FACILITY REQUIREMENTS FOR TEACHING A STANDARDS-BASED HIGH SCHOOL TECHNOLOGY EDUCATION CURRICULUM

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Education in Workforce Development Education

By

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ABSTRACT

This research established the essential equipment, tools, hardware and software needed to teach a contemporary standards-based Technology Education program at the high school level with one teacher. A three round Delphi study established what a contemporary Technology Education lab should ideally include utilizing the expert opinion of teachers in the field, teacher educators and administrators with direct roles in program development. The research also suggests types of activities which could be utilized in such a facility. Equipping a facility with these essential items could assist teachers in preparing students to become technologically literate, by addressing all of the *Standards for Technological Literacy* to include engineering and design concepts.

Most Americans believe all citizens should be technologically literate and should have adequate facilities to accomplish that goal (Rose, Gallup, Dugger and Starkweather, 2004). Shields and Harris (2007) indicated Technology Education facilities and components have been less defined over the past 26 years creating confusion when identifying Technology Education facilities and programs. The panel of experts chosen for this Delphi study established three categories: essential items, moderately important items and non-essential items. The panel identified equipment, tools, hardware and software needed to equip a contemporary Technology Education facility giving the teacher laboratory capabilities to teach a standards based curriculum.

Such a facility might provide a setting in which high school students could graduate with a basic understanding of technology; how to assess, use and manage technology in a facility with similar tools, equipment, hardware, and software; or in other words, achieve technological literacy (ITEA, 2000). Such a list gives school

administrators a tool to better understand facility needs, curricular areas, examples of activities, as well as the equipment, tools and materials necessary to implement a standards-based program within their respective districts.

INDEX WORDS: Facility Design, Technology Education Facility, Laboratory Design, Technology Education, School Architecture Design and Development, Technology Education Facility Needs, Technology Education Lab, Technology and Engineering Education Lab

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CHAPTER 1

Introduction

Context of the Problem

The first step necessary to achieve technological literacy at the high school level is to have a uniform set of outcomes or standards. Devleped and published by the International Technology and Engineering Educator's Association (ITEEA) the *Standards for Technological Literacy* serve that purpose (ITEA, 2000). Second, the standards must be taught using a prescribed standards-based curriculum, such as ITEEA's "Engineering by Design" establishing the coursework for achieving technological literacy (ITEEA, 2008). Finally, a clearly defined list of machines, equipment, hardware, software and materials prescribe what tools, machines, hardware and software are necessary to teach a standards-based curriculum. When combined, these compoents will allow schools and school districts to determine whether or not they want to invest time and money in a program serving as a path to technological literacy for all students. These components would assist the local technology teacher in establishing what is needed to meet national standards for technological literacy, rather than trying to establish a comprehensive technology program, curriculum and facility on his or her own.

Although Technology Education is rooted in an Industrial Arts heritage, the two disciplines have moved in the opposite direction since the emergence of Technology Education in the mid-1980s (Ritz & Reed, 2006). Until the 1980s, Industrial Arts was easily recognized in a school setting. Industrial Arts is often referred to as shop class or simply shop, and has defined spaces (i.e. wood shop, metal shop) and equipment (i.e. table saw, milling machine). Technology Education has grown to be more comprehensive than Industrial Arts, and since its inception in 1985, began including more content areas such as communication, transportation, and engineering. While some traditional Industrial Arts shops transitioned into more inclusive Technology Education laboratories, the equipment varied from school to school depending upon the curriculum implemented. Some schools kept traditional Industrial Arts programs while implementing a Technology Education program, which slowed the change from traditional Industrial Arts to Technology Education (Ritz & Reed, 2006).

Since the integration of Technology Education in the field, several factors influenced the direction to the current practice in the field. First, the *Standards for Technological Literacy* was published by the International Technology Education Association in 2000 defining the competencies all students should know and be able to do in order to become technologically literate. These standards provide a rationale for teaching Technology Education as a discipline (ITEA, 2000). Second, Project Lead the Way introduced "Pathway to Engineering" in 1997, a pre-engineering program complete with a defined curriculum, professional development, laboratory spaces, and defined equipment requirements (PLTW, 2009). Finally, the International Technology Education Association (ITEA) — the largest professional teacher association in the field — voted in February 2010 to change the name of the organization from the ITEA to the ITEEA. This move signaled to everyone that the field of Technology Education would also serve as a pre-engineering curricular subject complete with its Engineering by Design (EbD) curriculum (ITEEA C, 2010). Given the changes in the field, curricular models such as Industrial Arts, Project Lead The Way, and Technology and Engineering Education have varying opinions on what the curriculum should contain and how the program should be taught. Although all of the models encourage hands-on activities, Industrial Arts and pre-engineering programs approach the curriculum and learning activities differently. Industrial Arts centers around woodworking and metalworking projects, while the pre-engineering programs focuses on the design process. The only curriculum currently based on a national set of standards is the EbD curriculum, yet this ITEEA model is the only curricular area mentioned without defined laboratory spaces. The field of Technology Education needs to define what machines, equipment, hardware, software and materials are necessary to teach a standards-based curriculum. ITEEA did establish a task force in 2008 to establish a facility planning guide and was developed primarily through the work of the task force chairman, Michael Neden (ITEEA A, 2010). However, the facility guide recommended machines and spaces for a TE facility without any statistical data to reinforce its recommendations (ITEEA A, 2010).

The field did not evolve overnight; Technology Education has changed many times throughout the course of history. Although there were many developments with the pedagogy of Technology Education, developments are categorized into six distinct eras (Barlow, 1967):

- 1829-1890: The first development was associated with Victor Della Voss and the Russian system in the mid to late 1800s. In this system, exercises were used to teach skills in small elements, which later tied to a larger system. This is similar to teaching welding by using scrap metal pieces and repetitive practice.
- 1849-1907: The second distinct period was based on the Swedish Sloyd System introduced by Uno Cygnaeus and Otto Soloman in the countries of Finland and Sweden. This systems was developed in the late 1800s, shortly after the Russian

system was introduced, where simple, useful wooden items were made by students to gain their interest. The system is often criticized because it lacked quality design and aesthetics (Parker, 1912).

- 1880-1910: The third era marked the Arts and Crafts period, ending in the early 1900s. The emphasis of the field changed to more design and artistic expression – both qualities were aesthetic – while shifting away from the ability to use a tool or machine.
- 1890-1940: The industrial period in the first half of the 1900s was best known for Manual Arts. At this time, occupational training was introduced into the general education curricula. Manual arts system practices have similarities to that of the Russian System, where repetitive skills were utilized.
- 1908-1985: The Industrial Arts era established manual activities for general purposes versus activities for specific occupational training and was found in most schools up until the mid 1980s. Industrial arts was essentially developed from the manual training era, and was prominent in most schools until the 1980s.
- 1985-Present: Technology Education was introduced as a method for teaching technological literacy (ITEA, 2000). The emergence of Technology Education as a curricular subject provided the framework for the development of the *Standards for Technological Literacy*, published in 2000. In 2010, the ITEA changed its name to include engineering and became the ITEEA.

The field has made several transitions over the past century, yet this study will focus on the last two eras which include programs currently used in the high school setting. The Industrial Arts era of the mid 1900s, was defined by Barlow (1967) as the study of industrial tools, materials, processes, products, and occupations pursued for general education purposes in shops, laboratories and drafting rooms. Industrial Arts curricula provided courses such as Woods, Metals, Drafting, and Automotive which were further delineated by a numbering system such as Woods I, Woods II and Woods III reflecting the philosophy of the discipline and the needs of society at that point in history (Reeve, 2002).

Technology Education was defined in 1985 by the American Industrial Arts Association as "a comprehensive, action-based educational program concerned with technical means (technology), their evolution, utilization, and significance; with industry, its organization, personnel systems, techniques, resources, and products; and their socio-cultural impacts" (Maley, 1973). The International Technology Education Association redefined the field as a school subject specifically designed to help students develop technological literacy, meaning the ability to use, manage, understand, and evaluate technology (ITEA, 1996).

Although Industrial Arts and Technology Education are based in general education, serve all students, they serve two distinct purposes. While Technology Education focuses on technologically literacy as defined in the previous paragraph, Industrial Arts was and is still concerned with three concepts: first, that students solve problems with tools, materials and processes which are associated with industry; second, the program provides hands-on exploratory experiences; and third, students gain the ability to produce and use technical drawings (Barlow, 1967).

The ITEA's *Technology for All Americans Project* established the field as an important curricular subject across all grade levels for all students (ITEA, 1996). The result of this important project was the creation of a national set of standards to guide schools in developing equal opportunities for all students to achieve basic technological literacy (Rose & Dugger, 2002). Even though the standards provided a framework to teach technological literacy, reality indicated that not all schools and Technology Education teachers were as ready to embrace the change developed by the ITEA (Newberry, 2001).

The ever evolving profession was moving from a traditional Industrial Arts program to a much more comprehensive and inclusive program. These developments created a new issue hindering the ability for people to understand the new curricular area of Technology Education. Terminology became an obstacle to change as the term "technology" created a significant misunderstanding (Dugger, 2009).

The personal computer introduced to the general public in the early 1980s had a significant impact on the perception of technology education. Now when Technology Education is mentioned, most people equate the term to computer education or educational technology (National Academy of Engineering National Research Council, 2009; Rose, Gallup, Dugger and Starkweather, 2004). Some authors suggest this misunderstanding occurred because many schools changed the Industrial Arts program in name only. In other words, they coined the name Technology Education but continued to teach traditional Industrial Arts programs (Newberry, 2001). Sanders noted that even after 15 years in the Technology Education profession, he observed course titles in schools associating Technology Education with a majority of traditional titles such as Woods, Metals, Automotive and Drafting (Sanders 2001). This observation indicated that even though schools pursued teaching Technology Education in context, it appeared that many educators did not know what changing Technology Education entailed. Schools in different locations implemented significantly different curricula and laboratories and all under the umbrella term "Technology Education". Unlike Industrial Arts, which was easily identified by most people because of the facilities and equipment, Technology Education was not as accurately identified and needed a clear and defining laboratory environment. Specifically, Technology Education needed a specified curriculum capable of being used to teach a standards-based curriculum (Shields & Harris, 2007).

The confusion surrounding the term Technology Education is exposed at the classroom level. John White, a Technology Education instructor at St. Mary's/Colgan High School in Pittsburg, Kansas, reflected on a previous conversation with one of his administrators in the spring of 2009. The administrator stated "let's refer to your technology, meaning Technology Education as the 'little t' and my technology, referring to educational technology as the 'big T' because it is what all kids need to know to go to college and get good jobs" (White, 2009). This sentiment is common in most areas of the country according to the Gallup polls given in 2001 and 2004, respectively. When asked what first comes to mind when the term technology is used, 67% stated computers in 2001 and 68% indicated the same in 2004 (Rose et al., 2004).

Until Technology Education establishes a universally recognized identity- including a defined environment and a specific list of equipment, tools, hardware and software - confusion and misunderstanding of the intended mission of Technology Education will exist (Shields et al., 2007). As a result of poor identity, several related problems exist: public school administrators will be confused when determining what programs to implement, the classroom teacher may not have the appropriate facilities or equipment to teach the standards, students may not be prepared for the world they are entering, and parents may not have a good understanding of what possibilities are available for their children. Although many high quality innovative programs were developed during the 1980s and early 1990s, changes in administrative personnel and revised graduation requirements resulted in a patchwork of programs in public high schools (Suhr and Dettelis, 2009).

Statement of the Purpose

The purpose of this study is to determine the machines, equipment, hardware, and software programs needed for a high school with one teacher to teach the *Standards of Technological Literacy* to all students.

Statement of Research Questions

1. What machines, equipment, hardware, software, and materials are essential components of a Standards Based Technology Education high school model program according to a panel of experts?
2. Can the Delphi panel establish a set of categorical components based on the following descriptors: essential items, moderately important items and non-essential items?
3. Do significant differences exist between the agreement levels on the elements based on expert qualifications?

Definitions

The following terms were operationally defined clarify the study.

Career/Technical Education/Vocational Education: These areas are responsible job specific training for career preparation in a selected career field (ITEA, 2000).

Content Organizers: Categories of information within the framework of Technology Education which define specific areas such as communication, production, design, and construction (Suhr et al., 2009).

Educational Technology: Educational technology promotes the use and understanding of various computer systems and software applications to enhance the teaching and learning process (ITEA, 2000).

Engineering and Design: Engineering and Design focuses on the study and practice of applying practical math and science concepts to the design and engineering process (ITEA, 2000).

Industrial Arts: Is a study of changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes (Bonser & Mossman, 1923); or part of general education dealing with industry and with the problems of life resulting from the industrial and technological nature of society (Foster, 1994).

Model Program: Defines a Technology Education program committed to providing technological study, which are safe, facilitate creativity and enable students to meet local, state and national technological literacy standards (ITEA, 2008).

Modular Technology Education: A defined lab space where students spend the majority of their classroom time completing self-directed instructional activities. This space is equipped with the materials, tools and equipment that are required to complete the learning activities (Petrina, 1993).

Standards for Technological Literacy: These are also known as “STL”, these standards are designed as a guide for educating students by prescribing the intended outcomes needed for the study of technology at all grade levels; but do not provide a set curriculum (ITEA, 2000).

Technology Education: A school subject specifically designed to help students develop technological literacy; in other words, the student's ability to use, manage, understand, and evaluate technology (ITEA, 1996).

