Winter 1999

A Study to Determine Selected Industry's Perception in the Savannah Metropolitan Statistical Area Regarding the Competencies Required of Baccalaureate Industrial Technology Graduates in the Year 1998

Cary Alan Van Sickle

A STUDY TO DETERMINE SELECTED INDUSTRY'S PERCEPTION IN THE SAVANNAH METROPOLITAN STATISTICAL AREA REGARDING THE COMPETENCIES REQUIRED OF BACCALAUREATE INDUSTRIAL TECHNOLOGY GRADUATES IN THE YEAR 1998

Cary Alan Van Sickle

A STUDY TO DETERMINE SELECTED INDUSTRY'S PERCEPTION IN THE SAVANNAH METROPOLITAN STATISTICAL AREA REGARDING THE COMPETENCIES REQUIRED OF BACCALAUREATE INDUSTRIAL TECHNOLOGY GRADUATES IN THE YEAR 1998

by

Cary Alan Van Sickle

A Thesis Submitted to the Faculty

of the College of Graduate Studies

at Georgia Southern University

in Partial Fulfillment of the

Requirements for the Degree of

Master of Technology

in the School of Technology

Statesboro, Georgia

February, 1999

A STUDY TO DETERMINE SELECTED INDUSTRY'S PERCEPTION IN THE SAVANNAH METROPOLITAN STATISTICAL AREA REGARDING THE COMPETENCIES REQUIRED OF BACCALAUREATE INDUSTRIAL TECHNOLOGY GRADUATES IN THE YEAR 1998

by

Cary Alan Van Sickle

Dr. Charles H. Perry, Chairperson

Dr. David A. Williams

Dr. Waldo E. Meeks

G. Lane Van Tassell
Associate Vice-President of Academic Affairs
and Dean of Graduate Studies

4/27/99
Date

Dedication

To my wife, Michelle, thank you for your patience and support, and to my twins whose coming birth kept me focused on completing this study.

Table of Contents

APPENDICES

List of Tables

CHAPTER 1

Overview of the Study

Introduction

Industrial Technologists are typically employed in industry to manage and to solve technical problems (Hayden, 1993). "Industrial Technology is a field of study designed to prepare technical and/or technical management-oriented professionals for employment in business, industry, and government" (NAIT, 1997, p. 1). As the needs of our society become more versatile and technical, the engineering discipline alone has not been able to fulfill these needs. These needs have been met by technology and engineering technology graduates (Akinkuoye, 1991). This increase in technology may require new competencies of Industrial Technologists preparing for entry level employment in industry.

Industrial technologists are technical management-oriented professionals responsible for trouble shooting and problem solving and facilitating positions that efficiently combine technology and management. Industrial technologists must utilize many disciplines to manage and solve technical problems (Hayden, 1993). Technologists are an integral part of the technical team required by business and industry. Akinkuoye (1991) presents the technologist's relationship to engineering as "technology and engineering technology are both young professions when compared to the traditional engineering profession, but all share common educational experiences" (p.182). While engineers focus on plans to

convert natural resources to benefit humankind, technologists concentrate on converting the engineer's plan to reality. Typical job functions of a technologist include: a) product design, application and distribution, b) production and manufacturing, and c) operation (including supervision) and maintenance (Akinkuoye, 1991).

With technology changing in today's society, the needs of industry are also changing. Hodgson and Barnes (1994) state that there is an evolving need to educate engineers and technologists having a wide range of education in an effort to meet the needs of industrial sectors. Industry plays an important role in facilitating the growth and technical development of technologists (Garrod and Borns, 1988). Technology education is influenced by industry through internships, advisory boards, and selected survey populations. The success of a technology graduate is dependent on employment in industry, and employer input is critical to the development of a successful technology program (Brauer, 1994).

Statement of the Problem

The problem of this study was to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of industrial technology graduates in the year 1998.

Need for the Study

Badiru and Baxi (1994) stress the importance of undergraduate programs as being the basis for entry into graduate schools and other professional fields. "Undergraduate education is the foundation for professional practice" (p.66). Akinkuoye (1991) states that technology graduates have a "hands-on" orientation, and since technology programs

emphasize current industrial practices and design procedures, graduates are prepared to begin technical assignments immediately upon graduation. Changes are occurring in terms of technological, economic, and social developments (Badiru and Baxi, 1994). "Because technological methods and techniques for producing goods and services are continually changing, the required skills for individuals employed by service and manufacturing industries are also changing" (Zargari, Savage, and Waggoner, 1995, p.73). Keramas (1995) suggests that for the United States to maintain its position as a world leader, government and education must consider the needs of industry. "Our educational needs can be met only if we pay close attention to the needs of industry and maintain good communication and cooperation between industry and education" (Keramas, 1995, p.40).

The feedback from this study may be utilized when considering industrial technology program revisions and may also be used as a source of information for other studies. Additionally, this study identifies the entry level competencies expected by industry for industrial technology graduates and provides typical job positions held by program graduates.

Research Questions

The research questions examined within this study were as follows:

1. What are the most common competencies required of industrial technology graduates as perceived by industry?

2. What are the common positions held by industrial technology graduates in industry?

3. How many companies in the selected survey population employ industrial technology graduates?

Basic Assumptions

1. The data required for this study was obtainable by the use of a written survey questionnaire.

2. The individuals completing the questionnaire were qualified to rate the competencies required of entry level industrial technologists.

3. The responses collected from the questionnaire were a representation of the population.

Limitations and Controls of the Study

Limitations and controls placed on this study were as follows:

1. The survey population was limited to manufacturing companies in the Savannah Metropolitan Statistical Area agreeing to participate in the study and listed in the Georgia Manufacturers Register 1997 as having 50 or more employees.

2. The accuracy of the data collected from the survey instrument was dependent upon the response of the participants.

3. The study was limited to four year baccalaureate industrial technology degrees with an emphasis in manufacturing.

4. The study was limited to technical and administrative competencies.

Definition of Terms

The terms pertaining to this study are defined as follows:

Administrative Competencies - The areas of knowledge and skill that are closely related to an entire organization and how it is coordinated, to its information and records system, and to planning and controlling work (Bittel and Newstrom, 1990).

Industrial Technology - The field of study designed to prepare technical and/or technical management-oriented professionals for employment in business, industry, education, and government (NAIT, 1997).

National Association of Industrial Technology, (NAIT) - The accrediting body for Industrial Technology programs at two and four-year colleges (NAIT, 1997).

Savannah Metropolitan Statistical Area - Chatham, Bryan, and Effingham Counties in Georgia (Boatright and Bachtel, 1997).

Technical Competencies - The areas of knowledge and skill that are specific for a certain work area and are outside the areas of general education, mathematics, management and physical science (NAIT, 1990).

Procedures and Methodology of Conducting the Study

This study was conducted as follows:

A review of literature was conducted in an effort to locate similar studies. Some of the similar studies found are discussed in chapter II of this study. Additional information was reviewed to provide the necessary background information for the study and a need for the study. The review of literature provided information that indicated the descriptive survey method as the suitable method for collecting data. The procedures and methods following the review of literature included, selection of the population, questionnaire development, collection of data, and analysis of the data.

After establishing the procedure and methodology, the survey instrument was developed. The survey instrument, a mailed questionnaire, was designed to determine the competencies of industrial technology graduates as perceived by industry. Also, the

questionnaire was designed to identify the number of companies employing industrial technologists and the positions held by industrial technologists. The questionnaire was sent along with a cover letter explaining the purpose of the study. Each respondent was allowed two weeks from the mailing date of the questionnaire to respond. After two weeks, another questionnaire and a follow-up letter were mailed to those who had not responded. Another two weeks were given for responses from the second mailing.

The survey instrument was examined by the thesis committee for face validity. The thesis committee confirmed that the questionnaire addressed the research questions of the study. The survey instrument was corrected and modified based on recommendations made by the thesis committee. The data were collected, analyzed and reported. Conclusions and recommendations were created and reported based on the analyzed data.

Summary

This chapter provided information about Industrial Technology as a field of study. The role of the industrial technologist and the technologist's relationship to engineering were briefly discussed. It emphasized the changes occurring in society and the need to solicit input from industry regarding the development of a successful technology program.

This study addressed the competencies required by industrial technology graduates as perceived by industry in the Savannah Metropolitan Statistical Area in the year 1998. The specific information provided in this chapter included an introduction to the study, a need for the study, research questions of the study, basic assumptions, limitations and controls, definitions of terms, and the procedures and methodology guiding the study.

CHAPTER II

Review of Related Literature

Introduction

The primary purpose of reviewing literature is to assist the researcher in attacking the problem of the study. Leedy (1997) presents the importance of investigating related literature as "it is fundamental among researchers that the more you know about the peripheral investigations germane to your own study, the more knowledgeably you can approach your own research problems" (p.71).

The review of literature in this study includes an overview of the role of the industrial technologist followed by a review of the National Association of Industrial Technology. The chapter continues with a discussion of related studies, a review of skills needed in industry, and concludes with a discussion of skills needed in industry.

The Role of the Industrial Technologist

The advancement of manufacturing technology encompasses not only the physical creation of the product, but also the organization of people and work to produce the product. New proven manufacturing practices have been successful and American manufacturing must adopt these practices to remain competitive. This competitiveness requires a new type of person at all levels of design, implementation, management, operation, and maintenance (Shaw, 1992). This new type of person is the industrial

technologist. "Industrial technology (IT) is a growing field in education and industry" (Chen & Chang, 1996, p.11). Chen and Chang (1996) state that the Industrial Technology program prepares graduates to plan and coordinate materials, machines, methods, and workers in a manufacturing setting. Shofoluwe and Johnson (1993) present the general fields of industrial technology as construction, communication, electronics, energy and power, automotive, transportation and manufacturing. Miller (1992) describes the purpose of industrial technology programs as "industrial technology programs prepare students for technical management positions in areas such as industrial planning, production, supply, product market research, and sales" (p. 22).

