THE ASSOCIATION BETWEEN FACTORS AFFECTING ENROLLMENT DECISIONS IN MANUFACTURING OCCUPATIONAL CLUSTERS IN TWO-YEAR COLLEGES

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The Association between Factors Affecting Enrollment Decisions in

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

DOCTOR OF PHILOSOPHY

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ABSTRACT

The purpose of the study was to investigate the relationships between factors that affect student enrollment decisions in manufacturing occupational programs in two-year colleges and to describe current enrollment status of these programs. This purpose was pursued by five hypotheses and one research question that addressed the categorical factors that affect student enrollment decisions in a diversity of academic programs in higher education. These factors are: awareness; influence; recruitment; and socioeconomic status.

Quantitative data were gathered through an online survey instrument. The target populations were full time instructors, academic advisors, and program directors of manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States. The two-year colleges were mostly community and technical colleges that offer certificate and associate's degree programs in manufacturing-related occupations. A total of 288 full time faculty and academic advisors from 155 two-year colleges participated in the study by responding to the survey instrument and providing the data that were later analyzed to address the research questions.

PASW software was used for data processing and three statistical methods: descriptive statistics; path analysis; and discriminant analysis were employed for data analysis. The descriptive analysis corroborated most of what the literature suggest are the most and the least effective awareness, influence, recruitment, and socioeconomic factors that affect student enrollment decisions. While path analysis showed that, the path to student enrollment in manufacturing occupational programs in two-year colleges starts from awareness, and goes through influence, and recruitment factors, the discriminant analysis showed that, awareness and

recruitment factors are the main independent categorical variables that predict enrollment size in manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States.

AKNOWLEDGEMENTS

I want to thank my family for all their support during the course of my education, most especially, during the process of this dissertation. I am greatly indebted to my late aunt, Mrs. Aluuma Imom-Kartyo who picked me up from my parents when I was a child and sent me to school, provided me with both moral and financial support, and made sure I grew up in an academic environment. I also want to thank those who encouraged me to pursue a doctoral degree program and supported that cause morally, financially, or otherwise.

I am also deeply indebted to members of my committee for their guidance that led to the successful completion of this disquisition: Firstly, Dr. Myron Eighmy, the chairperson of the committee for his patience and professional guidance; Dr. Ronald Stammen, for his comments and moments of encouragement; the late, Dr. Mark Schmidt for his expertise in statistics and survey instrumentation; and Dr. Majura Selekwa for his review, comments and technical expertise. Finally, I must thank Dr. Thomas Hall for his acceptance to join the committee as a replacement for Dr. Schmidt who suddenly passed away.

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CHAPTER I. INTRODUCTION

Predictions have been made and are increasingly being made regarding the future of workforce education in the United States. Experts on workforce education seemed to have arrived at the startling conclusion that future businesses in the United States will require workers to have higher-level skills and more education to be considered for employment. This is because the United States is increasingly moving towards a knowledge-based economy. In the manufacturing sector, they contend that the only way the sector will remain competitive in the wake of high production cost and stiff competition from low-wage countries is to become labor-efficient by increasing productivity through technological innovations with few but high-skilled workers.

According to the United States Department of Labor (as cited in Fleming, 2006), 85% of future jobs in the United States will require advanced training, an associate's degree, or a four-year college degree; minimum skilled occupations will only account for 15% of all future jobs. Similarly, the National Association of Manufacturers (NAM) predicted that, "65% of future jobs will require or need a person with an associate degree" (NAM, 2008, p. 33). The Bureau of Labor Statistics (as cited in General Accountability Office [GAO], 2008) equally corroborated that, by 2014, 54% of total job openings in the United States will be filled by those with some college education or a bachelor's degree or higher.

While predictions are being made about the future, current employment conditions in the manufacturing sector already demand that workers have high-level skills. In the Skills Gap Survey Report of 2005, The Manufacturing Institute reported that: (a) 53% of the total respondents had at least 10% of their total positions unfilled due to a lack of qualified candidates; (b) 80% were experiencing overall shortages of qualified workers; (c) 90% reported a shortage of qualified production workers; (d) 65 percent reported a shortage of scientists and engineers; and (e) only 39% of the total respondents reported a shortage of qualified unskilled production workers (The Manufacturing Institute, 2005). A similar study conducted by NAM (as cited in Jasinowski, 2009) found that 36% of the 3000 companies polled had good jobs going unfilled due to a lack of qualified applicants.

Meanwhile, young people are not interested in occupational careers in manufacturing industry. In explaining the findings of a new study, Keeping America Competitive, Phyllis Eisen, Executive Director of the Center for Workforce Success at the National Association of Manufacturers summated that, respondents to the study "regarded manufacturing as a dark, dreary, and dead-end field offering low pay, and few, if any, benefits; a field in decline with jobs moving overseas" (AYPF Forum Brief, 2003, p. 1). According to Eisen, schools were not offering career guidance that would lead young people to choosing careers in manufacturing. "Students get little guidance beyond help in applying to college; they are not being given information about the courses they need to take to be prepared for careers as engineers or designers" (p. 2).

Besides poor quality guidance, Keeping America Competitive found that, educational and training systems in the United States were strategically misaligned with the emerging needs of the global economy, manufacturers, and young people. The proposed study seeks to identify the relationships or associations between how students find out about manufacturing occupational programs in two-year colleges and what makes them enroll in such programs. The study will also describe the current enrollment status of these programs. Identification of such relationships will help in designing better student recruitment strategies in manufacturing occupational clusters in two-year colleges.

Statement of the Problem

In the Skill-Gap Survey Report of 2005, The Manufacturing Institute (2005) reported that, the vast majority of American manufacturers were experiencing serious shortage of qualified employees. Overall, more than 80% of respondents were experiencing a shortage of qualified workers "with 13% reporting severe and 68% indicating moderate shortages" (p. 1). In a prior study, NAM (2003) found that, the shortage was created in part by the negative and inaccurate perceptions that young people, their parents, and school counselors have of careers in manufacturing occupational clusters. In a recent study on Graduation Trends in Machinist and Machine Shop Technology: 2000-06, Eighmy and Karl (2008) found that, graduation trends declined by 22.9% in the Plains States and by 79% in the Great Lakes States. Negative perceptions of manufacturing occupational clusters by youths, their parents, and school counselors coupled with a decline in graduation trends may suggest a decline in enrollment in the programs studied. Hence the need to investigate into the relationships of enrollment decision factors in manufacturing occupational clusters in two-year colleges.

Purpose of the Study

The purpose of this quantitative study was to investigate the relationships between factors affecting enrollment decisions in manufacturing-related programs from the perspectives of academic advisors, instructors, and program directors of manufacturing-related programs in two-year colleges in the Great Lakes and Plains States. An additional purpose was to describe the enrollment status of these programs

Research Questions and Hypotheses

The purpose of the study was accomplished by the following research questions and hypotheses:

1. Awareness factors have a direct effect on student enrollment decisions in manufacturing programs in two-year colleges;
2. Student enrollment in manufacturing programs in two-year colleges is directly affected by influence factors and indirectly affected by awareness factors;
3. Student enrollment in manufacturing programs in two-year colleges is directly affected by recruitment factors and indirectly affected by awareness and influence factors;
4. Student enrollment in manufacturing programs in two-year colleges is directly affected by socioeconomic factors and indirectly affected by recruitment and awareness factors;
5. Manufacturing occupational programs in two-year colleges in Great Lakes and Plains States are not in the state of decline.
6. What is the linear combination of independent variables that accounts for the most variation in enrollment size?

Definition of Terms

For the purpose of this study, the following definition of terms will be used:

Manufacturing: The United States Census Bureau (1997, p. 1) defined Manufacturing as "the mechanical, physical, or chemical transformation of materials or substances into new products".

Workforce Development: Hirsch (2007, p. 4) defined Workforce Development as "education and training whereby students or individuals are direct customers of the service delivery system. This includes education and training provided to and through: K-12, post-secondary, and proprietary institutions; existing unemployed workforce, displaced, disadvantaged or underemployed; and the existing employed workforce served through lifelong learning and continuing education”.

Workforce Training or Jobs Training: Hirsch (2007, p. 4) defined Workforce Training or Jobs Training as “the more immediate service relationship in responding to short term business and industry needs. It is business and industry driven and often involves customized or contracted training”.

Path Analysis: Cramer, Wehner, and Donaghy (1999, p. 260) defined Path Analysis as “a means of determining influence of independent factors on dependent factors, while also calculating the simple correlation between pairs of independent factors”

Path Model: Garson, D. G. (2008, p. 1) defined a Path Model as “a diagram relating independent, intermediary, and dependent variables.

Path Coefficient: Garson, D. G. (2008, p. 1) defined a Path Coefficient as “a standardized regression coefficient (beta) showing the direct effect of an independent variable on a dependent variable in the path model”.

Great Lakes States and Plains States: The National Center for Education Statistics, Integrated Postsecondary Education Data Systems (2007, p. 1) identified Great Lakes States as “Illinois, Wisconsin, Michigan, Indiana, and Ohio”, and Plains States as “Iowa, Minnesota, Kansas, Missouri, Nebraska, North Dakota, and South Dakota”.

Importance of the Study

Previous studies on workforce development and education by Deloitte Research (2007), NAM (2003), and NAM (2008) attributed the current shortage of skilled workers in manufacturing industry to the lack of student enrollment in manufacturing related programs in two-year colleges and to the strategic misalignment of educational and training systems with global economy and with the needs of young people.

The study conducted by Sandford, Frisbee, and Belcher (2006) to uncover what makes students enroll in automotive programs in four-year college found that, “what makes students aware of automotive programs and what influences them to enroll in these programs are quite similar” (p. 5). If the relationships between factors that trigger student enrollment are known, the information could be used in two major ways: to design recruitment strategies that would lead to successful recruitment of students into manufacturing-related programs in two-year colleges; and successful recruitment strategies would in turn lead to stable enrollment, proper prediction, coordination, and alignment of workforce development needs with industry demands. When this happens, the shortage of skilled workers currently being experienced in the manufacturing industry will be minimized.

Limitations of the Study

All respondents in the study were academic advisors, instructors, and programs directors of manufacturing-related programs in two-year colleges in the Great Lakes and Plains States. These groups of professionals routinely talk to students in their programs and have experiences in designing students’ enrollment strategies and conducting surveys to determine the best approach to attract students into manufacturing programs in their schools. This may suggest that their level of awareness of enrollment decision factors significantly differ from that of the general public. Only two-year colleges in the Great Lakes and Plains States were sampled for this study, and the manufacturing-related programs studied included only the Classification of Instructional Program (CIP) codes listed in Appendix E. Therefore, the findings of the study cannot be generalized beyond enrollment in manufacturing occupational clusters in two-year colleges. In addition, the path analysis method used for data analysis in the study is known to evaluate only causal hypotheses and tests between two or more causal hypotheses, but it does not establish the direction of causality (Garson, 2008).

Organization of Remaining Chapters

Chapter Two contains the related literature review on the historical perspectives, economic, and technological trends in manufacturing industry; the role of public education in preparing workers for manufacturing occupational clusters; the role of government in developing manufacturing occupational programs; access to those programs; and program variations and trends. It also contains the related literature review on student recruitment into two-year colleges; introduction of manufacturing programs to the general public; and job data in the manufacturing industry.

Chapter Three describes the procedures to obtain the IRB approval to conduct the research; target population for the study; method of sampling; instrumentation, reliability and validity of the instrument; data collection techniques; and the type of data analysis performed.

Chapter Four presents findings from the study organized around the research hypotheses presented in Chapter One. Finally, Chapter Five highlights and summarizes the results of the study, present conclusions, and outlines recommendations regarding utilization of the findings and the recommendations for further research.

CHAPTER II. LITERATURE REVIEW

The purpose of this study was to investigate the relationships between factors that affect student enrollment decisions in manufacturing occupational clusters from the perspectives of program directors, instructors, and academic advisors in two-year colleges in Great Lakes and Plains States. An additional purpose was to describe the current status of these programs. This chapter provides an overview of the historical perspectives, economic and technological trends in manufacturing industry; roles of public education and governments in workforce development; program design; access to those programs; and program variations and trends. It also provides an overview of student recruitment into two-year colleges; marketing strategies; and job data in the manufacturing industry.

Historical Perspectives

Apprenticeship

Organized apprenticeship was the first method of preparing people for work, especially in the manufacturing industry. It was adopted from Europe and adjusted to meet the needs of the early colonialists in the United States (Scott & Sarkees-Wircenski, 2001). According to Sleight (1993), apprenticeship programs were designed for training of beginners in the skilled occupations and "because the skills were more specialized and there were more of them to master, apprenticeships lasted longer than on-the-job-training, frequently for years" (p. 2).

On completion of the apprenticeship program, apprentices were required to make a master piece of their apprenticeships for inspection by a group of masters to gain guild recognition of their status (Washington State Department of Labor and Industries, 1968). Upon gaining guild recognition, the apprentices officially graduated as journeymen and could now continue to work for the same master for a fee; work for another master as journeymen; or setup their own shop as freemen (Iron-Workers Toronto Local 721, 2003).

Though apprenticeship served its purpose for more than 150 years (Scott & Sarkees-Wircenski, 2001), it could not cope with the demand for skilled workers following the unfolding of industrial revolution; the great depression; World War II; the maturing of the baby boomers; and immigration explosion (Chase & Halder, 2004). According to Sleight (1993), industrial revolution increased the ability of production facilities to produce goods quickly and cheaply, so more workers were needed to run factory machines. Consequently, factory owners required workers to be "trained quickly because there was a large demand for the produced goods" (p. 3). The desire to train workers quickly to run factory machines without interrupting production flow was not compatible with the set-up necessary to train apprentices (Scott & Sarkees-Wircenski, 2001). So, manufacturers increasingly turned to alternative arrangements for mass training of workers. These arrangements included classroom training; vestibule training; manual training schools; and technical training schools, among others.

Classroom Training

Classroom training was adopted for the mass training of factory workers because it was perceived to be economically feasible to train many workers at the same time and under a single trainer. Therefore, factory schools were constructed within factory walls to train workers in classrooms. According to Sleight (1993) "classrooms by that time had become the customary places of education, and were simply recreated in the factories, with the classroom subjects being how to do the tasks required in the factory" (p. 3). Unfortunately, factory schools did not produce the expected learning outcomes, so the system was considered a failure for several reasons including but not limited to:

1. workers learned away from the job, so they had to remember not only what they learned in the classroom, but to transfer the newly acquired knowledge abstractly to real production lines and equipment;
2. learning took place at the teacher's pace; therefore, rapid learners were held back and slow learners were dragged forward too quickly;
3. there was no immediate feedback; and
4. it was difficult to ask questions without distracting the rest of the class.

Vestibule Training

Vestibule training schools were miniatures of the factories for which the training programs were carried out, and were located near the facilities. According to Smith (as cited in Sleight, 1993), vestibule training utilized "machinery similar to that in operation on the production floor and qualified instructors, usually skilled operators or supervisors were provided to conduct the program" (p. 4). The method of training was a combination of classroom instructions and on-the-job training. Vestibule training had several advantages, namely:

1. training did not interfere with regular production activities;
2. training was provided on the exact equipment employees were required to use and on the exact work they would do on the production floor;
3. workers did not have to transfer knowledge from classroom to production floor;
4. there were only six to ten trainees per trainer; therefore, feedback was instantaneous as trainees asked questions more easily than in a classroom setting;
5. accidents were minimized because workers were trained on the equipment and production lines similar to those on the production floor;

6. vestibule training dovetailed with the concept of mass training of workers quickly to fill production orders and with the unskilled and semi-skilled tasks that did not require long training periods (Sleight, 1993).

Vestibule training was very effective but it was also expensive. The cost of duplicating an entire production facility for training purposes was prohibitive to many organizations; therefore, small and medium size manufacturers could not possibly utilize the concept of vestibule training for employee training and development.

Manual Training Schools

Manual training schools were established to train students to acquire skills in the use of tools and materials. They were not designed to prepare students for production of specific products as in vestibule training, neither were they designed to prepare students to specialize in specific trades. According to Scott and Sarkees-Wircenski (2001), they were four-year institutions "that provided instruction in mathematics, science, drawing, language, and literature, as well as practice in the use of tools" (p. 130). Scott and Sarkees-Wircenski posited that, the system was borrowed from the Russian Imperial Technical School of Moscow. Under the Russian system, trade instructions were provided in separate shops, and each shop was designed to support only one trade. Each shop provided as many work stations and tools as a teacher could reasonably handle in one instructional period. And in each shop, instructions were graduated according to the difficulty and complexity of the operations. The expected learning outcomes of manual training school included:

1. "longer attendance at the school;
2. better intellectual development;
3. more wholesome moral education;

4. sound judgment of men and things;
5. better choice of occupation;
6. material success for the individual and the community;
7. elevation of the perception of manual occupations from brute unintelligent labor work requiring and rewarding both knowledge and skills;
8. basis for an individual career in the mechanical art;
9. first step in the solution to labor problems; and
10. basis for higher education" (p. 132).

Though business and industry leaders generally considered manual training schools a success and wanted them to be more vocationally inclined, they were opposed by the organized labor for the fear that "it would flood the market with poorly trained workers who would be inferior to those trained through apprenticeship programs" (Scott & Sarkees-Wircenski, 2001, p. 133). Scott and Sarkees-Wircenski contended that the success of the initial manual training school in St Luis led to the establishment of manual training high schools in other parts of the country.

Technical Training Schools

As manual training schools became popular, many expanded their programs to become comprehensive high schools while those that concentrated on vocational programs became technical training schools. According to Scott and Sarkees-Wircenski (2001), "manual training schools in larger cities placed more emphasis on shop-work, drawing, and science and changed their names to technical schools" (p. 133). Other manual training schools provided regular high school instructions in addition to drawing, design, and hand and machine tools.

Economic and Technology Trends in Manufacturing

According to the North American Industry Classification System (NAICS), the manufacturing sector consists of establishments that assemble component parts into unit products and those that are engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products (Bureau of Labor Statistics, 2007). Based on this classification, Kerrigan, Schroeder, and Vargo (2001) estimated that there were 377,776 manufacturing establishments in the United States. These establishments make everything from semi-conductors to silverware, from socks to supersonic jets, and the nature of jobs performed in these establishments equally varies from janitorial to engineering (Helper, 2008). Besides production of core manufacturing products, manufacturing activities stimulate demand for "everything from raw materials to intermediate components to software to financial, legal, accounting, transportation and other services" (U.S. Department of Commerce, 2004, p. 14).

In the economy as a whole, manufacturing employs "14.3 million people in the United States out of a labor force of 146 million" (Helper, 2008, p. 5). In 2002, the National Association of Manufacturers (as cited in Fleming, 2006), found that manufacturing "supported 23 million jobs in the United States; fifteen millions of those jobs were in manufacturing and eight million were in other industries" (p. 9). In 2006, manufacturing supported "more than 20 million jobs in the United States: 14.2 million jobs directly within manufacturing and more than 6 million jobs in sectors outside of manufacturing such as accounting, wholesaling, agriculture, transportation, financed, insurance, and real estate" (NAM, 2008, p. 18). The motor vehicle and parts industries alone employed "732,800 workers directly as of September, 2008, and the Detroit Three employed 239,341 hourly and salary workers in the United States at the end of 2007, while the international producers employed roughly 113,000 people in the United States at that time" (Cole, McAlinden, Dziczek, & Menk, 2008, p. 4).

According to the United States Department of Commerce (2004), the United States manufacturing sector is the world's largest manufacturer of goods, accounting for more than one quarter of global manufacturing output, 4 percent of United States GDP, and 11 percent of total United States employment. United States manufacturing also has one of the highest multiplier effects as compared to other sectors of the economy. According to the United States Department of Commerce (as cited in NAM, 2008, p. 17), "every dollar in final sales of manufactured products supports $1.37 in other sectors of economy". This means "manufacturing has direct substantial links to non-manufacturing sectors of the economy that work backward – to mining and construction – and forward, to transportation, finance, and wholesale sectors that help deliver goods to final consumers" (p. 17).

Though the manufacturing sector peaked in 1979 when a total of 19.43 million people were employed in the core manufacturing establishments, it has been on the decline, for the most part, since 2000, the last time the sector employed more than 17 million people. Helper (2008) estimated that 16% of manufacturing jobs disappeared just in three years between 2000 and 2003, "with a further decline of almost 4 percent between then and now" (p. 2). According to Deitz and Orr (2006), the manufacturing sector's share of the total workforce has sharply dropped from 20 percent in 1979 to 11 percent today. In 2008, the hiring capacity of the manufacturing sector dipped to 13.4 million; currently, its monthly average in the first half of 2009 is about 12 million. "On average, U. S. manufacturing employment has fallen 0.4 percent annually over the past 35 years" (U.S. Department of Commerce, 2004, p.18). Figure 1 shows the declining profile of manufacturing employment between 1972 and 2008.

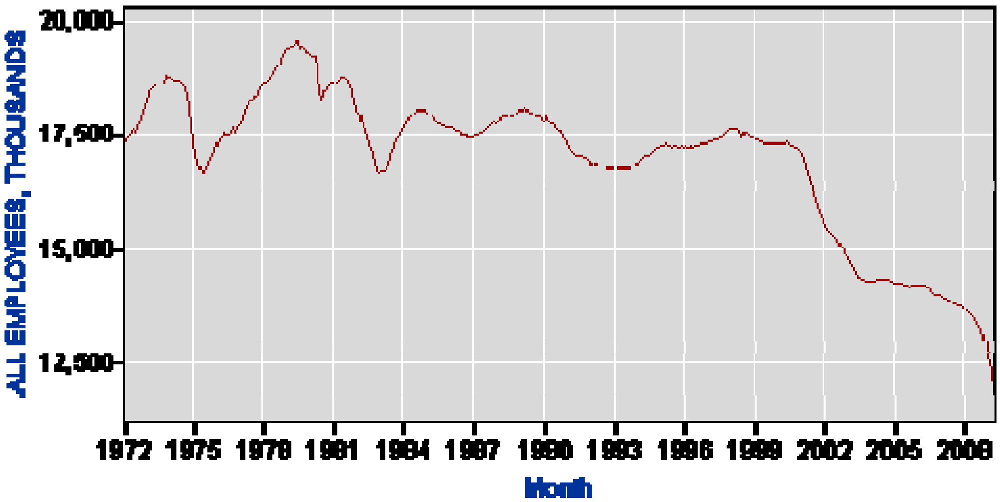


Figure 1: Manufacturing employment trend between 1972 and 2008
(Source: Bureau of Labor Statistics, 2009)

As manufacturing employment declined, average weekly hours of manufacturing production workers similarly declined from 42 hours per week in 1997 to 39.5 hours per week in 2009 (Bureau of Labor Statistics, 2009). Figure 2 displays the declining profile of average weekly hours of production workers from 1972 to 2008. Manufacturing employees earn higher wages and enjoy more benefits than employees in other sectors of the economy. Therefore, the

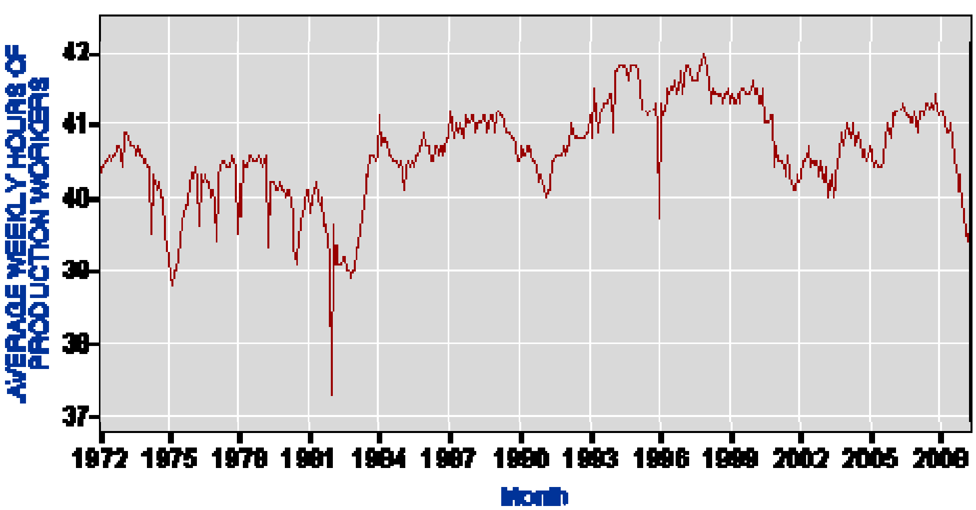


Figure 2: Average weekly hours of manufacturing production workers: 1972-2008
(Source: Bureau of Labor Statistics, 2009)

loss of manufacturing jobs has correspondingly resulted to loss of well-paid jobs. The United States Department of Commerce (2004) estimated that "the average hourly total compensation of production workers in manufacturing is higher than the average in all other sectors" (p. 17).

According to the United States Department of Labor (as cited in NAM, 2003), an average manufacturing worker earned $46,000 per year in wages, and an average total compensation packet of $54,000 in 2000. According to NAM, both of these figures were "20 percent higher than comparative averages for all U. S. workers" (p. 21). In 2004, the total annual average compensation packet of manufacturing employees was $65,000 while employees in other sectors earned an average total annual compensation packet of $53,000 per year (NAM, 2008). That's a "23% premium for working in manufacturing" (p. 16). Between 1972 and 2008, average hourly earnings of production workers in the manufacturing sector rose from $3.57 in 1972 to $18.10 in 2008 as shown in Figure 3.

While the causes of manufacturing employment decline have not yet been identified, several factors that influence employment in the manufacturing sector have been identified, namely: demand; technological innovations; international trade; and the overvalued dollar (Bivens, 2004). Though these factors have been identified, the degree to which each of them affects manufacturing employment remains controversial. The impacts of these factors on manufacturing employment are briefly discussed below.