Technological Literacy: An educational goal that promotes the concept that all students should have a minimum level of understanding of technology and how it affects their lives; stating they should be able to use, manage, assess and understand technology (ITEA, 2000).

Assumptions

Participants in this study were chosen based on the following criteria:

1. Each has a demonstrated understanding of the *Standards for Technological Literacy* (STL) directly relating to this study.
2. Each are members of a related profession: a Technology Education or related Science, Technology, Engineering, and Mathematics [STEM] classroom teacher at the high school level; those who prepare high school Technology Education teachers at the college or university level; individuals who promote technological literacy in an administrative role; and selected individuals who have significant real-world experience in Technology Education laboratory design or have experience in *Standards for Technological Literacy* Development.

It is assumed the participants of this study were unaware of other participants so they could provide honest, unbiased responses. It is also assumed the participants were computer literate and had the ability to communicate through a variety of technological means to include telephone, facsimile, and email.

The results of this study will provide a model with the following assumptions:

1. The program in the school will have a single Technology Education teacher who is charged with teaching a standards-based Technology Education program.
2. The basic model can be replicated in other schools of varying sizes, allowing larger schools with more instructors to teach additional classes which accommodate larger student populations as well as offer specific technology programs which supplement the technological literacy model.

Limitations and Delimitations

Limitations to the study include not defining the cost of implementing the proposed model for Technology Education. The listing of tools, equipment, hardware and software will prescribe the general nomenclature for each tool, piece of equipment or hardware as well as software; however, the list will not prescribe the vendor nor the cost of the equipment, as this will be at the discretion of the local school. The study will focus on Technology Education as the focal point of accomplishing technological literacy and not infer that engineering is the focus. Instead, engineering will be used as a descriptor used to define an area of technology.

Significance of the Study

With the development of a standardized facility and curriculum, students across the United States will be provided an equal opportunity to achieve technological literacy. If the proposed study were implemented, every high school student would have the opportunity to study technology and engineering in an adequate laboratory. School administrators will understand and be able to implement what comprises a standards-based Technology Education program. The administrators will understand the facility, the curricular areas, examples of activities, as well as the equipment, tools and materials necessary to implement the program within their respective districts (Lewis, 1999).

Conceptual Framework

Most Americans believe the daunting task of technological literacy should be a priority for our public school system (Rose et al., 2002). Each technology educator is responsible for ensuring his or her students are being prepared to enter the world in which they will live, as defined by the *Standards for Technological Literacy*. Educators must also provide machines, equipment, hardware, software and materials necessary for teaching technological literacy (ITEA, 1996). Increasing accountability in schools demands improved performance on standardized tests in curricular areas like mathematics, reading and science. Although necessary for the overall development of students according to ITEEA, many programs like Technology Education might not appear as important because of current testing practices (National Academy of Engineering and National Research Council, 2009). In many cases, test scores from paper and pencil tests are used as the sole determining factor of student success, but these same tests leave out critical ideals such as problem solving and creative thinking - critical in today's technolgical world (McKim, 1987).

Standardizing a curricular field allows students to have the same opportunities and hopefully achieve optimum success within the curricular area; however, if states do not want participate in the idea of standardization from the national level, standardization will be more difficult and will result in not every student being given the same opportunities (Ravitch, 1995). In the case of the *Standards for Technological Literacy*, the framework was standardized and prescribed outcomes for all students to become literate (ITEA, 2000). Currently, determining how many schools actually conform to the *Standards for Technological Literacy* is difficult, Newberry (2001) suggests 30.8% of states consider technology education an elective and another 19.2% indicated it was not the state's framework at all. Ritz and Reed (2005) suggests school districts will encounter difficulties teaching to the *Standards For Technological Literacy* if the following is not understood:

- teachers nearing the end of their career could be reluctant to change to address the new standards.
- newly trained teachers not adequately prepared to teach comprehensive technology education may not understand or be able to to adequately teach the Technology Education program.
- some teachers may feel a comprehensive technology education would not reflect the needs of a community that has previously supported the traditional programs and viewed them as a necessary part of school curriculum - even though traditional programs may not serve all students or move the entire student population towards technological literacy.

The only way to achieve technological literacy at the high school level is to outline a clear and concise set of outcomes or standards, as established in the *Standards for Technological Literacy*. The standards must then be enforced by a prescribed standards-based curriculum establishing what will be taught, such as ITEEA's "Engineering by Design". The final component needs to be a consistent and defined list of machines, equipment, hardware, and software which prescribe necessary components needed to teach the standards. (ITEEA A, 2010) When these components are combined, school districts can better evaluate whether or not they want to invest time and money in a program that could serve as a path to technological literacy for all students. These components would assist the local technology teacher in establishing what is needed to meet national standards for technological literacy, rather than trying establish a list of necessary components on his or her own.

Methods

A modified Delphi study was utilized to identify the ideal list of tools, equipment, hardware, and software of a model standards-based program that can provide the necessary medium for accomplishing Technological Literacy. The Delphi members were comprised of high school classroom teachers, university Technology Education teacher preparation professors, as well as state supervisors and school administrators with experience in laboratory/program development and/or play or have played a role in the development of the *Standards for Technological Literacy*.

Round 1 Modified Delphi

The Delphi study consisted of three rounds of questions, developed for establishing consensus of what lab equipment, tools, hardware, and software are needed to deliver technological literacy in the classroom. An ancillary list of activities was also developed to reinforce teaching the standards in a model program. The round one open ended questions established the major types of lab equipment, tools, hardware, and software needed. Round one data was tied directly to standards; specifically, the Delphi panel established, by standard, what specific equipment, tools, software and hardware were needed in a Technology Education facility.

Round 2 Modified Delphi

Round two categorized the aforementioned items determined by round one questions and asked the participants to rank each item on a five point anchored Likert scale with the following rankings: (1) unimportant, (2) of little importance, (3) moderately important, (4) important, and (5) very important. The purpose of round two was to establish basic descriptive statistics, to include the mean and standard deviation for each response.

Round 3 Modified Delphi

Round three allowed the participants to analyze the limited descriptive results from round two and make changes as necessary in order to come to consensus. The participants were given the group mean, group standard deviation, and the ranking they gave for each question in order to see how their answer compared to others. This round allowed the opportunity for the participants to change their response to gravitate towards the group mean. After round three was returned, the data was evaluated using an Analysis of Variance (ANOVA) test to determine if notable differences existed between the responses from the three categories of experts.

As a result of the study, a consensus of necessary components was established allowing school districts, high school teachers, teacher preparation faculty and parents to better understand what equipment and materials are necessary for high school students to achieve technological literacy.

Chapter Summary

Technology Education has a rich tradition and historical roots dating back more than a century and each era had an influence on the development of the field as it is known today. Technology Education was intended to provide all students with the basic concepts of technological literacy, yet that idealism has yet to come to fruition. The International Technology and Engineering Educator's Association developed the *Standards for Technological Literacy* as well as the recommended curriculum *Engineering by Design*, documents defining the philosophical foundation for technological literacy as well as what outcomes are to be taught. A necessary, yet lacking component was what a model technology lab should contain in order to teach the curriculum and ultimately the standards. Without a prescribed list of machines, equipment, hardware, software, and materials, achieving technological literacy is much more difficult.

This research provided the final component needed to achieve technological literacy at a small high school with only one teacher. The purpose is to establish a list of components to include machines, equipment, hardware, and software which are needed to teach technological literacy at the high school level. A consensus was established utilizing a panel of experts who participated in a three round modified Delphi study. The panel, through the course of the Delphi process determined what components were necessary to teach a high school Technology Education program with one teacher.

CHAPTER 2

Review of the Literature

Introduction

In 2002, the International Technology Education Association conducted a Gallup poll that asked the following question: how important is it for all people to develop some ability to understand and use technology? The results showed 76% of Americans believe that the development of technological literacy is very important for all people and 24% viewed it as somewhat important (Rose and Dugger, 2002). This poll was implemented at the same time the *Standards for Technological Literacy* was released and correlated well with the overall intent of the standards. In a follow-up Gallup poll in 2004, the percentage dropped two percent to 74% and 23%, respectively, although the percentages decreased, the results still indicated a strong support for the idea of technological literacy (Rose, Gallup, Dugger and Starkweather, 2004). The polls addressed other issues to including the term "technology" and "design', however, this study will focus on the importance of technological literacy in the public school system. Despite the public's view that technological literacy is very important for everyone, only 12 states (26%) require the study of technology education in the public schools as of 2007 (Dugger, 2007).

This chapter examines the importance of technological literacy, as well as the studies conducted concerning equipping facilities. Since vast differences exist between school size and structure, establishing an understanding of those differences is important. Once the difference are clearly understood, a systematic comparison can be utilized to define the best equipment needed for a technology education program used to teach a variety of technological areas such as communications, engineering design, manufacturing, construction, etc. In addition, the same equipment would teach concepts such as problem solving, team work and creative thinking.

General Technology Education

In 2002, the *Standards for Technological Literacy* were published by the International Technology Education Association after over 900 people throughout the United States reviewed its contents. The reviewers included teachers at all levels in a variety of curricular areas, teacher educators, state supervisors, and engineering professionals as shown in acknowledgement section of the *Standards for Technological Literacy* (ITEA, 2000). The standards defined what students should know and be able to do in order to be technologically literate and also provided standards prescribing the outcomes for the study of technology in grades K-12 should be (ITEA, 2000).

Both of the ITEA Gallup polls suggested public support for technological literacy in our school's curriculum. In 2001, ITEA published a report in *The Technology Teacher* by Newberry. In this report, she listed the results of a survey of all states which indicated 57.7% of the states reporting included Technology Education in the framework of the state. (Newberry, 2001) Newberry also found only 27% of states required Technology Education at some level, while 12% retain local control over the subject area. In other words, a locally controlled Technology Education program does not have to conform to any set of standards, but teach what they want to teach. The results from the Gallup polls and Newberry's report revealed the differences between the public perception of technology education's importance and what technology education is actually being taught within most state educational structures. For example, the 2004 Gallup poll showed 76% of the public believed people at all levels have some ability to understand and use technology and 98% believe it should be part of the school curriculum. This indicates a contradiction showing that 98% of the public believe it should be part of the curriculum, yet only 27% of states include Technology Educaiton as part of the mandated curriculum. Furthermore, although 27% of the states require Technology Education, it may be required at only one grade level (Rose et al., 2004).

In many states, “Technology Education” has many different names such as Industrial Technology, Industrial Arts, Industrial Education and Industrial Technology Education (Akmal, Barker, & Oaks, 2002). These variations in terminology are also apparent in the college and university programs teaching Technology Education as a degree, suggesting a lack of consistency even at the teacher preparation level. For instance, the state associations listed on the ITEEA website indicate differences from state to state in their affiliation name. Examples of varying Technology Education titles includes Career and Technology Education Association, Technology and Industrial Education Association, Association for Skilled and Technical Sciences, Industrial Technology Education Association and Technology Education Assocation (ITEA, 2009).

Program titles are reflective of the state associations with similar titles such as Career and Technical Education and Industrial Education. Within these program, course titles will vary in scope and sequence also indicating a lack of consistancy. For example, in a review of all programs in the state of Kansas, Missouri, and Oklahoma, examples of course titles include: Woodworking, Small Engine Repair, Computer Aided Design, Communication Systems, Manufacturing, Construction, Principles of Engineering, and Technological Design (Spielbusch & Klenke, 2010). Although, the diversity of programs reinforces the desire for local control within each district, it also indicates the inability for each school to teach a comprehensive standards-based Technology Education curriculum.

Determining and Equipping Facilities

The *Standards for Technological Literacy* has identified content areas of technology including design, communication, construction, manufacturing, power and energy, transportation, agriculture, related biotechnology, and medical technology (ITEA, 2000). These areas are comprised of 20 standards, each having benchmarks identified for four separate grade levels: kindergarten through second grade, third through fifth grade, sixth through eighth grade, and ninth through twelfth grade. Ritz and Reed (2005) indicated content organizers have generally evolved over time from various curriculum projects. For example, the Industrial Arts Curriculum Project which included the World of Manufacturing and World of Construction used manufacturing and construction as the content organizers. The model most current Technology Education models have drawn content organizers from is the Jackson's Mill Industrial Arts Curriculum Theory (Spencer and Rogers, 2006). This theory was intended to provide a rationale and direction for teaching Technology Education (Lauda, 2002). Jackson's Mill included four content organizers of communication, construction, manufacturing and transportation which are cited in the standards previously discussed. The content organizers from Jackson's Mill illusrate the comprehensiveness of a Technology Education program; they also indicate a traditional Industrial Arts environment does not have the necessary components to teach a standards-based Technology Education program.

The well-established Industrial Arts curriculum within a school was easily recognized due to its longevity within the educational system. Students taking an

Industrial Arts course, such as woodworking, generally complete the same projects older siblings or even parents completed in previous years (Volk, 1996). Although this type of stagnation was a problem, Volk emphasized the importance of skills learned should not be diminished.