Industrial technologists are an integral part of the technical team required by business and industry. The technical team usually draws members from categories such as: scientists, engineers, engineering technologists, technologists, technicians and crafts persons (Akinkuoye, 1991). Akinkuoye (1991) states that none of these professions are more important than the other and that the job functions of each technical team member are complementary in nature. Akinkuoye also suggests that "some overlap of these job functions does occur by virtue of education, training, and interests..." (p.183). In addition to the technical and managerial challenges, technologists are also faced with a status struggle. "Currently, technologists face a status struggle in being recognized as members of the engineering profession" (Akinkuoye, 1991, p.186). While engineering curriculum is preparing engineers primarily for careers in research and development, designing manufacturing processes and production operations have largely faded from the

curriculum (Shaw, 1992). Shaw (1992) states that "engineers are therefore entering industry with little knowledge of manufacturing processes" (p.2).

Supervision is a likely part of an industrial technologist's career. The organizational hierarchy over the last two decades has undergone a "flattening" in industry and has shifted toward participative and team management. The role of the supervisor has evolved to one that requires an educated person with a wide variety of technical and human relations skills. The industrial supervision component of the industrial technology curriculum provides industrial technologists with the training necessary to acquire many of these skills (Shaw, 1995).

Industrial technologists also have the opportunity for professional development through certification. There are two certifications offered through the National Association of Industrial Technology (NAIT). The first certification is the Certified Industrial Technologist (CIT) which is awarded to graduates and faculty of NAIT-accredited associate and baccalaureate degree Industrial Technology programs. The CIT is awarded for a maximum period of eight years and is non-renewable. The second certification is the Certified Senior Industrial Technologist (CSIT). The CSIT is also awarded to graduates and faculty of NAIT-accredited associate and baccalaureate degree Industrial Technology programs. The graduates and faculty must have at least five years of professional experience and 75 hours of professional development units. The CSIT is renewable every five years (NAIT, 1997). Regarding certification, Helsel and Kicklighter (1992) state "the importance of certification to industrial technologists is clearly evident

by the interest students and faculty have in being certified in related areas, e.g., manufacturing engineering, quality control" (p.1).

The future roles of industrial technology graduates are largely dependant upon industry. As Shofoluwe and Johnson (1993) suggest "...present industrial trends should be taken into consideration to ensure that these aspiring industrial technologists are prepared for the immediate future" (p.40). Some of the future roles of the industrial technologist as identified by Sofoluwe and Johnson include: launching new products within shorter time frames, utilization of manufacturing innovations and robotics to cut production costs, instituting Total Quality Management, and creating innovative training programs to train new and old employees on new/improved technology.

National Association of Industrial Technology (NAIT)

The quality and content of Industrial Technology programs may vary from one institution to another. Therefore, the competencies of an industrial technology graduate from one institution may vary from those of a graduate from another. Thus the need for standardization or at least a guarantee of minimum competencies for Industrial Technology program graduates exists. The National Association of Industrial Technology (NAIT) was formed in 1967 and has become the accrediting body for Industrial Technology programs (NAIT, 1986).

> The primary purpose of the National Association of Industrial Technology accreditation is to provide recognition of the attainment of certain professional goals and standards for Industrial Technology. The

> secondary purpose is to encourage others to strive toward these goals and standards (NAIT, 1997, p. 1).

NAIT has been involved in the accreditation process since 1974 and is devoted to the establishment and upkeep of curricula of Industrial Technology. Only clearly defined associate and baccalaureate level programs that meet the standards of accreditation may be accredited by NAIT (NAIT, 1997).

Related Studies

Miller (1989) conducted a study to identify and rank required competencies in technical courses in NAIT accredited industrial technology baccalaureate programs. The study used the Delphi research technique to obtain data from selected experts. Thirty-five chairpersons of NAIT accredited industrial technology programs were selected as the panel of experts to participate in the study.

The findings of the study identified and ranked 48 competency statements. The results are summarized in table 1. Seven were perceived as mandatory, 14 as essential, nine as important, seven as useful and 11 as not necessary for baccalaureate industrial technology programs. Competency statements topping the list that were perceived as important were the abilities to produce technical documents, safe working habits, and familiarity with personal computer applications in industrial applications. Two of the recommendations by Miller regarding this study were for curricula developers to utilize the information generated by his study to assess the appropriateness of content of industrial technology programs and courses and for employers of various kinds of industrial technology graduates to serve as subjects of similar studies.

Table 1

Miller's (1989) List of Technical Competencies for Industrial Technology

Competency Number	Competency Description
	Mandatory Competencies
48	The ability to produce technical documents.
43	Ability to prepare accurate and concise reports.
28	Understanding and practice of safe working conditions.
33	Organization of production data into report format for presentation to management.
39	Development and /or utilization of systematic problem solving techniques.
46	Familiarity with PC computer applications (i.e. word processing, spreadsheets).
37	Estimation of production cost for a product.
	Essential Competencies
31	Conduct cost analysis for a production run.
19	Reading and interpretation of assembly drawings.
47	Familiarity with CAM/CIM systems.
32	Conduct break-even analyses.
34	Development of statistical sampling plan.
29	Understanding of development, modification, and/or interpretation of equipment layout plan.
20	Preparation of suitable sketch from which engineering drawings could be developed.
14	Preparation of engineering/shop drawings.
25	Preparation of production specifications.
40	Familiarity with labor standards and measurement (time-motion studies).

(Table 1 continued)

Competency Number	Competency Description
26	Preparation of an engineering (change) order.
44	Familiarity with the application of electronic data processing.
30	Preparation of/or update of PERT/CPM schedules.
09	Familiarity with physical and mechanical properties of common industrial materials.
	Important Competencies
45	Familiarity with Computer Aided Design (CAD) programs.
27	Preparation of purchase requests.
13	Familiarity with plastic forming processes.
12	Familiarity with plastic molding processes.
38	Performance of mathematical calculations (i.e. static, stress analysis, bending moment).
08	Familiarity with Flexible Manufacturing Systems (FMS).
06	Familiarity with processes to change physical properties (i.e. heat treating, cold working).
03	Familiarity with material removal techniques (i.e. turning, milling, optical lasers).
02	Familiarity with material fabrication and joining techniques.
	Useful Competencies
5	Familiarity with material joining processes (i.e. bonding, welding, adhesives, fasteners).
07	Familiarity with finishing processes (i.e. coating, conversion).
04	Familiarity with shape changing processes (i.e. spinning, extrusion, electroforming).
41	Development of tooling & fixtures for new equipment & processes.
15	Reading and interpretation of electrical schematics.

(Table 1 continued)

Competency Number	Competency Description
10	Familiarity with non-destructive testing programs.
16	Reading and interpretation of electronic schematics.
	Not Necessary Competencies
01	Familiarity with different organizational structure.
18	Reading and interpretation of hydraulic schematics.
11	Familiarity with laser beams, ultrasonic, and electrical discharge machining processes.
17	Reading and interpretation of pneumatic schematics.
22	Troubleshooting of AC electrical systems.
35	Development of a CNC part program.
23	Troubleshooting of DC electrical systems.
36	Identify the mechanical components used in control and transmission of power.
42	Technical skill specialization (i.e. welding, machinist, draftsperson).
21	Operation of injection molding equipment.
24	Troubleshooting of hydraulic/pneumatic systems.

Rothaupt (1994) conducted a study to determine what technical competencies were perceived as necessary for work in manufacturing jobs of Industrial Technology graduates. The technical competencies for Rothaupt's questionnaire were obtained from Dr. Timothy Miller's (1989) previous study.

The population used in Rothaupt's study were limited to randomly selected graduates of NAIT accredited industrial technology programs from the years 1989, 1990, and 1991. The data for this study were collected via a mailed questionnaire with a self-addressed

stamped envelope and cover letter. Useable responses were 176 of the original 328 mailed-out.

Using descriptive statistics, the data were analyzed to find the differences between the competency valuations of department chairs and program graduates. The data were then analyzed to determine what relationship existed between the ranked technical competencies list of the department chairs obtained from Miller's 1989 study and the ranked technical competencies list of program graduates obtained from Rothaupt's study. The findings indicated that there was a strong relationship between the two ranked lists of competencies. It was demonstrated that Industrial Technology's technical curriculum, as a whole, was more externally valid than previously indicated.

Rothaupt recommended that information from his study be used as one basis for curriculum review of industrial technology in manufacturing programs. He also supported the appropriateness of developing a new set of technical competencies due to the increasing advancement of technology and the current change in American management practice. Rothaupt suggests that "further research needs to be conducted to determine the technical skills and knowledge most sought after by manufacturing industries that hire industrial technology graduates" (1994, p.88).

Stewart (1996) conducted a study regarding the varying methods employed to review and revise the curriculum of industrial technology programs. Five randomly selected Industrial Technology programs were chosen for the study. A questionnaire and telephone conversations were used to collect data from curriculum developers regarding the external and internal influences on the curriculum.

The findings of the study indicated that "faculty and employers provided input for review and revision [of curriculum] in all cases" (p. 57). All of the respondents reported using a variety of survey methods for gathering data.

Hayden (1993) conducted a preliminary investigation of the competencies required by Industrial Technologists. Fourteen industrial personnel were interviewed from eleven different companies. The following questions were asked:

1. What are the main duties of the Industrial Technologist at this company?
2. What will be added to those duties within the next five years?
3. What will be the most important things for all employees of this company to be able to do five years from now? (p.2)

Based on the data collected from these three questions, Hayden was able to generate a list of competencies that Industrial Technology programs should focus. The list of competencies are as follows:

1. Participate as a team member.
2. Communicate orally and in writing.
3. Think creatively to solve problems.
4. Adapt to new situations.
5. Find, analyze, and utilize information.
6. Use computer software: word processing, CAD, and spreadsheets in particular to perform/solve a variety of tasks and problems.

7. Manage: industrial operations in general using world class manufacturing (WCM) techniques as outlined by Deming and Peters; and specifically, process planning, quality, safety, scheduling, and inventory.

8. Design, as automated and flexible as feasible: processes; work stations/areas; product and process lines; facilities; and products.

