1=not at all important; 2 = little importance 3 = moderately important; 4 =very important; 5 = extremely important)

		1	2	3	4	5
1.	Cost estimation is a vital skill for graduates who wish to become IT consultants					
2.	*Technikon* IT graduates should be able to cost for software projects					
3.	Realistic costing of estimates for software projects contribute to the development of a positive reputation for IT consultants					
4.	Realistic cost estimation for software projects result in return business for an IT consultant					
5.	It is possible for IT graduates to acquire cost estimating skills for software projects in the workplace					
6.	It is preferable for graduates who wish to become IT consultants to learn to cost effectively in a simulated mentored environment					
7.	It is preferable for IT graduates to acquire the ability to cost for software projects prior to becoming consultants					
8.	It is preferable for IT graduates to improve their cost estimation skills on becoming consultants					
9.	IT graduates should be able to cost competitively for software projects					
10.	IT graduates should be able to compete for software projects as offshore developers					
11.	Accurate cost estimates are a problem in the software industry					
12.	The software industry requires accurate cost estimates					
13.	Software should be priced to gain a contract					
14.	Software functionality should be adjusted to the price of an estimate					

- Please provide any other information that you feel may be useful to this study.

Thank you for your participation and contribution to the improvement of IT education in South Africa.

E-Mail: khang@.pentech.ac.za

APPENDIX B - IT CONSULTANTS LETTER

TECHNIKON PENINSULA SKIEREILAND

FACULTY OF ENGINEERING:
DEPARTMENT OF INFORMATION TECHNOLOGY

ENQUIRIES
REF.NO. 1

26 October 2004

Dear Sir/Madam

MTECH (INFORMATION TECHNOLOGY) : GILLIAN KHAN

The Department of Information Technology at Peninsula Technikon is presently conducting research into issues relative to IT and to what we teach. In fulfillment of the requirements for a masters in IT, I, Gillian Khan, a full time lecturer at Peninsula Technikon am currently conducting research to determine whether cost estimation is a vital entrepreneurship skill for IT entrepreneurs.

Currently a course in Entrepreneurship Skills is taught at the Technikon, which aims to prepare students for the possibility of becoming an entrepreneur. I would like to gather information from IT consultants to determine if their experience highlighted a need for potential entrepreneurs to be taught to competitively cost for software development projects that they are tendering for.

The results of this study are to be used to assist me with amending the current syllabus for the Entrepreneurship Skills subject so that we may align what we teach with what is in fact needed by the IT industry. I understand that this information may be sensitive, so please note that all responses provided will be confidential. Research data will be summarized so that the identity of the individual respondents will be concealed.

I am hereby requesting that you please complete this questionnaire w.r.t your experiences as a consultant and then mail your saved response to me by 16:00 on Wednesday 10/11/04.

Should you have any questions please feel free to contact myself at the contact details supplied below or my supervisor Dr Theo Haupt.

Thank you in anticipation.

Yours faithfully

Gillian Khan
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APPENDIX C – IT SKILLS SURVEY

IT SKILLS - ENTREPRENEURSHIP QUESTIONNAIRE
PENINSULA TECHNIKON

COST ESTIMATING FOR CONSULTANTS
QUESTIONNAIRE FOR TECHNIKONS

This research aims to determine whether IT graduates wishing to become entrepreneurs, should be taught to do competitive costing for software development projects.

Please answer **all** the questions by marking your selection with an **X** as applicable and return this questionnaire to khang@.pentech.ac.za by **10/11/04**.

SECTION A Lecturer contact details

Name		**Technikon**	
Position		**Contact No**	
Email address			

SECTION B

- At which level do you teach Information Technology Skills (Entrepreneurship) ?

First year	
Second year	
Third year	

- Which of the following topics make up Information Technology Skills (Entrepreneurship) module at your institution and on a scale of 1 to 5, how important do you regard the topics below in the preparation of potential IT consultants?

(1 = not at all important; 2 = slightly important; 3 =important; 4 = moderately important; 5 = extremely important)

Topic	YES	NO	1	2	3	4	5
Forms of Business							
Taxation							
Insurance							
Finance & financial plans							
Purchasing							
Cost estimating & pricing							
Stock control							

Marketing & advertising							
Human Resources							
Types of businesses							
Business Plan							
Other (write below)							
Other (write below)							

- If "Cost estimating for consultants" is not included your current the IT Skills (Entrepreneurship) course as a module, should it?

Yes		No	

- Please motivate your response to question 3

- Is 'cost estimation' taught in any other subject?

Information Systems II	
Information Systems III	
Other: (write below)	

- What should be included in the "Cost estimating for consultants" module?

- Please explain why these topics should be included

SECTION C

- The following statements relate to your experience as a lecturer in the Information Technology Skills (or similar) subject. Read them carefully before responding and

mark your response in the relevant box with an **X.** Use the following rating scale of 1 to 5.