Demand: The demand for manufactured goods has universally declined over time as consumer spending has shifted mostly to services such as medical care, education, and tourism among others. According to the Congressional Budget Office (2004), 42% of United States consumer spending was devoted to goods in 2002, down from 53% in 1979 and 67% in 1950. Bivens (2004) posited that "employment in manufacturing will rise as demand for manufacturing output rises, but will fall as productivity rises and/or as domestic demand is satisfied by manufacturing imports" (p. 6).

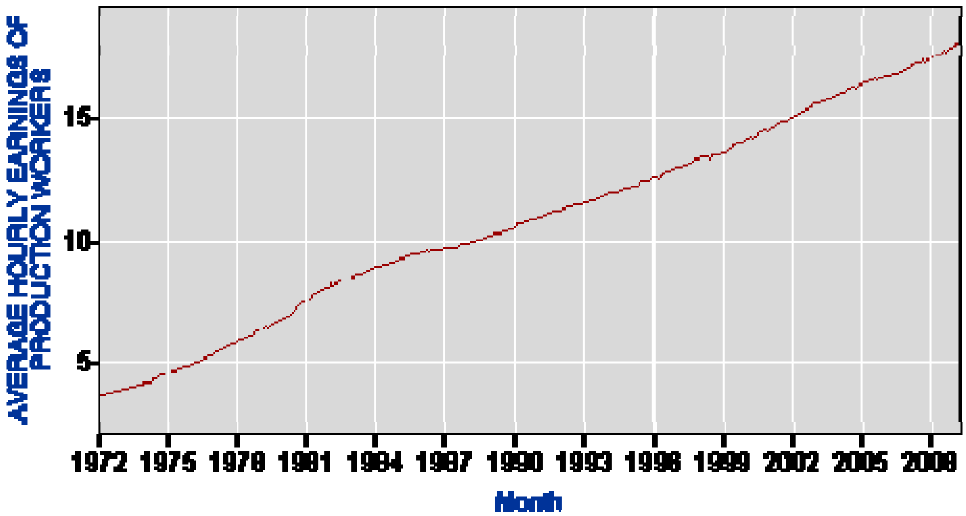


Figure 3: Average hourly earnings of production workers: 1972-2008 (Source: Bureau of Labor Statistics, 2008)

Figure 4 displays the profile of manufacturing employment and the ratio of United States output to demand for domestic manufactured goods between 1977 and 2004. This profile may suggest that manufacturing employment will directly vary with the demand for manufactured goods if other factors remain constant. Arguing along the same line, the former Federal Reserve Chairman, Alan Greenspan (2004) corroborated that "the loss of jobs over the past three years was attributable largely to rapid declines in the demand for industrial goods and to outsized gains in productivity that had caused effective supply to outstrip demand" (p. 3).

Technological Innovations: There are generally two forms of technological innovations that affect employment in the manufacturing sector. These are new inventions and continuous product and process improvement. According to the United States Department of Commerce (2004), new inventions are derived from large-scale investments in research and development (R&D). Manufacturing firms fund "60 percent of the $193 Billion that the U.S. private sector invests annually in R&D" (p. 15). The technologies derived from these investments are deployed across the manufacturing sector, and to a large extent, across the entire economy to increase productivity growth.

The other form of innovation that improves productivity growth in the manufacturing sector is continuous product and process improvement. The improvement technique may be Six-Sigma, Lean Manufacturing, or Total Quality Management, among others. According to NAM (2008) "between 1987 and 2005, manufacturing productivity grew by 94 percent, roughly two and half times faster than the 38 percent increase in productivity growth in the rest of the business sector" (p. 14). If demand is held constant or allowed to lag productivity growth over time, then productivity growth will lead to a smaller workforce to produce a given output.

Berry (as cited in Bivens, 2004) corroborated that most manufacturing jobs were eliminated because companies used new technologies, management techniques, and other methods to achieve productivity gains, so jobs lost to productivity gains will not come back regardless of what policy makers do. Perry (2008) similarly corroborated that "one of the most significant factors in the recent decline of American manufacturing jobs is the significant increase in productivity of U.S. workers – we're able to produce more and more with fewer and fewer workers" (p. 3). Figure 5 demonstrates the relationship between manufacturing employment and productivity growth between 1990 and 2005.

International Trade: Following the significant reduction in tariff and non-tariff barriers to trade in manufactured goods by multilateral trade agreements such as General Agreements on Tariffs and Trade (GATT), World Trade Organization (WTO), and North American Free Trade Agreement (NAFTA) among others, the value of the world trade rose from $58 billion in 1948 to $5.98 trillion in 2001 (U.S. Department of Commerce, 2004). This represented 87% growth in world trade. In the United States, the falling trade barriers contributed in raising GDP from $11,672 in 1950 to $34,934 in 2002. Between 1990 and 2000 the United States exports were up by 98%; the economy grew from $7 trillion in 1990 to $10 trillion in 2002, accounting for one-sixth of all growth in the United States economy; and exports of manufactured goods rose to about 60% of all sales. The boost in export sales was said to have supported more than 12 million jobs most of which paid between 13 and 18% higher than average wages (U.S. Department of Commerce, 2004).

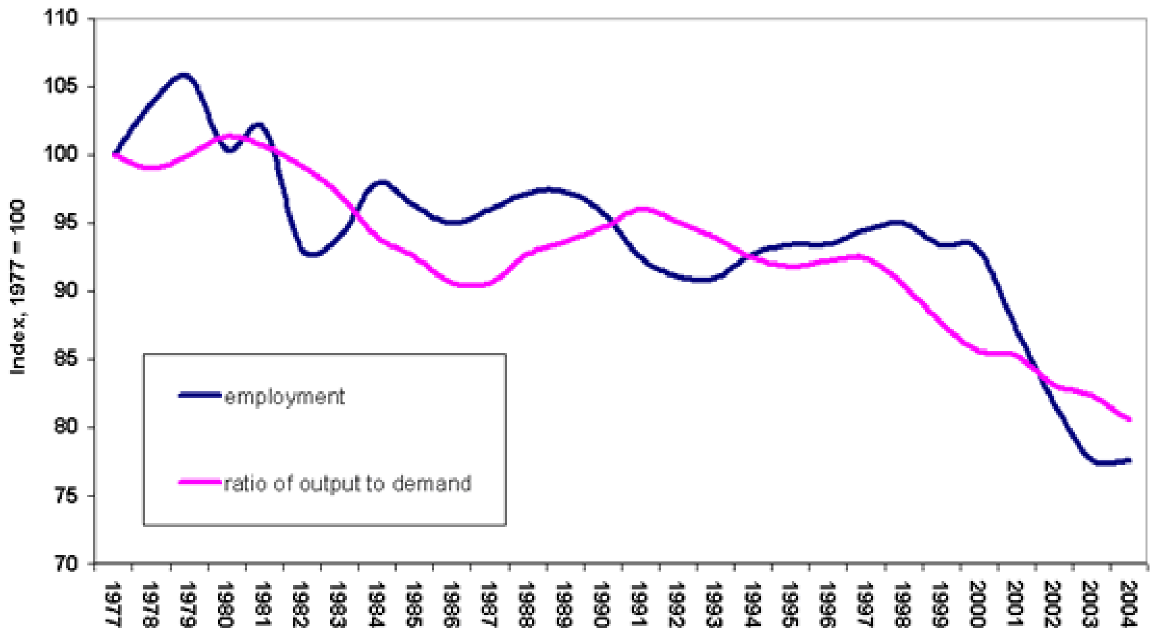


Figure 4: Manufacturing employment and the ratio of U. S. output to demand (Source: Bivens, 2005).

But with the emergence of China, and other countries in the world trading system, a different kind of competition was introduced in world trade. This competition, according to economists and experts on manufactured goods and international trade, has adversely affected United States exports. Since the emergence of China in WTO in 2001, the United States trade deficit with China has risen from "$84 billion in 2002 to $262 billion in 2007, an increase of

$178 billion" (Scott, 2008, p. 4). This represents a 21% increase in annual trade deficit with China. According to Scott, "the $84 billion trade deficit in 2001 displaced 1,021,500 jobs that year. Job displacement rose to 2,951,100 in 2006 and to 3,316,800 in 2007" (p. 5). Scott further asserted that, between 2001 and 2007, United States trade deficit with China eliminated or displaced a total of 2,295,300 jobs.

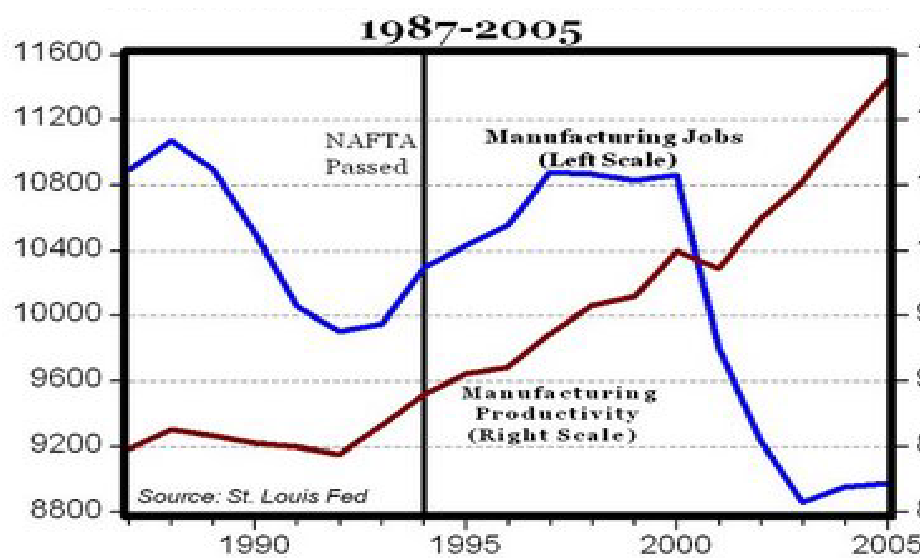
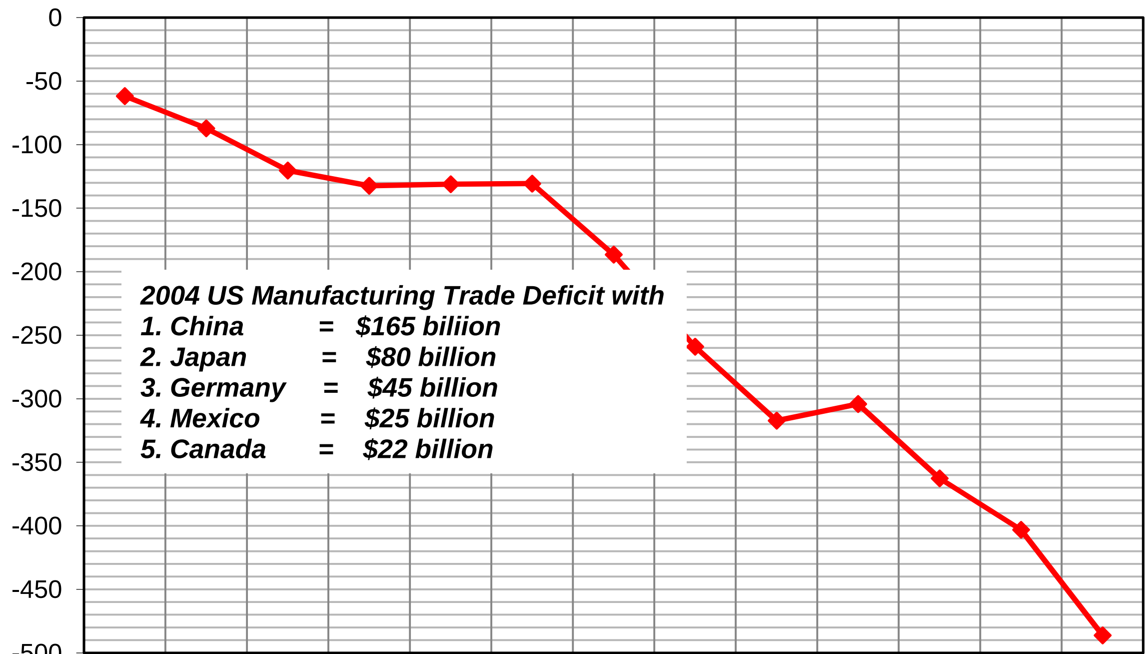


Figure 5: Manufacturing jobs vs. manufacturing productivity growth (Source: Perry, 2008)

Figure 6 exhibits the profile of United States trade with the rest of the world between 1992 and 2004. Table 1 shows details of United States trade with China that led to massive United States deficits and correspondingly to job losses between 2001 and 2007. In each case, evidence suggests that, deficit-trading leads to job losses in the manufacturing sector. Comparing Figure 1 to Figure 6, the reader will observe that, as trade deficits increases employment in the manufacturing sector correspondingly declines.



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
World Total	-61.72	-87.13	-120.3	-132.4	-131.1	-130.6	-186.5	-259	-317.2	-304.1	-362.6	-403.1	-486.2

Figure 6: U.S. Trade with the World between 1992 and 2004
Source: Department of Commerce (as cited in Baily, 2005)

A study conducted by Baily and Lawrence (2005) to estimate the impacts of imports and exports on the manufacturing employment in the United States between 2000 and 2003 found that, manufacturing employment fell by 2.85 million jobs during the period. The study attributed 89% of the loss to weak domestic demand and to strong productivity growth; only 11% of the loss was attributed to trade deficit. Specifically, the study found that: United States loss of competitiveness was the major factor in export weakness; between 50% and 80% of the loss of competitiveness was due to the overvalued dollar; and the rise in the dollar accounted for between 360,000 and 560,000 lost jobs in the manufacturing sector during the period (Baily & Lawrence, 2005).

While the study concluded that trade displaces a lot of manufacturing jobs but accounts for very little job loss, the researchers admitted that the size of United States trade deficits especially with China ($165 billion), Japan ($80 billion), Germany ($45 billion), Mexico (25 billion), and Canada ($22 billion) between 1992 and 2004 was a cause for concern. But Bivens (2004) disagreed. He posited that, "domestic factors (demand and productivity growth) cannot by themselves explain the scale of job loss in manufacturing – rising trade deficits have made a significant contribution to the industry's job loss" (p. 6). Using the same data from the Bureau of Labor Statistics, he found that, of the 3.04 million jobs that were lost in manufacturing between 1998 and 2003, imports of manufactured goods accounted for 1.78 millions or 58.5% of the total while demand and productivity accounted only for 41.5%. Figure 7 shows the impacts of productivity growth, demand, and net imports of manufactured goods on manufacturing employment between 1998 and 2003.

And between 2000 and 2003, Bivens found that "2.7 million jobs were lost in manufacturing, with rising net manufactured imports explaining about 935,000 or 34.2% of this decline" (p. 6). Again Figure 8 illustrates the impacts of productivity growth, demand, and net imports of manufactured goods on manufacturing employment between 2000 and 2003. On average, 382,500 jobs per year have been lost or displaced since China got into WTO (Scott, 2008, p. 5).

Growth in trade deficits with China has affected manufacturing employment trends in all fifty states including the District of Columbia. According to Scott (2008), between 2001 and 2007, "more than 200,000 jobs were lost in each of California and Texas, and more than 100,000 each in New York, Illinois, Ohio, and Florida" (p. 5). The least affected within the same time period were: the District of Columbia (2,400); Hawaii (4,100); Alaska (2,300); Wyoming (2,000); Montana (3,200); and North Dakota (2,700). At the regional level, Pacific Region which comprises Alaska, California, Hawaii, Oregon, and Washington lost a combined total of 413,900 jobs; Great Lakes which comprises Illinois, Indiana, Michigan, Ohio, and Wisconsin lost a total of 352,700 jobs; Mid Atlantic, comprising Delaware, Washington D.C., Maryland, New Jersey, New York, and Pennsylvania, lost a total of 313,500 jobs; Plains States comprising Nebraska, Iowa, Minnesota, Missouri, North Dakota, and South Dakota, lost a total of 162,00 jobs in that time period.

Table 1: U.S. – China trade and job displacement: 2001- 07

U.S. trade with China ($billions, nominal)

				Changes in: (Billions)			Percent change
	2001	2006	2007	2001-06	2006-07	2001-07	2001-07
U.S. domestic exports	$18.0	$51.6	$61.0	$33.7	$9.4	$42.1	240%
U.S. imports	102.1	287.1	323.1	185.0	36.0	221.0	217%
U.S. trade balance	-84.1	-235.4	-262.1	-151.3	-26.6	-178.0	212%
Average annual change in trade deficit				-30.0	-27.0	-30.0	21%

U.S. trade-related jobs supported and displaced (thousands of jobs)

				Change in: (Thousands of jobs)			Percent change	
	2001	2006	2007	2001-06	2006-07	2001-07	2001-07	
U.S. domestic exports	166.7	425.7	4 82.3	259.1	5 6.5	315.6	189%	U.S. import jobs
displaced	1188.2	3376.9	3799.1	2188.6	422.2	2610.9	220%	
U.S. trade balance-net jobs lost	1021.5	2951.1	3316.6	1929.6	365.7	2295.3	225%	
Average annual job displacement				385.9	365.7	382.5	22%	

Source: Economic Policy Institute (as cited in Scott, 2008).

The least affected were the Rocky Mountain Region which consists of Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and New Mexico, lost a total of 135,000 and New England comprising Connecticut, Maine, Massachusetts, and Vermont, lost a combined total of 112,400 jobs within the same time period. The two regions that are the focus of this study, Great Lakes and Plains States, have lost a combined total of 514,700 jobs in the same time period due to trade deficits in manufactured goods (Scott, 2008).

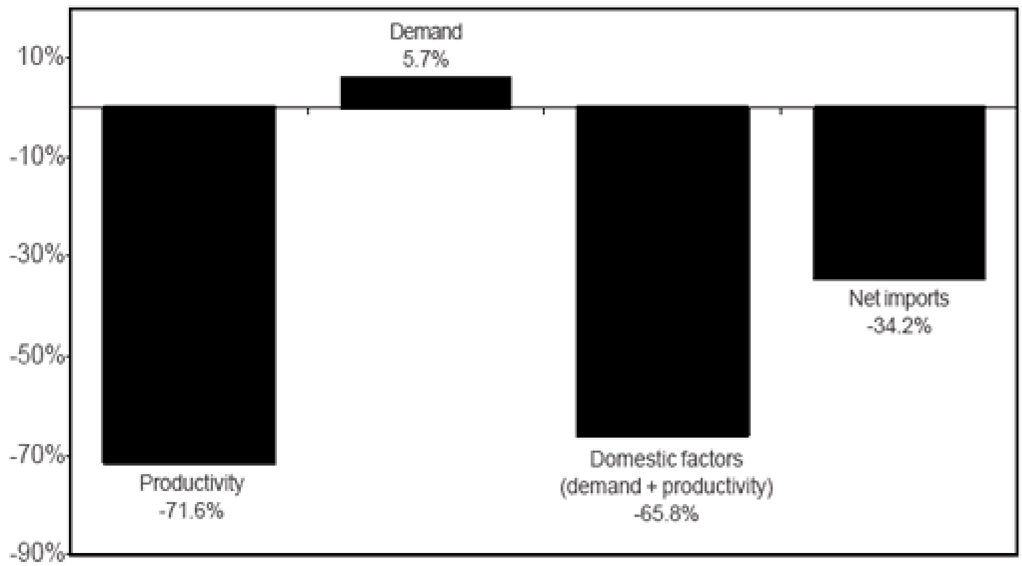


Figure 7: Contributions to manufacturing employment between 1998 and 2003 (Source: Bivens, 2004)

According to Scott (2008), the cumulative effect of demand, productivity growth, international trade, and to some extent, overvalued dollar on manufacturers has created a hydra-headed problem for the United States manufacturing sector. Besides strangulating economy, the competition from China and other low-wage countries has left United States manufacturers basically with three options, namely: become labor-efficient; relocate to low-wage countries; or shut down operations. Any of the three options available leads to the overall reduction in domestic manufacturing employment. While some manufacturers have already relocated or outsourced parts and components of their operations to overseas companies, those that are left behind have decided to become labor-efficient. This means restructuring, not only organizations, but also jobs to increase productivity growth through technological innovations with few but high-skilled workers. The strategy of organizational restructuring and job enrichment and enlargement has led to mass layoff of low-skilled workers and has inadvertently created a high demand for high-skilled workers in the manufacturing sector.

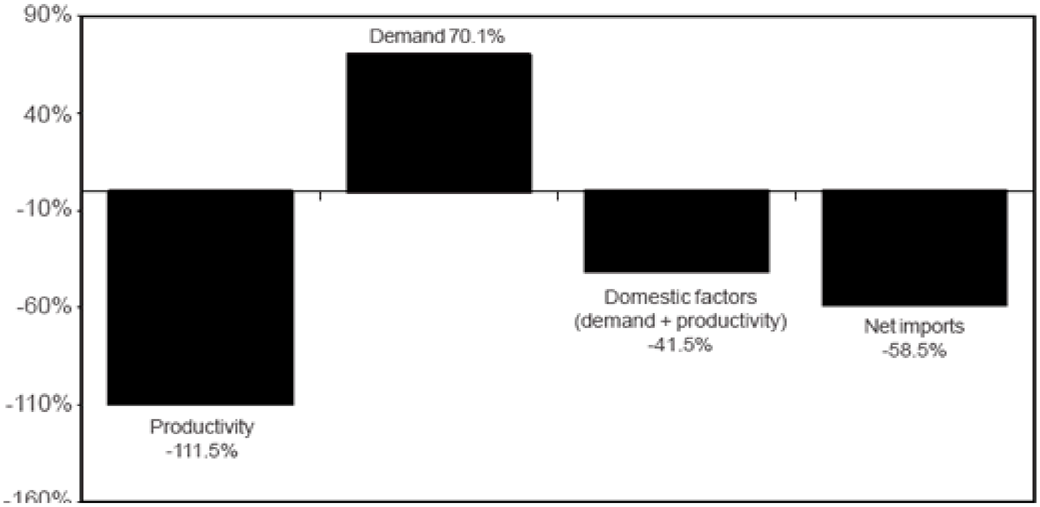


Figure 8: Contributions to manufacturing employment between 2000 and 2003 (Source: Bivens, 2004)

A recent study by the United States Department of Labor (as cited in Fleming, 2006) concluded that, “85% of future jobs in the United States will require advanced training, an associate’s degree, or a four-year college degree; minimum skilled occupations will only account for approximately 15% of all future jobs” (p. 6). According to Fleming, 54% of all manufacturing workers did not have a high school diploma thirty years ago; only eight percent had an associate’s degree or higher. In 2001, the share of manufacturing workers without a high school diploma dropped 21%, while the share of those with post-secondary education rose to 31%. Fleming predicted that, “if the current trend continues, over 40% of factory jobs will require post-secondary education by 2012” (p. 6).

The National Association of Manufacturers (2008) corroborated that, “in 1973, more than half of workers on the factory floor had not finished high school; but by 2001, nearly a third of production workers had some form of post-secondary education (associate/college/graduate degrees), up from just eight percent in 1973, and those without a high school degree dropped by more than half to only a fifth of production workers" (p. 31). National Association of Manufacturers further postulated, "65% of future jobs will require or need a person with an associate degree" (p. 33). The Bureau of Labor Statistics (as cited in GAO, 2008) similarly forecasted, "by 2014, 54% of total job openings will be filled by those with some college education or a bachelor's degree or higher" (p. 1).

In the Skills Gap Report of 2005, The Manufacturing Institute reported that: 53 % of the total respondent companies indicated that at least 10% of their total positions were currently unfilled due to a lack of qualified candidates; 80% were experiencing overall shortages of qualified workers; 90% reported a moderate to severe shortage of qualified production workers; 65% reported a moderate or severe shortage of scientists and engineers; and only 39% of the total respondents reported a moderate to severe shortage of qualified unskilled production workers (The Manufacturing Institute, 2005, p. 4).

The Skills Gap Report continued that, the shortage of skilled manpower was having a moderate to high degree of negative impacts on the ability of 54% of the total respondents to serve their customers; 80% anticipated shortages of skilled production workers over the next three years; and 74% reported that high-performance workforce was critical to their business success. According to Jasinowski (2009), a recent study conducted by the National Association of Manufacturers found that, nearly 36% of the 3,000 companies polled had good jobs going unfilled due to a lack of qualified applicants. Jasinowski posited that "if current trends continue, experts estimate that the U.S. will face a shortage of roughly 13 million qualified employees by 2020" (p. 1).

Meanwhile, young people are not interested in manufacturing occupations. A recent study conducted by the National Association of Manufacturers (2003) to determine why fewer young people were entering careers in the manufacturing sector, found that, American youths were simply disenchanted with modern manufacturing. Specifically, the study found that the image of the manufacturing sector was “heavily loaded with negative connotations and universally tied to an old stereotype of ‘the assembly line’ as well as perceived to be in a state of decline” (p. 9). Student respondents associated employment in the manufacturing sector with “serving a life sentence; being on chain gang; being a slave to the line; or even being a robot” (p. 9). Student respondents also indicated that manufacturing opportunities were in stark conflict with the characteristics they desire in careers; therefore, they were not planning on pursuing careers in the manufacturing industry. Adult respondents to the study similarly indicated “people just have no idea of manufacturing’s contribution to the American economy” (p. 9).

Similarly, a nationwide qualitative research study, also conducted by the National Association of Manufacturers (2003) to understand how the nation’s education and training programs were preparing young people for careers in manufacturing, found that, educational and training systems in the United States were “badly misaligned with the emerging needs of the global economy” (p. 23). Respondents to the study overwhelmingly indicated, “the existing programs are largely not meeting the current needs of manufacturers or young people” (p. 23).