9. Lead: defined as inspiring others toward a common goal.

10. Facilitate: act as a support person, teaching/training others. (p.3).

Hayden mentions that many of the competencies listed above might best be taught by non-Industrial Technology faculty and should be taught in a variety of courses. He concludes that the above list is not exhaustively comprehensive and that additional research could add to the list. It is noted that the listed competencies are a useful point of focus for planning the objectives for industrial technology programs.

Archer (1989) conducted a study of the curricular needs for the manufacturing specialty area of industrial technology. Archer's study focused on determining the most suitable manufacturing curriculum for the State of Oklahoma and the appropriate levels of technical skills for manufacturing technologists in Oklahoma. The study also identified significant problem areas of manufacturing technology graduates entering Oklahoma industries.

The population for Archer's study was limited to all 1987 graduates of Oklahoma colleges and universities majoring in manufacturing technology or similar programs, and to all Oklahoma manufacturers listed in the Oklahoma Directory of Manufacturers and Products employing over one hundred employees. The data was collected using a questionnaire asking respondents to rate a list of subject, skill, and problem areas on a Likert scale. Archer's recommendations of the importance of subject areas to Industrial Technology programs based on his study are listed in table 2.

Table 2

Archer's (1989) Recommendations of the Importance of Subject Areas to Industrial Technology Programs

Subject Areas Considered Very Important	
Design for Manufacturing	Technical Graphics
Resource Utilization	Industrial Operations
Manufacturing Planning and Management	Project Development
Leadership Styles	Inspection
Blueprint Reading	Material Handling and Plant Layout
Production Scheduling	Fabrication Processes
Control of Manufacturing Processes	
Subject Areas Considered Important to Very Important	
Manufacturing Information Systems	Tooling Systems
Data Processing	Computer Programming
Machine Tool Operations	Hazardous Materials
Organization Planning and Development	Supervision of Production
Technical Writing	Manufacturing Systems

(Table 2 continued)

Subject Areas Considered Very Important.	
Management of Industrial Systems	Manufacturing Cost Analysis
Value Engineering	
Subject Areas Considered Not Very Important Depending on Local Industry.	
CAD/CAM/CNC	Hydraulics and Pneumatics
CIM	Manufacturing Economics Analysis
Automation Technologies	Research and Development
Geometric Dimensioning	Sales Administration
Strength of Materials	Digital Electronics
Metallurgy	Electronic Controls
Materials Science	Environmental Problems
Materials Testing	
Emerging Technologies that Should Be Incorporated into the Curricula.	
Activated Diffusion Healing	Art to Part
Magnetic Eddy Current Testing (New Methods)	Lasers
Bonding Processes and Materials (new Developments)	Microwaves
Composite Structures, Bonding, and Repair	Artificial Intelligence
Non Destructive Testing (New Methods)	New Turbine Engine Technologies
Telecommunications and Networking Schemes	Hydrology
Computer Controlled Equipment	Optical Systems
Computer Generated Graphics and Image Manipulation	Polymer Research
Construction (Vertical and Horizontal)	Superconductors
Environmental Air and Water Testing Applications	Superplastic Forming

(Table 2 continued)

Exotic Materials	Taguchi Design for Experiments
Just in Time Manufacturing	Fiber Optics
Geotechnology	Thermoplastics (Engineering)
Glass Coating Technologies (New Methods)	Tooling Techniques
Group Technology	Ultrasonics
Hazardous Waste Disposal	World Class Manufacturing

Skills Needed in Industry

Bittel and Newstrom (1990) present three classifications of skills in industry: technical skills, administrative skills, and human relations skills. Technical skills are those skills that require a "knowledge of the industry and its particular processes, machinery, and problems" (p.17). Administrative skills require knowledge of the organization and the manner in which it functions, knowledge of its information system, and the ability to plan and regulate work. Human relations skills are presented as those skills that require a knowledge of human behavior and the ability to work productively with individuals and groups (Bittel and Newstrom, 1990). The scope of this study is limited to technical and administrative skills.

Summary

This chapter focused on the role of the industrial technologist in industry. The members of the technical team in business and industry were identified, and the overlap of the responsibilities of the related professions was acknowledged. The industrial technologist's relationship to engineering was briefly discussed, and the industrial technologist's supervisory role in industry was mentioned. This section continued with a

discussion of professional certification opportunities for industrial technologists and mentioned the future roles of the industrial technologist.

Chapter II continued with a brief overview of the National Association of Industrial Technology (NAIT). The purpose of NAIT, which is the accrediting body for Industrial Technology programs, was discussed.

The section following NAIT presented several related studies. Summaries of studies conducted by Timothy Miller (1989), Richard Rothaupt (1994), Donna Stewart (1996), Michael Hayden (1991), and Steve Archer (1989) were presented. Chapter II concluded with a discussion of skills needed in industry.

CHAPTER III

Procedures of the Study

Introduction

The purpose of this study was to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of industrial technology graduates in the year 1998. The research questions for this study were: (1) What are the most common competencies required of industrial technology graduates as perceived by industry? (2) What are the common positions held by industrial technology graduates in industry? (3) How many companies in the selected survey population employ industrial technology graduates?

This chapter contains a description of the methodology and procedures for selecting the population, developing a survey instrument, collecting data and data analysis.

Selecting the Population

Georgia Southern University, a regional university in southern Georgia, was selected as a model for this study. Georgia Southern offers baccalaureate degrees in manufacturing and serves the Savannah Metropolitan Statistical Area (Georgia Southern, 1997).

Archer's method for selecting the population in his 1989 study was used as a model for selecting the population in this study. Archer conducted a similar study that focused on the curricular needs for the manufacturing specialty area of Industrial Technology. The

population for Archer's study was composed of manufacturers employing over one hundred employees and listed in the Oklahoma Directory of Manufacturers and Products.

The Georgia Manufacturers Register 1997 was used as a source for identifying the manufacturers within the Savannah Metropolitan Statistical Area which includes Bryan, Chatham, and Effingham Counties in Georgia. The register listed 28 companies that employed one hundred or more employees. In order to increase the size of the population for the selected area, the population was expanded to 50 companies by including companies listed in the register as employing 50 or more employees

Questionnaire Development Fundamentals

The primary means for gathering data for this study was the questionnaire. "The questionnaire is a tool for soliciting and recording written responses from individuals (Lang and Heiss, 1987, p.122). Questionnaires should be devised to accomplish a specific research objective (Leedy, 1997). Three determining factors for using a questionnaire as a research instrument are: (1) a large sample size; (2) contact in person is not essential; and (3) funding is limited (Lang and Heiss, 1987).

Information gathered by the questionnaire should be information that cannot be gathered by other means. The questionnaire could become an annoyance to the respondent if it asks for information that may be found elsewhere. The instructions for the respondents must be clear, unambiguous and complete. The overall appearance of the questionnaire must be attractive, neatly arranged, clean and readable (Lang and Heiss, 1987).

A letter of transmittal should accompany the questionnaire. This letter is all-important and must contain: (1) the purpose of the survey; (2) the significance and potential value of the survey to the respondent; (3) a sensible deadline for the expected return of the survey to the sender; and (4) an offer to provide the respondent with a summary of the results (Lang and Heiss, 1987). "The initial letter should be carefully and thoughtfully structured and should stress the concerns of the person receiving the letter, rather than any selfish interests of the sender" (Leedy, 1997, p.196).

Development of the Survey Instrument

The method for collecting data was by a questionnaire composed of 28 competencies in section one and seven questions in section two. The 28 competencies on the questionnaire were developed and condensed from Miller's 1989 study, Hayden's 1993 study, and input from the thesis committee. The respondents were asked to rate the level of importance of the 28 competencies on a Likert scale. The first research question: What are the most common competencies required of industrial technology graduates as perceived of industry? was answered by the questions in section one and the first question in section two of the questionnaire.

In section two of the questionnaire, questions two and three were intended to gather demographic information such as what product was produced at that location and the title of the person completing the survey. Question four addressed the third research question of the study. This was to determine the number of companies that employ industrial technologists. Question five addressed the second research question regarding the common positions held by industrial technologists in industry. Question six was open

ended and was intended to gather any additional comments that the respondents may have. Question seven was intended to determine which respondents, if any, would like a copy of the results of this study.

Once the questionnaire was developed, it was submitted to the Thesis Committee for validation. Leedy (1997) states that face validity relies primarily on the subjective judgment of the researcher. This type of validity must answer two questions: "(a) Is the instrument measuring what it is supposed to measure? and (b) Is the sample being measured representative of the behavior or trait being measured" (Leedy, 1997, p.33)? Face validity was considered sufficient for the purpose of this study. The Thesis Committee, composed of three graduate faculty members of the School of Technology at Georgia Southern University, reviewed the questionnaire and made suggestions to modify the competency statements making them more generalized. After making the recommended improvements and modifications to the questionnaire, the consensus of the committee was that the survey instrument appeared to collect the data required for this study.

Data Collection

The mailed questionnaire was developed as the primary instrument for collecting data for this study. A cover letter, questionnaire, and pre-addressed postage paid return envelope were mailed to all selected respondents. After two weeks, an attempt to make personal contact with those not responding to the initial mailing was made asking for participation in the study. A follow-up letter and another questionnaire were mailed to

those who had not responded to the initial mailing. Two more weeks were allowed for those who had not responded.

Data Analysis

The data obtained from the returned questionnaires were organized into an electronic spreadsheet program named Quattro Pro. Quattro Pro was used as means to perform calculations to determine the mean and standard deviation for each competency rated by the respondents according to the perceived level of importance. The competencies were ranked according to the calculated mean value.

Summary

This chapter presented the methodology and procedures used for this study. The following sections of the methodology and procedures were discussed in detail: selecting the population, questionnaire development fundamentals, development of the survey instrument, data collection and data analysis.