The longevity can also be attributed to the multiple textbooks printed on Industrial Arts facility planning, such as "A Guide for Equipping Industrial Arts Facilities" published by the American Industrial Arts Association in 1967 which defined the areas, curriculum and equipment necessary for planning and managing such facilities which also help define and solidify the program within the school setting (AIAA, 1967). Technology Education facility management and organization has fewer published documents to reference. One reference, the Missouri's Department of Elementary and Secondary Education Technology Education Guide (2002), established "Planning Technology Education Facilities" in Chapter 13. However, according to the state supervisor, the guide is not currently used on a widespread basis. Virginia's Department of Education (2011) released the "Technology Education Equipment Resource Guide" clarifying equipment needed for middle school technology programs. Since the inception of Technology Education in 1985, few textbooks illustrate how to establish, manage and equip modern Technology Education programs. In 2010, the ITEEA produced a facilities guide that suggests equipment and facility needs. The document was significant because it was the first document the association endorsed as an initial planning document in its 26 year existence. Unfortunately, though produced and endorsed by ITEEA, the *ITEEA Facilities Guide* lacked statistical data to reinforce its findings (ITEEA A, 2010).

In the most current era, vendors assumed the role of curriculum and lab development moving that responsibility away from the classroom teacher. During the latter part of the 1980s and into the 1990s, vendors such as Pitsco, Synergistics, Depco, and Paxton/Patterson and others, strongly influenced how a Technology Education lab would be equipped and taught, and as a result, schools and teachers began to rely on these vendors for instructional and facility guidance (Ritz et al., 2005). Vendors marketed student centered "modular" labs with self-directed curriculums and all necessary equipment, tools, software and hardware for each technology. Modular Technology Education developed as a delivery method in the profession and competed for space with traditional unit and general lab facilities (Sanders, 2001). Although modular technology labs developed by vendors explicitly state equipment requirements in their structure, they have been scrutinized by some educators as not being as effective educationally as traditional programs because these programs may lack content and rigor (Rogers, 1998).

Some schools in the United States do provide quality Technology Education facilities and programs to students. Some of these programs are recognized through the Teacher of the Year and Program of the Year awards announced annually at the ITEEA conference (ITEEA B, 2010). Because the self-contained curriculum/equipment of modular technology programs differs so greatly from contemporary Technology Education laboratories or traditional Industrial Arts facilities, determining the necessary components of an ideal Technology Education facility has become a more confusing process for educators. For example, school districts with local control and their myriad of programs complicate the ideal realization of standardization. The disparity between Technology Education standards is also acerbated because some schools continue teaching traditional programs such as woodworking, metalworking and drafting, while other programs teach state of the art technologies and consider any technology over five years old obsolete (Wright, 1992).

For many reasons, various types of programs result in different competencies among students. One program called Project Lead the Way (PLTW) has grown substantially in popularity. In 1997, twelve New York state high schools implemented PLTW; by 2010, PLTW was funded in over 3500 schools nationwide (PLTW, 2009). This program gained approval from many schools for several reasons. First, PLTW has a clearly defined curriculum; secondly, it specifically lists the tools and equipment required to teach the curriculum. Finally, teachers must be educated on how to teach the curriculum through a training program developed by PLTW (PLTW, 2006). As a pre-engineering program, PLTW complements the goals of Technology Education, by itself however, PLTW does not accomplish the mission of technological literacy for all students as the PLTW curriculum is specifically targeted for those students who would successfully enter an engineering field. Ritz et al. (2006) indicated the successful implementation of PLTW courses relies heavily on educated Technology Education teachers, who are trained in a comprehensive nature rather than a specific field such as engineering. By providing teachers with a comprehensive set of standards, properly equipped facilities, and a standards-based curriculum, schools will be more able to promote and teach technological literacy.

School Size and Structure

School districts across the United States vary demographically and for the purpose of convenience, the researcher is basing this research on a small school with one teacher. School size is relevant because small schools need adequate facilities to teach standards-based Technology Education. The results of this study could be expanded to include larger school districts with multiple teachers. Larger schools having more instructors have the ability to teach a variety of courses in addition to a standards-based course.

According to U.S. Department of Education in the 2004-2005 report "Status of Education in Rural America, approximately 23,800 secondary schools existed in the United States, and served approximately 15.8 million students (Provasnik, KewalRamani, Coleman, Gilberson, Herring and Zie, 2007). The report also noted rural schools comprised nearly one third of all public schools, yet the enrollment consisted of only one-fifth of the student population. Traditionally, the Department of Education classified school districts as either as cities, suburbs, towns and rural areas. The Department of Education developed a new system splitting cities and suburbs into small, midsize and large; towns and rural areas were categorized by how close they were to urban areas and categorized into fringe distant or remote. The new classification system provided a better view into the actual populations of schools in the new classifications (Provasnik et al., 2007).

Nine percent of high schools had populations of less than 200 students accounting for 1,432,000 students in rural schools (Provasnik et al., 2007). This data is significant since smaller schools most likely have fewer teachers in elective areas such as Technology Education because classes have fewer students. Since smaller school districts are challenged with limited teacher and facility resources, this research will focus on the needs of the small school with one teacher. Additionally, for the sake of this study, the square footage of the project was limited to 3,000 square feet. Restricting the area requires the participants in the study to work from a similar space requirement.

Chapter Summary

Through two national Gallup polls, the general public established technological literacy is essential for all people. Specifically, society needs to be able to use, manage, understand and evaluate technology in our lives today. School districts throughout the country are currently faced with the challenge of providing technological literacy to their students without an understanding of the required facilities, equipment and curriculum required to do so. School administrators rely on teachers to develop curriculum and requisition equipment, purchase vendor driven curriculum and materials that may or may not provide a standards-based technology education program. Because no standards exist for Technology Education facilities, schools currently teach a conglomeration of programs with varying levels of quality and effectiveness, some do not even teach technological literacy.

Because school districts differ demographically, this study focuses on a technology education program with only one Technology Education teacher. Larger schools with more teachers will be able to accommodate a more diverse technology education program with a variety of courses, while schools with one teacher may need to restrict available courses offered. Therefore, the purpose of this research is to establish the minimal equipment, tool, hardware and software needs for a small Technology Education program.

CHAPTER 3

Methodology

Introduction

This chapter will define the research design and procedures used to conduct the Delphi study. This chapter will describe the Delphi research procedure used in this study, the research participants and how the data will be analyzed.

When asking teachers, teacher educators or administrators what a model high school technology education program should contain, the answers will vary considerably and consensus will be difficult. Wilhelm (2001) noted the Delphi Method will assist in developing consensus, and he indicated if an adequate theory based on tested scientific knowledge is not available, then a study to obtain relevant intuitive insights from experts based on sound judgment should be attempted. The Delphi Method is not new and dates back to the post Cold War era in the 1950s and 1960s when Dalkey and Hemler of the Rand Corporation introduced this method (Dalkey and Hemler, 1963). Although the method's original purpose was military in nature, researchers in other fields quickly found the process relevant for education, private corporations and academia for a variety of purposes (Wilhelm, 2001).

Linstone and Turoff (2002), identified specific uses for the Delphi Method which involved the following: a) gathering current and historical data not accurately known as well as the significance of such events, b) budget allocation evaluations, c) exploring urban and regional planning options, d) assembling a model structure similar to this study, e) delineating pro and con policy option implementation, f) developing causal relationships in complex economic or social phenomena, g) distinguishing and clarifying real and perceived human motivations and h) exposing priorities of personal values and social goals. They also defined a comprehensive list of situations where the Delphi technique can be utilized, including the following: a) times when the problem does not utilize precise analytical techniques but works well for collective judgments, b) the people necessary for the study have no history of communication or come from different backgrounds, c) face-to-face interaction is impractical for the number of experts needed, d) time and/or cost may be prohibitive for face-to-face meetings, e) group communication will be more productive for face-to-face meetings, f) disagreements between members of the group when face-to-face resolution is not practical, and g) the validity of the study is not jeopardized by strong personalities within the group which were referred to as the "bandwagon effect" in Linstone and Turoff's the book (Linstone and Turoff, 2002).

For this study, individuals with knowledge or expertise in the area of Technology Education laboratory development were used to establish a single list of what equipment, tools, software and hardware needed in a model Technology Education program. The Delphi Method is widely used and accepted as a group communication process to serve as a means to establish consensus of opinion through a series of questionnaires on a real-world issue (Hsu and Sandford, 2007). For instance, a Delphi study conducted by Wicklein and Rojewski (1999) established a "Unified Curriculum Framework" for the field. Wicklein and Rojewski's study utilized experts from engineering, science and education to establish a consensus of what mental processes necessary for critical thinking and problem solving skills. Asking every high school technology teacher, engineer and scientist to participate in such a study is impractical, so instead, sampling the aforementioned group was utilized to develop the list. Statistically, a Delphi study is conducted combining individual answers into a single list the participants and asks each participant to rank each of the listed items. Ideally, at the end of this process, consensus among the participants has been reached. For this research, a three-round modified Delphi study was used to form a consensus of the machines, tools, hardware and software required in a model high school Technology Education facility.

Delphi Study Panel Selection

To determine the panel for the Delphi study, experts were selected from the list of published contributors for the *Standards for Technological Literacy* (ITEA, 2000). These contributors possessed both content expertise and knowledge of Technology Education. Twelve names were selected from three separate categories; each person selected has significantly impacted on Technology Education laboratory development at some point during his or her career or have unique qualifications beneficial to the development of this study. Specifically, *The Technology Teacher* journal provided names of teachers or teacher educators submitting articles relating to lab development. These categories include five high school teachers, five teacher educators and two supervisors/school administrators. This research relied on cluster sampling to ensure participants were chosen from a variety of fields rather than a single grouping like teacher educators. This heterogeneous group provided different perspectives lending the study more depth than if only one group was utilized.

In order to validate the list, consultation was needed from a variety of sources to include the following; ITEEA professional staff, previous ITEEA presidents, board members, regional directors, and recommendations from this dissertation review committee. The *International Technology and Engineering Educator's Association* was a significant source for the study since it represents the professional organization for technology, innovation, design, and engineering educators. (ITEA, 1996)

Linstone and Turoff (2002), stated the size of the expert group can vary, yet a group as small as 10-15 individuals, can produce good results. Brockoff's (1975) study of Delphi performance suggested that for forecasting questions, smaller groups were more accurate than larger groups. Twenty-three people comprised the initial list for this study as shown in Appendix B; of these people, five were selected for the teacher group, five for the teacher educator group, while two were chosen for the administrator/ supervisor group. A few other individuals were also suitable for the study, but were not chosen due to time limitations. Eleven additional members were chosen in the event a participant dropped out during the study.

Among the different groups, the following attributes are common, several participants were solely responsible for the development of a Technology Education program or programs or had a direct influence on the implementation of the program; finally, every individual listed had direct influences on curricular activities associated with technology education at the high school level. A detailed description of each participant is located in Appendix B.

Design and Instrumentation

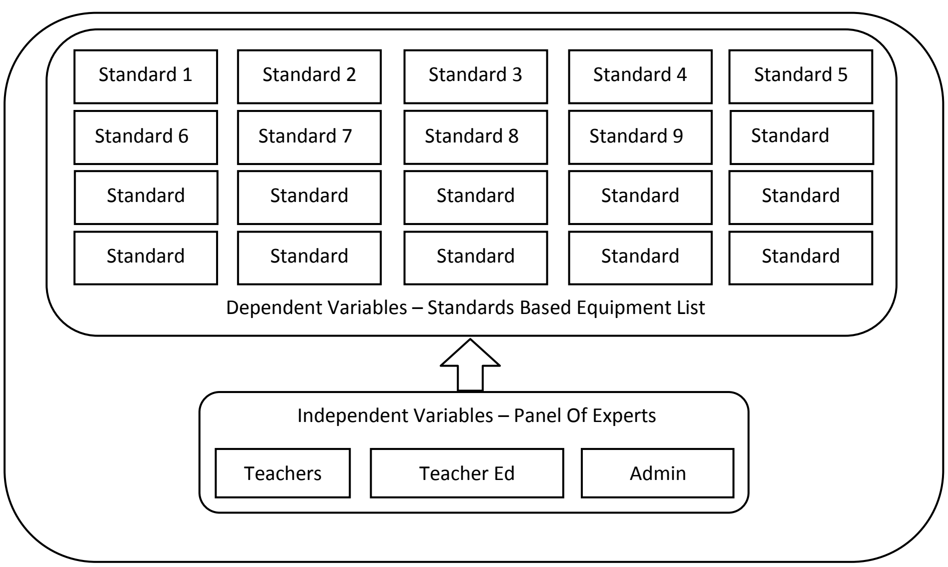
A three round approach determined these components. Round one determined a categorical data set for later rounds. The survey allowed the participants to establish two data sets by standard (as defined by the Standards for Technological Literacy): the first listed equipment, tools, hardware and software; and the second data set outlined potential activities to augment the standards if a teacher would choose to do so.

Round two asked the participants to rank and further define the categories of equipment, tools, hardware and software from round one using a Likert scale. Based on descriptive statistics, each of the responses from round two were analyzed and the group mean and standard deviation was established for each question. The data for activities were categorized by standard for informational purposes.

The third round questionnaire was given to the panel with the mean score and standard deviation for each item. The panel reviewed the questions with the provided descriptive statistics, and then asked if they would like to change any responses. After the surveys were returned and additional analysis was computed to answer research question three.

The relationship of the dependent and independent variables is depicted in Figure 3.1. Using Analysis of Variance determined the difference between the three groups of experts and the ratings they provided.

Figure 3.1



Statement of Research Questions

1. What machines, equipment, hardware, software and materials are agreed upon by experts to be essential components of a Standards Based Technology Education high school model program?
2. Can the Delphi panel establish a set of categorical components based on the following descriptors: essential items, moderately important items and non-essential items?
3. Are there significant differences between the agreement levels on the elements based on expert qualifications?