While American youths are openly disenchanted with modern manufacturing, China is graduating high numbers of scientists and engineers. According to the United States Department of Commerce (2004), 58% of all the degrees awarded in China in 2002 were in engineering and physical sciences as compared with 17% in the United States. “China’s 219,600 engineering graduates accounted for 39% of all college graduates, whereas U.S. engineering graduates, a total of only 59,500 engineers, represented a mere 5% of all graduates in United States” (p. 49). Besides the educational advantage, United States Firms (as cited in U.S. Department of

Commerce, 2004) estimated that “by 2010, as much as 90% of their research and development, design, and manufacturing will be conducted in either China or India” (p. 49).

Great Lakes and Plains States

In Great Lakes and Plains States, skills shortages in the manufacturing sector are equally endemic as in other parts of the country and youngsters are similarly not interested in manufacturing occupations. A recent study (Root Causes Report, 2006) jointly conducted by Workforce Development Strategies and Tecumseh Area Partnership on behalf of the Indiana Workforce Development to identify causes of occupation and skills shortages in Economic Growth Region 4 (EGR 4) found that, six causes were responsible for skills shortages in manufacturing occupations in EGR4, namely:

1. Companies are not attracting young people to manufacturing careers;
2. Employer screening and assess capabilities are limited and less effective than desired;
3. Misalignment of secondary and postsecondary education and training with student and employer needs;
4. Low postsecondary participation and graduation rates in manufacturing career areas;
5. Lack of accurate information on manufacturing careers for the emerging workforce;
6. Lack of clear career ladders in the manufacturing sector (Root Causes Report, 2006, p. 10)

Specifically, the Root Causes Report (2006) disclosed that, employers believed parents and schools were not encouraging young people to pursue careers in manufacturing; students were not aware of the programs offered or of the employment opportunities in manufacturing; colleges had difficulty finding properly credentialed faculty in manufacturing programs; about 900 vacancies were unfilled each year in Economic Growth Region 4; and regional two-year colleges were meeting less than 10 percent of the demand. Student respondents to the study rated pay and benefits as the most important factors in their career decisions; 28% rated pay as their top choice among factors contributing to future job satisfaction; less than 10% of the total student respondents were considering careers in manufacturing. On career decision-making, students relay very little on teachers and counselors for career decisions, instead they cited parents as the single greatest influence on their career decision-making.

On quality of information they have available to them, about 75% of school counselors rated the quality of labor market and career information available to them as fair to very poor; 90% were interested in learning about manufacturing careers and education and skill requirements; 60% "would be interested in learning more about manufacturing careers through in-service workshops, publications, marketing materials, and on-site visits to observe manufacturing work in progress' (p. 8). About 33% of the total respondent high school counselors were aware of the critical skills shortages in manufacturing occupations; less than 20% of postsecondary students were aware of skills shortages in manufacturing occupations; 75% of the total school counselor/teacher respondents "did not have enough information to be able to assist their students in making career decisions about careers in manufacturing" (p. 9).

Asked whether they would encourage their own children to pursue manufacturing occupation careers, about 65% of employer respondents would encourage their own children to pursue careers in manufacturing; less than 50% of the total school counselor respondents would encourage their own children to pursue manufacturing careers; only 25% of the total employee respondents would encourage their own children to pursue careers in manufacturing. Root Causes Report also found that, employers were not interested in objective assessment measures such as work-keys, skill tests or work samples in their hiring interviews; rather, they were more interested in assessing applicants' abilities in "problem identification, problem solving, critical thinking, and ability to communicate effectively in writing" (p. 6). Respondent employers overwhelmingly asserted that secondary and postsecondary schools were not teaching the skills required for success in manufacturing.

A recent study conducted by Eighmy and Karl (2008) to determine graduation trends in machinist and machine shop technology programs in two-year colleges in the Great Lakes and Plains States between 2000 and 2006, found that, graduation trends in these programs has declined, and in some cases, states and schools have lost their capacity to offer these programs. In the Plains States (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota) the study found that, for the CIP Code 48.0501 machinist programs, the percent change for all program lengths was -22.9%. The largest decrease was -55% for graduations in 1 < 2 year programs. Associate Degree program graduations increased by 4.9%. Iowa (66%), North Dakota (New program), and South Dakota (37.5%) had increases in graduations. Kansas (-49.5%), Minnesota (-45.4%), Missouri (-17.5%), and Nebraska (-28.7%) had negative graduation trends.

For the CIP Code 48.0503 machine shop assistant programs, the total number of graduates declined by 79.5%. Longer-term programs showed larger percentage of declines (AS, -83.9%; 2 < 4, -90.2%) than shorter-term programs. The previous years' average for all completions was 211.3 compared to the recent years' average of 43.3 graduates. Iowa and Nebraska, and to a large extent Minnesota and Missouri, have discontinued providing programs in machine shop assistant and have focused on machinist training. The number of colleges with these programs similarly declined from 19 colleges in 2000 to four colleges in 2006. This represents a significant reduction in the region's capacity to prepare machine shop assistants.

In the Great Lakes States the study found that, for the CIP Code 48.0501 machinist programs, graduation trend declined 26.6%. The largest decline was for programs of < 1 years (-42.2%) and 1 < 2 years (-30.3%). The number of graduates from Associate Degree programs remained steady throughout the study period. Graduation trend in Illinois, Indiana, and Ohio increased on average, but declined in Wisconsin by 50% and Michigan by 36.7%. The number of colleges providing machinist training in the Great Lakes increased by eight overall but Wisconsin declined from 14 colleges in 2000 to seven colleges in 2006.

For the CIP Code 48.0503 Machine Shop Assistant programs, graduation trend for all program lengths declined by 39%. Specifically, Michigan declined by 66.0%, Illinois declined 60.4%, and Wisconsin declined 9.4%. The average number of colleges reporting graduates has equally declined from 45 colleges in 2000 to 31 colleges in 2006. This represents a negative change of 44.2%. The Great Lakes appears to have lost significant capacity to train machine shop assistants.

A similar study conducted by Eighmy (2009) to determine graduation trends in two-year college manufacturing-related programs in the Great Lakes and Plains States between 1996 and 2005, found that, in the Great Lakes States, graduation trends for short-term programs declined by 7.9% and for long-term programs by 2.4%. In the Plains States, the decline was 3.5% for short-term programs and 5.3% for long-term programs. The manufacturing-related programs series and program codes studied included those exhibited in Appendix E.

Specifically, the study found that, Wisconsin, Illinois, Iowa, Missouri, South Dakota, Ohio and Kansas had declining short-term graduation trends. Kansas had the largest decline 18% and Ohio with 15.6% decline in graduations. Wisconsin, Minnesota, Michigan, Ohio, and Kansas had declining long-term graduation trends (p. 18). While Wisconsin, Michigan, Ohio, and

Kansas declined in both long-term and short-term graduation trends, Indiana, North Dakota and Nebraska registered increases in both long-term and shot-term graduation trends during the study period (Eighmy, 2009).

The Role of Public Education in Preparing Workers for Manufacturing

Community college education in the United States has its roots from three distinct forces, namely: the pressure from communities for education that included occupational training beyond high school; the pressure to extend the concept of free public education to grades 13 and 14; and the pressure from presidents of prestigious universities to concentrate on the last two-years of undergraduate work in which students began to specialize in disciplines, graduate education, and research work (Baack, 2004). These forces culminated to the establishment of the first community college - Joliet Junior College - in 1901 (History of Joliet Junior College, 2004).

Though the primary emphasis and mission of the early community colleges excluded technical and vocational education, several legislations were passed in the intervening years to include vocational education in the mainstream and higher education system. According to Wonacott (2003), these legislations, for the most part, were precipitated by "a complex set of social, economic, and political forces" (p. 8). Swanson (as cited in Wonacott, 2003), posited that, the Smith Hughes Act (PL 64-347) of 1917 "was enacted to prepare youths for jobs resulting from the industrial revolution and to provide them with an alternative to the general curriculum of schools, which were too exclusively literary in spirit, scope, and methods" (p. 8). Similarly, the unfolding of the great depression, World War II, the baby boom generation, immigration explosion, and other events of similar magnitude created the need for expanded government programs such as the G. I. Bill of 1944, the Truman Commission of 1947, amongst others. These programs directly impacted community colleges in terms of proliferation and program development in areas, which hitherto were excluded from community college framework (Chase & Halder, 2004).

Community college proliferation reached its height at one community college per week on average during 1960s and early 1970s, and resulted to an increase of 930 percent in public community college enrollments from 1960 to 1972 as compared to 220 percent for all of higher education in the same time period (Baack, 2004). According to the National Center for Education Statistics (2008), there were 1677 community colleges in the United States in the 2007/8 academic year. Of these, 1032 were public institutions and 645 were private. In the fall of 2007, students' enrollment in public institutions showed that, about 47% of the total enrollment was in community colleges, and the total enrollment at both public and private community colleges was about 6,617,930 students. A recent study of student enrollment in community colleges conducted by Mullin and Phillippe (2009) showed that the number of students enrolled in credit-bearing courses at community colleges in 2009 increased by 11.4% from 2008 and by 16.9% from 2007; full-time enrollment increased by 24.1% in the two-year period.

As community colleges proliferated and expanded their programs, the mission of the community college correspondingly expanded from its original intent to the standard stipulated by the Smith-Hughes' Act of 1917. For example, in 1922, the American Association of Junior Colleges (AAJC) argued that, the junior college was "an institution offering two-years of instruction of strictly collegiate grade" (Baack, 2004, p. 5). But in 1925, the Association modified that definition to include the concept that, "the junior college may, and is likely to, develop a different type of curriculum suited to the larger and ever-changing civic, social, religious, and vocational needs of the entire community in which the college is located" (p. 5).

Following these expansions and modifications was the introduction of terminal vocational degree programs not originally included in the community college framework, namely: the Associate of Applied Science (AAS) degree. These were terminal degree programs. Students in applied or terminal degree programs were not expected to transfer to a four-year college; they were trained for immediate manpower needs (Townsend, 2001). The inclusion of vocational education programs in the community college framework precipitated the expansion of the role of community colleges in economic development far beyond traditional vocational education and job training functions (Hirshberg, 1991). According to Hirshberg, the role of community colleges now includes as:

1. management and technical assistance for new and small businesses;
2. tech-prep programs with high schools;
3. cooperative education programs;
4. partnership with states in economic development activities
5. contract or customized training for industries;
6. business development activities; and
7. identifying the needs of the business community (p. 2).

Workforce Investment Act

Workforce Investment Act (WIA) was signed into law in 1998 (Scott & Sarkees-Wircenski, 2001). It replaced Job Training Partnership Act (JTPA) with three additional programs – Adult, Dislocated Worker, and Youth training programs, for a total of 16 program categories (General Accounting Office [GAO], 2008). The goal was to increase employment, retention, earnings and occupational skills of participants, and to simultaneously improve workforce quality, reduce welfare dependency, and enhance productivity and competitiveness of the nation. The Act established state and local Workforce Investment Boards (WIBs) and mandated them to deliver these programs through a single service System, known as One-Stop System (GAO, 2008). The 16 program categories covered by WIA include:

1. WIA Adult;
2. WIA Dislocated Worker;
3. WIA Youth;
4. Employment services (Wagner-Peyser);
5. Trade adjustment assistance programs;
6. Veterans' employment and training programs;
7. Unemployment Insurance;
8. Job corps;
9. Senior community service employment program;
10. Employment and training for migrant and seasonal farm workers;
11. Employment and training for Native Americans;
12. Adult education and literacy;
13. Vocational rehabilitation programs;
14. Vocational education (Perkins Act);
15. Community services (Block grant); and
16. HUD-administered employment and training (p. 8-9).

A recent study conducted by GAO (2008) to determine how community colleges meet the workforce training needs of their communities, and what they do to integrate with the nation's One-Stop-Systems found that, community colleges develop various approaches and programs for career and technical training to meet the needs of industry sectors, individual employers, and certain types of students and workers (GAO, 2008). These approaches include:

1. tailoring career and technical training courses to meet the workforce development needs of businesses, workers, and students;
2. conducting labor market analysis; advisory committees, and skills panels;
3. working directly with businesses through contract training small business centers;
4. designing career and technical training to help students and workers; and
5. operating and collocating with One-Stop Centers and participating on WIBs (p. 13-22).

The study also found that, 11% of One-Stop Centers were operated solely or jointly by a community college; 34% had community college staff collocated at the center; and 49% of local workforce investment boards had community college presidents represented on their boards. According to GAO, community colleges play an important role in implementing these programs by serving on the state and local Workforce Investment Boards (WIBs) responsible for the WIA system; becoming a One-Stop Center and overseeing its daily operations and services; and by working closely with local One-Stop Centers to provide them with information about the variety of classes available at the college and to help them become batter training providers.

Kasper (2003) corroborated that, partnerships with local communities and businesses "allow community colleges to develop specific programs and career fields to introduce to high school students, offer a support system for the corporation involved in partnership, provide workforce training for the local community, and enable companies to beef-up employee skills through short term training offered at the local community college" (p. 17).

Besides working in partnership with local communities and businesses, community colleges offer both vocational and traditional academic programs to prepare students for immediate occupational employment and for further studies. These programs consist of short-term, longer-term, and associate degree programs. While vocational certificates are granted in short-term and longer-term programs, associate degrees are granted in technical and transfer programs. Short-term certificate programs require less than one year to complete and longer-term certificates take at least one year but less than two-years to complete. According to Kasper, the most popular fields of study for all certificates awarded by community colleges in 1999/2000 academic year were:

1. Health Professions and related Sciences;
2. Business Management and Administrative Services;
3. Mechanics and Repairers;
4. Protective Services;
5. Precision Production Trades;
6. Vocational Home Economics;
7. Personal and Miscellaneous Services;
8. Engineering Technologies;
9. Construction Trades;
10. Transportation and Material Moving Workers;
11. Computer and Information Sciences;
12. Marketing Operations/Marketing and Distribution;
13. Agricultural Business and Production;
14. Liberal/General Studies and Humanities; and
15. Visual and Performing Arts (p. 17)

The highest number of certificates awarded was in Health Professions and related Sciences (54,819) and in Management and Administrative Services (27,214), the least was in Visual and Performing Arts (1,501). According to Kasper, while there was a remarkable increase in the number of certificates awarded in all fields over the decade – 1989/90 to 1999/2000, “there were decreases during the decades in awards of longer term certificates in engineering and technology related programs which fell from 4,995 to 3,996” (p. 19). This represented a 20% decline. In the associate degree programs, the most popular fields of study in the 1999/2000 academic year were:

1. Liberal/General Studies and Humanities;
2. Health Professions and related Sciences;
3. Business Management and Administrative Services;
4. Engineering-related Technologies;
5. Protective Services;
6. Multi/Interdisciplinary Studies;
7. Computer and Information Sciences;
8. Mechanics and Repairs;
9. Vocational Home Economics;
10. Education;
11. Visual and Performing Arts;
12. Precision Production Trades;
13. Social Sciences and History;
14. Law and Legal Studies; and
15. Agricultural Business and Production (p. 18)

Between 1989/90 and 1999/2000 academic years, “the number of associate degrees awarded by community colleges increased by 21%, rising from 340,091 to 411,633” (p. 19). About 41% of the degrees granted were in transfer programs in Liberal, general education studies, and humanities, while the rest were in terminal programs. According to the National Center for Education Statistics (2010), about 41% of all associate degrees awarded in 2007 were in liberal, general education studies, and humanities. This represented an increase of 39% between 1997 and 2007. In the same time period, the number of associate degrees awarded in engineering and technology programs declined by 23% while the number of associate degrees awarded in mathematics and science programs increased by 19%. Overall, the number of associate degrees awarded over the decade increased by 11%, and the number of associate degrees awarded in computer and information technology in the same time period increased by 98% (National Center for Education Statistics, 2010).

Enrollment of Students in Community Colleges

Grandillo (2003) posited that modern recruitment practices originated from the Servicemen’s Readjustment Act of 1944 and the baby boom, which culminated to the mass expansion of higher education system. Due to the high number of applicants seeking college admission at the time, colleges and universities dramatically increased enrollments and simultaneously expanded capacity to accommodate baby boomers and soldiers returning from the war. But as the abundance of college enrollees reversed in the 1980s, colleges and universities were left with increased capacity and a declining pool of prospective students (Grandillo, 2003). According to Grandillo, the prospects of declining enrollments prompted colleges and universities to adopt business-marketing practices that emphasize product, price, place, and promotion. Since then, college recruitment strategies have become heavily “reliant on market principles for success and matured into providing more information and increased attention to the prospective student" (p. 1).

Seidman (1995) defined recruitment as a "process undertaken to favorably influence a prospective student's decision to attend a college" (p. 3). Seidman identified two sets of primary variables that influence student's decision to enroll at a college, namely: student centered variables and college characteristics. Student centered variables include: "ability and interest; socioeconomic background; the influence of significant others; aspirations and goals; and expectations of the college" (p. 3). On the other hand, college characteristics include: "academic programs; cost; location; and reputation or quality" (p. 3). The student decision to enroll or not to enroll at a particular college is based on his or her "analysis of these variables and the perceived congruence between the student needs and priorities and college characteristics" (p. 3). Therefore, in designing student recruitment strategies, the student-centered variables become "the prospect search criteria" (p. 3). Grandillo (2003) corroborated that college recruitment practices in the early 21st century sought to individualize the process by: segmenting the market, targeting prospective students, and utilizing data that explain how prospective students make college choice decisions (Grandillo, 2003).

Black (2009) summited that the best way of identifying market segments was to analyze the "patterns of applications and enrollments of current students" (p. 8). According to Black, there are four segmentation categories, namely: geographic; demographic; psychographic; and behavioral segments. Geographic segmentation refers to the students' geographical location: in-state; out-of-state; and international. These may further be segmented into smaller geo-market segments. The geo-market approach provides enrollment professionals the opportunity to "hone messages, target recruitment outreach, purchase lists more effectively, and advertise strategically" (p. 9).

Demographic segmentation enables enrollment professionals to identify prospective students by gender, age, socioeconomic status, race and ethnicity, occupation, education levels, and religion. The purpose of the demographic segmentation is to identify motivators and barriers that vary according to demographic characteristics. Black (2009) asserted, “addressing these differences in marketing efforts will increase the probability of influencing choice” (p. 9).

Psychographic segmentation refers to the student’s personal characteristics such as: social class; lifestyle; and personality. The psychographic profile of a prospective student is established through surveying, application questions, tele-counseling, web-polling, and admission interviews. Information from the established psychographic profile are integrated into customized communication streams and outreach activities (Black, 2009).

Behavioral segmentation refers to learner objectives. The goal of the behavioral segmentation is to determine exactly what the prospective student intends to do with his or her education. The segment is further segmented into smaller segments, namely:

1. Career-oriented segment – Learners who are attending an educational institution in order to prepare for future careers;
2. Curiosity-driven segment – Students whose quest for knowledge represents their ultimate goal;
3. Socio-economic advantage segment – Learners seeking the status of obtaining a university or college degree;
4. Steeper segment – Leaners who want to build on their first degree, certificate, or diploma with additional educational credentials;
5. Undecided segment – Individuals who do not know specifically why they are attending a college or university;

6. Dual purpose segment – Learners interested in pursuing their primary objective (e.g. athletics, performing arts, delayed entry into workforce) while obtaining a college or university degree (p. 11).

Other market segments include: professional development segment; dual enrollment segment; program segment; and influencer segment. Influencer segment focuses on variables that influence students into enrollment. For traditional age students, influencers may include parents, peers, family members, guidance and counselors, teachers, coaches, and employers. For adult learners, influencers may include spouse, other family members, friends, and business associates (Black, 2009). Personal characteristics that are likely to influence student enrollment decisions include: age; race; gender; socioeconomic status; parental educational attainment; residency (urban or suburban); type of high school attended (public, private, boarding school, or home school); work experience; social network; leisure interest; and other lifestyle factors (Black, 2008).

In a study conducted to determine the relationship between parental income and students' college choices, Delaney (n.d.) found that, while students from higher income families were concerned about the surroundings (neighborhood, town or city) in which the institution was located and the lifestyle they would enjoy during their college experience, students from the lower income families were more concerned about the cost of attendance and opportunities for internships. Baird (1967) conducted a comparative socioeconomic analysis of 18,378 prospective college students and similarly found that social class was a primary determinant of college choice and vocational orientation. Student from higher income families were found to be more concerned with developing their intellectual capabilities while those from lower income families were more concerned with vocational and professional training. This may explain why market segmentation helps enrollment professionals in structuring segment-specific communication strategies.

Grandillo (2003) asserted that, the most effective recruiting practices and strategies employed by enrollment professionals were: "visit to high schools in primary markets by a member of the admissions office; interaction on the internet; hosting campus visit with prospective students; and offering merit-based scholarships" (p. 2), and less effective recruitment strategies were: "visit to a secondary or test markets; college fairs and nights; using alumni to recruit; hosting off campus meetings or social events for high school counselors; multimedia presentations; billboards, print, or broadcast advertising; and school promotional videos (p. 2).

Analytical recruitment techniques and market tools that have gained popularity among enrollment professionals include but limited to: direct mail; telemarketing; mail lists that contain information compiled by testing agencies; use of commercial vendors for prospect identification; alumni office; the internet; and the distribution of CD-ROMS to targeted prospective students (Grandillo, 2003). The Internet affords "a prospective student unlimited and uncontrolled access to formal information about any institution and the opportunity to apply online" (p. 2). For adults, transfer students, international students, and nontraditional learners, Grandillo asserted that: academic reputation; costs of attendance; personal relationships; simplified application forms; and simplified brochures were the most influential factors in choosing to apply and enroll. On the whole, researchers have identified four main categorical factors that affect students' enrollment decisions, namely: awareness factors; influence factors; recruitment factors; and socioeconomic factors.

Awareness Factors

In a study conducted to assess the initial awareness knowledge and sources of influence leading to enrollment decisions for students entering four-year automotive programs, Sandford et al (2006) listed items exhibited in Appendix G as sources of student awareness of four-year automotive programs. They found that, while reputation of the program and reputation of the university were rated by respondents as major sources of awareness knowledge of four-year automotive programs, athletic advisor, athletic coach, and program articulation arrangements through community colleges were not good sources of student awareness of four-year automotive programs.

Influence Factors

All of the items identified by Sandford et al. (2006) as awareness factors also doubled as "sources of influence leading to enrollment decisions for students entering four-year automotive programs" (p. 6). In a study conducted to determine the individuals and events and/or experiences influencing students' enrollment in an urban agricultural education program, Esters and Bowen (2004) included in the survey instrument (Appendix G) a list of individuals and events and/or experiences that influence student enrollment. Overall, they found that: mother or female guardian had a high influence; father or male guardian had low influence; and a friend had a very low influence on respondents' decisions to enroll in an urban agricultural program. Events and/or experiences that most influence respondents to enroll in an urban agricultural program were: recruitment activity (school tours, brochures, summer programs) and respondents' interest in animals.

In a similar study conducted to identify factors that influence students to enroll in technology education programs, Gray and Daugherty (2004) included in the survey instrument

(Appendix G) a list of individuals who influence career choice in technology education programs. They found that, while high school technology education teachers had the highest influence on respondents' decision to enroll in technology education programs, friends of the family, high school athletic coach, and high school counselor had least influence on respondents' decisions to enroll in technology education programs.

Recruitment Factors

The Gray and Daugherty (2004) study also found that, while faculty respondents rated face-to-face interaction as the most effective recruitment technique, departmental open houses was rated as being the least effective recruitment technique. The survey instrument (Appendix G) developed by Belcher, Frisbee, and Sandford (2003) in a study to identify differences between faculty and students' perceptions of recruitment techniques that influence students to attend four-year automotive programs was similar to the one developed by Gray and Daugherty (2004). Belcher et al. found that, while faculty respondents believed that most of the recruitment techniques were important in influencing students' decisions to attend a four-year automotive programs, student respondents felt that only a few of the recruitment techniques were important.

Socioeconomic Factors

The United States Department of Education (as cited in Donaldson, Lichtenstein, & Sheppard, 2007) defines socio-economic status as "a measure of an individual or family's relative economic and social ranking" (p. 3). Donaldson, Lichtenstein, and Sheppard identified two components of socio-economic status that affect college enrollment: parent education and parent income level. Besides socio-economic status, there are other socio-economic factors that may affect college enrollment decisions, namely: impact of economy on the society; cost of attendance; geographical location; gender; ethnicity; scholarship/financial aid offers; economic impact on re-enrollment; and number of children currently enrolled in college per family (Longmire and Company, 2009).

In a lecture presented to The Jefferson Foundation Distinguished Lecture Series, Bowen (2004) asserted that, "individual's chances of entering college remain closely correlated with family background; only 54% of high school graduates from the lowest income quartile enroll in college, compared to 82% of those with incomes above $86,000, the top quartile" (p. 6). In a study to determine economic conditions and participation in Minnesota post-secondary education among new high school graduates from 1990-1996, the Minnesota Higher Education Services Office (2000) found that "as family incomes improve, students are more likely to attend more expensive institutions; conversely, enrollments in less expensive and more affordable institutions are likely to increase when family incomes fall (p. 20), and that "the percentage of persons of color within a county is related negatively to participation in post-secondary education " (p. 2).

Summary of Literature Review

United States manufacturing industry makes all sorts of products from socks to supersonic jets, and the nature of jobs performed in the industry equally varies from janitorial to engineering. The United States Department of Labor (as cited in Helper, 2008) estimated that, out of the 146 million employees in the United States, about 14.3 million are employed in the manufacturing facilities. Manufacturing also supported about 23 million jobs in 2002, and 20 million in 2006. Though manufacturing peaked in 1979 when it supported a total of 19.34 million jobs in the core manufacturing establishments, it has been on the decline since 2000. In 2008, the sector supported only 13.4 million jobs; currently, its monthly average in the first half of 2009 is about 12 million. According to the United States Department of Commerce (2008), United States manufacturing employment has fallen 0.4% annually over the past 35 years.