Chapter III began with the selection of the population for this study. The population was limited to those companies in the Savannah Metropolitan Statistical Area listed in the Georgia Manufacturers Register 1997 as employing 50 or more employees. Next, the questionnaire was developed using Miller's 1989 study, Hayden's 1993 study, and input from the thesis committee. The questionnaire was composed of two sections. Section I contained 28 competencies that addressed research question one, and section two contained seven questions. Question one addressed any competencies that the responded thought should have been included in section one. Questions two and three were intended to obtain demographic information. Question four addressed research question three, and

question five of the questionnaire addressed research question two. Question six was open ended and was intended to gather any additional comments that the respondents may have. Question seven was intended to determine which respondents, if any, would like a copy of the results of this study.

After discussing the development of the survey instrument, the method of data collection was presented. The mailed questionnaire was used as the primary instrument for collecting data for this study. A cover letter, questionnaire, and pre-addressed postage paid return envelope were mailed to all selected respondents. The respondents were allowed two weeks to respond, after which, a follow-up letter and questionnaire were mailed to those who had not responded. Another two weeks were allowed for a response to the second survey.

Finally, the method of data analysis was explained. The data obtained from the returned questionnaires were organized in an electronic spreadsheet named Quattro Pro. Calculations were performed to determine the mean score, standard deviation, and rank of each competency.

CHAPTER IV

Analysis of the Data

Introduction

The purpose of this study was to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of industrial technology graduates in the year 1998. The research questions for this study were: (1) What are the most common competencies required of industrial technology graduates as perceived by industry? (2) What are the common positions held by industrial technology graduates in industry? (3) How many companies in the selected survey population employ industrial technology graduates? The data for this study were collected by using a mailed questionnaire. The electronic spreadsheet program called Quattro Pro (release 6.01) was used as a tool for tabulating and analyzing the data. The response rate and analysis are reported in this chapter.

Level of Company Response

The population for this study was composed of 50 companies listed in the Georgia Manufacturers Register 1997. Only those companies employing 50 or more employees in the Savannah Metropolitan Statistical Area were selected. Of the 50 potential respondents, 29 (58%) returned usable questionnaires that were acceptable for statistical

analysis (see Table 3). Explanations for the remaining 21 (42%) questionnaires that were not received are also listed in Table 3.

Table 3

Analysis of Company Responses

Companies	Number of Responses	Percentage
Returned Usable	29	58
Unable to Contact	1	2
Closed Plant Location	3	6
Duplicate Company	1	2
No Response	16	32
Total in Study	50	100

Of the 50 potential respondents, one respondent (2%) did not have an available phone number in order to contact that company to verify the current mailing address. One of the potential respondents (2%) was out of business, while two potential respondents (4%) were at plant locations that had been closed by a parent company. Additionally, it was discovered that one respondent (2%) was represented under two different company names, therefore one company in the population was disqualified from the study.

Of the remaining 16 potential respondents (32%), five (10%) agreed to participate in the study but did not. An attempt to establish personal contact and verify current mailing addresses with the final 11 potential respondents (22%) resulted in eight messages left with secretaries and three voice mail messages. Messages were left asking potential respondents to participate in the study.

The Georgia Manufacturers Register 1997 was used as a source for identifying the number of employees at each company. Assuming that the number of employees remained the same, the size comparisons of the responding companies are listed in table 4. The companies are grouped by size similar to Archer's (1989) method of grouping companies.

Table 4

Quantity of Employees at Responding Companies

Number of Employees Per Company	Total number of responses	Percentage
50 to 100	12	41.38
101 to 250	7	24.14
251 to 500	5	17.24
501 to 1000	1	3.45
1001 to 2500	2	6.90
Over 2500	2	6.90
Totals	29	100

Results of the Study

The data obtained from the questionnaire were tabulated and reported in the order as it appeared on the survey. Each item listed on the questionnaire and the data collected pertaining to each item are reported as follows.

Section I, Competencies

Section 1 of the questionnaire listed 28 competencies (Table 5) and asked the respondent to rate the level of importance of each competency on a Likert scale. The respondent had five choices to rate each competency ranging from not important to

extremely important and one choice of not applicable. The data gathered from the questionnaires are listed in Appendix D. Only 96.6% of the respondents rated competency numbers 4, 23, and 27, while 100% of the respondents rated the remaining competencies. There were no explanations given by those respondents for not rating competencies 4, 23, and 27.

Table 5

List of Competencies

Item no.	Competency Description
1	Knowledge of different organizational structures within manufacturing firms.
2	Knowledge of labor standards and measurement (motion-time studies).
3	Applying systematic problem solving techniques.
4	Preparation and utilization of PERT/CPM schedules.
5	Preparation of purchase requests.
6	Conducting cost and break-even analyses for a production run.
7	Performance of mathematical calculations (i.e. statics, stress analysis).
8	Reading and interpretation of engineering drawings.
9	Troubleshooting electrical systems.
10	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.
11	Knowledge of material processes (cold working, heat treating, coating, conversion).
12	Knowledge of physical and mechanical properties of common industrial materials.
13	Knowledge of material fabrication and joining techniques.
14	Knowledge of plastic molding and forming processes.
15	Operation of injection molding equipment.

(Table 5 continued)

Item no.	Competency Description
16	Development of a CNC part program.
17	Knowledge of quality assurance and testing procedures.
18	Development of tooling and fixtures.
19	Technical skill specialization (welding, machinist, draftsperson).
20	Preparation and presentation of accurate and concise reports and technical documents.
21	Preparation of product specifications.
22	Knowledge of manufacturing systems (CAM, CIM).
23	Understanding of equipment and material handling layout planning.
24	Practicing safe working habits.
25	Familiarity with personal computer applications in industry.
26	Ability to adapt to new situations.
27	Manage according to Deming and Peters' World Class Manufacturing techniques.
28	Acting as an industrial support person (teaching/training others).

Table 6 lists the competencies ranked in order according to the level of perceived importance of the entire survey population based on the calculated mean value.

The quartile deviation is a measure of dispersion that divides data into four equal parts (Leedy, 1997). Of the 28 competencies ranked by industry, the first seven are in the top quartile and were considered to be the most important. They are as follows:

Ability to adapt to new situations.

Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.

Practicing safe working habits.

Applying systematic problem solving techniques.

Familiarity with personal computer applications in industry.

Reading and interpretation of engineering drawings.

Preparation and presentation of accurate and concise reports and technical documents.

Table 6

Mean Ranking of Competencies by Entire Population

Rank	Item no.	Competency Description	*M*	*SD*
1	26	Ability to adapt to new situations.	4.55	0.56
2	10	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.	4.52	0.56
3	24	Practicing safe working habits.	4.34	0.76
4	3	Applying systematic problem solving techniques.	4.28	0.83
5	25	Familiarity with personal computer applications in industry.	4.21	0.66
6	8	Reading and interpretation of engineering drawings.	4.03	0.89
7	20	Preparation and presentation of accurate and concise reports and technical documents.	3.93	1.01
8	28	Acting as an industrial support person (teaching/training others).	3.79	0.96
9	17	Knowledge of quality assurance and testing procedures.	3.72	0.98
10	23	Understanding of equipment and material handling layout planning.	3.71	1.03

(Table 6 continued)

Rank	Item no.	Competency Description	*M*	*SD*
11	6	Conducting cost and break-even analyses for a production run.	3.62	1.19
12	7	Performance of mathematical calculations (i.e. statics, stress analysis).	3.61	1.08
13	2	Knowledge of labor standards and measurement (motion-time studies).	3.10	1.16
14	12	Knowledge of physical and mechanical properties of common industrial materials.	3.03	1.27
14	21	Preparation of product specifications.	3.03	1.40
16	11	Knowledge of material processes (cold working, heat treating, coating, conversion).	3.00	1.36
17	13	Knowledge of material fabrication and joining techniques.	2.97	1.27
18	27	Manage according to Deming and Peters' World Class Manufacturing techniques.	2.89	1.59
19	9	Troubleshooting electrical systems.	2.86	1.20
20	4	Preparation and utilization of PERT/CPM schedules.	2.82	1.31
21	22	Knowledge of manufacturing systems (CAM, CIM).	2.79	1.37
22	5	Preparation of purchase requests.	2.72	1.11
22	1	Knowledge of different organizational structures within manufacturing firms.	2.72	1.11
24	19	Technical skill specialization (welding, machinist, draftsperson).	2.62	1.24
25	18	Development of tooling and fixtures.	2.45	1.22
26	16	Development of a CNC part program.	2.14	1.41
27	14	Knowledge of plastic molding and forming processes.	1.69	1.18
28	15	Operation of injection molding equipment.	1.48	1.22

Section II

Question 1.

Question one in Section II of the questionnaire asked the respondent to list any technical competency that the respondent believed should have been included in the list of competencies. Of the 29 respondents, nine (31.0%) responded to question one. The responses follow in no particular order.

Composite materials manufacturing.

People skills - interviewing and meeting techniques.

Computer skills and problem solving techniques have become very important in the last decade.

Process mapping; group dynamics.

Government regulations skills; writing skills.

Work well with others; ask questions when in doubt.

Environmental issues; team work; spc [statistical process control].

We are a chemical plant, so Chemical Engineering, Chemistry, etc. would be appropriate.

None - good coverage.

Of the nine responses to question 1, four respondents added skills that appeared to be related such as group dynamics, team work, and people skills.

Question 2.

Question two in Section II of the questionnaire asked the respondent to list the primary product manufactured or service provided at that location. Of the 29 respondents, 27

(93.1%) responded to question one. The responses are listed in table 7 in descending order according to the most common types of products or services provided.