Collection of Data

Communication was established with each participant utilizing telephone and email correspondence. Each participant was initially contacted by telephone to personalize the invitation to participate. If telephone contact was unsuccessful, email correspondence was initiated to secure more participants. Once the panel members committed to participate, all subsequent correspondence was via email. This eliminated the need for the traditional mail system. If for any reason immediate communication was required, the telephone was used.

The round one questionnaire asked the participants to list the pieces of equipment and curricular materials needed to successfully teach technology education to meet the *Standards for Technological Literacy*. Responses from round one were entered into a Microsoft Excel spreadsheet and duplicate responses were deleted. The researcher carefully considered items required for each standard; however, duplication was unnecessary. For example, a table saw might have been listed under three separate standards in round one's data, but only listed once in the round two survey. A list of activities also provided by the participants, were entered into a spreadsheet by standard. Again, duplicate answers were deleted. This data was not analyzed, yet provides ancillary information for the teacher and could be utilized to teach the standards within the standardized technology education laboratory.

Round two listed the responses from the panel in round one allowing each participant to judge each item independently based on relevance. Each item was rated on a five-point Likert type scale with the following ratings: "unimportant". "of little importance", "moderately important", "important" and "very important". The responses were entered into a Microsoft Excel spreadsheet in order to calculate the mean and standard deviation for the panel's responses for each question.

Round three allowed the participants to analyze their given responses from round two with respect to the mean and standard deviation of the panel for each particular question. The statistical data was shared with participants to establish consensus among panel members. Each participant reviewed the question, compared their previous answer to the group, and made adjustments to their ranking if necessary to more closely align with the mean score.

Data Analysis

The responses of round one were collected, analyzed and combined into a questionnaire; on this questionnaire, the responses were distributed on a Likert scale. Each participant ranked the items on the questionnaire from *very important* or *unimportant*. One questionnaire item is depicted in Figure 3.2 and shows the item to be evaluated, the standards the item addressed, and the Likert answers they could choose.

Other descriptors used on the scale included *of little importance*, *moderately important* and *important*. This data was evaluated using descriptive statistical analysis. The mean and standard deviation were calculated for each question on the round two questionnaire.

Figure 3.2

	Unimportant	Of Little Importance	Moderately Important	Important	Very Important
Scanner (9,10,11,12,14,15,16,18,19,20)					

The round three questionnaires were emailed to the participants and was very similar to the round two questionnaire. The round three questionnaires included the mean, standard deviation, and the participant's previous response. Additionally, each Likert ranking item was assigned a number value to assist in statistical analysis. A sample of one questionnaire item is depicted in Figure 3.3 showing the additional items placed on the questionnaire.

Figure 3.3

Scanner (9,10,11,12,14,15,16,18,19,20)
GROUP MEAN 4.0-----YOUR RESPONSE 4-----STANDARD DEVIATION .85

(1) Unimportant (2) Of Little Importance (3) Moderately Important (4) Important (5) Very Important

The participants completed the round three questionnaire, reflecting on their given answer in comparison to the mean and standard deviation of the group. Basic descriptive statistical analysis in Microsoft Excel established mean for each item based on participant responses.

After the participants returned the round three questionnaires, the results were analyzed using Microsoft Excel and SPSS software. The group consensus was calculated using the mean as the primary evaluation tool. The standard deviation provides the degree of consensus, for example, if the standard deviation was low, a stronger consensus was indicated. An Analysis of Variance (ANOVA) was used to determine any differences between the three expert groups.

Summary

The purpose of the researcher's analysis was to find consensus among the study's participants regarding what equipment, tools, hardware and software are needed in a standards-based Technology Education program with one instructor. The participant's used their expertise to identify the necessary equipment, tools, hardware, and software for teaching a standards-based technology education program; each expert also suggested curricular activities which would augment the facility. Participants ranked each item on a Likert scale and the results were analyzed using basic descriptive statistics to show differences in the mean for each item. In round three the group mean and standard deviation was shown on the survey next to each item to allow each participant to compare his or her given to the group mean; then based on standard deviation, the participant was asked to re-evaluate the item using the original Likert scale. If their answer was similar to the mean, a change was unnecessary. However, if a participant's answer was significantly different from the mean, the participant could review the standard deviation and consider changing their response to better conform to the group mean.

When comparing the final responses, the importance of each item was compared to the consensus of the group and the standard deviation. This comparison allowed items to be evaluated according to teaching necessity for a standards-based Technology Education program. For this study, any responses between 3.50 and 5.0 are considered vital to the program; responses of 2.5 to 3.49 are considered secondary; and responses of

0 to 2.49 are considered unnecessary for the success of a standards-based Technology Education program.

Further evaluation compared the means of the various groups using an Analysis of Variance (ANOVA). Analyzing the various group scores would indicate if significant differences exist in each group's perception of an item's importance.

CHAPTER 4

Results

Purpose of the Study

A three-round Delphi research technique was utilized to establish a consensus among three groups of professionals with expertise in facility design implementation; these experts determined the machines, tools, hardware and software are needed to teach a standards-based Technology Education program. The study was designed to answer three research questions related to equipping a model Technology Education facility. The study also determined if a statistical difference existed in the responses between the three selected expert groups. The three groups of professionals included:

1) University professors (practitioners) responsible for preparing undergraduate and/or graduate students preparing to enter the teaching profession in the content area of Technology Education or a closely related field.

2) Administrators with experience in high school technology facility design and implementation.

3) High school technology teachers who have worked in exemplary programs, implemented and understand facility design, or expertise which would add to the quality of this study.

Delphi Study Participants

Experts were selected from the list of published contributors in the *Standards for Technological Literacy*; the contributors held both content expertise and knowledge of Technology Education (ITEA, 2000). Twelve names were selected from three separate categories. Each selected individual had a significant impact on Technology Education laboratory development during his or her career, or have unique qualifications which are beneficial to the development of this study. Five high school teachers, five teacher educators and two supervisor/school administrators were chosen for the study. Cluster sampling was chosen for this research to ensure participants were chosen from a variety of fields. Choosing participants from a variety of positions provided different perspectives giving more depth to the study. Of the twelve selected, every participant continued the process and completed all three surveys resulting in a 100% completion rate.

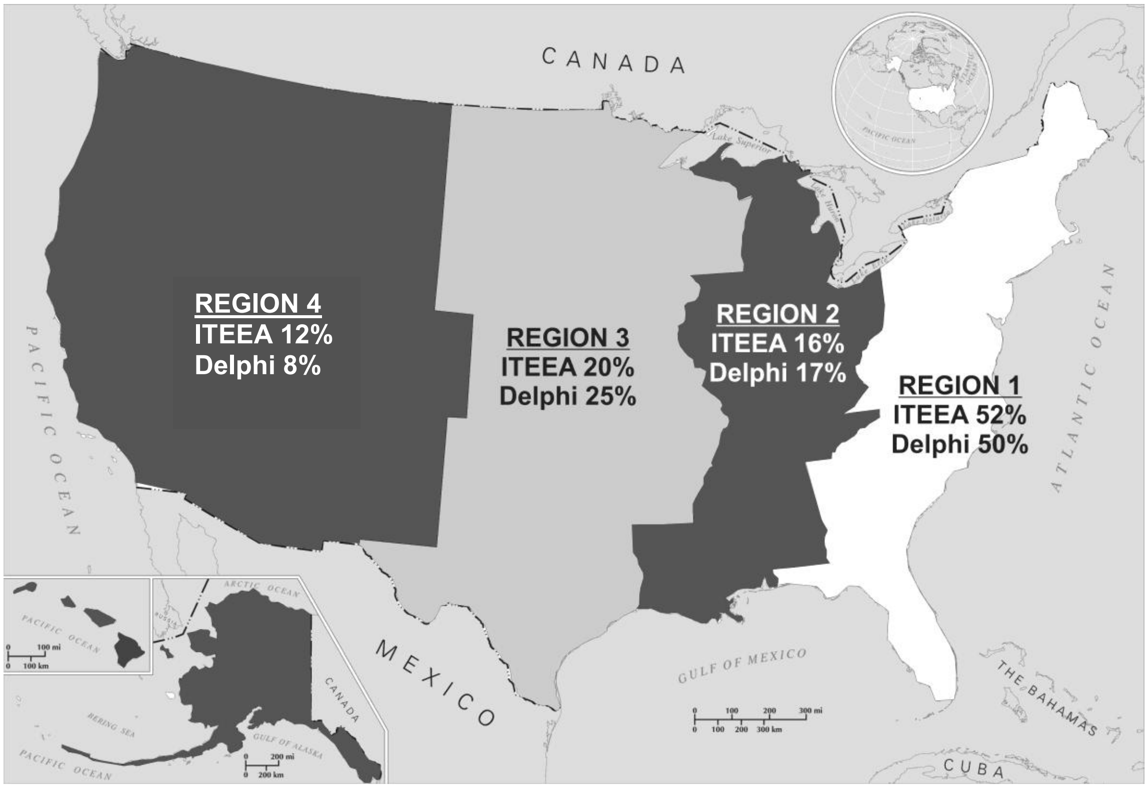
Demographic Data

The group of 12 experts provided input from 10 different states; including Florida, Illinois, Georgia, Indiana, Kansas, Missouri, New Jersey, Pennsylvania, Utah and Wisconsin. As many states participated in the study, a parallel representation of the International Technology and Engineering Educator's Association demographics was established (see Figure 4.1). The membership data have been shown in Table 4.1, and were listed in an August 2010 membership report from the International Technology and Engineering Educator's Association (ITEEA D, 2010). A detailed listing of the experts and their demographic data is found in Appendix B.

One of the 12 participants was female (8%); this percentage was slightly below the ITEEA membership report indicating 17% of the membership was female (ITEEA D, 2010). All members of the panel have taught or contributed to the educational field for at least 15 years.

Figure 4.1

Geographic membership data: ITEEA compared to Delphi study participation



Significance of the Study

This study will recommend equipment, tools, hardware and software for a standards-based Technology Education facility which may provide student the opportunity to achieve technological literacy. If program recommended by this study was implemented in every district in the United States, every high school student could potentially have the opportunity graduate high school with a basic understanding of how to assess, use and manage technology (ITEA, 2000). In other words, students would be given the opportunity to become good consumers of the vast technological knowledge, both now and in the future (National Academy of Engineering National Research Council, 2002). Additionally, students transferring from one school to another, regardless of size or location, might have a similar Technology Education laboratory experience because the schools would have similar capabilities. School administrators will ideally gain a better understanding of the facility and activities teachers need to become technologically literate. Administrators would have the knowledge to implement the program within their respective districts (Lewis, 1999).

Design of the Study

Round one of the study was completed via email; the word document attachment is shown in Appendix C. The survey was open ended in nature and required each participant to list equipment, tools, hardware, software and activities needed to teach each of the 20 standards. The survey was designed to elicit unbiased input from the participants, and provided an honest opinions from each participant concerning requirements for the ideal facility. The data were returned via email and combined into a comprehensive Microsoft Excel spreadsheet listing each different item and the standard(s) the item addressed. The equipment, tools, hardware and software chart is found in Appendix C. The survey also asked the participants to list, by standard, activities for supplementing the standards-based program. Activities were not rated, rather, the expert recommendations are a resource for teachers as they implement a to standards-based facility. The full listing of activities is located in Appendix C.

Rounds two and three were conducted through the on-line survey website instrument SurveyMonkey.com^{tm}. During round two, the participants were given an internet URL to a survey and each completed the survey as instructed in an email. The purpose of round two was to establish a mean and standard deviation for each piece of equipment, tool, hardware or software listed from round one; the means and standard deviations were used in the round three survey. In the round three survey, the participants were shown the mean for each question allowing each individual to compare his or her answer to the group. The group standard deviation was provided to show each participants how spread of each response; and if the respondent choose, could change his or her response and move toward the mean. Each participant's data was submitted and tracked separately, yet combined for descriptive statistical analysis.

Data Collection Results

Results of Round One

The round one survey was emailed November 18, 2009 and the last survey was returned March 8, 2010. The purpose of the survey was to allow the participants the opportunity to list, by standard, equipment, tools, software and hardware needed to teach a standards-based Technology Education program in a school with one instructor. In Table 4.1, a selected example of one standard return shows the level of details provided by one participant. Due to the various levels of expertise, participants provided critical insight in areas of their knowledge or experience. For example, one participant recently developed a program in bio-technology and provided information specifically relating to Standard 15. Participants with experience in other areas provided similar input, adding to the database of information; in other cases, answers were not provided by a participant because he or she did not have adequate knowledge to contribute to the study on a particular standard.