As manufacturing employment declined, average weekly hours of production workers equally declined from 42 hours per week in 1997 to 39.5 hours per week in 2009 (Bureau of Labor Statistics, 2009). Since manufacturing employees earn higher wages and enjoy more benefits than employees in other sectors of the economy, the loss of manufacturing jobs has correspondingly resulted to loss of well-paid jobs. The decline in the manufacturing employment in the United States has largely been attributed to four major factors: the shift in consumer demand for manufacturing goods to services; technological innovations and productivity growth; deficit trading; and the overvalued dollar. The cumulative effect of these factors on the United States manufacturing sector has essentially left manufacturers with three options: become labor-efficient; relocate to low-wage countries; or shut down operations. Any of these options leads to overall reduction in domestic manufacturing employment and to the demand for high skilled workers.

According to the United States Department of Labor (as cited in Fleming, 2006), 85% of future jobs in the United States will require advanced training, an associate's degree, or a four-year college degree; minimum skilled occupations will account for only 15% of future workforce. NAM (2008) and the Bureau of Labor Statistics (2009) corroborated this prediction. Already the Manufacturing Institute has reported widespread shortages of high-skilled workers in its Skill-Gap Survey Report of 2005. A similar study conducted by NAM (2009), found that 36% of the 3000 companies studied had job vacancies unfilled due to a lack of qualified applicants (Jasinowski, 2009).

Meanwhile, young people are not interested in occupational careers in manufacturing industry. They regard manufacturing as a dark, dreary, and dead-end field, offering low pay, and little or no benefits; a field in decline with jobs moving overseas. A study conducted by NAM

(2003) concluded that, schools were not offering career guidance that would lead young people to careers in manufacturing; they were not being given information about courses that would prepare them for careers as engineers or designers. The study also concluded that, educational and training systems in the United States were strategically misaligned with the emerging needs of the global economy, manufacturers, and young people.

In the Great Lakes and Plains States, the situation is the same. Skills shortages persist and youngsters are similarly not interested in manufacturing occupations. In a study to determine graduation trends in manufacturing-related programs in two-year colleges between 2000 and 2006, Eighmy and Karl (2008) found that, in the Plains States, graduation trend for all programs studied was -22.9%, and in the Great Lakes States, the trend was -79%. A similar study conducted by Eighmy (2009) to determine graduation trends in two-year college manufacturing-related programs in the Great Lakes and Plains States between 1996 and 2005, found that, in the Great Lakes states, graduation trend for short-term programs declined by 7.9% and for long-term programs it declined by 2.4%. In the Plains States, the decline was 3.5% for short-term programs, and 5.3% for long-term programs.

While the mission of the early community colleges excluded technical and vocational education, the unfolding of the great depression, World War II, the baby boom generation, immigration explosion, and other events of similar magnitude led to legislations that mandated inclusion of vocational education programs in the community college curriculum. The role of community colleges now includes development of vocational and technical training programs to meet the needs of industry sectors, employers, students, and workers. Specifically, this role includes: integrating with the One-Stop-Systems; providing management and technical assistance to industry sectors; tech-prep programs with high schools; cooperative education programs; partnership with states in economic development activities; contract or customized training for industries; business development activities; and environmental scanning for business communities.

For successful student enrollment, enrollment managers need to employ a combination of two important strategies: market segmentation; and environmental scanning strategies. While environmental scanning helps enrollment professionals to identify college characteristics, market segmentation helps in identifying student-centered variables. The four main categorical factors identified as most affecting students' enrollment decisions are: awareness factors; influence factors; recruitment factors; and socioeconomic factors.

CHAPTER III. METHODS AND PROCEDURES

Chapter Three is organized into five main sections: population, sample, size and sampling procedures; data collection; research design; and methods of data analysis. As already explained in the previous chapters, the purpose of this study was to describe the current status of manufacturing occupational clusters in two-year colleges in Great Lakes and Plains States, and to investigate the associations between factors that affect student enrollment decisions in these programs. The purpose was accomplished by the following research questions and hypotheses:

1. Awareness factors have a direct effect on student enrollment decisions in manufacturing programs in two-year colleges;
2. Student enrollment in manufacturing programs in two-year colleges is directly affected by influence factors and indirectly affected by awareness factors;
3. Student enrollment in manufacturing programs in two-year colleges is directly affected by recruitment factors and indirectly affected by awareness and influence factors;
4. Student enrollment in manufacturing programs in two-year colleges is directly affected by socioeconomic factors and indirectly affected by recruitment and awareness factors;
5. Manufacturing occupational programs in two-year colleges in Great Lakes and Plains States are not in decline;
6. What is the linear combination of independent variables that accounts for the most variation in enrollment size?

Population, Sample Size, and Sampling Procedures

The target populations for the study were full time instructors, academic advisors, and program directors of manufacturing occupational clusters in community and technical colleges in the Great Lakes and Plains States. The list of these populations was compiled from the websites and catalogs of 155 community and technical colleges. There were approximately 1,455 full time faculty and academic advisors on this list. The entire population was used as a sample for the study. The manufacturing faculty and academic advisors in manufacturing programs in two-year colleges were targeted for the study because of their cumulative experiences in dealing with students on many levels including but not limited to instruction delivery, academic advising, and student recruitment among others. Therefore, it was assumed that the information they had regarding students' enrollment decisions in their programs was reliable and relevant to this study.

Data Collection

Instrumentation

The survey instrument was designed to gather information from the perspectives of two-year college manufacturing-related program directors, instructors, and academic advisors about how their schools make prospective students aware of manufacturing occupational programs; recruitment techniques they use to attract students into enrollment decisions; and what role socioeconomic status of prospective students play in making enrollment decisions. They were also asked to respond to questions regarding the pattern of enrollment in manufacturing occupational programs in their schools; graduation trends; and their plans for the future. The purpose was to gather information that could be used to determine the association between enrollment decision factors in manufacturing related-programs in two-year colleges.

The survey instrument consisted of six sections: awareness factors; influence factors; recruitment factors; socioeconomic factors; enrollment status; and the demographic section. The list of awareness factors was adapted from Sandford et al. (2006). The list of factors that influence students into enrollment was generated from the review of literature and published instruments (Gray & Daugherty, 2004; Esters & Bowen, 2005).

The list of recruitment factors was developed from previous studies on students' recruitment techniques and published instruments (Gray & Daugherty, 2004; Belcher et al. 2003; Grandillo, 2003). The list of socioeconomic factors was similarly generated from previous studies and published instruments (Donaldson, Lichtenstein, & Sheppard, 2007; Longmire & Company, 2009; Bowen, 2004; Grandillo, 2003; Baird, 1967). The adapted list was modified to address the hypotheses of the study, and then combined with the lists generated from literature review to form the survey instrument for this study. The survey instrument was then converted to online format at the NDSU Group Decision Center (GDC) as exhibited in Appendix B.

The GDC is a technology laboratory that provides group facilitation services for development of students' skills, and faculty and administrative planning, evaluation, and research activities (NDSU Group Decision Center, 2010). The laboratory consists of 22 workstations, which enable students and faculty members to engage in electronic group discussions; obtain training on the use of Group Systems Software; and engage in electronic web-based data collection activities. The information collected can be statistically summarized and presented in the form of charts and graphs. And most importantly, the GDC has the capability to export the data collected to other statistical software packages for further analysis.

The survey instrument consisted of nine items and each item was included in the survey for a specific reason. Item 1 consisted of factors that make students aware of manufacturing occupational programs in two-year colleges, and sought to identify respondents' level of agreement with each factor. This information could aid in developing strategies to introduce manufacturing occupational programs to high school students and their parents.

Item 2 consisted of a list of factors that influence students to enroll in manufacturing-related programs in two-year colleges, and sought information about respondents' level of agreement with each factor. Responses to this item could provide information that may be used in designing strategies to attract students into enrollment in manufacturing programs. Item 3 presented a list of recruitment factors and sought to identify respondents' level of agreement with each factor. Responses to this item could aid recruitment personnel in prioritizing recruitment strategies.

Item 4 presented a list of socio-economic factors and sought information about respondents' level of agreement with each factor. Responses to this item could aid enrollment personnel in designing specific enrollment strategies for individual socio-economic subgroups in the society. Levels of agreement in items 1 through item 4 were given as*: SD = Strongly Disagree; D = Disagree; U = Undecided; A = Agree; and SA = Strongly Agree*. The study was designed to use the responses from these items to determine the association between factors that affect student enrollment decisions in manufacturing occupational clusters in two-year colleges. The method for determining this relationship was path analysis, and the method of predicting enrollment size was discriminant analysis. Information obtained from these analyses could be used to design student enrollment strategies and to predict enrollment size in manufacturing programs in two-year colleges.

Items 5, 6, 7, and 8 were designed to address the fifth hypothesis. Responses to these items were intended to provide information that could be used to gauge the status of manufacturing related programs in two-year colleges and the ability of the two-year college system to remain the dominant supplier of workforce to the manufacturing industry. Item 9 was the demographic section of the survey instrument. It sought information about respondents' job title. The purpose was to ensure that respondents were actually faculty members and academic advisors in manufacturing-related programs in two-year colleges. Details of the survey questions and the research hypotheses they were intended to address and the hypothetical variables or constructs that were measured are exhibited in Table 2.

Table 2: Matrix of research hypotheses by construct measured and survey items

Research Hypotheses	Construct Measured	Survey Items
Awareness factors have a direct effect on student enrollment decisions in manufacturing programs in two-year colleges	Awareness Factors	1
Student enrollment in manufacturing programs in two-year colleges is directly affected by influence factors and indirectly affected by awareness factors	Influence Factors	1, 2
Student enrollment in manufacturing programs in two-year colleges is directly affected by recruitment factors and indirectly affected by awareness and influence factors;	Recruitment Factors	1, 2, 3
Student enrollment in manufacturing programs In two-year colleges is directly affected by Socioeconomic factors and indirectly affected by recruitment and awareness factors;	Socioeconomic Factors	1, 3, 4
Manufacturing occupational programs in two-year colleges in Great Lakes and Plains States are not in the state of decline	Program Stability	5, 6, 7, 8

Instrument Validity

Validity is a major concept in research that has many specific meanings, but in a general sense, is concerned mostly with the methodological and conceptual soundness of research (Graziano & Raulin, 1997). Gay, Mills, and Airasian (2007) defined validity as “the degree to which a test measures what it is supposed to measure and, consequently, permits appropriate interpretation of scores" (p. 134). Leedy (1989) corroborated that "the principal question that validity asks is: Are we really measuring what we think we are measuring?" (p. 27). Therefore, validity is not only concerned with the appropriateness of an instrument to the study domain, it is holistically concerned with how well, how comprehensively, and how accurately an instrument measures what it is designed to measure. Though Graziano and Raulin (1997), noted that there were many types of validity associated with research activities, only four types were considered critical to this study, namely: content validity; construct validity; external validity; and statistical validity.

Content Validity

According to Leedy (1989) content validity is "the accuracy with which an instrument measures the factors or situations under study" (p. 27). It is "the extent to which the questions on the instrument and scores from these questions are representative of all possible questions that a researcher could ask about the content or skills" (Creswell, 2005, p. 164). Though there is no statistical formula to compute content validity, and there is no way to quantitatively express it (Gay, Mills, & Airasian, 2006), Creswell (2005) recommended that, researchers "ask experts if the questions on the instrument are representative of the area of interest" (p. 165). The survey instrument for this study was generated from previous studies and published instruments, and its content validity was reviewed by the study committee and found to adequately represent all of the possibilities of questions available.

Construct Validity

Construct validity is "the degree to which a test measures an intended hypothetical construct" (Gay et al., 2006, p. 137). Graziano and Raulin (1997) corroborated that construct validity "refers to how well the study's results support the theory or constructs behind the research and asks whether the theory supported by the findings provides the best available theoretical explanation of the result" (p. 190). This can be determined statistically or non-statistically. Creswell (2005) recommended that researchers "use statistical procedures such as correlating scores with other scores; examine the correlation among questions on an instrument; or test a theory against scores" (p. 165). This study used statistical procedures to establish construct validity of its instrument. Five constructs were measured in this study, namely: awareness factors; influence factors; recruitment factors; socio-economic factors; and stability. About 15 to 18 items measured each construct. Item analysis was then used to determine question items that were correlated and no items were removed, suggesting that, all items on the instrument were sufficiently significant, meaningful, useful, and had a purpose.

External Validity

External validity is "the degree to which study results are generalizable or applicable to groups and environments outside the experimental setting" (Gay et al., 2006, p. 237). Graziano and Raulin (1997) similarly defined external validity as "the degree to which we are able to generalize the results of a study to other subjects, conditions, times, and places" (p. 191). And Leedy (1989) equally referred to external validity as the "type of validity that is concerned with the generalizability of the conclusions reached through observation of a sample to the universe; or, more simply stated, can conclusions drawn from a sample be generalized to other cases?" (p. 27). According to Gay et al., (2006), if threats to external validity are not properly controlled, the findings of a study may give rise to rival interpretations, therefore, not generalizable. Addressing the same topic, Graziano and Raulin (1997) proffered that "problems of generalization from a sample to a population are often best controlled by random selection of subjects from the population" (p. 191).

The target populations for this study were full time instructors, academic advisors, and program directors of manufacturing occupational clusters in two-year colleges in the Great Lakes and Plains States. A total of 1,455 instructors, program directors, and academic advisors were identified as full time faculty members in the manufacturing-related programs in 155 colleges. The entire population of 1,455 full time faculty was used as a sample for the study.

Statistical Validity

Statistical validity is "the accuracy of the conclusion drawn from a statistical test" (Graziano & Raulin, 1997, p. 189). There are several threats to statistical validity in every study that employs statistical methods for data processing but only one threat was considered most critical to this study, namely: the researcher's violations of the assumptions that underlie statistical tests. According to Graziano and Raulin, "using statistical procedure where one or more of these assumptions are not true can threaten the study's statistical validity" (p. 189). In this study, all applicable statistical rules and assumptions were observed during data processing including path multiplication and effect decomposition rules of path analysis methodology.

Instrument Reliability

Reliability is the "index of the consistency of a measuring instrument in repeatedly providing the same score for a given subject" (Graziano & Raulin, 1997, p. 440). Gay et al. (2006) defined it as "the degree to which a test consistently measures what it measures" (p. 601). Creswell (2005) identified five types of instrument reliability, namely: test-retest reliability; alternate forms reliability; inter-rater reliability; and internal consistency reliability. Only internal consistency reliability was considered most critical to this study. Gay et al. (2006) defined internal consistency reliability as "the extent to which items in a single test are consistent among themselves and with the test as a whole" (p. 141). Sowell and Casey (1982) advised that, whether the instruments were designed by the researcher or gotten from other sources "both the validity and the reliability and consistency of the results from the instruments must be checked prior to using the instruments in a project" (p. 57). Leedy (1989) similarly advised that "all questionnaires should be pre-tested on a small population item-by item, and should be quality-tested again and again for precision of expression, objectivity, relevance, suitability to the problem situation, and probability of favorable reception and return" (p. 143). This study used a pilot study and internal consistency reliability test to assess reliability of scales of the instrument prior to using the instrument in the main study.

Pilot Study: Sowell and Casey (1982) defined pilot study as "a small scale study using a few subjects who are similar to those you plan to use in your project" (p. 216). According to Creswell (2005), it is a "procedure in which a researcher makes changes in an instrument based on a feedback from a small number of individuals who complete and evaluate the instrument" (367). The data for the pilot study of the instrument for this research was collected between April 12, 2010 and April 22, 2010 from faculty members of manufacturing-related programs in randomly selected two-year colleges in Minnesota and North Dakota states. A total of 30 instructors, academic advisors, and program directors of manufacturing-related programs in these colleges were selected to participate in the pilot study.

After the research committee approved the survey instrument, the Institutional Review Board (IRB) Protocol Form (Application to conduct research involving human participants) was completed and a cover letter was written in compliance with the IRB's current guidelines for the protection of human subjects in research. The protocol form, the cover letter, the survey instrument, and chapter one of the study were submitted to the IRB office on March 23, 2010 for approval to conduct the research. The IRB approval was granted on March 30, 2010. The IRB letter of approval to conduct the research is exhibited in Appendix A, and the cover letter is exhibited in Appendix C.

The survey instrument for the pilot study (Appendix B) and the cover letter were initially distributed online to the 30 faculty members of manufacturing-related programs in selected two-year colleges in Minnesota and North Dakota states on April 12, 2010. The link to the online survey was provided in the email (Appendix C) that invited respondents to participate in the pilot study project. The survey was scheduled to run from April 12, 2010 to April 17, 2010. Though the researcher distributed the cover letter and the survey instrument, completed instruments were returned to the North Dakota State University Office of Group Decision Center and a link was provided to the researcher to monitor the survey return.

After a few minutes of emailing these documents to potential participants and directing them to the link, two emails came back as undeliverable; this reduced the number of potential respondents from 30 to 28. Three respondents completed and returned their survey instruments after the first two days of receiving the document. The first letter of reminder (Appendix C) was sent out on April 15, 2010. No responses were received, so the survey could no longer be closed on April 17, 2010 as was originally planned; instead a second letter of reminder (Appendix C) was emailed to potential respondents on April 17, 2010 notifying them that, the survey could not close due to poor response and their participation was critical to the success to study. Four more respondents completed and returned the survey instrument after the second letter of reminder.

The third letter of reminder (Appendix C) was sent to respondents on April 20, 2010, urging them to respond to the survey. Four more responses were received after this reminder.

The final letter of reminder (Appendix C) was emailed to respondents on April 22, 2010, begging them to respond to the survey. Three more respondents completed and returned their survey instrument after this reminder. This brought to 14 the total number of respondents who completed and returned the survey instrument. Of the 14 responses, only 10 were usable. Therefore, based on the number of usable responses and the actual number of respondents who received the survey instrument, the rate of return for the pilot study survey was 35.7% of the potential respondents as shown in Table 3.

The pilot study was conducted without incidents. Besides complaining that there were too many letters of reminder, respondents did not complain about the survey instrument and did not proffer any suggestions on how it should be improved. The data collected were processed by North Dakota State University Information Technology Services (*ITS*) to determine the reliability coefficient of the survey instrument. The application software used for this procedure was *PASW*, and the reliability statistics applied to measure the reliability coefficient or average correlation of items in the survey instrument was Cronbach’s alpha. Santos (1999) posited that, “Cronbach’s alpha is an index of reliability associated with the variation accounted for by the true score of the underlying construct” (p. 2).

Four reliability tests were conducted; one for each relevant construct measured. The reliability coefficients of internal consistency for each construct measured are shown in Table 4. Overall, these coefficients ranged from 0.74 to 0.87 for raw variable and from 0.74 to 0.87 for standardized variables. Nunnaly (1978) similarly asserted that, a reliability coefficient of 0.70 was acceptable for research purposes.

Besides reliability test, factor analysis was conducted using raw variable alpha values to weed out variables (factors) that had low item-total correlation values. According to Santos

(1999), variables that have lower item-total correlation values “are not measuring the same construct as the rest of the items in the scale are measuring” (p. 3). This analysis did not yield any items to be weeded out; therefore, no items were neither deleted nor added to the survey instrument after factor analysis.

Table 3: Sample selection process for the pilot study

Sample information	*N*
Potential faculty respondents for the pilot study	30
Those with undeliverable email addresses	(-2)
Those who received the survey instrument	28
Total responses logged	14
Non-usable responses	(-4)
Usable responses	10
Rate of return for the pilot study survey was 10/28 = 35.7%	

Procedure for Data Collection

After the pilot study was completed, the survey instrument (Appendix B) and the cover letter (Appendix C) were initially distributed online to 1,455 academic advisors, program directors, and instructors of manufacturing-related programs in 155 two-year colleges in the Great Lakes and Plains States on May 2, 2010. The link to the online survey was provided in the email (Appendix D) that invited respondents to participate in the study to identify factors that affect student enrollment decisions in manufacturing-related programs in two-year colleges. The survey instrument was originally scheduled to run from May 3, 2010 to May 14, 2010. While researcher distributed the cover letter and the survey instrument, the completed instruments were returned to the GDC office. The link to monitor the survey return was provided to the researcher.

Table 4: Reliability coefficient of internal consistency of the survey instrument for the pilot study

		Variables	
Constructs Measured	Number of Factors	Raw Alpha	Standardized Alpha
Awareness factors	16	0.74	0.74
Influence factors	14	0.85	0.85
Recruitment factors	17	0.87	0.87
Socio-economic factors	15	0.76	0.78

After emailing the instrument to the potential respondents and directing them to the link, 126 emails came back as undeliverable; five respondents responded that they were not part of manufacturing occupational programs in their colleges; seven declined to respond for personal reasons; and 17 emails were reportedly blocked by the software security system as spam. This reduced the number of potential respondents from 1,455 to 1,300. About 139 respondents completed and returned their instruments on May 7, 2010. On the same date, the first letter of reminder (Appendix D) was emailed to respondents soliciting them to respond to the survey instrument if they had not yet done so. The second letter of reminder (Appendix D) was emailed to respondents on May 12, 2010 soliciting them to respond to the survey instrument and reminding them that the survey was scheduled to close on May 14, 2010.

Table 5: Net yield of participants in the online survey

Sample Information	N
Potential respondents obtained from college websites and catalogs	1455
Reportedly not part of manufacturing occupational programs	(-5)
Undeliverable email addresses	(-126)
Declined to respond for personal reasons	(-7)
Blocked emails	(-17)
Total responses logged	355
Properly completed responses	288
Actual sample size	1300
Rate of return for the survey (288/1300)	22.15%

On May 14, 2010, a total of 253 respondents completed and returned their survey instruments. This information was communicated to the research advisor (Appendix D) to make a determination as to whether the survey should close or keep running. The research advisor recommended that the survey should close on May 21, 2010. The third letter of reminder (Appendix D) was emailed to respondents notifying them that the survey was not going to close on May 14, 2010 as was originally scheduled, so they were welcome to respond if they haven't yet responded. By May 21, 2010, a total of 355 respondents completed and returned their instruments. Then the survey was closed. Of the 355 responses that were stored, only 289 were completed and usable. Therefore, based on the number of usable responses and the actual number of respondents who received the survey instrument, the rate of return for the survey was 21% of the potential respondents. Details of sample selection process are exhibited in Table 5.

Research Design

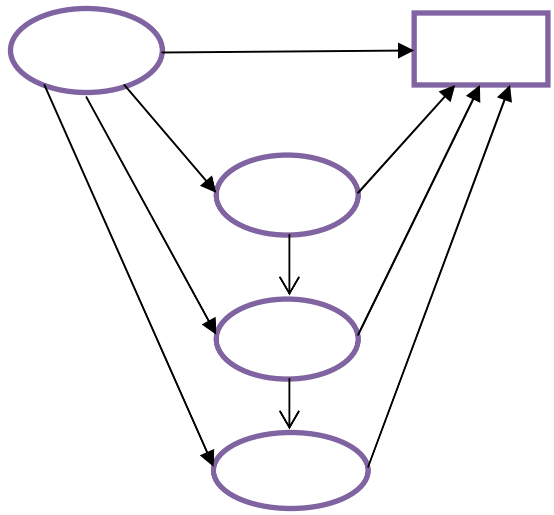


Figure 9: Input diagram of causal relationships in the student enrollment survey

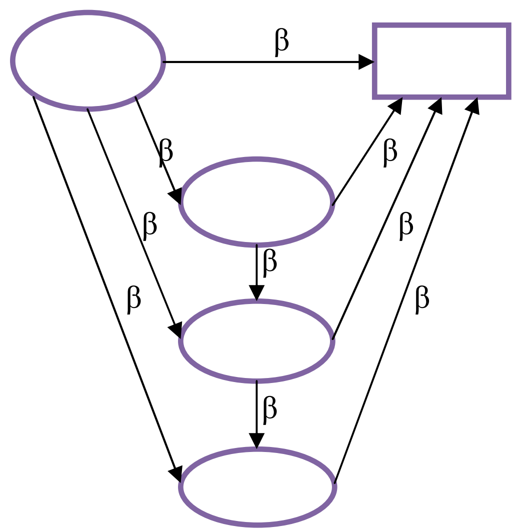


Figure 10: Output diagram of causal relationships in the student enrollment survey

Where:

AF = Awareness Factors
RF = Recruitment Factors
SEF = Socio-economic Factor
IF = Influence Factors
SE = Student Enrollment (Criterion Variable)
B = Co-relation Coefficient (Beta weights)

Path analysis and discriminant analysis methodologies were used for the design of this study. According to Akhtar, Oki, and Adachi (2007), path analysis is a standardized partial regression analysis that measures the direct influence of one variable upon the other, and permits separation of correlation into direct and indirect effects. Rutgers University (as cited in Martin, Wang, Nelson, & Phillips, 2004, p. 7), equally defines path analysis as "an extension of multiple regression whose aim is to provide estimates of hypothesized causal relationship between sets of variables linked together in a path sequence, usually referred to as a path diagram".