Table 7

Product or Service Provided at Respondent's Company

Product or Service Provided	Number	Percent
Metal Fabrication	4	13.79
Chemical Production (Fertilizers, Acids, Pigments)	4	13.79
Pulp, Paper and Paper Board Products	3	10.34
Asphalt Products	3	10.34
Food Products (Baked Foods)	2	6.90
Printing	2	6.90
Aseptic Liquid (High and Low Acid Drinks and Milks)	1	3.45
Process Machinery Manufacturing	1	3.45
Pressure Treated Wood Products	1	3.45
Commercial Food Preparation Equipment (Slicers, Choppers)	1	3.45
Aircraft Manufacturing	1	3.45
Gypsum Drywall Manufacturing	1	3.45
Refined Sugar	1	3.45
Residential Roofing	1	3.45
Composite Ships/Boats	1	3.45
No Response	2	6.90
Total Responses	29	100

Of the 29 respondents, the two most common products or services provided were metal fabrication (13.8%) and chemical production (13.8%). The second most common

products or services provided were pulp, paper, and paper board products (10.3%) and asphalt products (10.3%). The third most common products or services provided by the respondents were food products (6.9%) and printing (6.9%). The remaining ten products or services provided were not common within the responses to question two with each of the ten responses representing 3.5% of the total responses.

Excluding the two respondents that did not respond to question two, the products or services provided by the remainder of the companies appeared to fall within two general categories, metal fabricators and non-metal fabricators. The companies specializing in process machinery manufacturing, commercial food preparation equipment, and aircraft manufacturing were included in the metal fabrication group, while the remainder of the responding companies were included within the non-metal fabrication group. Table 8 lists the competencies ranked according to the level of perceived importance by the metal fabricators, and table 9 lists the competencies ranked according to the level of perceived importance by the non-metal fabricators.

Table 8

Mean Ranking of Competencies by Metal Fabricators

Rank	Item no.	Competency Description	*M*	*SD*
1	10	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.	4.86	0.35
2	8	Reading and interpretation of engineering drawings.	4.43	0.73
2	26	Ability to adapt to new situations.	4.43	0.73
4	20	Preparation and presentation of accurate and concise reports and technical documents.	4.29	1.03

(Table 8 continued)

Rank	Item no.	Competency Description	*M*	*SD*
5	17	Knowledge of quality assurance and testing procedures.	4.14	0.64
5	3	Applying systematic problem solving techniques.	4.14	0.83
7	25	Familiarity with personal computer applications in industry.	4.00	0.76
8	24	Practicing safe working habits.	3.86	0.99
8	27	Manage according to Deming and Peters' World Class Manufacturing techniques.	3.86	0.83
8	19	Technical skill specialization (welding, machinist, draftsperson).	3.86	0.99
11	12	Knowledge of physical and mechanical properties of common industrial materials.	3.71	1.03
11	6	Conducting cost and break-even analyses for a production run.	3.71	1.03
11	7	Performance of mathematical calculations (i.e. statics, stress analysis).	3.71	1.16
11	23	Understanding of equipment and material handling layout planning.	3.71	0.88
15	28	Acting as an industrial support person (teaching/training others).	3.57	0.90
15	11	Knowledge of material processes (cold working, heat treating, coating, conversion).	3.57	0.90
17	13	Knowledge of material fabrication and joining techniques.	3.43	1.40
17	2	Knowledge of labor standards and measurement (motion-time studies).	3.43	1.40
17	16	Development of a CNC part program.	3.43	1.05
17	22	Knowledge of manufacturing systems (CAM, CIM).	3.43	1.18
21	21	Preparation of product specifications.	3.29	1.39

(Table 8 continued)

Rank	Item no.	Competency Description	*M*	*SD*
21	18	Development of tooling and fixtures.	3.29	1.03
23	4	Preparation and utilization of PERT/CPM schedules.	3.14	1.12
24	1	Knowledge of different organizational structures within manufacturing firms.	3.00	1.20
24	9	Troubleshooting electrical systems.	3.00	1.41
26	5	Preparation of purchase requests.	2.71	1.39
27	15	Operation of injection molding equipment.	1.86	1.46
28	14	Knowledge of plastic molding and forming processes.	1.57	0.90

Table 9

Mean Ranking of Competencies by Non-metal Fabricators

Rank	Item no.	Competency Description	*M*	*SD*
1	26	Ability to adapt to new situations.	4.65	0.48
2	24	Practicing safe working habits.	4.60	0.49
3	10	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.	4.40	0.58
3	3	Applying systematic problem solving techniques.	4.40	0.80
5	25	Familiarity with personal computer applications in industry.	4.35	0.57
6	28	Acting as an industrial support person (teaching/training others).	4.00	0.89
7	20	Preparation and presentation of accurate and concise reports and technical documents.	3.95	0.92
8	8	Reading and interpretation of engineering drawings.	3.90	0.94

(Table 9 continued)

Rank	Item no.	Competency Description	*M*	*SD*
9	6	Conducting cost and break-even analyses for a production run.	3.85	0.91
10	23	Understanding of equipment and material handling layout planning.	3.79	1.06
10	7	Performance of mathematical calculations (i.e. statics, stress analysis).	3.79	0.69
12	17	Knowledge of quality assurance and testing procedures.	3.75	0.94
13	2	Knowledge of labor standards and measurement (motion-time studies).	3.15	0.85
13	21	Preparation of product specifications.	3.15	1.28
15	11	Knowledge of material processes (cold working, heat treating, coating, conversion).	3.00	1.34
15	9	Troubleshooting electrical systems.	3.00	0.95
17	5	Preparation of purchase requests.	2.85	0.85
17	12	Knowledge of physical and mechanical properties of common industrial materials.	2.85	1.31
19	1	Knowledge of different organizational structures within manufacturing firms.	2.80	0.93
20	13	Knowledge of material fabrication and joining techniques.	2.75	1.22
21	27	Manage according to Deming and Peters' World Class Manufacturing techniques.	2.74	1.62
21	4	Preparation and utilization of PERT/CPM schedules.	2.74	1.41
23	22	Knowledge of manufacturing systems (CAM, CIM).	2.70	1.31
24	19	Technical skill specialization (welding, machinist, draftsperson).	2.20	1.08
25	18	Development of tooling and fixtures.	2.10	1.14
26	14	Knowledge of plastic molding and forming processes.	1.90	1.18

(Table 9 continued)

Rank	Item no.	Competency Description	*M*	*SD*
27	16	Development of a CNC part program.	1.80	1.25
28	15	Operation of injection molding equipment.	1.50	1.07

The competencies included within the top quartile of the metal fabricator group and non-metal fabricator group appeared to be similar. However, the ranking within the top quartile appeared to be different between the metal fabricator group and the non-metal fabricator group. The following five competencies listed in no particular order appeared in the top quartile for both groups.

Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.

Ability to adapt to new situations.

Preparation and presentation of accurate and concise reports and technical documents.

Applying systematic problem solving techniques.

Familiarity with personal computer applications in industry.

The top quartile of ranked competencies for the metal fabricator group listed the following two competencies that were not included in the non-metal fabricator group.

Reading and interpretation of engineering drawings.

Knowledge of quality assurance and testing procedures.

Similarly, the top quartile of ranked competencies for the non-metal fabricator group listed the following two competencies that were not included in the metal fabricator group.

Practicing safe working habits.

Acting as an industrial support person (teaching/training others).

The competency, reading and interpretation of engineering drawings, was ranked high in the third quartile for non-metal fabricator group, while the competency, practicing safe working habits, was ranked high in the third quartile for the metal fabricator group.

Question 3.

Question three in Section II of the questionnaire asked the respondent to list his or her title. Of the 29 respondents, 28 (96.6%) responded to question three. The titles are listed in table 10 in descending order according to the most common titles. Of the 28 responses to question three, 37.9% had Manager in the title, 20.7% had Vice President in the title, and 13.8% were company Presidents. These titles represented 72.4% of the respondents.

Table 10

Titles of Respondents

Title	Number	Percent
President	4	13.79
Plant Manager	4	13.79
Vice President	2	6.90
Vice President of Operations	2	6.90
Vice President of Engineering	1	3.45
Vice President of Estimating and Engineering	1	3.45
Director of Manufacturing	1	3.45
Director of Major Assembly	1	3.45
General Manager of Operations	1	3.45

(Table 10 continued)

Title	Number	Percent
Assistant Superintendent - Pulp Processing	1	3.45
Engineering Manager	1	3.45
Branch Manager	1	3.45
Processing and Logistics Manager	1	3.45
Production Manager	1	3.45
Manufacturing Manager	1	3.45
Refinery Manager	1	3.45
Manufacturing Engineering Manager	1	3.45
Coordinator of Manufacturing/Equipment	1	3.45
Production Supervisor	1	3.45
Plant Engineer	1	3.45
No Response	1	3.45
Totals	29	100

Excluding the one respondent that did not respond to question three, the titles of the remaining respondents appeared to fall within two general categories, executives and non-executives. The respondents with the titles of either President or Vice-president comprise the executive group, while the remainder of the respondents are included within the non-executive group. Table 11 lists the competencies ranked according to the level of perceived importance by the executives, and table 12 lists the competencies ranked according to the level of perceived importance by the non-executives.

Table 11

Mean Ranking of Competencies by Executives

Rank	Item no.	Competency Description	*M*	*SD*
1	10	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.	4.50	0.67
2	25	Familiarity with personal computer applications in industry.	4.30	0.64
2	26	Ability to adapt to new situations.	4.30	0.64
4	8	Reading and interpretation of engineering drawings.	4.10	1.04
4	3	Applying systematic problem solving techniques.	4.10	0.83
4	24	Practicing safe working habits.	4.10	0.83
7	20	Preparation and presentation of accurate and concise reports and technical documents.	3.90	1.04
7	17	Knowledge of quality assurance and testing procedures.	3.90	0.70
9	7	Performance of mathematical calculations (i.e. statics, stress analysis).	3.60	1.28
10	13	Knowledge of material fabrication and joining techniques.	3.40	1.11
11	23	Understanding of equipment and material handling layout planning.	3.22	0.79
12	28	Acting as an industrial support person (teaching/training others).	3.20	0.75
12	6	Conducting cost and break-even analyses for a production run.	3.20	1.47
14	21	Preparation of product specifications.	2.90	1.45
14	2	Knowledge of labor standards and measurement (motion-time studies).	2.90	1.45
16	22	Knowledge of manufacturing systems (CAM, CIM).	2.80	1.17

(Table 11 continued)

Rank	Item no.	Competency Description	*M*	*SD*
16	12	Knowledge of physical and mechanical properties of common industrial materials.	2.80	1.33
16	27	Manage according to Deming and Peters' World Class Manufacturing techniques.	2.80	1.60
19	5	Preparation of purchase requests.	2.70	0.78
19	19	Technical skill specialization (welding, machinist, draftsperson).	2.70	1.42
21	11	Knowledge of material processes (cold working, heat treating, coating, conversion).	2.60	1.43
22	4	Preparation and utilization of PERT/CPM schedules.	2.56	1.17
23	1	Knowledge of different organizational structures within manufacturing firms.	2.50	1.02
24	9	Troubleshooting electrical systems.	2.30	1.35
25	16	Development of a CNC part program.	2.10	1.51
26	18	Development of tooling and fixtures.	1.80	1.25
27	14	Knowledge of plastic molding and forming processes.	1.40	1.20
28	15	Operation of injection molding equipment.	1.00	1.10

The competencies included within the top quartile of the executive and non-executive groups appeared to be similar. However, the ranking within the top quartile appeared to be different between the executive group and the non-executive group. The following six competencies listed in no particular order appeared in the top quartile for both groups.

Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.

Ability to adapt to new situations.

Preparation and presentation of accurate and concise reports and technical documents.

Applying systematic problem solving techniques.

Familiarity with personal computer applications in industry.

Practicing safe working habits.

The top quartile of ranked competencies for the executive group listed the following two competencies that were not included in the non-metal fabricator group.

Reading and interpretation of engineering drawings.

Knowledge of quality assurance and testing procedures.

Table 12

Mean Ranking of Competencies by Non-executives

Rank	Item no.	Competency Description	*M*	*SD*
1	26	Ability to adapt to new situations.	4.76	0.42
2	24	Practicing safe working habits.	4.59	0.60
3	3	Applying systematic problem solving techniques.	4.47	0.78
3	10	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.	4.47	0.50
5	28	Acting as an industrial support person (teaching/training others).	4.29	0.75
6	25	Familiarity with personal computer applications in industry.	4.18	0.62
7	20	Preparation and presentation of accurate and concise reports and technical documents.	4.00	1.03
8	8	Reading and interpretation of engineering drawings.	3.94	0.80

(Table 12 continued)

Rank	Item no.	Competency Description	*M*	*SD*
8	23	Understanding of equipment and material handling layout planning.	3.94	1.11
8	6	Conducting cost and break-even analyses for a production run.	3.94	0.87
11	17	Knowledge of quality assurance and testing procedures.	3.71	1.07
12	7	Performance of mathematical calculations (i.e. statics, stress analysis).	3.65	0.97
13	11	Knowledge of material processes (cold working, heat treating, coating, conversion).	3.29	1.32
14	9	Troubleshooting electrical systems.	3.24	1.00
15	27	Manage according to Deming and Peters' World Class Manufacturing techniques.	3.19	1.47
16	2	Knowledge of labor standards and measurement (motion-time studies).	3.18	0.98
16	21	Preparation of product specifications.	3.18	1.42
18	12	Knowledge of physical and mechanical properties of common industrial materials.	3.12	1.28
19	1	Knowledge of different organizational structures within manufacturing firms.	2.94	1.16
20	4	Preparation and utilization of PERT/CPM schedules.	2.88	1.32
20	5	Preparation of purchase requests.	2.88	1.13
22	22	Knowledge of manufacturing systems (CAM, CIM).	2.82	1.54
23	18	Development of tooling and fixtures.	2.71	1.07
24	13	Knowledge of material fabrication and joining techniques.	2.65	1.33
25	19	Technical skill specialization (welding, machinist, draftsperson).	2.53	1.19
26	16	Development of a CNC part program.	2.24	1.39

(Table 12 continued)

Rank	Item no.	Competency Description	*M*	*SD*
27	14	Knowledge of plastic molding and forming processes.	1.82	0.98
27	15	Operation of injection molding equipment.	1.82	1.20

Similarly, the top quartile of ranked competencies for the non-executive group listed the following competency that was not included in the executive group.

Acting as an industrial support person (teaching/training others).

The competencies, reading and interpretation of engineering drawings and knowledge of quality assurance and testing procedures, were ranked in the third quartile for the non-executive group, while the competency, practicing safe working habits, was ranked in the third quartile for the executive group.

Question 4.

Question four in Section II of the questionnaire addressed research question three which was, "how many companies in the selected survey population employ industrial technology graduates?". Question four asked the respondent if he or she was aware of any industrial technology graduates employed at his or her facility and to list the approximate quantity.

Of the 29 respondents, 24 (82.8%) responded to question four. Ten (34.5%) of the respondents reported that they were not aware if their company employed industrial technology graduates. Six (20.7%) of the respondents reported that no industrial technology graduates were employed at their company. And eight (27.6%) of the

respondents reported that their companies did employ industrial technology graduates. The approximate quantity of industrial technology graduates and the product or service provided at the respondent's company are listed in table 13.

Table 13

Approximate Quantity of Industrial Technology Graduates and Product or Service Provided

Product or Service Provided at Respondent's Company	Quantity
Refined Sugar	4
Pulp, Paper and Paper Board Products (1st company)	5 to 6
Pulp, Paper and Paper Board Products (2nd company)	Unknown
Aircraft Manufacturing	Unknown
Chemical Production (Fertilizers, Acids, Pigments) (1st company)	Unknown
Chemical Production (Fertilizers, Acids, Pigments) (2nd company)	No response
Asphalt Products	1
Process Machinery Manufacturing	2

Question 5.

Question five in Section II of the questionnaire addressed research question two which was, "what are the common positions held by industrial technology graduates in industry?". Question five asked the respondent to list the titles of positions currently held by industrial technology graduates. Of the 29 respondents, seven (24.1%) responded to question five. The responses to question five are listed in table 14.

Table 14

Titles of Industrial Technology Graduates

Instrument Maintenance Engineer	Packing House Superintendent
Packaging Maintenance Engineer	Superintendent
Electrical Engineer	Department Manager
Field Engineer	Logistics Manager
Industrial Engineer	Manager of Application Labs
Supervisor	Production Assistant

There were 12 titles of industrial technologists provided by the seven respondents. Of the 12 titles, five had "Engineer" in the title; three had "Manager" in the title; and two had "Superintendent" in the title.

Additional Comments

A section for additional comments was included at the end of the questionnaire. The intent of this section was to gather information not addressed by the questionnaire. Seven (24.1%) respondents provided additional comments. The following written responses have been altered to remove company names where necessary to maintain confidentiality and are listed in no particular order.

1. Tech[nology] graduates should have an understanding of the various codes and standards related to the industrial environment: ANSI; ASME; ASTM; etc.

2. Initially, technical skills are important attributes, but over an individual's career, soft skills or people skills become increasingly important: leadership, ethics, motivation skills to name a few. There's a tremendous difference between a manager and a leader.

Society needs leaders with technical skills or competencies not just managers and problem solvers.

3. If you know any recent grad[uate]s or [any] about to grad[uate] this year, I would like to interview [them].

4. Good job!

5. The job market seems to have plenty of applicants with technical skills and degrees, but lack good supervisory skills and management training. Interpersonal skills have become extremely important in today's industrial environment.

6. Texas A & M has a wholesale distribution major in which students have one term each of hands-on training with welding, robotics, fabrication, electronics, electricity, and other skills. Great program! Produces well rounded sales rep[resentative]s.

7. [Our company] is an industrial, commercial and residential contractor. We are not a manufacturing company, therefore, we do not believe this survey is applicable to our company.

Summary

The presentation and analysis of the data for this study are reported in this chapter. The purpose of this study was to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of baccalaureate industrial technology graduates in the year 1998. Additional purposes for this study were to determine the common positions held by industrial technology graduates in industry and to determine the quantity of companies in the survey population that employ industrial technology graduates.

Information for this study was collected from industry by a mailed questionnaire. The questionnaire asked the respondent to rate the level of importance of each competency listed on the questionnaire on a five point Likert scale. The data collected from the respondents were recorded and analyzed in an electronic spreadsheet program called Quattro Pro (Release 6.01). The data were used to rank the competencies listed on the questionnaire in order of perceived importance based on the mean score. The data pertaining to the common positions held by industrial technology graduates and the quantity of companies employing industrial technology graduates are also presented. The chapter concludes with additional comments provided by the respondents.

CHAPTER V

Conclusions, Implications, Recommendations, and Summary

Introduction

The purpose of this study was to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of industrial technology graduates in the year 1998. The research questions for this study were: (1) What are the most common competencies required of industrial technology graduates as perceived of industry? (2) What are the common positions held by industrial technology graduates in industry? (3) How many companies in the selected survey population employ industrial technology graduates? A review of literature indicated that changes are occurring in technology and that skills for individuals employed in industry are also changing. A list of 28 competencies for industrial technology graduates was developed from Miller's 1989 study, Hayden's 1993 study, and input from the thesis committee.

The questionnaire was selected as the primary instrument for collecting data for this study. The questionnaires were mailed to the selected population for this study which was limited to those companies in the Savannah Metropolitan Statistical Area listed in the Georgia Manufacturers Register 1997 as employing 50 or more employees. The responses were recorded and analyzed by using the electronic spreadsheet software Quattro Pro (Release 6.01).

Conclusions

The following conclusions were developed from the data collected for this study and from the Review of Literature presented in chapter two. The first research question was to determine what were the most common competencies required of industrial technology graduates as perceived of industry. Of the 28 competencies identified in this study, the following seven (25.0%) competencies listed in order of importance appeared to be perceived as the most important by the respondents. They are as follows:

Ability to adapt to new situations.

Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.

Practicing safe working habits.

Applying systematic problem solving techniques.

Familiarity with personal computer applications in industry.

Reading and interpretation of engineering drawings.

Preparation and presentation of accurate and concise reports and technical documents.