Table 4.1

STANDARD 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES
Robotic Workcell	8" Bench Grinder	Computers w/Flat Panels,	Microsoft Office	On Demand Video –
(Pneumatics)	Air Compressor	DVD, 2 Gigs of RAM,	2007	Participants write,
Robotic Arm with	with Air Line and	Etc.	SolidWorks	shoot, and edit a video
Conveyer	Accessories		CamWorks	about social, economic,
Wind Tunnel	Shop Vacuum	HP Laser Jet Color	Adobe Photoshop,	and political effects of
Structural Stress	Swivel Base Vise	Network Printer	Dreamweaver and	technology.
Analyzer	Dust Collector		Flash	
Laser Engraver	(small)	Classroom Student Project	Solid Professor	
Vinyl Cutter	Table Top Lathe	Server		And
Laser Lab Equipment	Sears Portable			
Gears ID Kits	Hand Drill	Classroom Sound System		Electronic Research and
Work Bench	Sears Portable			Experimentation -
Student Project Lockers	Circular Saw	Sony Camcorder		Participants research,
Student Notebook	Sears Portable			plan, design, and
Bookcase	Orbiter Sander	Sony Digital Camera with		construct an electronic
Textbook Case	Sears Portable Jig	Accessories		device. Projects are
Drafting Boards	Saw			evaluated on quality of
Student Chairs	Dremel Rotary	HDTV LCD 40in		research, ingenuity and
Dimensions 3D Printer	Tool			complexity of the
with Cleaning Station	Fluke Multi-meter	Student Response System		device, and
File Cabinets	Soldering Iron with			effectiveness of the
Universal Laser	Accessories			exhibit display.
Engraver 30 Watt Min.	Digital Scale			
Tenco CNC Router	Sears Combo Tool			
20x16 Min Work Area	Ratchet set			
Basic Electricity and	(standard and			
Electronics	metric)			
Industrial Control	Sears Open end /			
Learning System	box end combo			
Materials and	wrench set(standard			
Processing Learning	and metric)			
Systems	Sears Screwdriver			
Mechanisms Learning	set			
Systems	Sears Socket Set ¼,			
Pneumatics Learning	and 3/8 (standard			
Systems	and metric)			
Research and Design	Sears Table Top			
Learning Systems	Drill Press			
Robotics and	Sears Table Top			
Automation Learning	Combo Belt/Disk			
Station	Sander			
Industrial Control	Sears Table Top			
Learning Systems	Band Saw			
Student Workstations	Sears Table Top			
Response IR Student	Scroll Saw			
Pads	Table Fan			
Power and	Vacuum Wet-Dry 5			
Transportation	Gal. Tank			
Learning Systems	Assorted Hand			
Safety Glass Goggle	Tools			
Cabinet 50 Pairs	High Temp Low			
Storage Cabinet	Temp Glue Gun			
Flammable Liquid				
Bridge Building Video,				
Guide and Stock				
Catapult Learning				
System				
C02 Race Track,				
Learning System and				
Stock				
Aerospace Engineering				
Learning System				
Civil Engineering				

Learning System
Environmental Learning System
Graphics Learning System
Mechanical Learning System
Sustainable Energy Learning System
Fuel Cell Learning System
Simple Machine Learning System
INCLINED PLANE Learning System
Solar Vehicle Learning System
Outdoor Spray Paint System
Hand Drafting Instruments
Starrett Micrometer and Caliper
Lego Mind storm system
Speed Radar Gun

After all participants returned the round one survey, a Microsoft Excel spreadsheet was designed to organize the various types of equipment, tools, hardware and software by standard and eliminate any duplication (see Appendix D). Nomenclature for each machine was not requested because schools would choose the specific make, model and vendor for an identified item. The participants were asked to give generic answers rather than specific answers, for example, a participant would list a table saw versus a specific brand and model like *Powermatic 66* Table Saw. Duplicate answers were combined and listed with identified standards as shown in Table 4.2.

Table 4.2

Sample equipment listing from Round 1

EQUIPMENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3D Scanner									9	10	11	12		14	15	16		18	19	20
Aerospace Engineering Learning System				4		6														
Air Compressor with lines and accessories	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Alternative Energy Training Set (Solar, Wind, Hydroelectric, Fuel Cell, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arbor Press	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Audio Trainer					5												17			

A similar spreadsheet shown in Appendix C was utilized for listing activities for teaching each standard. Duplicate answers were deleted in the final list; this list shows each activity and the standard(s) addressed. A variance existed on the amount of activity details provided by the participants; some provided very specific examples while others provided only a vague description of the activity. To save space in the document, a selected portion of the activity spreadsheet has been shown in Table 4.3. The information collected in the activities section was qualitative in nature and intended as reference material during facility development. This list provides 154 different activities, by standard, designed to support facility capabilities.

Since several curriculum models have already been established, like Engineering by Design (EbD), these activities provide supplemental information in supporting those curricula within a standards-based Technology Education facility.

Table 4.3

Sample activity listing from Round 1

ACTIVITIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Preparing and Presenting Projects (printed and oral)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Design - Market and Profit Project Students will be assigned a specific contemporary product to research “backwards.” Students are to develop a timeline of development for the product function, such as a cordless drill, tracing its history back to the bow and stick drill. Each student team will develop an illustrated presentation and report to be presented to the class.	1 1																		19	

Results of Round 2

Since the Round One data was not changed, but consolidated, the Round Two survey was shown to Drs. Michael Daugherty and Greg Belcher to establish validity. Delphi process experts recommend at least two people monitor the development of the round two instrument: one individual possessing expert knowledgeable in the field while the other needs familiarity but not expertise of the field studied (Linstone and Turoff, 2002). In this study, Dr. Daugherty posesses vast knowledge regarding Technology and Engineering Education, while Dr. Belcher's expertise is specific to Career and Technical Education. The entire second round survey is shown in Appendix F to save space within this section.

The Round Two survey was developed using a 5-point Likert scale with *1-Unimportant, 2-Of Little Importance, 3-Moderately Important, 4-Important and 5-Very Important*. The respondents were given the response options for each piece of equipment, tool, hardware or software; these options are depicted in the first two items shown on the survey in Figure 4.2. For informational purposes, the items were listed by the standards they correlate to with respect to round one. The standards are shown in parenthesis to save the participants time in looking up standards information. The participants were asked to use the online survey tool SurveyMonkey[tm] to select and submit their responses. The responses were collected from the participant and recorded into a Microsoft Excel spreadsheet.

Figure 4.2

1. Equipment

Below is a listing of the equipment which was collected from the Round 1 survey. Please select the appropriate response which indicates your perception of how important the piece of equipment is in a standards-based HS Technology Education lab. Please note that the numbers within the parenthesis indicate which standards were identified with that particular piece of equipment.

1. Scanner (9,10,11,12,14,15,16,18,19,20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

2. Aerospace Engineering Learning System (4,6)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

Results of Round 3

Round two data collected was entered into Microsoft Excel and basic descriptive statistics were run on each of the 178 items of the round two survey. This data sheet can be found in Appendix G. This data showed each respondent's answers for each item on the survey based on mean and standard deviation from round two; the descriptive statistics showed the new mean and standard deviation gathered in round three. To verify whether the data validated the study, additional statistics were calculated utilizing SSPS software to expose any statistical differences between the three categories of respondents. An Analysis of Variance was performed on all 178 items to see if there was a statistical difference in the responses of the three expert groups. This additional information validated the responses by indicating a consensus of the group, by category, on each response.

Data Analysis

The Round Two analysis determined the mean and distribution of each answer using descriptive statistics in a Microsoft Excel spreadsheet. These descriptive statistics were used as the foundational core for determining the tools, equipment, hardware and software necessary for a standards-based curriculum. Round one listed 178 items from the following categories:

Equipment	Tools	Software	Hardware
104	19	18	37

The mean and standard deviation were the only statistics analyzed in round two and were added to the round three survey for comparative purposes. All 178 items were analyzed; however, due to limited space in this document, only a sample of questions are included in this section. Questions 1-3 and 56-58 statistics for round two are shown in Table 4.4.

Table 4.4

ID NUMBER	004	007	012	003	008	006	001	005	011	002	010	009	STATISTICS	
GROUP	P	A	T	P	T	P	P	P	T	A	T	T	MEAN	STANDARD DEVIATION
QUESTION														
1 - Scanner	4	3	5	5	3	5	4	4	5	3	4	3	4.00	0.85
2 – Aerospace LS	2	2	5	4	4	4	4	3	3	3	3	2	3.25	0.97
3 – Air Compressor	4	3	5	5	5	5	4	5	5	2	4	4	4.25	0.97
56 – Metal Lathe	4	2	5	3	4	2	4	5	2	2	2	4	3.25	1.22
57 – Metal Mill	3	2	5	3	4	2	4	4	3	2	2	4	3.17	1.03
58 – Metal Shear/Roll	3	4	5	1	4	2	4	5	3	2	2	4	3.25	1.29

Round three responses provided the information needed for two key analyses. The first used descriptive statistics to determine the specific equipment, tools, hardware and software needed to teach a standards-based curriculum. The second used an Analysis of Variance to determine any statistical differences between the groups of respondents.

Descriptive analysis of the first three questions and questions 56-58 of round three are shown in Table 4.5. This example when compared to the data in Table 4.4 from Round Two shows the difference in the mean and also shows the standard deviation gathered from each survey. The results indicate the Delphi process worked according to definition because the group moved toward the mean. The final result was a consensus on the equipment, tools, hardware and software needed for a standards-based Technology Education facility.

Table 4.5

ID NUMBER	007	002	001	003	004	006	005	012	011	008	010	009	STATISTICS	
GROUP	A	A	P	P	P	P	P	T	T	T	T	T	MEAN	STANDARD DEVIATION
QUESTION														
1 - Scanner	4	4	4	4	4	5	4	5	4	4	4	3	4.08	0.51
2 – Aerospace LS	3	3	4	3	3	4	3	4	3	3	3	2	3.17	0.58
3 – Air Compressor	4	4	4	5	4	5	5	5	5	4	4	4	4.42	0.51
56 – Metal Lathe	3	3	4	3	3	2	3	5	2	4	2	4	3.17	0.94
57 – Metal Mill	3	3	4	4	3	2	3	5	3	4	2	4	3.33	0.89
58 – Metal Shear/Roll	3	3	4	2	3	2	4	5	3	3	2	4	3.17	0.94

The descriptive statistics from round three were evaluated and an acceptable standard deviation established for discriminating the agreement level of the participants. A standard deviation (σ) of $>.75$ established a basis for determining the agreement level based on the review of data in Appendix J. For instance, in Table 4-7, questions 1-3 indicate the survey responses from each participant are fairly consistent with an occasional outlier. A highlighted example of an outlier is shown in question 2 of Table 4.5.

When the standard deviation exceeds $\sigma.75$, the data set is more diverse; this diversity shows the response is inconsistent and the participants did not find agreement on that particular question. Using $\sigma>.75$, categorizing the data was accomplished using the scale shown in Figure 4.3. The data in Table 4.5 shows the final group mean for each item is not a whole number; however, the mean will fall within one of the scales in Figure 4.3. Because the survey instrument was based on a scale from one to five, the researcher utilized a range of one or one-half on each side of the given number. This explains why a measurement of 1 to 1.49 would score a one, while a score of 1.50 to 2.49 would score a two. The score of five would have a range of one-half because the scale stops at five.

Figure 4.3

1	Of Little Importance 1.50-2.49	3	Important 3.50-4.49	5
Unimportant 1.00-1.49	2	Moderately Important 2.50-3.49	4	Very Important 4.50-5.00

In Figure 4.3 the data were categorized into pre-determined groups. Questions having a mean of four or five were considered essential to equipping a standards-based Technology Education facility. Questions assigned a mean of three were considered secondary or moderately important, but not essential. More practically speaking, if funding allowed, these could be added to the facility and positively add to the program, but are not crucial to the program or necessary to teach the curriculum. Questions assigned a one or two were considered items purchased if funding would allow, not necessary to teach the standards. These non-essential items would have specific purposes for specific projects or objectives, but the outcomes can also be achieved in other ways, with other equipment, tools, hardware or software. Items having a $\sigma<.75$ were evaluated on an individual basis to determine the reason for the higher standard deviation. If the outliers contributed to the higher standard deviation, the contribution will be noted and an appropriate recommendation was made.

Based on the data from Round Three using a σ>.75, the following items in Table 4.6 were considered essential for a standards-based technology education facility. The mean for this category had to measure 3.5 or greater.