In this study, figure 9 was an input path diagram that represented the causal relationships that were predicted by the research hypotheses 1, 2, 3, and 4, while Figure 10 was the expected output path diagram that displayed the results of the statistical analyses. The structural equations derived from the hypothesized paths in the input diagram were:

1. $Z_1 = e_1$
2. $Z_2 = B_{21}Z_1 + e_2$
3. $Z_3 = B_{31}Z_1 + B_{32}Z_2 + e_3$
4. $Z_4 = B_{41}Z_1 + B_{43}Z_3 + e_4$
5. $Z_5 = B_{51}Z_1 + B_{52}Z_2 + B_{53}Z_3 + B_{54}Z_4 + e_5$

Where:

Z = Standard score, while the subscript is the equation number;

e = Unexplained variances and the subscript is the equation number;

B = Path coefficient and the subscripts are equation and variable number

Discriminant analysis "is a multivariate statistical technique designed to assess how well a set of continuous independent variables *(IV)* predicts membership in a categorical grouping variable, usually dichotomous in nature" (Scanlan, 2004. p. 1). It predicts membership by creating a composite vitiate known as a discriminant function. According to Scanlan, "discriminant function represents a linear combination of the *IV*s, weighted to maximize the difference between or among the groups categorized by the dependent variable" (p. 1). In this study, the discriminant function model used to predict group membership (enrollment level) was:

$$D = B_0 + B_1X_1 + B_2X_2 + \ldots\ldots + B_iX_i$$

Where:

D = discriminant function score for a given person

B = discriminant coefficient or weight for the i^{th} predictor variable

X = value of the i^{th} independent variable for a given person

i = number of predictor variable

Data Analysis

The descriptive statistics of the returned survey instrument were obtained on the fully completed survey instruments (N = 288, Table 5), for all of the survey questions and then for the variables included in the path analysis. For the variables included in the path analysis and discriminant analysis, the study further averaged over selected questions within a factor to create a factor scale. The selection of sub-questions was made through statistical analysis. Within each of the factors, examination of the sub-question correlation matrix was used to eliminate sub-questions with negative or low correlations.

The internal consistency analysis utilized Cronbach's alpha, and iteratively eliminated sub-questions within a factor that reduced the alpha value of the factor scale. The goal was to create a factor scale with an alpha of at least 0.70. This process was repeated for each of the four scales (awareness factors; influence factors; recruitment factors; and socioeconomic factors). While this procedure produced one number per participant for each of the four factors in the path analysis, it required the original data to be modified according to the following criteria:

1. Only participants with valid data for dependent variable (student enrollment) were included in the data analysis; and

2. Only participants with valid data for all of the four independent variable factors were included in the data analysis.

This procedure reduced the final data set for all of the survey questions from 288 to 213. The final composition of the four independent variables for the path analysis became:

1. Awareness: average value if answered at least 8 of the following questions Question1 awareness factors row2, Question1 awareness factors row4, Question1 awareness factors row5, Question1 awareness factors row7, Question1 awareness factors row8, Question1 awareness factors row9, Question1 awareness factors row10, Question1 awareness factors Row11, Question1 awareness factors row13, Question1 awareness factors Row15, Question1 awareness factors row16.
2. Influence: average value if answered at least 11 of the following questions Question2 influence Factors row1 to Question 2 Influence factors row14.
3. Recruitment: average value if answered at least 13 of the following questions Question3 recruitment factors Row1 to Question 3 recruitment factors row17.
4. Socio-economic: average value if answered at least 11 of the following questions: Question 4 socioeconomic factors row1 to Question 4 socioeconomic factors row15

Four reliability tests were conducted (one for each relevant construct measured) after original data set was modified and sample size reduced from 288 to 213. The reliability coefficients of internal consistency for each construct are shown in Table 6. Path coefficients (betas) were obtained by running regression analyses of the equations derived from the input diagram with student enrollment, influence factors, recruitment factors, and socio-economic factors as dependent variables in turn, and then using the independent variables specified in the equations. Path multiplication rule was used to compute path values. The multiplication rule suggests that “the value of any compound path is the product of its path coefficients” (Garson, 2008, p. 3). Effect decomposition rule was applied to determine total indirect effect, direct effect, and total causal effect of all independent variables on the criterion variable.

Table 6: Reliability coefficient of internal consistency of the modified data set for the path analysis

Constructs Measured	Number of Factors	Cronbach’s Alpha	Sample size *N*
Awareness factors	11	0.807	153
Influence factors	14	0.801	167
Recruitment factors	17	0.875	168
Socio-economic factors	15	0.807	176

Effect decomposition suggests that “in a linear system, the total causal effect of variable **i** on variable **j** is the sum of the values of all the paths from **i** to **j**” (p. 3). *T*-test was applied at the 5% level to determine the statistical significance of path coefficients. Results of these analyses were displayed in the output diagram (Figure 10). The widths of the arrows in the output diagram were proportional to the size (beta weights) of path coefficients. The path with the biggest arrows was considered better supported; therefore, was preferred over the rest of the paths or hypotheses.

Discriminant analysis was used to address research question 6. The purpose was to predict group membership (enrollment level) based on a set of independent variables (awareness, influence, recruitment, and socioeconomic factors). To predict group membership through discriminant function analysis methodology, the following qualifying statistical analyses and tests were conducted:

1. Test of analysis of variance *(ANOVA)* was conducted to determine whether there were any significant differences between the groups on each of the dependent variables. If there were no significant group differences, discriminant analysis would have terminated. The differences between the groups were found to be statistically significant.
2. The omnibus statistic (Wilks' Lambda) was computed to test if the discriminant model as a whole was significant. If the model were not significant, discriminant analysis would have terminated. The model was found to be significant.
3. The multivariate discriminant functions were assessed as defined by independent variables. The maximum number of functions in a discriminant analysis equals the number of groups minus one or the number of independent variables in the analysis, whichever is smaller. In this study, there were only two groups; therefore, there was only one discriminant function. For this lone function, the eigenvalue, canonical correlation, standardized and unstandardized coefficients, and structure matrix were assessed to determine how variance in group membership was explained.
4. Finally, the discriminant analysis model was evaluated to determine how well it classified or predicted group membership. This analysis provided an overall 2x2 classification table that compared actual to predicted group membership.
5. All basic assumptions underlying discriminant analysis were checked and observed in the course of this analysis.

For the portion of the survey instrument designed to address the fifth hypothesis, the method of data analysis was descriptive statistics – measures of central tendency (mean, median, mode), and measures of variability (range, standard deviation, and variance). The application software for data analysis in each case was *PASW*.

CHAPTER IV. DATA ANALYSIS AND PRESENTATION OF RESULTS

The purpose of this study was to investigate the relationship between factors that control students' enrollment decisions in manufacturing-related programs in two-year colleges from the perspectives of academic advisors, instructors, and program directors of manufacturing-related programs in two-year colleges in the Great Lakes and Plains States. An additional purpose was to describe current enrollment status of these programs.

Three statistical methods were used for data analysis in this study. For all survey items, descriptive statistics method - measures of central tendency (mean, median, mode), and measures of variability (range, standard deviation, and variance) - was used to describe the raw data. For the survey items that addressed the research hypotheses 1- 4, path analysis methodology was used. For the survey items that addressed the research question 6, discriminant analysis methodology was used. The application software employed for data analyses in each case was *PASW*. The data collected were all statistically analyzed and presented in both descriptive and inferential statistics. This presentation pattern was to ensure that findings of the study were properly communicated to the reader.

Demographic Information

The target population for this study consisted of all 1,455 faculty members of manufacturing-related programs in 155 two-year colleges in the Great Lakes and Plains States initially identified as full time instructors, academic advisors, and program directors. The listserv of their email addresses was created by the researcher from the websites and catalogs of the 155 two-year colleges in the Great Lakes and Plains States that offer manufacturing-related programs. Of the 1,455 full time faculty members, five were reportedly not part of manufacturing-related programs in their schools; 126 had undeliverable email addresses; seven declined to respond for personal reasons; and the survey instruments sent to 17 others were blocked as spam. This narrowed the study's potential sample to 1,300 full time academic advisors, instructors, and program directors. About 355 respondents who received the survey instrument responded but only 288 responses were usable. This represented a response rate of 22.15%.

Questionnaire Findings

The demographic questions regarding gender, age, marital status, racial groupings, and several others were not deemed critical to the study; therefore, they were not included in the survey instrument. The only demographic question that was considered critical to the study was item 9 which addressed respondents' job title. Responses to this question varied as tabulated in Table 7. The list of other job titles of respondents is exhibited in Appendix F under Question 9.

Table 7: Frequency and percentages of respondents by job title

Title	Frequency	Percentages
Program Directors	29	10.1%
Academic Advisors	8	3.1%
Professors	52	18.1%
Instructors	180	62.7%
Other	19	6.6%
Total	288	100.0%

Of all respondents, 10.1% were program directors; 2.4% were academic advisors; 18.1% were professors; 62.7% were instructors; and 6.6% were other. The 19 respondents who came under the category of "other" were instructors and professors who doubled as: Division Chairs; Department Chairs; Campus Division Chairs; Program Chairs; Deans; Program Directors; and Associate Deans. A Tech Prep Coordinator and two Technicians also found their way on the listserv and identified themselves with this category.

With the exception of item 9, the findings of the study are presented in the order of the items in the survey instrument to ensure consistency and ease of understanding. In items 1, 2, 3, and 4, the dependent (criterion) variable was student enrollment, and independent (predictor) variables were: awareness factors; influence factors; recruitment factors; and socioeconomic factors. Data for the criterion variable were captured by responses to the survey instrument item 8, which read: Overall, how would you characterize enrollment in manufacturing programs in your college? Cyclical, decreasing, stable, increasing, don't know (choose one). Both "Cyclical" and "Don't know" options were automatically eliminated by *PASW* software, thereby leaving only three possible alternatives to characterize current enrollment status of manufacturing occupational clusters in the two-year colleges studied.

In item 1, respondents were given a set of factors that may make students aware of manufacturing occupational programs to indicate the extent to which they agreed that each of the factors was an effective way of creating student awareness of manufacturing-related programs. Responses to this item were tabulated as shown in Table 8. Data from these responses were used to compute measures of central tendency and variability of responses to each factor. Mean and standard deviation values were then extracted and tabulated as shown in Table 9. Of the total respondents, 98.1% agreed or strongly agreed (M = 3.82; SD = 0.452) that reputation of the program was an effective way of creating student awareness of manufacturing-related programs;

Table 8: Percentages of agreement level with awareness factors in mfg. related programs

SD = Strongly Disagree; *D* = Disagree; *A* = Agree; *SA* = Strongly Agree; *N*=Sample Size

Awareness Factors	*SD*	*D*	*A*	*SA*	*N*
College catalog	5 (2.4%)	34 (16.2%)	125 (59.5%)	46 (21.6%)	213
Admissions Office	16 (7.8%)	63 (30.9%)	84 (41.2%)	41 (20.1%)	204
Friends at the college	1 (0.5%)	6 (2.9%)	55 (26.2%)	148 (70.5%)	210
Campus visit	1 (0.5%)	4 (1.9%)	47 (22.1%)	161 (75.6%)	213
Reputation of the program	1 (0.5%)	3 (1.4%)	29 (13.6%)	180 (84.5%)	213
Alumni of the program	2 (1.0%)	9 (4.3%)	67 (32.1%)	131 (62.7%)	209
Marketing/promotional materials	2 (0.9 %)	17 (8.0%)	127 (59.9%)	66 (31.1%)	212
College website	2 (0.9%)	19 (8.9%)	112 (52.6%)	79 (37.3%)	212
College recruiters visiting high school	5 (2.4%)	25 (11.8%)	88 (41.5%)	94 (44.3%)	212
College admissions counselors	10 (4.7%)	50 (23.6%)	96 (45.3%)	56 (26.4%)	212
Student ambassador of the college	6 (3.1%)	52 (27.2%)	94 (49.2%)	39 (20.4%)	191
Manufacturing faculty members of the college	1 (0.5%)	9 (4.3%)	68 (32.4%)	132 (62.9%)	210
Advertisements in public Media	6 (2.9%)	29(14.1%)	105(51.2%)	65 (31.7%)	205
Live in the community where college is located	7 (3.4%)	32(15.5%)	103 (50.0%)	64 (31.1%)	206
Employer education programs	3 (1.3%)	22 (10.3%)	100 (48.5%)	81 (39.3%)	206
Workforce Investment Act	6 (3.6%)	41 (24.6%)	74 (44.3%)	46 (21.6%)	167

97.7% agreed or strongly agreed ($M = 3.73$; $SD = 0.515$) that campus visit was an effective way; 96.7% agreed or strongly agreed ($M = 3.67$; $SD = 0.556$) that friends at the college was an effective way; 95.3% agreed or strongly agreed ($M = 3.58$; $SD = 0.600$) that manufacturing faculty members of the college were an effective; 94.8% agree or strongly agreed ($M = 3.56$; $SD = 0.626$) that alumni of the program were an effective way; 91.0% agreed or strongly agreed (*M*

= 3.21; *SD* = 0.621) that marketing and promotional materials were an effective way; and 89.9% agreed or strongly agreed (*M* = 3.36; *SD* = 0.657) that college website was an effective way of creating student awareness.

Table 9: Measures of central tendency and variability for awareness factors (Scale: 1-4)

Awareness factors	*M*	*SD*	*N*
Reputation of the program	3.82	0.452	213
Campus visit	3.73	0.515	213
Friends at the college	3.67	0.556	210
Manufacturing faculty members of the college	3.58	0.600	210
Alumni of the program	3.56	0.626	209
College recruiters visiting high school	3.28	0.762	212
College website	3.26	0.657	212
Employer education programs	3.26	0.703	206
Marketing/promotional materials	3.21	0.621	212
Advertisements in public media	3.12	0.751	205
Live in the community where college is located	3.09	0.773	206
College Catalog	3.01	0.692	210
Workforce Investment Act	2.96	0.817	167
College admissions counselors	2.93	0.829	212
Student ambassador of the college	2.87	0.767	191
Admissions office	2.74	0.870	204

On the other hand, only 61.3% of all respondents agreed or strongly agreed (*M* =2.74; *SD* = 0.870) that admissions office was an effective way of creating student awareness of manufacturing-related programs; 65.9% agreed or strongly agreed (*M* = 3.96; *SD* = 0.817) that workforce investment act was an effective way; 69.9% agreed or strongly agreed (*M* = 2.87; *SD* = 0.767) that student ambassador of the college was an effective way; and 71.9 % agreed or strongly agreed (*M* = 2.93; *SD* = 0.829) that college admissions counselors were an effective way of creating student awareness of manufacturing programs.

Therefore, based on percentages, mean, and standard deviation values, respondents agreed or strongly agreed that, the most likely factors to create student awareness of manufacturing occupational programs were: reputation of the program; campus visit; friends at the college; and the manufacturing faculty members of the college. And the most unlikely factors to create student awareness of manufacturing occupational programs were: admissions office; admissions counselors; and workforce investment act.

In item 2, respondents were given a set of factors that may influence students to enroll in manufacturing occupational programs to indicate the extent to which they agreed that each factor was an effective way of influencing students to enroll in manufacturing programs in two-year colleges. Their responses were tabulated as shown in Table 10. The data from these responses were used to compute measures of central tendency and variability for each factor. The mean and standard deviation values were then extracted from the computations and cross-tabulated against each factor as shown in Table 11.

Of the total respondents, 97.7% agreed or strongly agreed (*M* = 3.65; *SD* = 0.544) that friends in the program were an influencing factor for students' enrollment in manufacturing occupational programs in two-year colleges; 97.2% agreed or strongly agreed (*M* = 3.58; *SD* = 0.599) that campus visit was an influencing factor; 96.6% agreed or strongly agreed *(M* = 3.65; SD = 0.543) that personal interest in manufacturing occupations was an influencing factor; 95.2% agreed or strongly agreed (*M* = 3.47; *SD* = 0.621) that manufacturing faculty members from the college were an influencing factor; 94.1% agreed or strongly agreed *(M* = 3.34; *SD* = 0.592) that relatives were an influencing factor; 93.6% agreed or strongly agreed (*M* = 3.38; SD

= 0.604) that father or female guardian was an influencing factor; and 92.9% agreed or strongly agreed (*M* = 3.31; *SD* = 0.614) that family friends were an influencing factor for students' enrollment in manufacturing programs in two-year colleges.

Table 10: Percentages of agreement level with influence factors for enrollment in manufacturing related programs

SD = Strongly Disagree; *D* = Disagree; *A* = Agree; *SA* = Strongly Agree; *N* =Sample Size

Influence Factors	*SD*	*D*	*A*	*SA*	*N*
Father or male guardian	1 (0.5%)	10 (5.0%)	103 (51%)	88 (43.6%)	202
Mother or female guardian	1 (0.5%)	45 (22.7%)	97 (49%)	55 (27.8%)	198
Friends in the program	1 (0.7%)	4 (1.9%)	64 (30.2%)	143 (67.5%)	212
College admission counselors	12 (5.6%)	53 (24.9%)	114 (53.5%)	34 (16%)	213
High school guidance counselor	33 (15.8%)	66 (31.6%)	69 (33%)	41 (19.6%)	209
Recruitment activities	2 (0.9%)	20 (9.5%)	108 (51.2%)	81 (38.4%)	211
Personal interest in manufacturing occupations	1 (0.5%)	4 (1.9%)	63 (29.7%)	144 (67.9%)	212
Relatives	1 (0.5%)	10 (4.7%)	116 (54.7%)	85 (40.1%)	212
Family friends	1 (0.5%)	14 (6.7%)	114 (54.3%)	81 (38.6%)	210
High school teachers	6 (2.8%)	33 (15.5%)	93 (43.7%)	81 (38%)	213
Bulletin board advertisement at high school	16 (8.2%)	80 (41%)	86 (44.1%)	13 (6.7%)	195
Manufacturing faculty members from the college	2 (1.0%)	8 (3.8%)	89 (42.8%)	109 (52.4%)	208
High school athletic coach	40 (21.2%)	77 (40.7%)	61 (32.3%)	11 (5.8%)	189
Campus visit	3 (1.4%)	3 (1.4%)	73 (34.6%)	132 (62.6%)	211

Table 11: Measures of central tendency and variability for influence factors for enrollment in manufacturing related programs (Scale: 1-4).

Influence Factors	*M*	*SD*	*N*
Personal interest in manufacturing occupations	3.65	0.543	212
Friends in the program	3.65	0.544	212
Campus visit	3.58	0.599	211
Manufacturing faculty members from the college	3.47	0.621	208
Father or male guardian	3.38	0.604	202
Relatives	3.34	0.592	212
Family friends	3.31	0.614	210
Recruitment activities	3.27	0.668	211
High school teachers	3.17	0.789	213
Mother or female guardian	3.04	0.725	198
College admission counselors	2.80	0.772	213
High school guidance counselor	2.56	0.979	209
Bulletin board advertisement at high school	2.49	0.742	195
High school athletic coach	2.23	0.848	189

On the other hand, 61.9% of all respondents disagreed or strongly disagreed ($M = 2.23$; $SD = 0.848$) that high school athletic coach was an influencing factor for students' enrollment in manufacturing occupational programs; 49.2% disagreed or strongly disagreed ($M = 2.49$; $SD = 0.742$) that bulletin board advertisements at high school were an influencing factor; 47.4% disagreed or strongly disagreed ($M = 2.56$; $SD = 0.979$) that high school guidance counselors were an influencing factor; and 30.5% of all respondents disagreed or strongly disagreed (*M* = 2.80; *SD* = 0.772) that college admission counselors were an influencing factor for students' enrollment in manufacturing occupational clusters in two-year colleges.

Therefore, considering the mean values relative to the standard deviation values, respondents agreed or strongly agreed that factors that were most likely to influence students to enroll in manufacturing occupational programs were: personal interest; friends in the program; relatives; and campus visit. Similarly, high school guidance counselors; high school athletic coach; high school teachers; and college admission counselors had lower percentages of agreement and means as influencing factors for students' enrollment in manufacturing occupational programs in two-year colleges.

Item 3 referred to recruitment factors. Respondents were given a list of recruitment techniques that are commonly used to attract students into manufacturing occupational programs and asked to indicate the extent to which they agreed that each recruitment technique was effective in attracting students to their manufacturing-related programs. Their responses to each recruitment technique were tabulated as shown in Table 12. The data from these responses were used to compute measures of central tendency and variability for each technique. The mean and standard deviation values were then extracted from the computations and cross-tabulated against each factor as shown in Table 13.

Of all respondents, 96.7% agreed or strongly agreed (*M* = 3.56; *SD* = 0.594) that promoting program reputation was an effective recruitment technique; 95.8% agreed or strongly agreed (*M* = 3.55; *SD* = 0.593) that expected earnings was an effective technique; 95.6% agreed or strongly agreed (*M* = 3.48; *SD* = 0.603) that face-to-face interactions with high school students were an effective recruitment technique; 93.2% agreed or strongly agreed (*M* = 3.60;

Table 12: Percentages of agreement level with recruitment factors for enrollment decisions in manufacturing-related programs

SD = Strongly Disagree; *D* = Disagree; *A* = Agree; *SA* = Strongly Agree; *N* = Sample size

Recruitment factors	*SD*	*D*	*A*	*SA*	*N*
Recruiters visiting high school	4 (1.9%)	26 (12.2%)	98 (46.0%)	85 (39.9%)	213
Bulletin board advertisement at high school	16 (7.5%)	88 (44.9%)	79 (40.3%)	13 (6.6%)	196
Admissions counselors or representatives	12 (5.7%)	57 (27.1%)	104 (49.5%)	37 (17.4%)	210
Instructors in manufacturing-related program at the college	1 (0.5%)	5 (2.4%)	72 (34.0%)	134 (63.2%)	212
Program articulation with high school	3 (1.4%)	19 (9.0%)	66 (40.8%)	103 (48.8%)	211
Targeting undeclared students on campus	7 (3.3%)	65 (34.0%)	104 (54.5%)	15 (7.9%)	191
Face-to-face interactions with high school students	1 (0.5%)	9 (4.2%)	90 (42.3%)	113 (53.1%)	213
Program information on college website	1 (0.5%)	28 (13.1%)	135 (63.4%)	9 (23.0%)	213
Advertisement through public media	8 (3.8%)	37 (17.6%)	118 (56.2%)	47 (22.4%)	210
Recruiters to high school career days	6 (2.8%)	27 (12.7%)	103 (48.4%)	75 (35.5%)	211
High school recruitment posters	16 (8.2%)	56 (28.7%)	104 (53.3%)	19 (9.7%)	195
Department recruitment video	7 (3.6%)	35 (17.9%)	113 (57.7%)	41 (20.9%)	196
Printed brochures	4 (1.9%)	41 (19.5%)	133 (63.3%)	32 (15.2%)	210
Scholarship offers	3 (1.4%)	15 (7.2%)	104 (50.0%)	86 (41.3%)	208
Promote program reputation	2 (1.0%)	5 (2.4%)	76 (36.2%)	127 (60.5%)	210
Expected earnings	1 (0.5%)	8 (3.8%)	76 (35.7%)	128 (60.1%)	213
Career goals	0 (0.0%)	15 (7.2%)	107 (51.7%)	85 (41.1 %)	207

93.2% agreed or strongly agreed (*M* = 3.60; *SD* = 0.563) that instructors in the manufacturing-related programs at the college were an effective technique; 92.8% agreed or strongly agreed (*M* = 3.34; *SD* = 0.609) that career goals were an effective technique; and 91.3% agreed or strongly agreed (*M* = 3.31; *SD* = 0.669) that scholarship offers were an effective recruitment technique.

On the other hand, 52.4% of the total respondents disagreed or strongly disagreed (*M* = 2.45; *SD* = 0.739) that bulletin board advertisement at high school was an effective recruitment technique; 33.1% disagreed or strongly disagreed (*M* = 2.79; *SD* = 0.797) that admissions counselors or representatives were a effective technique; 37.3% disagreed or strongly disagreed (*M* = 2.66; *SD* = 0.675) that targeting undeclared students on campus was an effective technique; and 37% disagreed or strongly disagreed (*M* = 2.65; *SD* = 0.769) that high school recruitment posters were an effective recruitment technique.

Table 13: Measures of central tendency and variability for recruitment factors enrollment decisions in manufacturing related programs (Scale: 1-4)

Recruitment factors	*M*	*SD*	*N*
Instructors in manufacturing related program at the college	3.60	0.563	212
Promote program reputation	3.56	0.594	210
Expected earnings	3.55	0.593	213
Face-to-face interactions with high school students	3.48	0.603	213
Program articulation with high school	3.37	0.708	211
Career goals	3.34	0.609	207
Scholarship offers	3.31	0.669	208
Recruiters visiting high School	3.24	0.736	213
Recruiters to high school career days	3.17	0.755	211
Program information on college website	3.09	0.612	213
Advertisement through public media	2.97	0.744	210
Department recruitment video	2.96	0.729	196
Printed brochures	2.92	0.647	210
Admissions counselors or representatives	2.79	0.797	210
Targeting undeclared students on campus	2.66	0.675	191
High school recruitment posters	2.65	0.769	195
Bulletin board advertisement at high school	2.45	0.739	196

Therefore, based on percentages, mean, and standard deviation values, respondents agreed or strongly agreed that the recruitment techniques that were most likely to be effective in attracting students into manufacturing occupational programs in two-year colleges were: instructors in the manufacturing-related programs at the college; expected earnings; program reputation; face-to-face interactions with high school students; career goals; and program information on the college website. On the other hand, they disagreed or strongly disagreed that admissions counselors or representatives; high school recruitment posters; recruiters to high school career days; advertisement through public media; and bulletin board advertisement at high school were effective recruitment techniques.

Item 4 referred to socioeconomic factors. Respondents were given a set of socioeconomic factors that affect students' enrollment decisions in manufacturing occupational programs in two-year colleges and asked to indicate the extent to which they agreed that each was an influencing factor in students' enrollment decisions in manufacturing related programs in two-year colleges. Their responses to this question were tabulated as shown in Table 14, and measures of central tendency and variability associated with these responses were also tabulated as shown in Table 15.