The data collected from the respondents were divided into two groups, metal fabricators and non-metal fabricators, based on the product manufactured or service provided. Next, the competencies were ranked according to these two groups. The following five (17.9%) competencies listed in no particular order were included within the top quartile of the rankings for the metal fabricator group and non-metal fabricator group and appeared to be the most important.

Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.

Ability to adapt to new situations.

Preparation and presentation of accurate and concise reports and technical documents.

Applying systematic problem solving techniques.

Familiarity with personal computer applications in industry.

The individual ranking of each competency within the top quartile appeared to be different between the metal fabricator group and the non-metal fabricator group.

Finally, the data from the respondents were divided into two other groups, executives and non-executives, based on the title of each respondent. The competencies included within the top quartile ranking of the executive and non-executive groups appeared to be similar. The following six (21.4%) competencies listed in no particular order were included in the top quartile ranking for both groups and appeared to be the most important.

Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.

Ability to adapt to new situations.

Preparation and presentation of accurate and concise reports and technical documents.

Applying systematic problem solving techniques.

Familiarity with personal computer applications in industry.

Practicing safe working habits.

The individual ranking of each competency within the top quartile of the rankings appeared to be different between the executive group and the non-executive group.

Question one in section II of the questionnaire asked the respondent to list any competency that the respondent believed should have been included in the list of competencies. In addition to question one, there was a section provided for each respondent to write additional comments. The following eleven competencies were developed from the responses to question one and from the additional comments of the respondents.

Knowledge of composite material manufacturing.

Ability to conduct meetings within an industrial environment.

Ability to conduct interviews.

Knowledge of process mapping.

Knowledge of group dynamics.

Familiarity with environmental issues and government regulations.

Ability to work on a team.

Familiarity with statistical process control.

Knowledge of Chemistry.

Familiarity with common industrial codes (ANSI, ASME, ASTM, etc.).

Ability to supervise others.

Based on responses to the questionnaire, these eleven competencies may need to be added to the 28 competencies listed table 5 (page 33). Of the eleven competencies listed above, those skill areas related to interaction with personnel appeared to be the most important.

The second research question was to determine what were the common positions held by industrial technology graduates in industry. Only seven (24.1%) of the 29 respondents responded to this question on the survey instrument. Based on responses to this question, the most common positions held by industrial technology graduates appear to be engineering and management positions. However, due to the few number of responses to this question, a follow-up study of industrial technology graduates may provide a greater number of different positions.

The third research question was to determine the number of companies in the selected survey population that employ industrial technology graduates. Based on the responses to the questionnaire, at least eight (27.6%) of the companies responding to the questionnaire employ industrial technology graduates. Only six (20.7%) of the respondents reported that no industrial technology graduates were employed at their companies. Fifteen (51.7%) of the respondents either did not respond to this question or responded that they were unaware of any industrial technology graduates employed at their companies. Based on this, there is a possibility that more than eight of the companies in the population employed industrial technology graduates.

Implications

A general knowledge of technical skills (welding, machinist, draftsperson) is more important for industrial technologists than technical skill specialization. The respondents

of this study perceive that competencies requiring general knowledge of manufacturing techniques are more important for industrial technologists than specialization in a technical skill. In order to obtain a general knowledge of technical skills, exposure to a variety of manufacturing equipment and processes is essential to the development of the industrial technologist. Additionally, competencies such as practicing safe working habits, reading and interpretation of engineering drawings, and knowledge of quality assurance and testing procedures could be taught within a materials machining course.

Industrial technologists have an identity problem in industry. The majority of the respondents did not respond to the third research question which asked if the respondent was aware of any industrial technologists employed at the respondent's company. Continuous marketing of industrial technology programs and information from this study will help employers determine the types of positions best suited for industrial technology graduates. Also, this study will aid employers in understanding the role of the industrial technologist in industry.

Recommendations for Further Study

The first recommendation for further study is to conduct a similar study focusing on selected industry's perception of the competencies required of industrial technology graduates in other geographic areas of Georgia.

The second recommendation for further study is to conduct a follow-up study of industrial technology graduates. Information such as the county of employment and job position of the graduate should be collected. This information could be used to develop populations for other studies.

The third recommendation for further study is to conduct similar studies focusing on the competencies of industrial technology graduates majoring in building construction and contracting and printing management.

Summary

The purpose of this study was to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of industrial technology graduates in the year 1998. Additionally, the study focused on the common positions held by industrial technology graduates in industry and the number of companies in the selected survey population that employ industrial technology graduates.

A review of literature was conducted to locate similar studies, and additional information was reviewed to provide the necessary background information for the study. A list of 28 competencies was developed from Miller's 1989 study, Hayden's 1993 study, and input from the thesis committee. The respondents were asked to rate the level of importance of each of the 28 competencies on a Likert scale. The procedures and methods following the review of literature included, selection of the population, questionnaire development, collection of data, analysis of the data, findings, recommendations for further study, and conclusions.

The questionnaire was selected as the primary instrument for collecting data for this study. The questionnaires were mailed to the selected population for this study which was limited to those companies in the Savannah Metropolitan Statistical Area listed in the Georgia Manufacturers Register 1997 as employing 50 or more employees.

The data for this study was collected, analyzed and reported. The ratings of the competencies by the respondents were used as a resource for determining industry's perception of the competencies required of industrial technology graduates.

Sufficient information was collected through the review of literature and questionnaire to determine selected industry's perception in the Savannah Metropolitan Statistical Area regarding the competencies required of industrial technology graduates in the year 1998.

References

Akinkuoye, N. O. (1991, Spring). Technology and engineering technology: their affinity to engineering programs. Journal of Studies in Technical Careers, 13, 2, 181-188.

Archer, S. L. (1989). A study of the curricular needs for the manufacturing specialty area of industrial technology. Unpublished doctoral dissertation, University of Arkansas.

Badiru, A. B. & Baxi, H. J. (1994, July). Industrial engineering education for the 21st century. Industrial Engineering, 26, 66-68.

Bittel, L. R. & Newstrom, J. W. (1990). What every supervisor should know. (6th edition). New York: McGraw-Hill, Inc.

Boatright, S. R. & Bachtel, D. C. (1997). The Georgia County Guide. (16th edition). The Cooperative Extension Service. The University of Georgia.

Brauer, W. M. (1994, November). Industrial curriculum for engineering technology graduate programs. Proceedings of 1994 IEEE Frontiers in Education Conference, San Jose, CA, USA, 2-6.

Chen, J. C. & Chang, T. C. (1996, Fall). Design for manufacturing: an industrial technology point of view. Journal of Industrial Technology, 12, 4, 11-16.

Garrod, S.A.R. & Borns, R. J. (1988, October). Forecasting the professional profile of technology students. Proceedings of 1988 IEEE Frontiers in Education Conference, Santa Barbara, CA, USA, 105-11.

Georgia Manufacturers Register 1997 (1996). Evanston, IL: Manufacturers' News, Inc.

Georgia Southern University Undergraduate & Graduate Catalog. (1997-1998). Statesboro, GA: Georgia Southern University.

Hayden, M. A. (1993, Summer). A preliminary investigation of the competencies needed by industrial technology graduates. Journal of Industrial Technology, 9, 3, 1.

Hodgson, R. M. & Barnes, D. J. (1994, November). The education of professional engineers and technologists for careers in adding value. Proceedings of Electrical Engineering Congress, Sydney, NSW, Australia, 24-30.

Helsel, L. D. & Kicklighter, C. E. (1992, Summer). Industrial technology certification: why now? Journal of Industrial Technology, 8, 3, 1.

Keramas, J. G. (1995, Fall). The impact of new technologies on education. Journal of Industrial Technology, 11, 4, 36.

Lang, G. & Heiss G.D. (1987). A practical guide to research methods. Lantham, MD: University Press of America, Inc.

Leedy, P. (1997). Practical research planning and design (6th ed.). New Jersey: Prentice-Hall, Inc.

Miller, P. W. (1992). Industrial technology curriculum: a comparison of NAIT accredited and nonaccredited programs. Journal of Industrial Technology, 8, 3, 22.

Miller, T. (1989). Technical competencies needed by industrial technology graduates as perceived by NAIT-accredited institutions. Unpublished doctoral dissertation, Southern Illinois University at Carbondale.

National Association of Industrial Technology. (1986). NAIT history. Ann Arbor, MI.

National Association of Industrial Technology. (1990). NAIT accreditation handbook: associate and baccalaureate degree level. Ann Arbor, MI.

National Association of Industrial Technology. (1997). Industrial technology accreditation handbook associate and baccalaureate degree programs. Ann Arbor, MI.

Rothaupt, R. (1994). Technical competencies as perceived by industrial technology program graduates and department chairs. Unpublished doctoral dissertation, Colorado State University, Fort Collins.

Shaw, R. D. (1992, Fall). Educating manufacturing technologists for the 21st century. Journal of Industrial Technology, 8, 4, 1.

Shaw, R. D. (1995/1996, Winter). Industrial supervision competencies for industrial technology programs. Journal of Industrial Technology, 12,1, 16.

Shofoluwe, M. A. & Johnson, H. (1993, Spring). The future role of industrial technologists in industrial organizations. Journal of Industrial Technology, 9, 2, 38.

Stewart, D. H. (1996). An analysis of varying methods employed to review and revise the curriculum of industrial technology programs. Unpublished doctoral dissertation, University of Minnesota.

Zargari, A., Savage, E. & Waggoner, T. (1995, Summer-Fall). A curriculum content for the master of industrial technology program in manufacturing. Journal of Technology Studies, 21, 2, 73-76.

Appendix A

Correspondence

C. Alan Van Sickle
7 Mallard Ct.
Rincon, GA 31326

October 21, 1998

Respondent
Company
Address

Dear ,

Continuous input from industry is essential in order to ensure that colleges and universities continue to supply graduates with the knowledge required to meet the needs of industry.

As a graduate student at Georgia Southern University, I am conducting a study to determine the competencies required of Georgia Southern University graduates as perceived by industry. The study is focused on Industrial Technology graduates from a four year program having the degree of Bachelor of Science in Manufacturing or Bachelor of Science in Technology with an emphasis in Industrial Management.