Table 4.6

ITEM- SURVEY #	STANDARD / MEAN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3D Arch Building Design - 143	4.33						X														X
3D CAD - 144	4.75		X		X		X		X	X	X	X	X	X	X	X	X	X		X	
5HP Dust Coll Vacuums -26	4.75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Air Compressor -3	4.42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Alt Energy Training Set - 4	4.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Animation Software - 146	3.58																	X			
Applied Science Tools - 105	3.92		X	X	X		X	X	X	X	X	X	X		X	X	X				
Audio Edit/ Prod. Sftwr - 147	3.83					X												X			
Band Saw - 8	4.42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Belt/Disc Sander - 9	4.33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bench Grinder 8" - 10	4.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Biotech Gen Lab Equip - 107	3.92															X					
Bridge Design Software - 149	4.00																		X		X
Bridge/ Tower Tester - 15	4.08	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CAM Software - 151	4.08																			X	
Chem Analysis Software - 152	3.83															X					
CIM/FMS Trainer - 18	3.83								X	X	X	X	X	X			X		X	X	
Civil Engineering LS - 19	3.50				X		X					X								X	
Classroom Furniture - 20	4.83	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Classrm Project Server -124	4.25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Classroom/Lab Sound Sys - 125	3.92	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CNC Metal Lathe & Tooling - 21	4.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CNC Metal Mill & Tooling - 22	4.08	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Color Laser Printer - 126	4.33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Construction Tools - 108	3.50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Desktop Pub Software - 157	4.42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Digital Video Recorder - 129	4.25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Drill Press - 25	4.50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elec Circuit Software - 159	4.08																X				
Elect Equip w oscilloscope - 28	4.50					X	X					X	X				X		X		X

Elect Present Board - 130	4.17	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Electronics Tools - 109	4.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Environment LS - 29	3.83				x		x					x									
Fabrication Msmt Tools 110	4.75	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Fastener Supply - 111	4.58	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Filing System/ Cabinets - 30	4.25				x																
Flammable Cabinet - 31	4.67				x		x														
Floor Plan Software - 161	3.58		x	x	x			x	x	x	x	x	x	x	x	x			x		
Game Dev Software - 153	3.83		x	x	x			x	x	x	x	x	x	x	x	x			x		
Gears ID Kits or Equiv -34	4.00				x		x			x			x		x	x			x		
General Chem Tools - 112	3.92	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
GPS Units - 132	3.92																		x		
Graphics LS - 35	3.92				x		x						x								
Greenhouse for Biotech/Fuel -36	3.58															x					
HDTV 42" min - 131	4.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Industrial Controls LS - 38	3.75				x		x					x	x				x		x		x
Injection Molder - 39	4.08	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Instructor Laptop Comp - 133	4.83	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Internet Connection -162	5.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Land Based Auto Cntrl - 154	3.50																		x		
Laptop Comp Set/Cart - 134	4.08	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Laser Printer - 135	4.75	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Laser Lab Equip - 45	3.67				x		x														
Lego Mindstorms - 47	3.92				x		x						x				x		x	x	
Material Stock (various) - 49	4.67	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Measuring Devices - 114	4.75	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mechanical Learning Sys - 51	3.92				x		x					x	x				x		x	x	
Mechatronics Learning Sys - 52	4.08				x		x		x	x	x	x	x	x		x	x		x	x	
Microscope with video - 60	3.58															x					
Min 30wLaser Engraver - 44	4.17	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Misc Fab Power Tools - 117	4.58	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Misc Tools Fabrication- 116	4.58	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mon Sftwr Land Base Trns -155	3.50																		x		
MS Office Sftwr (equiv) - 163	4.75	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Multisander Oscillating - 62	3.83	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Office Equipment - 119	4.67	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Photoshop or equiv - 164	4.42				x		x	x	x	x	x		x	x	x	x	x	x	x		
Photovoltaic Cell LS - 64	3.67																x				
Plastic Tools - 120	3.83	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Plastics Oven - 66	3.67	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
PLC Software - 156	4.08																		x		

Pneumatic Tools - 121	3.83	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pneumatic/ Hydraulic LS - 68	3.92				X		X					X	X				X		X		
Power Miter Saw - 70	4.58	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Power/ Energy/ Trans LS - 71	3.75				X		X					X	X				X		X		
Project Storage System - 89	4.83	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Projector - 136	4.67	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
R&D LS -74	3.50				X		X						X				X		X		
Rapid Prototype 8x8x10 Min - 73	4.33				X		X		X	X	X	X	X		X	X	X		X	X	X
Robot Control Software - 166	3.75		X	X	X			X	X	X	X	X	X	X	X	X			X		
Robotics Workcell -75	3.92				X		X			X	X	X	X	X			X		X	X	
Safety Equipment - 122	4.83	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Scanner - 1	4.08									X	X	X	X		X	X	X		X	X	X
Scanner -137	4.33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Scroll Saw - 82	4.08	X	X	X						X	X	X	X		X	X	X	X	X	X	X
Sound Level Meter - 123	3.92															X					
Strip Heater - 90	3.83	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Structural Tester - 91	4.00				X		X				X									X	X
Table Saw - 93	4.25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vacuum/Therm Former - 95	3.83	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vernier Software - 173	3.67																X				
Video Camcordr - 139	4.17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Video Editing Software - 174	4.33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vise System - 98	4.50				X					X	X	X	X		X	X	X		X	X	X
Web Design Software - 178	3.83				X	X	X	X	X	X	X		X	X	X	X		X	X		
White Board Software - 160	3.75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wide Format Printer - 140	4.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wind Tunnel - 102	4.08				X		X			X	X	X	X								
Work Benches - 104	4.67				X		X			X	X	X	X	X	X	X	X	X	X	X	X

Note: Table 4.6 is organized alphabetically

The following items in Table 4.7 were considered moderately important items for a standards-based Technology Education facility. These items had a mean between 2.5 and 3.49.

Table 4.7

	STANDARD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	MEAN																				
2D CAD - 142	0.67	X	X	X					X	X	X	X	X	X	X	X	X	X		X	
Aerospace Learning Sys - 2	0.58				X		X														
Air Quality Analysis Software - 145	0.45															X					
Arbor Press - 5	0.51	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Audio Trainer - 6	0.60																	X			
Auto Product ID System - 7	0.39																			X	
Barcode Gen Software - 148	0.58																			X	
Barcode Scan (equiv) - 106	0.62																			X	
BIM Software - 150	0.51																				X
Blower - 11	0.45																		X		
Box and Pan Brake - 13	0.67	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Buffing Wheel - 16	0.60	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Catapult Learning Sys - 17	0.51				X		X														
Computer Metrology Equip - 24	0.39																			X	
Dynomometer - 27	0.45																X				
EKG Analysis Software - 158	0.51															X					
Fitness Equipment - 69	0.72			X	X	X	X	X						X	X						
Hand Draft Tools - 113	0.75				X		X	X	X	X		X	X			X	X	X		X	X
Int & Ext Cobust Engine -41	0.43																X				
Jointer - 42	0.51									X	X	X	X		X	X	X		X	X	
Lab Pro Waste Mgmt Sys - 43	0.39															X					
Laser Survey Equip - 46	0.29																				X
Medical Equipment -115	0.62		X	X	X		X	X	X	X	X	X	X		X	X					
MIG Welder - 61	0.29	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Plant layout software - 165	0.58																			X	
Plasma Cut/ Route Sys - 65	0.43									X	X	X	X		X	X	X		X	X	X
Radial Arm Saw - 72	0.51																		X	X	
Rokenbok Integ Trans Syst - 40	0.39	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rotation Molder w/molds - 77	0.29				X		X		X	X	X	X	X		X	X	X		X	X	X
Scale Trans Vehicles - 80	0.75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Screen Print equipment - 81	0.67																	X			
Sim City Software - 167	0.62				X																X
Sim Farm Software - 168	0.51					X															
Small Gas Engines - 84	0.43	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Smart Draw Software - 170	0.39		X	X	X			X	X	X	X	X	X	X	X	X			X		

Soil pH Software - 171	0.60															X					
Solar Vehicle Learning Sys - 85	0.62				X								X						X		
Speed Radar Gun - 86	0.43				X		X			X	X	X	X		X		X	X	X	X	
Stat Process Software - 172	0.58															X					
Student Resp Syst - 138	0.45	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tachometer No Contact - 118	0.51																		X		
Vertical Hole Punch - 96	0.62	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Watercraft Test Track 20' - 99	0.49								X	X	X	X	X	X					X		
Waterjet Cutting System - 100	0.52									X	X	X	X		X	X	X		X	X	X
Waterjet Software - 176	0.51																			X	
Web 2.0 Tools Free - 177	0.67		X	X	X			X	X	X	X	X	X	X	X	X			X		
Weld/cutOxy/ Acetylene - 63	0.74	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wireless Mics - 141	0.39	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wood Lathe -103	0.75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note: Table is organized alphabetically

The following items found in Table 4.8 were considered non-essential items for a standards-based Technology Education facility. These items would only be purchased if funding allowed and are unnecessary for teaching the standards. These items had a measured mean between 1.0 and 2.49.

Table 4.8

	STANDARD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	MEAN																				
Book Binding System - 22	2.33				X		X														
Braille Stylus, Slate, Etc - 14	2.00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lithography Equipment - 48	2.08																	X			
Metal Forging Furnace - 59	2.33																			X	

Experts did not reach consensus on the remaining items; these items had a standard deviation greater than σ>.75, including questions 23, 32, 22, 37, 50, 53, 54, 55, 56, 57, 58, 67, 76, 78, 79, 83, 87, 88, 92, 94, 97, 101, 127, 128, 169 and 179. The responses from the participants on these questions were varied, indicating selections with a spread exceeding two numbers on the Likert scale and consensus was not reached. During the evaluation of data, the experts established by category, a list of equipment, tools, hardware and software needed to teach a standards-based Technology Education program.

Research question number three asked if there were any significant differences between the agreement levels for each item based on expert qualifications. The researcher conducted an Analysis of Variance (ANOVA) and found no significant difference between administrators, teachers and teacher educator groups. A significance (alpha) value of $\alpha .05$ was used to conduct the analysis. The results of the analysis are found in Appendix K. The consensus is a direct result of the correct application of the Delphi study; the process is specifically designed to develop consensus between expert groups, in this study is based on the group mean. Because no significant differences between the expert groups, an additional Post-hoc analysis was deemed unnecessary.

Chapter Summary

The purpose of this study was to determine the equipment, tools, hardware and software is needed to teach a standards-based Technology Education program in a 3,000 square foot facility with one teacher. The participants in this study consisted of five high school classroom teachers, five teacher educators/practitioners and three school administrators. All participants were chosen based on several criteria; they possess valuable high school teaching experience, have experience with the *Standards for Technological Literacy*, or have information specifically contributing to this study.

Establishing the equipment, tools, hardware and software needed in a Technology Education facility was accomplished using a three round modified Delphi study. Round one established a standards-based listing of equipment, tools, hardware and software through an open-ended questionnaire. The participants listed, by standard, what they believed necessary for outfitting a Technology Education laboratory. The participants submitted 154 different activities, by standard, to be used in the facility to teach technological literacy. These activities provide supplemental information only and were not subjected to any statistical analysis. The participants listed 178 items necessary for equipping a facility. Of these items, 104 directly related to equipment needs, 19 identified tooling needs, 18 were related to hardware and 37 listed software needs.

During round two the participants rated each of the 178 items based on a 5 point anchored Likert scale using an on-line survey instrument. The participants could chose whether the item was *1) unimportant, 2) of little importance, 3) moderately important, 4) important or 5) very important*. The responses were entered in a Microsoft Excel spreadsheet and the group mean and standard deviation for each item was calculated.

Round three allowed the participants to reevaluate their given response based on the group mean and standard deviation, displayed by each item, using the same on-line survey instrument. The purpose of round three was to move the group toward consensus using the group mean. The participant was allowed to alter their response toward the mean or leave it unchanged if he or she felt the original answer was accurate. The responses were then subjected to two separate analyses. Descriptive statistics were calculated to establish a new group mean and standard deviation for each item.

In reviewing the data, a standard deviation of σ>.75 was used to determining if the item should be accepted or not. If the standard deviation was greater than σ<.75, then too much disagreement existed around the item. Subsequently, 99 items were measured as *important/very important*, or essential elements to the program; 49 items were considered *moderately important* or of secondary importance; and only 4 items were listed as *unimportant* or *of little importance*. Additionally, 26 items had a standard deviation greater than .75 and were not included in the suggested listing.

To ensure the data was valid, an Analysis of Variance (ANOVA) was conducted to determine any statistical differences between the expert groups of teachers, practitioners and administrators. Using a significance value of α.05, the analysis showed no statistical difference between the three groups. This observation confirmed the intent of the Delphi study to establish a predetermined level of agreement and/or assimilation of data.

CHAPTER 5

Conclusions and Recommendations

Summary

The purpose of this research was to establish the essential lab components needed to teach a standards-based Technology Education program at the high school level with one teacher. Additionally, the research suggested types of activities which could be utilized in such a facility. Through a modified Delphi study, the research established the equipment, tools, hardware and software a contemporary Technology Education lab should ideally contain as per the expert opinion of teachers in the field, teacher educators and administrators with direct roles in program development.

Historically, Technology Education can be traced to the early 1800s, with the development of the Russian System. Other systems — like the Swedish Sloyd system, the Arts and Crafts Movement, and the Industrial Arts eras, — significantly influenced today's Technology Education model (Barlow, 1967). Despite a traceable history, Technology Education lacks an identity for several reasons. First, most people still identify with "shop" class in a high school, but when asked about the Technology Education lab or Technology Education, much confusion exists (Shields and Harris, 2007). This confusion is better understood through two Gallup polls conducted by the International Technology and Engineering Educator's Association; both polls in 2002 and 2004 indicated that the majority of people believe Americans should be technologically literate, but cannot clearly define the term. (Rose and Dugger, 2002; Rose, Gallup, Dugger and Starkweather, 2004) The poll showed most associate the term technologically literate with computers instead of the ability to use, manage, assess and understand all forms of technology as indicated by the ITEEA (ITEA, 2000).

In 2000, the ITEA released the *Standards for Technological Literacy* or STLs. These standards provided the framework for technological literacy. In 1997, the International Technology Education Association implemented the complete Engineering by Design (EbD) curriculum model and provided the foundation of instruction for public education (ITEA, 2008). A missing component was providing a facility model capable of teaching the EbD curriculum and ultimately the standards and therefore technological literacy. Although the association released the Facilities Planning Guide in 2010 and provided a basic model for Technology Education, it lacked statistical data to reinforce the proposal. This document will provide an integral piece of the puzzle for Technology Education: the statistical support for equipping a standards-based technology education facility.

Findings and Recommendations

The purpose of this study was to determine the equipment, tools, hardware and software are needed to teach a standards-based Technology Education program at the high school level having one teacher. The study was guided by the following research questions:

1. What machines, equipment, hardware, software and materials are agreed upon by experts to be essential components of a Standards Based Technology Education high school model program?