Of the total respondents, 97.6% agreed or strongly agreed ($M = 3.75$; $SD = 0.506$) that high school counselors do not have a clear understanding of career pathways in manufacturing industry; 97.1% agreed or strongly agreed ($M = 3.61$; $SD = 0.545$) that high school students and their parents/guardians do not have a clear understanding of career pathways in manufacturing industry; 94.7% agreed or strongly agreed ($M = 3.40$; $SD = 0.623$) that students' career goals often exclude manufacturing careers; 92.4% agreed or strongly agreed ($M = 3.49$; $SD = 0.650$) that negative perceptions of manufacturing industry affect students' enrollment decisions;

Table 14: Percentages of agreement level with socioeconomic factors that affect enrollment decisions in manufacturing related programs

SD = Strongly Disagree; *D* = Disagree; *A* = Agree; *SA* = Strongly Agree; *N* = Sample Size

Socioeconomic factors	*SD*	*D*	*A*	*SA*	*N*
High school students and their parents/ guardians do not have a clear understanding of career pathways in manufacturing industry	0 (0.0%)	6 (2.9%)	70 (33.3%)	134 (63.8%)	210
High school counselors do not have a clear understanding of career pathways in manufacturing industry	1(0.5%)	4 (1.9%)	42 (19.9%)	164 (77.7%)	211
Economic status of parents or guardians	0 (0.0%)	25 (12.1%)	128 (61.8%)	54 (26.1%)	207
Parents perceive manufacturing careers as dead-end occupations	3 (1.4%)	18 (8.6%)	75 (35.9%)	113 (54.1%)	209
Youths lack basic background in mathematics and science to pursue careers in manufacturing industry	4 (1.9%)	25 (11.8%)	86 (40.6%)	97 (45.8%)	212
On-going relocation of manufacturing companies to other countries	5 (2.4%)	24 (11.4%)	84 (40.0%)	97 (46.2%)	275
Negative perceptions of manufacturing industry	1(0.5%)	15 (7.1%)	74 (35.1%)	121 (57.3%)	211
Increased competition for students from four-year colleges	6 (3.0%)	70 (34.7%)	82 (40.6%)	44 (21.8%)	202
Increased costs to students in tuition and fees	8 (3.9%)	79 (38.2%)	90 (43.5%)	30 (14.5%)	207
Decline in manufacturing industry	9 (4.3%)	37 (17.6%)	99 (47.1%)	65 (31.0%)	210
Employer demand for graduates	3 (1.4%)	37 (17.6%)	106 (50.5%)	64 (30.5%)	210
Desirability of the work environment	1 (0.5%)	37 (17.9%)	121 (58.5%)	48 (23.2%)	207
Student/parents perceive manufacturing as a low paying career	3 (1.5%)	34 (16.7%)	8 4 (41.4%)	82 (40.4%)	203
Students' career goals often exclude manufacturing careers	2 (1.0%)	9 (4.4%)	99 (48.1%)	96 (46.6%)	206
Level of Education of parents or guardians	3 (1.5%)	31 (15.6%)	110 (55.3%)	55 (27.6%)	199

90.0% agreed or strongly agreed (*M* = 3.43; *SD* = 0.711) that parents perceive manufacturing careers as dead-end occupations; and 87.9% agreed or strongly agreed (*M* = 3.14; *SD* = 0.603) that economic status or parents or guardians affects enrollment decisions of their children in manufacturing occupational programs in two-year colleges. On the other hand, 42% of all respondents disagreed or strongly disagreed (*M* = 2.69; *SD* = 0.765) that increased costs to students' tuition and fees affect students' enrollment decisions; 37.7% disagreed or strongly disagreed (*M* = 2.81; *SD* = 0.807 that increased competition for students from four-year colleges affect students' enrollment decisions in two-year colleges; and 22% disagreed or strongly disagreed (*M* = 3.05; *SD* = 0.811) that the decline in manufacturing industry affects students' enrollment decisions in manufacturing occupational programs in two-year colleges.

Therefore, based on percentages, mean, and standard deviation values, respondents agreed or strongly agreed that, socioeconomic factors that were most likely to affect students' enrollment decisions included: high school counselors do not have a clear understanding of career pathways in manufacturing industry; high school students and their parents/guardians do not have a clear understanding of career pathways in manufacturing industry; economic status of parents or guardians; students' career goals often exclude manufacturing careers; negative perceptions of manufacturing industry; and desirability of the work environment.

In survey item 5, respondents were asked whether or not they have discontinued offering any manufacturing-related programs in the past five years. Their responses were tabulated as shown in Table 16. Of the total respondents, 72.6% did not discontinue offering any manufacturing related programs while 27.4% discontinued offering some manufacturing related programs in the past five years. The list of programs that were discontinued by various institutions is exhibited in Appendix F under item 5.

Table 15: Measures of central tendency and variability for socioeconomic factors that affect enrollment decisions in manufacturing related programs (Scale = 1-4)

Socioeconomic factors	*M*	*SD*	*N*
High school counselors do not have a clear understanding of career pathways in manufacturing industry	3.75	0.506	211
High school students and their parents/guardians do not have a clear understanding of career pathways in manufacturing industry	3.61	0.545	210
Negative perceptions of manufacturing industry	3.49	0.650	211
Parents perceive manufacturing careers as dead-end Occupations	3.43	0.711	209
Students' career goals often exclude manufacturing careers	3.40	0.623	206
Youths lack basic background in mathematics and science to pursue careers in manufacturing industry	3.30	0.750	212
On-going relocation of manufacturing companies to other countries	3.30	0.764	210
Student/parents perceive manufacturing as a low paying career	3.21	0.769	203
Economic status of parents or guardians	3.14	0.603	207
Employer demand for graduates	3.10	0.728	210
Level of Education of parents or guardians	3.09	0.698	199
Decline in manufacturing industry	3.05	0.811	210
Desirability of the work environment	3.04	0.656	207
Increased competition for students from four-year colleges	2.81	0.807	202
Increased costs to students in tuition and fees	2.69	0.765	207

In survey item 6, respondents were asked if they planned on discontinuing any manufacturing related programs in the next two years. Their responses to this question were tabulated as shown in Table 17. Of the total respondents, 92.7% did not plan to discontinue offering any manufacturing related programs in the next two years, while 7.3% planned to discontinue offering certain manufacturing related programs in the next two years. The programs that they planned on discontinuing are listed in Appendix F.

Table 16: Frequency and percentages of respondents by program discontinuation in the past five years

Response	Frequency	Percentages
No	209	72.6%
Yes	79	27.4%
Total	288	100.0%

Table 17: Frequency and percentages of respondents by plan to discontinue offering any manufacturing programs in the next two years

Response	Frequency	Percentages
No	267	92.7%
Yes	21	7.3
Total	288	100.0%

In survey item 7, respondents were asked if they planned on adding any new manufacturing related programs in the next five years. Their responses to this item were tabulated as shown in Table 18. Of the total respondents, 49.65% did plan on adding new manufacturing related programs in the next five years, while 50.35% planned on adding new manufacturing related programs in the next five years. The programs they planned on adding are listed in Appendix F.

Survey item 8 was part of the path analysis because it dealt with the dependent (criterion) variable – student enrollment; therefore, the rules for path analysis automatically applied. The modified data set was used to process responses to this question.

Table 18: Frequency and percentages of respondents by plan to add any manufacturing related programs in the next five years

Response	Frequency	Percentages
No	143	49.65%
Yes	145	50.35%
Total	288	100.0%

Table 19: Frequency and percentages of respondents by overall characterization of student enrollment in manufacturing programs in their college

Responses	Frequencies	Percentages
Decreasing	44	20.7%
Stable	82	38.5%
Increasing	87	40.8%
Total	213	100.0%

Out of the five alternative choices (cyclical, decreasing, stable, increasing, and don't know) originally provided to respondents, only decreasing, stable, and increasing were used. Cyclical and don't know options were dropped by the *PASW* software. And the data set was again screened from 288 to 213 according to path analysis rules. In this item, respondents were asked, "Overall, how would you characterize enrollment in manufacturing programs in your college?" Table 19 exhibits their responses based on the modified data set. About 20.7% of all respondents indicated that student enrollment in manufacturing occupational programs in their colleges was decreasing; 38.5% indicated it was stable; while 40.8% said it was increasing.

Path Analysis of Enrollment Decision Factors

This section represents the estimates of the hypothesized causal relationships between sets of variables linked together in a path sequence. The following tables showed standardized partial regression analysis of the input equations conducted with all variables and all data elements to measure the direct influence of one variable upon the other, and to separate correlation of variables into direct and indirect effects. The input equations derived from the hypotheses were:

1. $Z_1 = e_1$
2. $Z_2 = B_{21}Z_1 + e_2$
3. $Z_3 = B_{31}Z_1 + B_{32}Z_2 + e_3$
4. $Z_4 = B_{41}Z_1 + B_{43}Z_3 + e_4$
5. $Z_5 = B_{51}Z_1 + B_{52}Z_2 + B_{53}Z_3 + B_{54}Z_4 + e_{51}$

Where:

Z = Standard score, while the subscript is the equation number;
e = Unexplained variances and the subscript is the equation number;
B = Path coefficient (beta) and the subscripts are the equation and variable Numbers.

Reported values included:

1. Significant beta relationship ($p < 0.05$);
2. *R*-Square or Adjusted *R*-Square (measure of model significance). "When the number of independent variables or paths in the analysis is greater than five, Adjusted *R*-Square is the measure of model significance, and when the number of independent variables or paths is less than 5, *R*-Square is used (Martin, et al., p. 15);
3. Only beta values taken from the output were inserted into the output path diagram; and

4. Policy Significance: To be considered policy significant, “at least one independent variable in a particular path analysis model must be statistically significant ($p < 0.05$), and a substantial portion of the variation in the dependent variable must be explained by the model” (Martin et al., 2004, p. 15).

Analysis of Path Diagram

Equation 2: $Z_2 = B_{21}Z_1 + e_2$

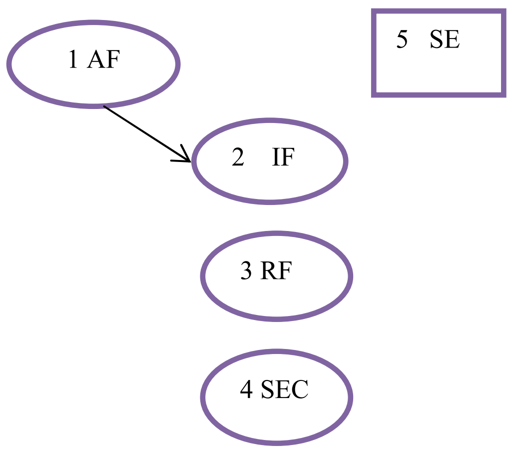


Figure 11: Path to influence factors from awareness factors

In this section, the relationship between influence factors and awareness factors in the student enrollment path diagram expressed in equation *2* ($Z_2 = B_{21}Z_1 + e_2$) was analyzed. Figure 11 represents the path from awareness factors to influence factors while Tables 20, 21, and 22 represent the Model Summary, *ANOVA*, and Regression Coefficients respectively. Based on this analysis, $Z_2 = 0.626 * Z_1$. A statistically significant positive relationship was found between awareness factors and influence factors ($\beta = 0.626$; $p < 0.000$), and 39.2% of the model variation (*R-Square* = *0.392*) was explained.

Table 20: Model summary for the path from awareness to influence factors

Model	*R*	*R*-Square	Adjusted *R*-Square	*Std*. Error of the Estimate
1	0.626	0.392[a]	0.390	0.28510

a. Predictors: Awareness

Table 21: The *ANOVA* table for regression of influence factors as dependent variable

Model		Sum of Squares	*df*	Mean Square	*F*	*Sig*
1	Regression	11.075	1	11.075	136.262	0.000
	Residual	17.150	211	0.810	-	-
	Total	28.225	212	-	-	-

a. Predictors: (Constant), Awareness; b. Dependent Variable: Influence

Table 22: Regression coefficients for influence factors as dependent variable

	Unstandardized coefficients		Standardized coefficients		
	B	*Std.* Error	Beta	*t*	*Sig*
1. (Constant)	1.372	0.154	-	8.925	0.000
Awareness	0.554	0.047	0.626	11.673	0.000

a. Dependent Variable: Influence

Equation 3: $Z_3 = B_{31}Z_1 + B_{32}Z_2 + e_3$

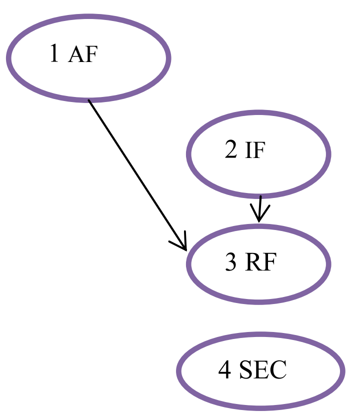


Figure 12: Paths to recruitment factors from awareness and influence factors

In this section, the relationships between the paths to the recruitment factors from awareness factors and influence factors expressed in equation 3 ($Z_3 = B_{31}Z_1 + B_{32}Z_2 + e_3$) were analyzed. Figure 12 represents the path diagram while Tables 23, 24, and 25 represent the Model Summary, *ANOVA*, and Regression Coefficients respectively.

Table 23: Model summary of paths to recruitment factors from awareness/influence factors

Model	R	R-Square	Adjusted R-Square	Standard Error of the Estimate
1	0.768[a]	0.590	0.586	0.25028

a. Predictors: (Constant), Influence, Awareness

Table 24: The *ANOVA* table for regression of influence and awareness factors

Model		Sum of Squares	*df*	Mean Square	*F*	*Sig*
1	Regression	18.956	2	9.478	151.310	0.000a
	Residual	13.154	210	0.063	-	-
	Total	32.110	212	-	-	-

a. Predictors: (Constant), Influence, Awareness; b. Dependent Variable: Recruitment

Table 25: Regression coefficients for awareness and influence factors

		Unstandardized Coefficients		Standardized Coefficients		
Model		*B*	*Std*. Error	Beta	*t*	*Sig*
1	(Constant)	0.397	0.158	-	2.504	0.013
	Awareness	0.330	0.053	0.350	6.177	0.000
	Influence	0.532	0.060	0.499	151.310	0.000

a. Dependent Variable: Recruitment

Based on these analyses, $Z_3 = 0.350{*}Z_1 + 0.499{*}Z_2$. The path from awareness factors to recruitment factors demonstrates a statistically significant positive relationship (Beta = 0.350; $p < 0.000$), and a statistically significant positive relationship was equally found for the path from influence factors to recruitment factors (*β* = 0.499; $p < 0.000$). About 59% of the model variation (R-Square = 0.590) was explained.

Equation 4: $Z_4 = B_{41}Z_1 + B_{43}Z_3 + e_4$

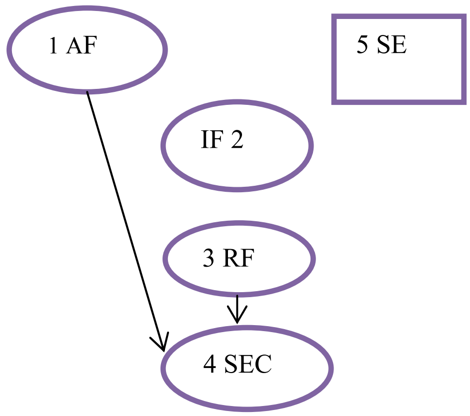


Figure 13: Paths to socioeconomic factors from awareness and recruitment factors.

In this section, the paths to the socioeconomic factors from awareness factors and recruitment factors expressed in terms of equation 4 ($Z_4 = B_{41}Z_1 + B_{43}Z_3 + e_4$) were analyzed. Figure 13 represents the path diagram while Tables 26, 27, and 28 represent the Model Summary, *ANOVA*, and Regression Coefficients respectively.

Table 26: Model summary of paths to socioeconomic factors from awareness and recruitment factors

Model	*R*	*R*-Square	Adjusted *R*-Square	*Std*. Error of the Estimate
1	0.186[a]	0.035	0.025	0.35387

a. Predictors: (Constant), Recruitment, Awareness

Based on these analyses, $Z_4 = 0.141 * Z_1 + 0.060 * Z_3$. The path from awareness factors to socioeconomic factors did not demonstrate a statistically significant relationship (*β* = 0.141; $p < 0.121$), and no statistically significant relationship (*β = 0.060;* $p < 0.508$) was found for the path from recruitment factors to socioeconomic factors. And only 3.5% of the model variation (*R*-Square = 0.035) was explained.

Table 27: The *ANOVA* table for regression of recruitment and awareness factors

Model		Sum of Squares	*DF*	Mean Square	*F*	*Sig*
1	Regression	0.945	2	0.473	3.773	0.025(a)
	Residual	26.297	210	0.125	-	-
	Total	27.242	212	-	-	-

a. Predictors: (Constant), Recruitment, Awareness; b. Dependent Variable: Socioeconomic

Table 28: Regression coefficients for awareness and recruitment factors

		Unstandardized Coefficients		Standardized Coefficients		
Model		*B*	*Std. Error*	Beta	*t*	*Sig*
1	(Constants)	2.661	0.213	-	12.507	0.000
	Awareness	0.123	0.079	0.141	1.557	0.121
	Recruitment	0.055	0.083	0.060	0.663	0.508

a. Dependent Variable: Socioeconomic factors

Equation 5: $Z_5 = B_{51}Z_1 + B_{52}Z_2 + B_{53}Z_3 + B_{54}Z_4 + e_5$

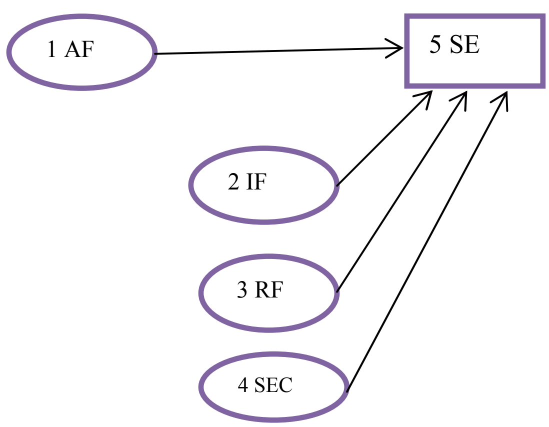


Figure 14: Paths to student enrollment from all predictor variables

Table 29: Model summary of paths to student enrollment from predictor variables

Model	*R*	*R*-Square	Adjusted R-Square	*Std*. Error of the Estimate
1	0.199[a]	0.039	0.021	0.752

a. Predictors: (Constant), Socioeconomic, Recruitment, Awareness, and Influence

Table 30: The *ANOVA* table for regression of awareness, influence, recruitment, and socioeconomic factors

Model		Sum of Squares	*df*	Mean Square	*F*	*Sig*
1	Regression	4.828	4	1.207	2.137	0.077(a)
	Residual	117.491	208	0.565	-	-
	Total	122.319	212	-	-	-

a. Predictors: (constant), Socioeconomic, Recruitment, Awareness, and Influence
b. Dependent Variable: Student Enrollment

Table 31: Regression coefficients for awareness, influence, recruitment, and socioeconomic factors

		Unstandardized Coefficients		Standardized Coefficients		
Model		*B*	*Std*. Error	Beta	*t*	*Sig*
1	(Constants)	1.292	0.612	-	2.111	0.036
	Awareness	0.225	0.175	0.122	1.286	0.200
	Influence	-0.284	0.213	-0.136	-1.330	0.185
	Recruitment	0.356	0.207	0.182	1.716	0.088
	Socioeconomic	-0.011	0.147	-0.005	-0.072	0.943

a. Dependent Variable: Student Enrollment

The paths to student enrollment from awareness, influence, recruitment, and socioeconomic factors (predictor variables) were expressed in terms of equation 5 ($Z_5 = B_{51}Z_1 + B_{52}Z_2 + B_{53}Z_3 + B_{54}Z_4 + e_5$) and then analyzed. Figure 14 represents the path diagram while Tables 29, 30, and 31 represent the Model Summary, *ANOVA*, and Regression Coefficients respectively. Based on these analyses, $Z_5 = 0.122*Z_1 - 0.136*Z_2 + 0.182*Z_3 -$

0.005*Z_4. None of the paths to Student Enrollment demonstrates a statistically significant relationship. For the awareness path, $\beta = 0.122$, and $p < 0.200$; for Influence, $\beta = -0.136$ and $p < 0.185$; for recruitment, $\beta = 0.182$, and $p < 0.088$, and for the socioeconomic path, $\beta = -0.005$ and $p < 0.943$. The combined explanatory power of the model (*R*-Square = 0.039) was only 3.9%.

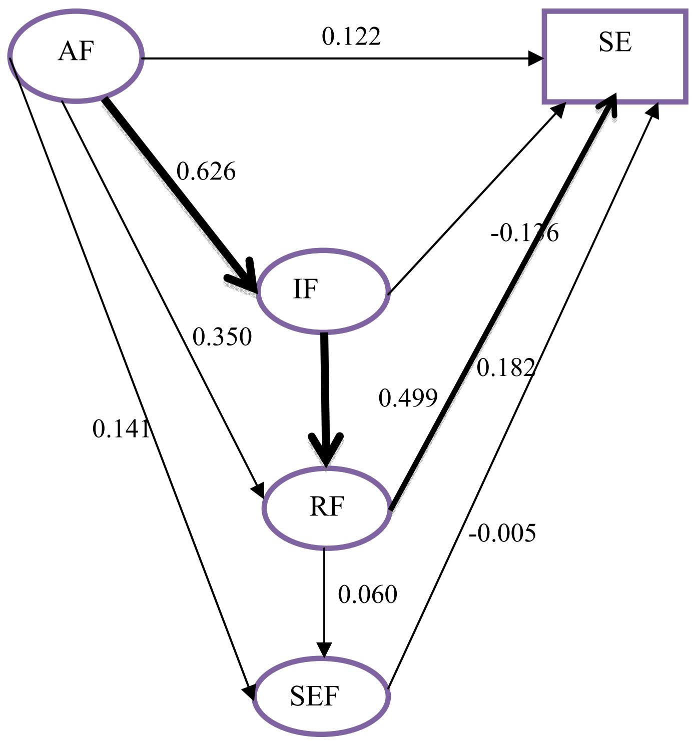


Figure 15: Output diagram of causal relationships in the student enrollment survey expressed in co-relation coefficients (beta weights)

The output of the paths analyzed in equations 2 - 5 were then combined as exhibited in Figure 15 to determine which path(s) to the student enrollment were better supported. As mentioned earlier, Martin et al. (2004) posited that, to be considered policy significant, “at least one independent variable in a particular path analysis model must be statistically significant ($p < 0.05$), and a substantial portion of the variation in the dependent variable must be explained by the model” (p. 15). In this model, two independent variables in a particular path analysis were statistically significant: the path from awareness factors to influence factors ($\beta = 0.626$; $p < 0.000$; R-Square = 0.392) and the path from influence factors to recruitment factors ($\beta = 0.499$; $p < 0.000$; R-Square = 0.590). And model variations for both paths were substantially explained. Recruitment factors, the third independent variable in the same path analysis model, was marginally significant ($\beta = 0.182$; $p < 0.088$; R-Square = 0.039). Therefore, the output diagram of causal relationships in the student enrollment survey in Figure 15 may suggest that, the path to the student enrollment that is better supported is:

AF ⟶ *IF* ⟶ *RF* ⟶ Student Enrollment.

Total Effect of Awareness Factors on Student Enrollment

AF ⟶ Student enrollment = 0.122 (Direct effect)

AF ⟶ *IF* ⟶ Student Enrollment = 0.626*(-0.136) = -0.0851

AF ⟶ *IF* ⟶ RF ⟶ Student Enrollment = 0.626*0.499*0.182 = 0.0569

AF ⟶ *RF* ⟶ Student Enrollment = 0.350*0.182 = 0.0637

AF ⟶ *RF* ⟶ *SEF* ⟶ Student Enrollment = 0.350*0.060*(-0.005) = -0.000105

AF ⟶ *SEF* ⟶ Student Enrollment = 0.141*(-0.005) = -0.00071

Total Indirect effect = -0.0851 + 0.0569 + 0.0637 – 0.000105 – 0.00071 = 0.0347

Therefore, the total effect of awareness factors on student enrollment =

Total indirect effect + direct effect = 0.122 + 0.0347 = 0.1567

Discriminant Analysis

The purpose of the discriminant analysis was to predict group membership (enrollment level) based on a set of independent variables (awareness, influence, recruitment, and socioeconomic status). The discriminant function model derived for this prediction was:

$$D = B_0 + B_1X_1 + B_2X_2 + \ldots\ldots + B_iX_i$$

Where:

D = discriminant function score for a given person

B = discriminant coefficient or weight for the i^{th} predictor variable

X = value of the i^{th} independent variable for a given person

i = number of predictor variables

Group Statistics

Table 32: Group statistics of increasing and decreasing enrollment

Enrollment: Increasing/Decreasing		Mean	SD	Valid (listwise)	
				Unweighted	Weighted
Increasing	Awareness	3.302	0.371	87	87
	Influence	3.189	0.324	87	87
	Recruitment	3.207	0.370	87	87
	Socioeconomics	3.245	0.333	87	87
Decreasing	Awareness	3.154	0.389	44	44
	Influence	3.130	0.408	44	44
	Recruitment	3.042	0.412	44	44
	Socioeconomic	3.237	0.360	44	44
Total	Awareness	3.253	0.382	131	131
	Influence	3.169	0.354	131	131
	Recruitment	3.151	0.391	131	131
	Socioeconomic	3.243	0.341	131	131

The first step in conducting discriminatory analysis was to compute group descriptive statistics to determine if there were any significant differences between groups on each of the independent variables as categorized by dependent variable group (increasing and decreasing enrollment). The result of group statistics exhibited in Table 32 showed that, there were significant group differences in the means of independent variables. Standard deviation values similarly showed significant differences in the independent variable variances between groups.