1.1 Answer the section below with your **CURRENT STUDENTS** in mind.

(1 = not at all important; 2 = slightly important; 3 =important; 4 = moderately important; 5 = extremely important)

		1	2	3	4	5
1.	**IT Skills (Entrepreneurship) students are adequately prepared to become IT consultants**					
2.	**IT Skills (Entrepreneurship) students should be taught to start up a business**					
3.	**IT Skills (Entrepreneurship) students should be taught to sustain a business**					
4.	**Cost estimation is a vital skill for students who wish to become IT consultants**					
5.	**It is preferable for IT students who are potential consultants to learn to competitively cost for projects in a simulated mentored environment**					

1.2 Answer the section below with **IT GRADUATES** in mind

(1 = not at all important; 2 = slightly important; 3 =important; 4 = moderately important; 5 = extremely important)

		1	2	3	4	5
1.	**IT graduates would be productive in industry as consultants**					
2.	**IT graduates are able to estimate costs for software projects**					
3.	**IT graduates are able to develop competitive cost estimate for software projects**					
4.	**Realistic costing of estimates for software development projects contribute to the development of a positive reputation for IT consultants**					
5.	**Realistic costing of estimates for software development projects result in return business for an IT consultant**					
6.	**The software industry requires accurate cost estimates**					
7.	**IT graduates are to compete for software projects as offshore developers**					

- The following 4 stages are commonly associated with the development of a business. How important, on a scale of 1 to 5, do you regard the preparation of potential IT consultants in relation to these stages of a business?

(1 = not important ; 2 = little importance; 3 = moderate importance; 4 = very important; 5 = extremely important)

		1	2	3	4	5	Motivate your response
1.	**Business start up**						....

2.	**Establishing a reputation**						....
3.	**Sustaining a business**						....
4.	**Expansion**						....

- Please provide any other information that you feel may be useful to this study.

Thank you for your participation and contribution to the improvement of IT education in South Africa.

E-Mail: khang@.pentech.ac.za

APPENDIX D - IT LECTURER LETTER

TECHNIKON PENINSULA SKIEREILAND

FACULTY OF ENGINEERING:
DEPARTMENT OF INFORMATION TECHNOLOGY

ENQUIRIES
REF NO 1

26 October 2004

Dear Sir/Madam

MTECH (INFORMATION TECHNOLOGY) : GILLIAN KHAN

The Department of Information Technology at Peninsula Technikon is presently conducting research into issues relative to IT and to what we teach. In fulfillment of the requirements for a masters in IT, I, Gillian Khan, a full time lecturer at Peninsula Technikon am currently conducting research to determine whether cost estimation is a vital entrepreneurship skill for IT entrepreneurs.

Currently a course in Entrepreneurship Skills is taught at the Technikon, which aims to prepare students for the possibility of becoming an entrepreneur. I would like to gather information from IT lecturers at the different technikons to establish what is taught at those institutions and if they feel that there is a need for potential entrepreneurs to be taught to competitively cost for software development projects that they are tendering for.

The results of this study are to be used to assist me with amending the current syllabus for the Entrepreneurship Skills subject as well as with my masters studies. I understand that this information may be confidential to some lecturers, so please note that all responses provided, will be confidential. Research data will be summarized so that the identity of the individual respondents will be concealed.

I am hereby requesting that you please complete this questionnaire w.r.t your experiences as an IT Skills (Entrepreneurship) lecturer asap.

Should you have any questions please feel free to contact myself at the contact details supplied below or my supervisor Dr Theo Haupt.

Thank you in anticipation.

Yours faithfully

Gillian Khan
Lecturer : Department of Information Technology
Peninsula Technikon
Ph (021) 959-6514
Fax (021) 959-6124
khang@pentech.ac.za

Supervisor details

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APPENDIX E - FOLLOW UP REMINDER EMAIL

TECHNIKON PENINSULA SKIEREILAND

FACULTY OF ENGINEERING:
DEPARTMENT OF INFORMATION TECHNOLOGY
ENQUIRIES
REF NO. 1

10 November 2004

Dear Respondent

MTECH (INFORMATION TECHNOLOGY) : GILLIAN KHAN

I understand that you may be very busy and are probably having a hard time keeping abreast of the many obligations, which are essential and required. This is just a friendly reminder that the COST ESTIMATING FOR CONSULTANTS QUESTIONNAIRE is due on Friday 12/11/04.

Thank you for your assistance.

Gillian Khan
Lecturer : Department of Information Technology
Peninsula Technikon
Ph (021) 959-6514
Fax (021) 959-6124
khang@pentech.ac.za

Supervisor details

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BIOGRAPHICAL SKETCH

Gillian Khan (nee Thomas) was born in Cape Town South Africa on January 27, 1962. She completed the National Diploma in Electronic Data Processing at Peninsula Technikon, Cape Town (ND in EDP Pen Tech). In 1984, after having worked in industry, Gillian joined the academic domain as a lecturer at Peninsula Technikon. During this period she furthered her studies by completing the National Higher Diploma in Computer Data Processing. She has lectured in various subjects ranging from Development Software to Information Systems in the Software Development Stream of the Information Technology Diploma.

Her lecturing portfolio includes coordination of the subject Industry Exposure (Cooperative Education) in the Information Technology Diploma. This responsibility includes liaising with industry via experiential learning placements and the department's Advisory Board. This involvement with industry allows her to keep abreast of the software industry's needs from Peninsula Technikon's IT students. She has maintained contact with professional IT bodies through her completion of the Computer Users Society (CUC) examinations and membership of the Computer Society of South Africa (CSSA). Gillian's research interests include programme and skills development, project management and entrepreneurship.

Her non-academic portfolio includes involvement in student activities in the IT Department at Peninsula Technikon as the coordinator of the E-STUDENTS computer club and via a student outreach programme to the community in conjunction with the Shuttleworth Foundation's *tuXlab* project.