2. Can the Delphi panel establish a set of categorical components based on the following descriptors: essential items, moderately important items and non-essential items?
3. Are there significant differences between the agreement levels on the elements based on expert qualifications?

The following conclusions and recommendations directly stem from the results of this research. For clarity, all conclusions are based on findings from the data provided by the Delphi panel and recommendations are derived from those conclusions as well. The conclusions for each research question will be addressed within this chapter.

The conclusions for the first research question are based on the standard deviation derived in the descriptive statistics in round three. When evaluating the data, a natural break occurred at the standard deviation of σ.75. Any scores below $\sigma<.75$ indicated relative agreement on the item; a finding $\sigma>.75$ indicated the panel did not agree on the item. Disagreement was typically apparent in a spread of 3 or more on the Likert scale with each Likert category having at least two responses. The researcher confidently asserts the natural break of σ.75 is a reasonable delineation of agreement versus disagreement.

Essential Lab Requirement Findings

Based on the findings in round three data, the final conclusions were established based on the items considered "essential" for the model Technology Education facility. The Delphi panel participants suggested 178 possible types of equipment, tools, hardware and software to use in a standards-based Technology Education program. The findings indicated 99 of the 178 items were considered essential items in a standards-based facility. To determine whether an item was essential or not, the Likert scale readings were utilized. If an item scored at or above a 3.5 on the Likert scale the item was considered an essential item for the Technology Education facility.

Essential Lab Requirement Recommendations

Based on the conclusions listed above, the following recommendations define the equipment, tools, hardware and software are essential for a standards-based Technology Education program. Table 4.9 indicated all standards could be taught using the items found in Table 5.1.

Table 5.1

Technology Education Lab Essential Elements

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE
Air Compressor	Applied Science Tools	Classroom/ Lab Sound System	3D Arch Building Design
Alternative Energy Training Set	Biotech Gen Lab Equip	Classroom Project Server	3D CAD
Band Saw	Construction Tools	Color Laser Printer	Animation Software
Belt/Disc Sander	Electronics Tools	Digital Video Recorder	Audio Edit/ Prod. Software
Bench Grinder 8”	Fabrication Measurement Tools	Electronic Presentation Board	Bridge Design Software
Bridge/Tower Tester	Fastener Supply	42” (min) HDTV	CAM Software
CIM/FMS Trainer	General Chemistry Tools	GPS Units	Chemistry Analysis Software
Civil Engineering Learning System	Measuring Devices	Instructor Laptop Comp	Game Development Software
Classroom Furniture	Miscellaneous Fabrication Tools	Laptop Comp Set/Cart	Land Based Automobile Control
CNC Metal Lathe & Tooling	Miscellaneous Fabrication Power Tools	Laser Printer	Monitoring Software Land Base Transportation
CNC Metal Mill & Tooling	Office Equipment	Projector	PLC Software
Drill Press	Plastic Tools	Scanner	Desktop Publication Software
5HP Dust Collection with Shop Vacuums	Pneumatic Tools	Video Camcorders	Electricity/Electronic Circuit Software
Electronic Equipment with oscilloscope	Safety Equipment	Wide Format Printer	White Board Software
Environment Learning System	Sound Level Meter		Floor Plan Software
Filing System/Cabinets			Internet Connection

Flammable Cabinet	MS Office Software (or equiv)
Gears ID Kits (or Equiv)	Photoshop (or equiv)
Graphics Learning System	Robot Control Software
Greenhouse for Biotech/BioFuel	Vernier Software
Industrial Controls Learning System	Video Editing Software
Injection Molder	Web Design Software
Laser Engraver Minimum 30 watt	
Laser Lab Equipment	
Lego Mindstorms	
Material Stock (various)	
Mechanical Learning System	
Mechatronics Learning System	
Microscope with video capabilities	
Multisander Oscillating	
Photovoltaic Cell Learning System	
Plastics Oven	
Pneumatic/ Hydraulic Learning System	
Power Miter Saw	
Power/ Energy & Transportation Learning System	
Project Storage System	
Rapid Prototype (8x8x10 Min)	
Research and Development Learning System	
Robotics Workcell	
Scanner	
Scroll Saw	
Strip Heater	
Structural Tester	
Table Saw	
Vacuum/ Thermo Former	
Vise System	
Wind Tunnel	
Work Benches	

Moderately Important Lab Requirement Findings

Based on the findings in round three data, the final conclusions were established according to the items considered secondary items for a Technology Education facility. Of the 178 different types of equipment, tools, hardware and software identified by the Delphi panel, 49 were agreed upon as secondary to equipping a standards-based facility. These items were deemed moderately important and scored between 2.5 and 3.49 on the Likert scale; this score indicates the items were non-essential for a standards-based Technology Education facility, but could compliment program if funding allowed.

Moderately Important Lab Requirement Recommendations

Based on the conclusions listed previously, the following recommendations define the equipment, tools, hardware and software considered moderately important items in a standards-based Technology Education program if funding allows. These items scored moderately important and could enhance to the facility and curriculum if funding allowed, yet not critical to teaching the standards-based curriculum. These items have been listed in Table 5.2.

Table 5.2

Technology Education Lab Moderately Important Elements

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE
Aerospace Learning System	Barcode Scanner (or equiv)	Student Response System	2D CAD
Arbor Press	Hand Draft Tools	Wireless Microphones	Air Quality Analysis Software
Audio Trainer	Medical Equipment		Barcode Gen Software
Auto Product Identification System	Non Contact Tachometer		BIM Software
Blower			EKG Analysis Software
Box and Pan Brake			Plant layout software
Buffing Wheel			Sim City Software
Catapult Learning System			Sim Farm Software
Computer Metrology			Smart Draw Software

Equipment	
Dynamometer	Soil pH Software
Rokenbok Integrated Transportation System	Stat Process Software
Internal & External Combustion Engine	Waterjet Software
Jointer	Web 2.0 Tools Free
Lab Pro Waste Management System	
Laser Survey Equipment	
MIG Welder	
Weld/cut	
Oxy/Acetylene	
Plasma Cut and Routing System	
Fitness Equipment	
Radial Arm Saw	
Rotational Molder w/molds	
Scale Transportation Vehicles	
Screen Printing equipment	
Small Gas Engines	
Solar Vehicle Learning System	
Speed Radar Gun	
Vertical Hole Punch	
Watercraft Testing Track 20' Minimum	
Waterjet Cutting System	
Wood Lathe	

Non-Essential Lab Requirement Findings

Based on the findings in round three data, the final conclusions established items considered unimportant or non-essential items for a Technology Education facility. Of the 178 different types of equipment, tools, hardware and software identified by the Delphi panel, only four were found to be unimportant for a standards-based facility. These items were deemed to be of *little importance* or *not important* and scored between 0 and 2.49 on the Likert scale; this low score indicates the items not essential for a standards-based Technology Education facility.

Non-Essential Lab Requirement Recommendations

Based on the findings listed above, the following recommendations are given for defining what equipment, tools, hardware, and software are unimportant items or non-essential items for a standards-based Technology Education program. The items listed in Figure 5.3 scored *of little importance* or *unimportant* on the Likert scale and would not contribute the quality of the program or curriculum.

Table 5.3

Non-Essential Technology Education Lab Elements

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE
Book Binding System			
Braille Stylus, Slate, and Practice Cell			
Lithography Equipment			
Metal Forging Furnace			

Items of Significant Disagreement Conclusions

Several items in round three showed a standard deviation greater than $\sigma.75$ indicating the panel did not agree on the items (see Table 5.4). The researcher confidently asserts a standard deviation greater than $\sigma.75$ provides reasonable assurance of disagreement and indicates several panel members felt strongly enough about the item to resist adjusting their answer to correlate with the mean. Several items contained outliers one or two people separated from the majority of the sample and skewed the data. The items are noted in bold in Table 5.4. Because some items scored significantly higher than others, the outliers noted in bold within the table were removed when recalculating the mean and standard deviation. The adjusted statistics are shown in Table 5.4.

Figure 5.4

ID NUMBER	007	002	001	003	004	006	005	012	011	008	010	009	STATISTICS			
GROUP	A	A	P	P	P	P	P	T	T	T	T	T	Original Mean	Original SD	Adjusted Mean	Adjusted SD
QUESTION																
23 – CO2 Racecar Track with Supplies	5	3	3	3	4	4	3	5	3	4	3	3	3.58	0.79	3.58	0.79
32 – Fluid Power Training System	4	3	4	4	3	4	3	***5***	4	4	4	***2***	3.67	0.78	3.7	0.48
33 – Fuel Cell Learning System	4	3	4	4	3	4	3	***5***	***2***	4	4	3	3.58	0.79	3.60	0.52
37 – Hydropoincs/ Aquaponics Equipment with Supplies	3	3	4	3	5	3	3	5	3	4	3	3	3.50	0.80	3.50	0.80
50 – Materials and Processes Learning System	4	4	4	5	4	3	4	5	4	4	3	***2***	3.83	0.83	4.00	0.63
53 – Metal Brake	3	3	4	3	3	3	4	***5***	2	3	2	4	3.25	0.87	3.09	0.70
54 – Metal Cut-off Saw	3	3	3	2	3	3	3	***5***	2	3	3	**4**	3.08	0.79	2.80	0.42
55 – Metal Horizontal Band Saw	3	3	3	2	3	3	3	***5***	2	3	2	***4***	3.00	0.85	2.70	0.54
56 – Metal Lathe	3	3	4	3	3	2	3	5	2	4	2	4	3.17	0.94	3.00	0.77
57 – Metal Milling machine	3	3	4	4	3	2	3	5	3	4	2	4	3.33	0.89	3.18	0.75
58 – Metal Shear/Roll	3	3	4	2	3	2	4	5	3	3	2	4	3.17	0.94	3.00	0.77
67 – PLC Sensor Application Trainer	4	3	4	4	3	4	4	***5***	3	4	3	**2**	3.58	0.79	3.60	0.52
76 – Roll Forming Machine	***1***	3	3	3	3	2	3	***5***	2	3	2	3	2.75	0.97	2.70	0.48
78 – Router Table/Shaper	***2***	3	4	4	4	4	4	***5***	3	4	3	3	3.58	0.79	3.60	0.52
79 – Ready To Fly Planes	3	3	3	3	3	2	2	***5***	3	3	2	2	2.83	0.83	2.64	0.50
83 – Simple Machine Learning System	2	3	4	4	4	4	4	5	3	4	4	2	3.58	0.90	3.45	0.82
87 – Spot/ Resistance Welder	3	3	4	4	3	3	4	***5***	3	3	***2***	3	3.33	0.78	3.30	0.48
88 – Spray Booth Portable	4	3	4	4	4	**2**	4	**5**	4	4	3	3	3.67	0.78	3.70	0.48
92 - Sustainable Energy Learning System	4	4	4	4	4	4	3	**5**	3	4	3	**2**	3.67	0.78	3.70	0.48
94 – Thickness Planer	3	3	3	2	4	3	3	**5**	2	3	2	3	3.00	0.85	2.82	0.60
97 – Vinyl Cutter	3	3	4	3	3	3	4	**5**	4	3	4	**2**	3.42	0.79	3.40	0.52
101 – Wind Generation Experiment	3	3	3	4	4	4	3	**5**	3	4	3	**2**	3.42	0.79	3.40	0.52

System																
127 – Desktop Computers with Flatscreen Monitors	4	5	4	5	5	5	5	5	5	5	5	**2**		4.58	0.90	4.82	0.40
128 – Digital Cameras with Tripods and Portable Lighting System	4	4	4	4	4	4	4	5	5	4	5	**2**		4.08	0.79	4.27	0.47
169 – Sketchup from Google	4	**2**	3	4	4	4	3	**5**	4	4	3	4		3.67	0.78	3.70	0.48
175 – Waterjet Software	2	4	4	4	4	4	4	4	4	4	2	3		3.58	0.79	3.58	0.79

Items of Significant Disagreement Recommendations

In reviewing the data shown in Table 5.3, the researcher recommends the following recommendations be implemented in future research on this topic.

1) An additional round be conducted on these items to try to establish a more concise mean.

2) The following items categorized based on the adjusted means and the reader understands the recommendations are adjusted. (See Table 5.5)

Table 5.5

Technology Education Adjusted Item Reserved Recommendations

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE
Fluid Power Training System		Desktop Computers with Flat Screens	Sketchup From Google
Fuel Cell Learning System		Digital Cameras, Tripods & Port Lighting System	
Materials and Processes Learning System			
Metal Brake			
Metal Cut-off Saw			
Metal Horizontal Band Saw			
PLC Sensor Application Center			
Ready To Fly Planes			
Roll Forming Machine			
Router Table/Shaper			
Spot/Resistance Welder			
Spray Booth Portable			
Sustainable Energy Learning System			
Thickness Planer			

Vinyl Cutter			
Wind Generation Experiment System			

Table 5.6 shows presenting considerable variance even when the standard deviation was adjusted — and should not be considered for implementation.