Box's *M Test* of Equality of Covariance Matrices

The purpose of Box's *M* Test of Equality of Covariance Matrices was to test the discriminant analysis' assumption that the population covariance matrices of the sample groups were equal. Table 33 exhibits Log determinants of Box's *M* Test of Equality of Covariance Matrices. It shows the natural Log of the determinants of each group's covariance matrix; a Log determinant for the covariance matrix that would result if the two groups were merged (pooled within groups); and the rank number (the number of independent variables).

Table 33: Log determinants of group covariance matrices (increasing and decreasing)

Enrollment: increasing or decreasing	Rank	Log determinants
Increasing	4	-9.468
Decreasing	4	-9.943
Pooled within group	4	-9.517

The ranks and natural logarithmic determinants of group covariance matrices

Table 34: Results of Box's *M* test of Equality of Covariance Matrices

Box's M		14.122
F.	Approx.	1.357
	df1	10
	df2	5767.511
	Sig	0.194

Tests null hypothesis of equal population covariance matrices

Table 34 exhibits the actual Box's Test result for the null hypothesis that the population covariance matrices of the sample groups were equal. Test results showed that the F-ratio for the Box's test was not significant ($p > 0.194$); therefore, it was concluded that, the covariance matrices for population group were equal (homogeneous variance).

Summary of Canonical Discriminant Functions

For each computed discriminant function, the software provided information on the following functions: eigenvalue; canonical correlation; multivariate significance; standardized and unstandardized coefficients; and structure matrix. Some of these functions are represented in the tables below.

In discriminant analysis, an eigenvalue is the relative amount of variance that the linear combination of independent variables explains in the dependent variable. In this study, there was only one discriminant function; therefore, the eigenvalue of 0.060 represented 6% of the total explained model variance. Both the percentage (%) of Variance and Cumulative percentage (%) values were similarly equal to 100% as shown in Table 35. The discriminant function analysis model for this study had only one function; therefore, the canonical correlation represented the index of the overall model fit or the proportion of the explained variance. Table 35 shows that, the canonical correlation for this discriminant function analysis was 0.239.

Table 35: Eigenvalues of the discriminant model

Function	Eigenvalue	% of Valiance	Cumulative %	Canonical Correlation
1	0.060[a]	100.0	100.0	0.239

a. Fist 1 canonical discriminant functions were used in the analysis

The discriminant function analysis assumes that, the populations represented by the sample groups have identical mean scores on the discriminant function. This null hypothesis was tested by Wilks' Lambda statistic. The result indicated a highly significant function ($p > 0.05$) and the Wilks' Lambda value of 0.943 on Table 36 suggests that about 94.3% of the total model variance was not explained.

Standardized canonical discriminant function coefficients are the weights or the amount of influence independent variables exert on the model. They allow for comparison of relative importance of each independent variable in predicting group membership. In this study, the standardized canonical discriminant coefficients of independent variables are exhibited in Table 37. The signs indicate the direction of the relationship. Based on these values, the estimated function model was: □ = 0.552(Awareness) – 0.678(Influence) + 0.965(Recruitment) – 0.092(Socioeconomic)

Table 36: Results of Wilks' Lambda Test for each discriminant function

Test of Function(s)	Wilks' Lambda	Chi Square	df	Sig
1	0.943	7.441	4	0.114

Table 37: Standardized canonical discriminant function coefficients

	Function
	1
Awareness	0.552
Influence	-0.678
Recruitment	0.965
Socioeconomic	-0.092

These values further suggest that recruitment was the strongest predictor with a discriminant function coefficient of 0.965, followed by influence with -0.678, and awareness with 0.552. With the discriminant function coefficient of less than 0.30, socioeconomic status is not loaded on the discriminant function; therefore, it is the weakest predictor variable. This may suggest that socioeconomic status is not associated with student enrollment factors.

Structure matrix is another way of ordering independent variables by absolute size of their correlations with each function. In this study, there is only one function as shown in Table 38. The table shows the correlations of each variable with the discriminant function. While the standardized canonical discriminant function coefficients are used to assess each independent variable's unique contribution to the discriminant function, the structure matrix correlations are used to assign meaning to the discriminant functions. With the cut-off between important and less important variables generally set at 0.30, socioeconomic factors may again be considered not associated with student enrollment. While influence is minimally associated with student enrollment, recruitment and awareness are the main variables that discriminate between increasing and decreasing enrollment.

Table 38: Structure Matrix correlations

	Function
	1
Recruitment	0.830
Awareness	0.759
Influence	0.319
Socioeconomic	0.044

Pooled within-groups correlations between discriminating variances and standardized canonical discriminant functions variances ordered by absolute size of correlation within function

Another way of further interpreting discriminant analysis is group centroids. A group centroid is the mean value of a group's discriminant score. In this study, the group centroids are displayed in Table 39. Schools with increasing enrollment have a mean of 0.173 while those with decreasing enrollment have a mean of -0.343.

Table 39: Functions at group centroids for increasing and decreasing enrollment

Enrollment: Increasing or decreasing	Function 1
Increasing	0.173
Decreasing	-0.343

Unstandardized canonical discriminant functions evaluated at group means

Classification Statistics

The classification phase of the discriminant function analysis compares predicted group membership to observed group membership to determine how well the discriminant function performs. Table 40 shows that the probability of being classified in either group by chance was 0.500 for increasing enrollment and 0.500 for decreasing enrollment. In other words, the prior probability of being classified in either group was 50/50.

Table 40: Prior probabilities for schools with increasing and decreasing enrollment

		Cases Used in Analysis	
Enrollment: Increasing or Decreasing	Prior	Unweighted	Weighted
Increasing	0.500	87	87.000
Decreasing	0.500	44	44.000
Total	1.000	131	131.000

Table 41 is the classification results table. It compared the predicted group membership to observed group membership, and the results revealed that 58% of the schools surveyed were correctly classified into ‘increasing’ or ‘decreasing’ groups. This gave a hit-ratio of 58. About 57.5% of the schools with ‘increasing enrollment’ were correctly classified while those with ‘decreasing enrollment’ were classified with accuracy of 59.1%.

Table 41: Classification results for schools with increasing and decreasing enrollment

			Predicted group membership		
		Increasing/Decreasing	Increasing	Decreasing	Total
Original	Count	Increasing	50	77	87
		Decreasing	18	26	44
	%	Ungrouped cases	42	40	82
Cross-validated		Increasing	57.5	42.5	100.0
		Decreasing	40.9	59.1	100.0
	%	Ungrouped cases	51.2	48.8	100.0

a. 58.0% of original grouped cases correctly classified

Summary of Results

This chapter presented data analyses and results of the study. Methods of data analyses employed for the study were descriptive statistics, path analysis, and discriminant analysis. The results were organized into demographic information, questionnaire findings, path analysis of enrollment decision factors, and the prediction of enrollment level.

The descriptive statistics of the survey of factors affecting enrollment decisions in manufacturing occupational clusters in two-year colleges showed that participants were most likely to create student awareness of manufacturing occupational programs in their college by improving on reputation of their programs; arranging for more prospective students to visit their campus; and by getting manufacturing faculty members involved in the recruitment process. They did not seem to believe that admissions office, admissions counselors, and workforce investment act were better approaches to creating student awareness of manufacturing occupational programs in two-year colleges.

On influence factors, respondents believed that prospective students who have personal interest in manufacturing programs, have friends in the program, and are encouraged by relatives were better motivated to enroll in manufacturing related programs in two-year colleges. On the other hand, they did not consider high school guidance counselors, high school athletic coach, high school teachers, and college admissions office to be effective approaches to attracting students into enrollment in manufacturing programs in two-year colleges.

The descriptive analysis showed that the recruitment techniques instructors, academic advisors, and program directors of manufacturing programs considered most likely to be effective in student recruitment in manufacturing related programs in two-year colleges were: instructors in the manufacturing-related programs at the college; expected earnings; program reputation; face-to-face interactions with high school students; career goals; and program information on the college website. And those considered to be least effective techniques were: admissions counselors/representatives; high school recruitment posters; recruiters to high school career days; advertisement through public media; and bulletin board advertisement at high schools.

Similarly, the study found that socioeconomic factors that affect students' enrollment decisions in manufacturing programs were: lack of clear understanding of career pathways in manufacturing industry by career guidance and counselors; lack of clear understanding of career pathways in manufacturing industry by high school students and their parents/guardians; economic status of parents or guardians; and exclusion of manufacturing careers in students' career goals.

In the past five years, majority of the community and technical colleges in the Great Lakes and Plains states that participated in the study did not discontinue offering any manufacturing-related programs. About 29% of the schools studied discontinued offering a total of 77 manufacturing-related programs in the past five years, and about 7.3% plan on discontinuing 16 programs in the next two years. While about half of the schools studied (49.6%) do not plan on adding any new manufacturing-related programs in the next five years, 50.4% plan on adding a total of 134 new manufacturing-related programs in the next five years. On the whole, majority of the respondents characterized student enrollment in their colleges as either stable or increasing, only about 20.7% characterized student enrollment in their colleges as decreasing.

The path analysis showed that the total effect of awareness factors on student enrollment was about 0.1567, and the direct effect of awareness factors on student enrollment was 0.122. It also showed that, the path to student enrollment that is better-supported starts from awareness factors and goes through influence factors and recruitment factors to student enrollment.

The discriminant analysis was conducted to predict membership (enrollment levels) based on independent variables (awareness, influence, recruitment, and socioeconomic factors). Significant mean differences were observed for all independent variables on the dependent variable. Log determinants were similar and Box's *M* test indicated homogeneous variance. Though the discriminant function indicated a significant association between groups and predictor variables, the canonical correlation of 0.239 suggested that only about 6% of between groups variability was explained. A closer analysis of the structure matrix revealed only two significant predictors: recruitment (0.830); and awareness (0.759). The cross-validated classification showed that overall 58% of all cases were correctly classified.

CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to investigate the relationships between factors that affect student enrollment decisions in manufacturing occupational programs in two-year colleges, and to describe current enrollment status of these programs from the perspectives of academic advisors, program directors, and instructors who teach in these programs. The study was guided by five hypotheses and one research question that addressed dependent and independent categorical factors that have been proven by previous research studies to affect student enrollment decisions in a diversity of academic programs in higher education. These categorical factors were: awareness; influence; recruitment; and socioeconomic status. The goal was to identify the exact contribution of each categorical factor in affecting student enrollment decisions and to identify the right path(s) to follow while in pursuit of prospective students for enrollment into manufacturing occupational programs in two-year colleges.

Recent research findings in workforce development and education have shown that, the vast majority of American manufacturers were experiencing serious shortage of qualified manpower; the manpower shortage was credited to negative perceptions that young people, their parents, and school counselors have of careers in manufacturing programs; and graduation trends in manufacturing occupational programs in two-year colleges were similarly found to be on the decline. Negative perceptions of manufacturing occupational programs by youths, their parents, and school counselors coupled with a decline in graduation trends may suggest a decline in enrollment in manufacturing programs. Hence the need to investigate into enrollment levels and the association between factors affecting student enrollment decisions in manufacturing occupational clusters in two-year colleges.

The literature review for this study was gathered from several sources including: history of apprenticeship; history of industrial revolution; history of community college in the United States; published and unpublished dissertations; professional journals; and government websites. The review covered historical perspectives on workforce education and training; economic and technological trends in manufacturing industry; trends in workforce development and education; and job data in manufacturing industry. It also covered roles of public education and government in workforce development; recruitment of students in two-year colleges; strategies for marketing and public awareness of programs; and student enrollment decision factors.

The target populations for the study were full time instructors, academic advisors, and program directors of manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States. The targeted two-year colleges were mostly community and technical colleges that offer certificate and associate's degree programs in manufacturing-related occupations. About 1,455 full time faculty and academic advisors from 155 two-year colleges were identified as potential participants in the study, but only 1,300 actually participated.

A 9-item survey instrument was designed to gather information from the perspectives of the targeted populations with respect to how their schools introduce manufacturing occupational programs to prospective students; their recruitment techniques; influence strategies; and the role socioeconomic status of prospective students play in enrollment decisions. It also covered recent enrollment levels; discontinued programs; and plans respondents' colleges have for the future. The survey instrument was divided into six sections: awareness; influence; recruitment; socioeconomic status; enrollment levels; and demographic sections. Items 1, 2, 3, 4, and 8 consisted of 63 Likert-type statements, while items 5, 6, and 7 were statements requiring monosyllabic responses with provisions for input data, if required, and item 9 was a demographic question.

The survey instrument was converted to online format by the NDSU Group Decision Center, and electronically distributed to respondents by the researcher through email addresses obtained from the catalogs and websites of the two-year colleges in the Great Lakes and Plains States. Of the 1,455 potential respondents who received the survey instrument, 155 eliminated themselves from participation for various reasons, thereby narrowing sample size to 1,300. Of the remaining 1,300 who did not eliminate themselves from participation, 355 responded to the survey instrument but only 288 responses were properly completed and useable for data analysis.

The Group Decision Center analyzed the useable survey instruments and provided descriptive statistics of summary of the results in percentages, bar graphs, pie charts, and frequency distribution tables. The data were further analyzed by the Applied Research Center at the University of Wisconsin-Stout using *PSAW* for path analysis (standardized partial regression) and discriminant analysis to determine the associations between enrollment decision factors and the linear combination of independent variables that accounts for the most variation in enrollment size.

Summary of Findings

The results of descriptive analysis showed that respondents varied program mix in manufacturing departments in their colleges to attract more students and to improve on enrollment size by either discontinuing or adding more manufacturing related programs. Demographically, they consisted of academic advisors, instructors, professors, program directors, deans, and department/division chairs of manufacturing occupational programs in two-year colleges in the Great Lakes and Plains states.

Respondents were most likely to create student awareness of manufacturing occupational programs by improving on reputation of the programs; arranging for campus visit; using friends of prospective students in the college; and by involving manufacturing faculty members in the recruitment process. They did not believe that: admissions office; student ambassador of the college; college admissions counselors; and workforce investment act were better approaches to creating student awareness of manufacturing occupational programs in two-year colleges. This finding closely corroborates previous research findings on sources of student awareness of specific academic programs (Sandford et al., 2006).

They believed that factors that most influence students to enroll in manufacturing programs were: personal interest in manufacturing programs; friends in the program; campus visit; manufacturing faculty members from the college; and father or male guardian. They did not consider high school athletic coaches, bulletin board advertisement, high school guidance counselor, and college admissions counselors to be effective influencing factors for student enrollment in manufacturing occupational programs in two-year colleges. This result is generally in agreement with previous research findings on factors that influence students to enroll in a specific college program at a college (Sandford et al., 2006; Esters & Bowen, 2004).

The descriptive analysis showed that respondents considered: instructors in the manufacturing-related programs at the college; expected earnings; program reputation; face-to-face interactions with high school students; career goals; and program information on the college website to be the most effective recruitment strategies. On the other hand they considered: admissions counselors/representatives; high school recruitment posters; recruiters to high school career days; advertisement through public media; and bulletin board advertisement at high schools to be the least effective recruitment strategies. This result is in agreement with most of what the literature suggested as the most effective and least effective recruitment strategies (Gray & Daugherty, 2004; Belcher et al., 2003).

The descriptive analysis also showed that the socioeconomic factors that most affect students' enrollment decisions in manufacturing programs were: lack of clear understanding of career pathways in manufacturing industry by career guidance and counselors; lack of clear understanding of career pathways in manufacturing industry by high school students and their parents/guardians; economic status of parents or guardians; and exclusion of manufacturing careers in students' career goals. This finding does not only corroborate previous research findings on manpower shortages in the manufacturing industry, it also confirms previous research findings on the impacts of socio-economic status on college enrollment (NAM, 2003; Bowen, 2004; Longmire and Company, 2008).

On the whole, about 29% of the schools studied discontinued offering a total of 77 manufacturing related programs in the past five years, and about 7.3% planned on discontinuing 16 manufacturing occupational programs in the next two years. About 49.6% of the total respondents did not plan on adding any new manufacturing-related programs in the next five years, but 50.4% planned on adding a total of 134 new manufacturing-related programs in the next five years. While most respondents characterized student enrollment in their colleges as either stable or increasing, only 20.7% indicated it was decreasing in their colleges. These findings may suggest that student enrollment in the manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States is either stable or increasing. Implications of these findings relative to what literature has suggested are discussed under conclusions and implications of the findings.

The path analysis showed that, the total effects of awareness factors on student enrollment decision was 0.1567; direct effect was 0.122; and indirect effect was 0.0347. The path to student enrollment that is better supported starts from awareness factors and goes through influence factors and recruitment factors to enrollment. This may suggest that, awareness knowledge of manufacturing related programs at a college alone is not enough to attract students into enrollment. There must be some form of recruitment activities and individuals who exert influence on potential students should be involved during recruitment activities. Events that influence students into enrollment must similarly be organized and conducted for meaningful enrollment to be expected.

The discriminant analysis showed that, there were significant differences between groups on each of the independent variables; Log determinants were similar; and Box's *M* indicated lack of statistical significance (Box's $M = 14.122$; $F = 1.357$; $p > 0.194$), suggesting homogeneity of variance. The discriminant function indicated a significant association between groups and predictor variables, but the canonical correlation was only 0.239, suggesting that only about 6% of between groups variability was explained. The structure matrix showed that only two predictor variables were significant: recruitment (0.830); and awareness (0.759). The cross-validated classification showed that overall 58% of all cases were correctly classified.

Conclusions and Implications of the Findings

Five hypotheses and one research question were addressed in this study. Each is briefly discussed below with its findings.

Hypothesis 1: Awareness factors have a direct effect on student enrollment decisions in manufacturing programs in two-year colleges

This hypothesis was tested by equation 5. The regression analysis of the output of equation 5 showed that, the direct path to student enrollment from awareness factors was not statistically significant: $\beta = 0.122$; $p < 0.200$; R-Square = 0.039. While the standard regression coefficient was positive, the explanatory power of the model was far below 10%. Therefore, the hypothesis is not supported. The implication of this finding is that, mere awareness knowledge of manufacturing occupational programs at a college may not be enough to attract prospective students into enrollment.

Hypothesis 2: Student enrollment in manufacturing programs in two-year colleges is directly affected by influence factors and indirectly affected by awareness factors.

Equation 2 and the influence section of equation 5 tested this hypothesis. The regression analyses of the output of these equations showed that, for equation 2, awareness: $\beta = 0.626$; $p < 0.000$; and R-Square = 0.392. For influence factors in equation 5: $\beta = -0.136$; $p < 0.185$; and R-Square = 0.039. While the first section of the path was statistically significant, the second had a negative regression coefficient, and only 3.9% of the model variation was explained. Therefore, the hypothesis is not supported. This finding implies that influence and awareness knowledge alone are not enough to attract students into enrollment in manufacturing occupational programs in two year colleges.

Hypothesis 3: Student enrollment in manufacturing programs in two-year colleges is directly affected by recruitment factors, and indirectly affected by awareness and influence factors

Equation 3 and the recruitment section of equation 5 tested this hypothesis. The regression analyses of the output of these equations showed that, for equation 3, the path from awareness factors to recruitment factors was statistically significant ($\beta = 0.350$; $p < 0.000$), and the path from influence factors to recruitment factors was also statistically significant ($\beta = 0.499$; $p < 0.000$). About 59% of the model variation (R-Square = 0.590) was explained. For the recruitment section in equation 5: $\beta = 0.182$; $p < 0.088$; and R-Square = 0.390. According to Martin et al. (2004), to be considered significant, at least one independent variable in a particular path analysis model must be statistically significant and the model must explain a substantial portion of the variation in the dependent variable. In this path model, two independent variables (awareness and influence) were statistically significant, and the model variation was substantially explained. Therefore, the hypothesis is supported. This may suggest that enrollment in manufacturing occupational programs is directly dependent on recruitment activities and inversely dependent on awareness and persons/things that influence students into enrollment.

Hypothesis 4: Student enrollment in manufacturing programs in two-year colleges is directly affected by socioeconomic factors and indirectly affected by recruitment and awareness factors.

Equation 4 and the socioeconomic section of equation 5 tested this hypothesis. The regression analyses of the output of these equations showed that, the path from awareness factors to socioeconomic factors was not statistically significant ($\beta = 0.141$; $p < 0.121$), and the path from recruitment factors to socioeconomic factors was similarly not statistically significant ($\beta = 0.060$; $p < 0.508$), and only about 3.6% of the model variation (*R*-Square = 0.036) was explained. The socioeconomic path in equation 5 was similarly not statistically significant ($\beta = -0.005$; $p < 0.943$) and the model explanatory power was less than 10% (*R*-Square = 0.039). Therefore, the hypothesis is not supported. Contrary to several descriptive research findings in literature that have suggested that socioeconomic factors affect student enrollment in higher education (NAM, 2003; Bowen, 2004; Longmire and Company, 2008), the path analysis of enrollment factors showed that socioeconomic factors do not affect student enrollment in manufacturing occupational programs in two-year colleges.

Hypothesis 5: Manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States are not in decline

This hypothesis was tested by responses to item 8 of the survey instrument: “Overall, how would you characterize enrollment in manufacturing programs in your college?” The descriptive statistics of responses to this question showed that, of all respondents, 20.7% indicated that student enrollment in manufacturing occupational programs in their colleges was decreasing; 38.5% indicated it was stable; while 40.8% said it was increasing. Therefore, the hypothesis is supported.

Previous research findings in workforce education and development found that there were serious shortages of skilled manpower in the manufacturing industry in the United States (NAM, 2003; The Manufacturing Institute, 2005; Deitz, & Orr, 2006), and the graduation trends in the manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States was found to be similarly on the decline (Eighmy, 2009; Eighmy & Karl, 2010). This finding poses several implications: (a) Enrollment is increasing but not every enrolled student is graduating, therefore graduation trends will decline and a shortage of skilled manpower will occur; (b) Enrollment is increasing but manufacturing occupational programs in two-year colleges are grossly misaligned with industry demands, therefore a shortage of skilled manpower will occur; (c) Enrollment is increasing but the manufacturing industry is expanding faster, therefore a shortage of skilled manpower will occur.

Research Question 6: What is the linear combination of independent variables that accounts for the most variation in enrollment size?

This research question was addressed by responses to item 8 of the survey instrument. The discriminant analyses is of these responses showed that, the estimated function model (linear combination) was: D = 0.552(Awareness) – 0.678(Influence) + 0.965(Recruitment) – 0.092(Socioeconomic). The estimated function model revealed in numerical values the standardized canonical discriminant function coefficients, the beta weights, or the amount of influence exerted on the function model by independent variables (awareness, influence, recruitment, and socioeconomic status). Scanlan (2004) posited that, the standardized discriminant function coefficients “allow us to compare and rank the relative importance of each independent variable in predicting group membership” (p. 10). The minimum beta weight an independent variable must attain on the discriminant score to be considered important is ± 0.3 – 0.4 (Scanlan, 2004). This implies that, recruitment is the best discriminator because it contributes the most to the discriminant score, followed by influence, and then by awareness. Socioeconomic status is the worst contributor to the discriminant score.

While the standardized canonical discriminant function coefficients are used in assessing influence and contributions of independent variables to the discriminant functions, the structure matrix correlations are used in assigning meaning to the discriminant functions and in ordering independent variables by absolute size of their correlations with the function. According to Scanlan (2004), a correlation of 0.30 or more is considered important in defining a discriminant function. For this analysis, the structure matrix table showed that: D = 0.830(Recruitment) + 0.759(Awareness) + 0.319(Influence) + 0.044(Socioeconomic). This implies that, socioeconomic factors may be considered not associated with student enrollment. While influence is minimally loaded on the discriminant score, recruitment and awareness are the main independent categorical factors (variables) that predict enrollment size (increasing or decreasing). This finding may suggest that, two-year colleges that seek to increase enrollment in their manufacturing occupational programs must first expand on the awareness knowledge of their programs and then intensify their student recruitment activities.

The major highlights of the findings of this study are as follows: (a) the results of the descriptive analysis corroborated most of what the literature suggest are the most and the least effective awareness, influence, recruitment, and socioeconomic factors that affect student enrollment decisions; (b) the path analysis showed that, the path to the student enrollment in manufacturing occupational programs in two-year colleges passes through awareness, influence, and recruitment factors; and (c) the discriminant analysis showed that, awareness and recruitment factors are the main independent categorical variables that predict enrollment size in manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States.

Recommendations Regarding Utilization of the Findings

Based on the responses and comments of respondents and the overall findings of the study, the following recommendations are given:

1. Two-year colleges in the Great Lakes and Plains States are adding more than they are discontinuing offering manufacturing related programs; therefore, attempts should be made to align all manufacturing occupational programs with the industry demands to alleviate the shortage of skilled manpower in the manufacturing industry;
2. Recent research findings in workforce development and education attributed the endemic shortage of skilled manpower in the manufacturing industry to lack of enthusiasm on the part of young people to pursue manufacturing occupational careers, but this study found that, enrollment in these programs at the two-year college level is actually increasing and new manufacturing occupational programs are being added. This may suggest that lack of enthusiasm may not be a factor; therefore, it is advisable for manufacturers to work cooperatively with education leaders to determine the real causes of shortage of skilled manpower in the manufacturing industry;
3. Information gleaned from recent literature suggested that graduation trends in the manufacturing occupational clusters in two-year colleges in the Great Lakes and Plains States was on the decline, but this study found that enrollment in these

programs is actually increasing. This may suggest that there is a drop-out rate in these programs that may require the attention of officials in two-year colleges who are responsible for administration of these programs.

4. The discriminant analysis in this study showed that, enrollment size in manufacturing occupational programs in two-year colleges is predicted by awareness and recruitment factors. Therefore, two-year colleges may need to appropriate more funds and human resources in awareness and recruitment activities to expand on enrollment size in these programs; and
5. Though enrollment size is predicted by awareness and recruitment factors, path analysis showed that incorporating into recruitment activities people/things that influence prospective students will likely facilitate student enrollment into manufacturing occupational programs in two-year colleges.