Your input is very valuable whether you employ Georgia Southern University graduates or not. As such, I am asking for your assistance by completing and returning the enclosed questionnaire. The questionnaire will take only a few minutes of your valuable time. While your participation in this survey is voluntary, maximum participation will add credibility to my findings.

Please return this questionnaire in the self-addressed, stamped envelope. Your response will be held in strict confidence. At no time will you or your company be identified.

If you have any questions about this research project, please call me, Alan Van Sickle, at (912)644-2536. If you have any questions or concerns about your rights as a research participant in this study, they should be directed to the IRB Coordinator at the Office of Research Services and Sponsored Programs at (912)681-5465. Thank you for your time, effort, and cooperation in this study.

Sincerely,

C. Alan Van Sickle
Graduate Student
Georgia Southern University

Appendix B

urvey Instrument

Section I

On a scale of 1 to 5, please rate the level of importance of each of the following competencies. **1=not important, 2=slightly important, 3= important, 4=very important, 5=extremely important, NA=not applicable**

	Competency	Rating
1.	Knowledge of different organizational structures within manufacturing firms.	1 2 3 4 5 NA
2.	Knowledge of labor standards and measurement (motion-time studies).	1 2 3 4 5 NA
3.	Applying systematic problem solving techniques.	1 2 3 4 5 NA
4.	Preparation and utilization of PERT/CPM schedules.	1 2 3 4 5 NA
5.	Preparation of purchase requests.	1 2 3 4 5 NA
6.	Conducting cost and break-even analyses for a production run.	1 2 3 4 5 NA
7.	Performance of mathematical calculations (i.e. statics, stress analysis).	1 2 3 4 5 NA
8.	Reading and interpretation of engineering drawings.	1 2 3 4 5 NA
9.	Troubleshooting electrical systems.	1 2 3 4 5 NA
10.	Utilizing computer software (CAD, word processing & spreadsheets) to perform tasks.	1 2 3 4 5 NA
11.	Knowledge of material processes (cold working, heat treating, coating, conversion).	1 2 3 4 5 NA
12.	Knowledge of physical and mechanical properties of common industrial materials.	1 2 3 4 5 NA
13.	Knowledge of material fabrication and joining techniques.	1 2 3 4 5 NA
14.	Knowledge of plastic molding and forming processes.	1 2 3 4 5 NA
15.	Operation of injection molding equipment.	1 2 3 4 5 NA
16.	Development of a CNC part program.	1 2 3 4 5 NA
17.	Knowledge of quality assurance and testing procedures.	1 2 3 4 5 NA
18.	Development of tooling and fixtures.	1 2 3 4 5 NA
19.	Technical skill specialization (welding, machinist, draftsperson).	1 2 3 4 5 NA
20.	Preparation and presentation of accurate and concise reports and technical documents.	1 2 3 4 5 NA
21.	Preparation of product specifications.	1 2 3 4 5 NA
22.	Knowledge of manufacturing systems (CAM, CIM).	1 2 3 4 5 NA
23.	Understanding of equipment and material handling layout planning.	1 2 3 4 5 NA

Over

Competency	Rating
24. Practicing safe working habits.	1 2 3 4 5 NA
25. Familiarity with personal computer applications in industry.	1 2 3 4 5 NA
26. Ability to adapt to new situations.	1 2 3 4 5 NA
27. Manage according to Deming and Peters' World Class Manufacturing techniques.	1 2 3 4 5 NA
28. Acting as an industrial support person (teaching/training others).	1 2 3 4 5 NA

Section II

1. Please list below any technical competency that you feel should have been included within the list above._____
_____
_____

2. What is the primary product manufactured or service provided at this location?_____
_____

3. Title of person completing survey._____

4. Are you aware of any Industrial Technology graduates (B.S. in Technology or B.S. in Manufacturing) employed at your facility? If so, approximately how many?_____
_____

5. If available, please list the titles of positions currently held by Industrial Technology graduates?_____
_____

6. Additional Comments (If any)_____
_____
_____
_____

7. Would you like a copy of the results of this study?___Yes___No

Thank You!

Alan Van Sickle
7 Mallard Ct.
Rincon, GA 31326

Appendix C

Follow-up Letter

C. Alan Van Sickle
7 Mallard Ct.
Rincon, GA 31326

November 9, 1998

Respondent
Company
Address

Dear ,

Two weeks ago a questionnaire was mailed to your company regarding competencies required of Georgia Southern University Industrial Technology graduates. The purpose of this questionnaire is to gather data regarding the competencies required of Industrial Technology graduates as perceived by industry. The study is focused on graduates from a four year program having the degree of Bachelor of Science in Manufacturing or Bachelor of Science in Technology with an emphasis in Industrial Management.

Your input is very valuable to this study whether you employ Georgia Southern University graduates or not. As such, I am asking for your assistance by completing and returning the enclosed questionnaire. The questionnaire will take only a few minutes of your valuable time. While your participation in this survey is voluntary, maximum participation will add credibility to my findings.

Please return this questionnaire in the self-addressed, stamped envelope. Your response will be held in strict confidence. At no time will you or your company be identified. If you have already completed this questionnaire, then no further action is required.

If you have any questions about this research project, please call me, Alan Van Sickle, at (912)644-2536. If you have any questions or concerns about your rights as a research participant in this study, they should be directed to the IRB Coordinator at the Office of Research Services and Sponsored Programs at (912)681-5465. Thank you for your time, effort, and cooperation in this study.

Sincerely,

C. Alan Van Sickle
Graduate Student
Georgia Southern University

Appendix D

Data From Questionnair

Comp.	Questionnaire Number																												
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	2	2	3	2	5	2	3	2	3	5	3	4	1	2	1	3	2	2	4	2	3	3	3	3	n/a	3	4	3	4
2	4	3	5	3	5	3	1	3	3	3	3	4	4	3	1	4	3	2	4	2	4	3	4	3	n/a	3	5	3	2
3	3	4	5	3	5	4	3	5	5	5	5	5	4	5	3	5	4	3	5	5	5	4	4	4	3	5	3	5	5
4	5	4	3	n/a	5	2	1	2	n/a	3	4	3	4	3	2	3	2	3		4	4	3	n/a	3	3	4	3	3	3
5	3	2	4	3	5	2	3	2	3	5	5	3	1	3	3	2	n/a	1	3	2	3	3	3	2	3	2	3	3	2
6	4	2	5	3	5	2	3	4	4	5	4	4	3	4	3	4	2	2	3	5	4	4	5	4	n/a	5	5	4	3
7		4	4	4	5	2	4	3	4	4	5	2	4	4	3	4	3	5	3	4	4	4	4	2	n/a	4	3	4	5
8	5	5	5	4	5	3	5	4	4	4	5	3	4	5	4	3	4	5	2	2	5	3	4	4	4	4	3	4	5
9	3	2	3	3	5	4	5	4	3	3	5	2	3	2	3	1	2	2	2	2	3	2	4	1	n/a	3	3	4	4
10	5	5	5	5	5	4	5	4	5	4	5	4	5	5	4	5	5	5	4	4	4	4	3	5	4	5	5	4	4
11	3	n/a	4	3	5	2	3	3	3	n/a	5	2	3	4	4	2	2	4	3	3	2	3	3	4	n/a	3	5	4	5
12	4	n/a	5	2	5	2	4	3	3	n/a	5	2	3	4	4	3	3	3	2	3	2	2	3	4	2	3	3	4	5
13	4	3	5	n/a	1	2	4	3	3	n/a	4	2	3	4	3	2	3	5	2	3	2	2	3	4	4	3	3	4	5
14	4	n/a	n/a	n/a	1	2	3	1	2	n/a	3	2	2	2	3	n/a	n/a	2	2	2	1	2	3	1	n/a	2	3	3	3
15	2	n/a	n/a	n/a	5	2	2	1	2	n/a	3	1	2	2	2	n/a	n/a	2	n/a	2	1	1	3	1	n/a	2	3	3	1
16	1	n/a	3	n/a	5	3	4	n/a	n/a	3	2	2	4	3	2	n/a	2	2	3	2	3	2	4	4	n/a	2	2	3	1
17	4	4	4	3	5	4	4	2	5	5	3	3	5	4	2	5	2	4	4	4	4	4	4	4	2	3	5	4	2
18	3	n/a	3	2	5	3	2	1	3	4	3	2	4	3	2	n/a	4	3	n/a	2	2	2	3	4	2	1	3	3	2
19	3	n/a	5	3	5	2	4	1	3	n/a	4	2	3	2	2	3	3	4	3	2	3	1	3	4	2	2	3	3	1
20	4	3	4	3	5	3	5	3	4	5	5	4	5	5	2	5	3	5	4	5	4	3	3	2	2	4	5	5	4
21	3	3	4	n/a	5	3	3	2	3	4	5	3	2	2	2	1	2	5	4	5	3	3	4	1	n/a	4	5	4	3
22	2	4	3	n/a	5	2	3	1	3	n/a	3	2	4	4	2	2	3	2	4	3	2	3	3	5	n/a	4	5	4	3
23	4		4	5	5	3	3	1	5	5	4	4	4	3	2	4	4	2	4	3	4	3	4	4	2	5	5	4	4
24	4	4	4	5	5	4	4	4	5	5	5	5	3	4	4	5	3	2	4	5	5	5	5	4	4	5	5	5	4
25	5	5	5	4	5	3	4	4	5	4	5	3	4	5	4	5	3	3	4	5	4	4	4	4	4	5	4	4	4
26	4	4	5	5	5	5	4	5	5	5	5	5	5	4	4	5	4	3	5	5	5	5	4	4	4	4	4	5	5
27	n/a	n/a	3		5	3	3	1	3	n/a	4	5	4	4	1	5	2	3	4	2	3	4	2	4	n/a	5	4	3	4
28	3	2	4	5	5	4	3	4	5	5	5	4	3	3	3	4	2	2	4	5	5	4	3	4	3	4	5	4	3