Recommendations for Further Research

This study captured information regarding enrollment factors in manufacturing occupational programs in two-year colleges from the perspectives of academic advisors, instructors, and program directors. It used online survey instrument for data collection and descriptive statistics for data analysis to provide insights into the four variables that were investigated: awareness, influence, recruitment, and socioeconomic factors. It further used path analysis to determine the best path enrollment managers need to follow while in pursuit of prospective students. Finally, it used discriminant analysis to determine the linear combination of independent variables that accounts for the most variation in enrollment size. Based on the results of these analyses, the following recommendations for further study are given:

1. Replicate this study in other geographical regions of the country and compare the findings with the findings of this study;
2. Replicate this study using students who have already enrolled in manufacturing occupational programs in two-year colleges in the Great Lakes and Plains States as the target population, and then compare the findings with the findings of this study; and
3. Conduct a research to determine dropout rate in manufacturing occupational programs in two-year colleges in the Great lakes and Plains States.

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APPENDIX A. IRB LETTER OF APPROVAL

NDSU NORTH DAKOTA STATE UNIVERSITY

Institutional Review Board
Office of the Vice President for Research, Creative Activities and Technology Transfer
NDSU Dept. 4000
1735 NDSU Research Park Drive
Research 1, P.O. Box 6050
Fargo, ND 58108-6050

701.231.8995
Fax 701.231.8098

Federalwide Assurance #FWA00002439
Expires April 24, 2011

Tuesday, March 30, 2010

Dr. Myron Eighmy
School of Education
EML 216C

Re: IRB Certification of Human Research Project:

"The Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-Year Colleges"
Protocol **#HE10241**

Co-investigator(s) and research team: **Ralph Karl**

Study site(s): **NDSU/online** Funding: **n/a**

It has been determined that this human subjects research project qualifies for exempt status (category # 2) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, *Protection of Human Subjects*). This determination is based on the protocol form received 3/24/2010 and consent/information sheet received 3/29/2010.

Please also note the following:

- This determination of exemption expires 3 years from this date. If you wish to continue the research after 3/29/2013, the IRB must re-certify the protocol prior to this date.
- The project must be conducted as described in the approved protocol. If you wish to make changes, pre-approval is to be obtained from the IRB, unless the changes are necessary to eliminate an apparent immediate hazard to subjects. A *Protocol Amendment Request Form* is available on the IRB website.
- Prompt, written notification must be made to the IRB of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
- Any significant new findings that may affect the risks and benefits to participation will be reported in writing to the participants and the IRB.
- Research records may be subject to a random or directed audit at any time to verify compliance with IRB policies.

Thank you for complying with NDSU IRB procedures; best wishes for success with your project.

Sincerely,

Kristy Shirley

Kristy Shirley, CIP
Research Compliance Administrator

APPENDIX B. SUREY INSTRUMENT

Q1: Awareness FactorsThe following statements refer to factors that may make students aware of Manufacturing Occupational Programs in two-year colleges. Please indicate the extent to which you agree that each of the following items is an effective way of creating student awareness of your manufacturing-related programs.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
College Catalog	○	○	○	○	○
Admissions office	○	○	○	○	○
Friends at the college	○	○	○	○	○
Campus visit	○	○	○	○	○
Reputation of the program	○	○	○	○	○
Alumni of the program	○	○	○	○	○
Marketing/promotional materials	○	○	○	○	○
College website	○	○	○	○	○
College recruiters visiting high school	○	○	○	○	○
College admissions counselors	○	○	○	○	○
Student ambassador of the college	○	○	○	○	○
Manufacturing faculty members of the college	○	○	○	○	○
Advertisements in public media	○	○	○	○	○
Live in the community where college is located	○	○	○	○	○
Employer education programs	○	○	○	○	○
Workforce Investment Act	○	○	○	○	○

Q2: Influence FactorsThe following statements refer to factors that may influence students to enroll in Manufacturing Occupational Programs in two-year colleges. Please indicate the extent to which you agree that each of the following items is a factor in influencing students to enroll in your manufacturing-related programs.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
Father or male guardian	○	○	○	○	○
Mother or female guardian	○	○	○	○	○

Friends in the program	○	○	○	○	○
College admission counselors	○	○	○	○	○
High school guidance Counselor	○	○	○	○	○
Recruitment activities	○	○	○	○	○
Personal interest in manufacturing occupations	○	○	○	○	○
Relatives.	○	○	○	○	○
Family friends.	○	○	○	○	○
High school teachers.	○	○	○	○	○
Bulletin board advertisement at high school.	○	○	○	○	○
Manufacturing faculty members from the college.	○	○	○	○	○
High school athletic coach.	○	○	○	○	○
Campus visit.	○	○	○	○	○

Q3: Recruitment FactorsThe following statements refer to recruitment techniques that are commonly used to attract students into Manufacturing Occupational Programs in two-year colleges. Please indicate the extent to which you agree that each of the following recruitment techniques is effective in attracting students to your manufacturing-related programs.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
Recruiters visiting high school	○	○	○	○	○
Bulletin board advertisement at high school	○	○	○	○	○
Admissions counselors or representatives	○	○	○	○	○
Instructors in manufacturing-related program at the college	○	○	○	○	○
Program articulation with high school	○	○	○	○	○
Targeting undeclared students on campus	○	○	○	○	○

Face-to-face interactions with high school students	○	○	○	○	○
Program information on college website	○	○	○	○	○
Advertisement through public media	○	○	○	○	○
Recruiters to high school career days	○	○	○	○	○
High school recruitment posters	○	○	○	○	○
Department recruitment video	○	○	○	○	○
Printed brochures	○	○	○	○	○
Scholarship offers	○	○	○	○	○
Promote program reputation	○	○	○	○	○
Expected earnings	○	○	○	○	○
Career goals	○	○	○	○	○

Q4: Socio-economic FactorsThe following statements refer to socio-economic factors that affect students enrollment decisions in Manufacturing Occupational Programs in two-year colleges. Please indicate the extent to which you agree that each of the following socio-economic factors influence students enrollment decisions in manufacturing-related programs.

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
High school students and their parents/guardians do *not have a clear* understanding of career pathways in manufacturing industry.	○	○	○	○	○

High school counselors do not have a clear understanding of career pathways in manufacturing industry.	○	○	○	○	○
Economic status of parents or guardians	○	○	○	○	○
Parents perceive manufacturing careers as dead-end occupations.	○	○	○	○	○
Youths lack basic background in mathematics and science to pursue careers in manufacturing industry.	○	○	○	○	○
On-going relocation of manufacturing companies to other countries	○	○	○	○	○
Negative perceptions of manufacturing industry	○	○	○	○	○
Increased competition for students from four-year colleges.	○	○	○	○	○
Increased costs to students in tuition and fees.	○	○	○	○	○

Decline in manufacturing industry.	○	○	○	○	○
Employer demand for graduates.	○	○	○	○	○
Desirability of the work environment.	○	○	○	○	○
Student/parents perceive manufacturing as a low paying career.	○	○	○	○	○
Students career goals often exclude manufacturing careers.	○	○	○	○	○
Level of Education of parents or guardians.	○	○	○	○	○

Q5: In the past 5-years, have you discontinued offering any manufacturing related programs?

○ No ○ Yes, Specify:

If you have chosen "other", please specify:

Q6: Do you plan to discontinue offering any manufacturing related programs in the next 2-years?

◯ No ◯ Yes, specify:

If you have chosen "other", please specify:

Q7: Do you plan to add any new manufacturing related programs in the next 5-years?

◯ No ◯ Yes, specify:

If you have chosen "other", please specify:

Q8: Overall, how would you characterize enrollment in manufacturing programs in your college?

◯ Cyclical ◯ Decreasing ◯ Stable ◯ Increasing ◯ Don't know

Q9: What is your job title?

◯ Program Director ◯ Academic advisor ◯ Professor ◯ Instructor
◯ Other, please specify:

If you have chosen "other", please specify:

APPENDIX C. LETTERS TO PILOT STUDY RESPONDENTS

NDSU NORTH DAKOTA STATE UNIVERSITY

School of Education
NDSU Dept. 2625
P.O. Box 6050
Fargo, ND 58108-6050

Administrative Offices
210 Family Life Center
701.231.7921
Fax 701.231.7416
www.ndsu.edu/ndsu/education

The Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges

Dear respondent,

My name is Ralph Karl. I am a graduate student in the Department of Occupational and Adult Education at North Dakota State University, and I am conducting a research project to identify the association between factors that affect students' enrollment decisions in manufacturing-related programs in two-year colleges. Results of this study will help in designing recruitment strategies that would lead to successful recruitment of students into manufacturing-related programs, and successful recruitment will in turn lead to stable enrollment, proper prediction, coordination, and better alignment of workforce development needs with industry demands.

You are invited to participate in this research project. Your participation is entirely voluntary, and you may decline or withdraw from participation at any time, without penalty. If you decide to participate, please click on the link below to advance to the survey questions. By simply checking the appropriate responses, it should take about ten minutes to complete the questionnaire about factors that affect students' enrollment decisions in manufacturing-related programs in two-year colleges.

You will not be identified in the study and your responses will remain anonymous. Only the regression analyses of the information you provide will be made and reported in summary form.

If you have any questions about this project, please, call me at (701) 850-2386 or my advisor, Dr. Myron Eighmy at (701) 231-5775. If you have questions about the rights of human participants in research, or to report a problem, contact the NDSU IRB Office, (701) 231-8908, or ndsu.irb@ndsu.edu.

Thank you for your participation in this research. If you wish to receive a copy of the results, leave your name and contact address with Dr. Myron Eighmy at myron.eighmy@ndsu.edu.

Sincerely,

Ralph Karl
Researcher

Dr. Myron Eighmy
Research Advisor

Counseling SGC Suite C | *Educational Leadership* 210 Family Life Center | *Teacher Education* 155 EML Hall | *Institutional Analysis* 216 Family Life Center | *Occupational Adult Education* 216 Family Life Center

NDSU is an equal opportunity institution.

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

April 12, 2010

Dear Respondent,

You are invited to participate in the pilot study of the Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges. Below is the link to the Survey. http://tt1.opinio.net/s?s=8631
Thanks for your participation.

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

April 15, 2010

Dear respondent,

We recently invited you to respond to a survey to identify the Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges. The survey will close on Friday, April 17, 2010. We will appreciate if you would have a few minutes to respond to this survey. Again, the link to the survey is: http://tt1.opinio.net/s?s=8631

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

April 17, 2010

Dear respondent,

We recently invited you to respond to a survey to identify the Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges. This survey is scheduled to close today by 12:00 Midnight. If you have already responded, then disregard this notice. Otherwise, we will appreciate if you would have a few minutes to respond to this survey. Again, the link to the survey is:
http://tt1.opinio.net/s?s=8631

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

April 20, 2010

Dear respondent,

This survey did not close as scheduled because we did not get enough responses to run reliability test of the survey instrument. Therefore, we are still begging those who have not yet responded to take a few minutes and respond to this important survey on student enrollment in Manufacturing Occupational Programs in two-year collages. Once again, the link to the survey is: http://tt1.opinio.net/s?s=8631

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

April 22, 2010

Dear respondent,

This survey will close today by 12 Midnight. We did not get enough responses but we need to move on to the next phase of the study. If you are interested in the findings, then leave your name and email address with Dr. Myron Eighmy at myron.eighmy@ndsu.edu - we will email a copy of the research findings to you. Once again the link to the survey is:
http://tt1.opinio.net/s?s=8631
Thanks to all who have participated in this pilot study project.

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

APPENDIX D. LETTERS TO MAIN RESEARCH STUDY RESPONDENTS

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

May 3, 2010

Dear Respondent,

You are invited to participate in a survey to identify the Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges. We will appreciate if you would have a few minutes to respond to this Survey. The Survey will close on May 14, 2010. The link to the Survey is:
http://tt1.opinio.net/s?s=8862

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

May 7, 2010

Dear respondent,

We recently invited you to respond to a survey to identify the Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges. If you have already responded, then disregard this notice. Otherwise, we will appreciate if you would have a few minutes to respond to this important survey. Again, the link to the survey is: http://tt1.opinio.net/s?s=8862

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

May 12, 2010

Dear respondent,

We recently invited you to respond to a survey to identify the Association between Factors Affecting Enrollment Decisions in Manufacturing Occupational Clusters in Two-year Colleges. If you have already responded, then disregard this notice; otherwise, we are pleading with you to respond so we may have enough data to generalize the findings of the study. Again, the link to the survey is:

http://tt1.opinio.net/s?s=8862

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

College of Human Development and Education
North Dakota State University
FLC 216 Box 5057 Fargo, ND 58105
Phone: (701) 231-7210; Fax: (701) 231-7416

May 14, 2010

Dear respondent,

Disregard if you have already responded. This survey is not going to close on May 14, 2010 as was originally scheduled due to poor response, instead it will close on May 21, 2010; therefore, we are still asking you to respond so we may have generalizable data for the study. Again, the link to the survey is: http://tt1.opinio.net/s?s=8862

Sincerely,

Ralph Karl	Dr. Myron Eighmy
Researcher	Research Advisor

APPENDIX E. MANUFACTURING PROGRAM SERIES AND CODES STUDIED

1. 15.03 Electrical Engineering Technologies;

    15.0303 Electrical, Electronic and Communications engineering Technology,

    15.0304 Laser and Optical Technology,

    5.0399 Electrical and Electronic Engineering Technologies, Other

2. 15.04 Electromechanical Instrumentation and Maintenance Technology;

    15.0401 Biomedical Technology,

    15.0403 Electromechanical Technology,

    15.0404 Instrumentation Technology,

    47.0401 Instrument Calibration,

    15.0499 Electromechanical Instrumentation Technologies, Other.

3. 15.05 Industrial production Technologies;

    15.0603 Industrial/Manufacturing Technology

    15.06.07 Plastics Engineering Technology,

    15.0611 Mechanical Technology,

    15.0612 Industrial Technology,

    15.0613 Manufacturing Technology,

    15.0688 Industrial Manufacturing Technology,

    15.0699 Industrial Production Technologies, Other.

4. 15.07 Quality Control and Safety Technologies;

    Instructional contents for this group of programs are defined in codes 15.0701-15.0799.

5. 15.08 Mechanical Engineering Technologies;

    15.0805 Mechanical Engineering/Mechanical Technology,

    15.0899 Mechanical Engineering-related Technology, Other.

1. 15.11 Engineering-related Technologies;

    15.1103 Hydraulics and Fluid power Technology,

    15.1199 Engineering-related Technology, Other.

2. 15.12 Computer Engineering Technologies;

    15.0301 Computer Engineering Technology,

    15.1201 Computer Engineering Technology,

    15.0402 Computer Maintenance Technology, 16.1202 Computer Technology.

3. 15.13 Drafting/Design Engineering Technologies;

    15.1301 Drafting and Design Technology,

    48.0101 Drafting General,

    15.1301 CAD/CADD Drafting,

    15.1305 Electrical/Electronics Drafting,

    15.1399 Drafting/Design Engineering, Other,

    48.0199 Drafting, Other.

4. 47.01 Electrical/Electronic Maintenance and Repairer Technology;

    47.0101 Electrical/Electronics Equipment Installation and Repair,

    47.0105 Industrial Electronics Technology,

    47.0303 Industrial Mechanics and Maintenance Technology,

5. 48.05 Precision Manufacturing;

    48.0501 Machine Tool Technology,

    48.0503 Machine Shop Technology,

    48.0507 Tool and Die Technology,

    48.0508 Welding Technology" (p. 6)

APPENDIX F. RESPONDENTS TEXT INPUT FOR ITEMS 5, 6, 7, AND 9

Question 5

In the past 5 years, have you discontinued offering any manufacturing related programs?

Text input

Mechanical Design

Paper Chemistry, others

CNC

C.A.D +

Automotive Repair, Cabinet Making, Jewelry

CAD, CNC

Electronics

Lack of enrollment in Electrical program

Electronics technology

Manufacturing Technology

Electronics, Laser, Machinist Trades Apprenticeship

Industrial Truck Mechanic

Plastics

Machine tool program

Manufacturing Technology, Drafting

A Machine Tool Technology, Electronics Technology, Engineering

Closed Machine Tool, CAD and Industrial Electrical programs

Machine Shop

Mechanical Drafting

Tool & die

Mechanical engineering technology, drafting and design technology, mechanical drafting,

Mold making technology

Revised Manufacturing Engineering Technology to Mechatronics automation classes

Electronics

Machine Tool

Machining

Plastics

Higher ups made incompetent decisions on how to run programs, leaving good programs to fail

Aviation Mechanics

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CAD Design

Machine tool at our satellite campus

Residential electrician

Fluid power etc...

Hydraulics

Electrical Technician

Machinist program

Electronics

All but Elect Apprenticeships

Machine Tool, Automation

Automation

Automated Mfg. Due to low student enrollment

Low enrollment

Associate degree in Welding dropped, One-year diploma retained

Removed oxy-fuel welding from program

Automated manufacturing

Automotive

We dropped our machine tool degree

Repetition of curricula with other courses

Laser/Photonics

Hydraulics

Mechanical Design

Civil Engineering Technology

Combined a CNC program with a Tool & Die Program, there used to be two separate programs

Machine Tool; Quality Control

Tool and die

Electronics Technology

Construction

Previous employment at a customized training facility closed

Carpentry

Aviation Cabinetry

Mechanical Design

Industrial maintenance

Eliminated stand alone CIM program and rolled into Engineering Technology program

Electronics, machine tool

Fabrication

Machining

Automated manufacturing

Tool & Die Making

Electronics

Mechanical Design, Electrical Engineering Technician

Electronics

Machine Tool

Automated manufacturing; Electronics

Foundry

Electronics

Design Engineering, Horticulture

<u>Question 6</u>

Do you plan to discontinue offering any manufacturing related programs in the next 2-years?

<u>Text input</u>

Apprenticeships

It depends on enrolment

Electricity, Alternative Energies

Air Conditioning & Refrigeration

CAD

Robotics & Machine Tool

Fluid Power Technology & Machine Assembly Specialist

Combining 5 manufacturing programs into one per school boards decisions

Moving from two semester to one (CNC)

Machining

Electronic Engineering Technology

Pending enrollment and local need

Industrial machinery repair program will be eliminated due to no interest

Mechanical

Welding

Question 7

Do you plan to add any new manufacturing related programs in the next 5 years?

<u>Text input</u>

Mechanical Design and Micro Machining

Safety Lean Gree

Advanced Manufacturing

Energy

Expand maintenance programs, possible train maintenance program

CNC wind energy

Two-year A.A.S. in Welding Technology that will be a 2+2 Capstone with SIU-Carbondale, IL

Various ones

Advanced CNC programming on state of the art production machines (Swiss lathes)

Alternative Energy, Multi-craft

47 / 52

CNC

Advanced Technical Certificates

Pipe Welding

Engineering technology, alternative energy technology

Green related programming.

Wind energy

Production Engineering Technician

Plastics/polymers

Two-year production manufacturing degree where the students take a core block and then can specialize in chosen area

Mechatronics

Green technologies

Robotics

2-year associates CAD degree

Another welding offering

Engineering

Green

4-year degree

Nano-technology

Expand industrial maintenance program of study

Design Technology

Motor controls

Energy Technician Specialist

Welding Apprenticeship

Alternative Energy

Wind power

Injection molding

Eng Tech

Green careers

Pulse mig welding

Solar and other green related processes

Manufacturing Technician

Electrical maintenance

Wind energy

Energy Programs

Mechatronics

Solar technician

CAD Operator

Fabrication

Electricians Apprenticeship

Robotics

Solar

48 / 52

CNC Programming

Three-dimensional scanning technology advancements into solid modeling design

Recently added industrial maintenance certificate and will add/modify AAS in industrial Maintenance

Renewable fuels

Micro-manufacturing/medical etc

Basic math for welders taught in welding classroom

Micro machining - Maybe

Computer Integrated Manufacturing

Alternative Energy

Alternative energy

Medical Device Manufacturing

Alternative Energy Solutions

Production Engineering Technician, Plastics

Robotics

Industrial Engineering

Energy Tech

Robotics

Our Automation Technology has 5 different tracks to choose from. We plan on adding a new Track, Mechatronics

We added a Fabrication program this year and Mechatronics next year

Welding

Advanced Manufacturing and GD&T

Bachelor’s degree in Industrial Engineering

Welding technology & management; Prototype program

Wine and grape production program

Applied Engineering - Sustainability, Supply Chain Management

We are adding a new quality class this fall and added a materials class last fall

CAD/CAM Technician

Integrated systems troubleshooting, work flow

Chemical Technology

Maintenance

Green Energy

Advanced Processes

B.S. Industrial Engineering

Thinc Technology

Clean Energy Technology

CNC

Materials

Digital Fabrication diploma

Energy Generation

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Green energy manufacturing

Mechatronics

Expand in welding

Robotics

Construction trades

Manufacturing Engineering Technology

Mechanical technician

Adding a new welding jig program to the robot training course

Renewable energy

Machine condition monitoring & reliability track will be added to Engineering Technology Program

Engineering technologist

Re-design MFTG curriculum to include more CNC in all classes

Composites - for wind turbine components

Intelligent machine integration

Fabrication

Welding

Wind

Industrial Electronics

Possibly micro manufacturing

Chemical Process Technician

Depends where the industry goes; our job is to stay ahead of it.

Robotics Program

Clean Room Technician - Chemist

Energy related

Power distribution

Mechatronics, Robotics, AAS in Welding Technology

Renewable energies

Advanced fabrication

Ag Power

Renewable energy

Multi-skilled degree and Mechatronics degree

Unknown at this time

2-year degree

Solar

Robotics Academy

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Question 9
What is your job title?
Text input

Machine Tool Instructor & Department Chair

Division Chair

Dean, School of Technology

Program chair

Dept. Chair and Professor

Dean of Occupational Programs

Associate Dean

Telecommunications Assistant

Program director/Associate professor

Technician

Program director/Instructor

Manufacturing Instructor and Campus Division Chair

Industrial/Dean

Division Chair

Program Director and Instructor of the Drafting and Design program

Tech Prep Coordinator

Administrator

Division Chair of Agricultural and Industrial Technology

APPENDIX G. LISTS OF STUDENT ENROLLMENT DECISION FACTORS

Awareness Factors

Sources of student awareness of four-year automotive programs (Sandford, Frisbee, and Belcher, 2006, p. 4):

1. Reputation of the four-year automotive program;
2. Reputation of the university;
3. Tour of the Kansa Technology Center;
4. Friends at the university/community college/high school;
5. Campus visit;
6. Parent(s)/relatives;
7. High school/community college teacher;
8. Alumni of the university;
9. Alumni of the program;
10. University catalog;
11. Promotional materials;
12. High school/community college counselor;
13. Internet web page of the program;
14. University recruiters visiting high school/community college;
15. Admissions Office;
16. Student representatives of the program visiting;
17. Program faculty visiting high school;
18. Athletic coach/counselor; and
19. Articulation arrangement

Influencing Factors

Individuals influencing student enrollment in an urban agricultural education program (Esters & Bowen, 2004, p. 31):

1. Mother or female guardian;
2. Father or male guardian;
3. A friend;
4. Guidance counselor;
5. Another teacher;

6. Another family member: and
7. An agricultural teacher

Events and experiences influencing enrollment in an urban agricultural program (Esters & Bowen, 2004, 32):

1. Recruitment;
2. Interest in animals;
3. Career aspirations;
4. Parents;
5. School environment;
6. Family;
7. Good school;
8. Enjoyed outdoor activities;
9. Curriculum;
10. Friends; and
11. Neighborhood school

People who influence choice of career in technology education program (Gray & Daugherty, 2004):

1. High school technology teacher;
2. Other high school teacher;
3. Myself;
4. Parents
5. University professor
6. Coworker;
7. CC Counselor;
8. Friend
9. Relative;
10. Sibling;
11. Friends of the family;
12. High school athletic coach;
13. High school counselor; and

14. None

Recruitment Factors

Recruitment techniques used in the survey instrument for the technology teacher education study (Gray & Daugherty, 2004):

1. Face-to-face interactions
2. Maintaining rapport with high school technology education teachers
3. Current technology education students to recruit
4. Alumni to recruit
5. Modern Lab Facilities
6. Scholarships
7. Promote reputation of the program/university
8. Alternative certification programs
9. Share positive related characteristics
10. Contest for high school
11. Personal letters to students
12. Articulating university to community and technical colleges
13. Email to students
14. Talk at TSA or Skills USA type activities
15. Contact undeclared university students
16. Information on departmental website
17. Talk in University GE courses
18. High school counselors with information
19. Printed brochures
20. Talk during student teacher supervisions
21. Advertise through media
22. Wide variety of courses in department
23. Recruitment video
24. University recruiter to community and junior colleges
25. University recruiter to high schools
26. Recruitment posters

27. Recruiters to high school career days
28. Bulletin board display
29. Displays at Teacher conferences
30. Departmental open houses

Recruitment techniques used in the survey instrument to identify differences between faculty and students' perceptions of recruitment techniques that influence students to attend four-year automotive programs (Belcher, Frisbee, & Sandford, 2003, p. 11):

1. Reputation of automotive program
2. Reputation of the university
3. Campus visit
4. Parents and/or relatives
5. High school/community college
6. Technology recruitment activities
7. Friends at the university/community college/high school
8. Reading university catalogs
9. Community in which university is located
10. Promotional materials (brochures, video, letters)
11. Alumni of the university
12. Articulation or direct transfer from community college
13. Admission office at this university
14. University recruiters visiting high school
15. University recruiters vising my community college
16. Bulletin board at my previous school
17. Athletic advisor/coach