Table 5.6

Technology Education Lab Dismissed Elements

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE
Aquaponics/Hydroponics Equipment with Supplies			Waterjet Software
Metal Lathe			
Metal Milling Machine			
Metal Shear/Roll			
Simple Machine Learning System			

Suggested Activity Findings

The list of suggested activities found in Appendix D provides the high school Technology Education teacher a vast resource of ideas. The activities submitted by the Delphi panel were qualitative in nature and offered a variety of content with a wide range of details. Because the classroom teacher creates lessons from experience, activities vary based on the amount of time, allocations, standards/outcomes and the number of students in each particular course. One hundred and fifty-four different activities available for exploration into the classroom establishes a myriad of activities that could be implemented in the classroom.

All of the suggested activities could be completed in the model Technology Education facility with the essential items listed. The purpose of the facility is to empower the instructor to teach a hands-on, standards based program, such as *Engineering by Design*, and this ideal facility could clearly facilitate these goals. The recommended equipment, tools, hardware and software could easily be adapted to the facility planning guide promoted by ITEEA.

Suggested Activity Recommendations

Because the classroom teacher is responsible for teaching to the standards, it is recommended each teacher evaluate the curriculum, based on *The Standards for Technological Literacy*, and implement activities that would best augment the curriculum. The teacher can reference Appendix D and develop a series of activities for each standards-based curriculum component based on professional preferences.

Research Conclusions

In reviewing the findings, the researcher provides the following conclusions. First, it is apparent ITEEA has a curriculum called Engineering by Design potentially providing technological literacy to all students based on the *Standards for Technological Literacy*. The curriculum relies on teachers to define what the Technology Education laboratory should contain in order to engage students in meaningful hands-on learning experiences. Teachers may not have the time or knowledge to develop an adequate list of equipment, tools, hardware and software to complete such a task.

The Facilities Guide published by ITEEA provides suggestions for teachers and administrators, but does not explicitly state that if the EbD curriculum is utilized, the facility must contain the certain items. Utilizing this study as a statistical measure for implementing the facilities guide is a logical and necessary step for creating a standardized facility model which is currently non-existent. The Delphi participants utilized in this study are representative of the ITEEA association population and establish the necessary components of a standards-based facility. Reflecting on the success of other pre-engineering programs that do require a specific list of equipment, tools, hardware and software; it is recommended that ITEEA develop a similar required list needed to teach the EbD curriculum based on this study. This would be a substantial and important step towards standardizing facilities and potentially giving students a similar laboratory experience in Technology and Engineering education.

The researcher also concludes that ITEEA does not currently have a high school facility which exemplifies what a model program should contain based on this study. Having a flagship program would provide ITEEA a facility capable of funding research in the areas of integrated learning, STEM, career exploration and other areas related to the field. Linking hands-on learning to academic areas and could begin to elevate the importance of the field to that of math and science. It is recommended that pursuing the research in the context of STEM would validate the concept that Technology and Engineering Education are the T&E of STEM.

Recommendations for Further Research

After completing this research, the researcher suggests the following recommendations for further research:

1. This study was designed to establish a baseline of information regarding necessary equipment, tools, hardware, and software in a standards-based Technology Education lab based on expert opinions derived from a Delphi study. The researcher recommends a follow-up study utilize the entire membership of ITEEA. A larger sample size would reinforce the statistical relevance of this study.

2. Due to local options at the district level, this study may have a greater influence if it were conducted at the regional or state level. Each state faces unique challenges and

requirements which need to be addressed. Showing correlation to standards at the regional or state level would reinforce the necessity for standardization of curriculum and facilities.

3. The ITEEA is scheduled to revisit the *Standards for Technological Literacy* within the foreseeable future. When the standards are revised, this study should be revisited to ensure the facilities are current with the curriculum and revised standards.

4. With the integration of STEM curriculum models, appropriate facilities for teaching an integrated curriculum would be necessary. This study recommends a similar study be conducted with a panel of science, technology, mathematics and engineering teachers to develop a facility successfully integrating all four facets of the STEM model. Equipping an integrated facility would require including items from the science discipline as found in the National Science Teacher Association's book on establishing a science lab, mathematic requirements derived from books explaining how to equip a mathematics lab, engineering and technology requirements as found in this study. (Motz, Biehle and West, 2007)

The disciplines of Science, Technology, Engineering and Math rarely work within their own field if disciplines focus on application; it makes logical sense to develop laboratories that support the integration of various disciplines. Using a parallel study, the development of an integrated lab is possible. The proposed study only addresses the facility and not the pre-service/in-service required for STEM instructors to successfully teach in the suggested environment. Cooperative teaching models would also need to be studied for the successful integration of a STEM laboratory.

5. A study should be conducted on a laboratory with a successfully implemented a standards-based Technology Education lab. A comprehensive evaluation of the program could illustrate a change in student perceptions of technology and related fields, as well as develop baseline data to measure technological literacy with appropriate lab experiences.

6. A study could be conducted establishing the Technology Education laboratory as the launching pad for making career choices based on a longitudinal study of students' decisions on future employment. Utilizing the comprehensive Technology Education lab as a vehicle for Career and Technical programs, students could be allowed to choose a career path based on sound experiential learning. A study of this nature could potentially allow students to make informed career choices.

Summary

The results of this research study answered three research questions. The first question asked what machines, equipment, hardware, software, and materials are essential components of a Standards Based Technology Education high school model program according to a panel of experts? The Delphi panel participants agreed on 99 items considered to be essential items in a standards-based facility. These items are shown in Table 5.1.

Research question two asked the Delphi panel to establish a set of categorical components based on three descriptors: essential items, moderately important items and non-essential items. The panel accomplished this in Tables 5.1, 5.2 and 5.3. As a result of the data analysis several items were identified having significant disagreement. The data identified these items having outliers, which skewed the data, showing the standard deviation to be greater than .75. When the outliers were removed from the data set, consensus was established and the items standard deviation fell below .75. The items of significant disagreement cannot be considered as part of the three categories, but should be result in further research for those items identified having a standard deviation to great. The essential and secondary items identified in this study fit easily into the single teacher example laboratories shown in the ITEEA Facilities Guide (ITEEA A, 2010).

Research question three established if a significant difference exists between the agreement levels on the elements based on expert qualifications. The ANOVA data shown in Appendix K establishes there is no significant difference in agreement on any item within this study between the three expert groups, based on an alpha value of .05. The purpose of a Delphi study is to establish consensus between panel members, in this case the study fulfilled that purpose.

Recommendations for further research include: expanding the study to include the full membership of ITEEA; conduct a regional/state study to meet local option concerns; revisit the study when new standards for technological literacy are created; conduct a similar study to include STEM teachers; conduct a study on a standards-based Technology Education lab currently being utilized; and conduct a study identifying a model Technology Education lab as the vehicle for career development and integration of Career and Technical Education programs.

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APPENDIX A

IRB Approval

UNIVERSITY of ARKANSAS

120 Ozark Hall • Fayetteville, Arkansas 72701 • (479) 575-2208 • (479) 575-3846 (FAX)
Email: irb@uark.edu

Research Support and Sponsored Programs
Institutional Review Board

October 5, 2009

MEMORANDUM

TO:	Andrew Klenke Michael Daugherty
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	09-09-113
Protocol Title:	*Facility Requirements for Teaching a Standards Based High School Technology Education Curriculum*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 10/02/2009 Expiration Date: 10/01/2010

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Compliance website (http://www.uark.edu/admin/rsspinfo/compliance/index.html). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

If you wish to make *any* modifications in the approved protocol, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 120 Ozark Hall, 5-2208, or irb@uark.edu.

Pittsburg State University
Application for Approval of Investigations Involving the Use of Human Subjects

This application must be completed by the Investigator and sent to the Office of Continuing and Graduate Studies by the first Tuesday of the month during the fall and spring academic semesters to be considered for full review on the second Tuesday of the month.

Expedited and exempt reviews can be turned in any time. For questions about the review process contact Brian Peery in Russ Hall,#112, Ext. 4175.

1. Investigator(s) Name(s): Andrew M. Klenke   Department: Technology & Workforce Learning

2. Local Address: 102 Twin Acres, Pittsburg, KS 66762

3. Phone: 620-231-9366   E-mail Address: amklenke@pittstate.edu

4. Project Title: Dissertation (University of Arkansas):

5. Expected Starting Date: Fall Term 2009   Expected Completion Date: Spring Term 2010

6. Is this project (check all that apply): Use review criteria in Form CR-1 to determine which category of review applies.

- [ ] Application for Full Review
- [ ] Application for Expedited Review
- [x] Application for Exempt Review
- [ ] Protocol Change
- [ ] Continued Review
- [ ] Faculty Research
- [ ] A Class Project
- [ ] Thesis/Special Investigation
- [ ] Being submitted for external support
- [ ] Being conducted in a foreign country
- [ ] Publishable research

7. If notification of human subject approval is required give date required : 9 September 2009

Name of agency: Dr. Michael Daugherty, 214 Peabody Hall, University Of Arkansas. Fayetteville, AR 72701

8. If you are a student, complete the following:

Faculty Sponsor: Dr. Gregory Belcher   Department: Technology & Workforce Learning   Phone: 620-235-4637

**** If submitted externally, a complete copy of the proposal must be submitted to the IRB.****

CERTIFICATION AND APPROVAL

Certification by Investigator: I certify that (a) the information presented in this application is accurate, (b) only the procedures approved by the IRB will be used in this project, (c) modifications to this project will be submitted for approval prior to use, and that all guidelines outlined in the PSU Policy and Assurance Handbook for the Protection of Human Research Subjects will be followed as well as all applicable federal, state and local laws regarding the protection of human subjects in research as outlined in Form VA-1.

Signature of Investigator   9/1/09 Date

Faculty Sponsor: If the Investigator is a student, his/her Faculty Sponsor must approve this application.
I certify that this project is under my direct supervision and that I accept the responsibility for ensuring that all provisions of approval are met by the investigator.

Signature of Faculty Sponsor   9-2-09 Date

Department Review Committee Chair: I acknowledge that this research is in keeping with the standards set by our department, university, state and federal agencies and I assure that the student principal investigator has met all departmental requirements for review and approval of this research.

Signature of Department Review committee Chairperson   9-2-09 Date

CPHRS Chairperson   9-10-09 BP Date

UNIVERSITY of ARKANSAS
1871

120 Ozark Hall • Fayetteville, Arkansas 72701 • (479) 575-2208 • (479) 575-3846 (FAX)
Email: irb@uark.edu

Research Support and Sponsored Programs
Institutional Review Board

September 24, 2010

MEMORANDUM

TO:	Andrew Klenke Michael Daugherty
FROM:	Ro Windwalker IRB Coordinator
RE:	PROJECT CONTINUATION
IRB Protocol #:	09-09-113
Protocol Title:	*Facility Requirements for Teaching a Standards Based High School Technology Education Curriculum*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Previous Approval Period:	Start Date: 10/02/2009 Expiration Date: 10/01/2010
New Expiration Date:	10/01/2011

Your request to extend the referenced protocol has been approved by the IRB. If at the end of this period you wish to continue the project, you must submit a request using the IRB approved form "Request for Continuation." Failure to obtain approval for a continuation on or prior to this new expiration date will result in termination of the protocol and you will be required to submit a new protocol to the IRB before continuing the project. Data collected past the protocol expiration date may need to be eliminated from the dataset should you wish to publish. Only data collected under a currently approved protocol can be certified by the IRB for any purpose.

If you have questions or need any assistance from the IRB, please contact me at 120 Ozark Hall, 5-2208, or irb@uark.edu.

APPENDIX B

Delphi Panel Participants

Administrators/Supervisors

Mr. Duane Hume Florida Department of Education State Supervisor IT/Technology Education	Mr. Hume serves as Florida's technology education director/supervisor. He coordinates all technology education efforts in the state and is very progressive in the areas of business, IT and STEM education in Florida.
Mr. Doug Wagner Director, Adult, Career & Technical Education Manatee County Public Schools, FL	2003-2004 ITEA CS Director. School Administrator for Manatee County public schools. Accrued over $30 million in grants since 2001 implementing a 309,000 square foot facility. Developed model CTE program for the state of Florida.

Teacher Educators

Dr. Kara Harris Technology and Engineering Education Department of Technology Management Indiana State University	Teacher Educator with an emphasis in Project Lead The Way expertise. Multiple degrees from different universities in technology education. Specific interests involve technology and engineering education.
Teacher Educator Past editor for the Journal of Technology Education	

Mr. Michael Neden Assistant Professor, Technology Education Pittsburg State University	DTE (Distinguished Technology Educator) Mr. Neden's most notable accomplishments include developing the modular exploratory program at Pittsburg Middle School in the mid 1980s; and developing a district wide technology education program (K-12) in the Delta County School System in Colorado. Most recently, he has implemented technology His innovative lab designs and curriculum projects have been recognized worldwide.
Dr. Mark Nowak California University of Pennsylvania	DTE (Distinguished Technology Educator) with an emphasis in Bio-Related technology and manufacturing technology. TEAP high school Technology Education curriculum guide advisor.
Mr. Ben Yates Technology Education Consultant	DTE (Distinguished Technology Educator) Mr. Yates has experience as both a high school instructor and a teacher educator. His most recent experience includes developing UCM as a Project Lead The Way center, training most of Missouri's PLTW educators.

Teachers

Robert Eady Conserve School	Mr. Eady is a high school teacher at the Conserve School in Land O' Lakes, Wisconsin. He is currently is coaching an award-winning Robotics Team, coordinating a joint water quality project between Conserve students and university students, and making plans to build an electric vehicle with students in the Electrathon America Electronic Vehicle Competition.

Mr. Brad Dearing Technology Education/Department Chair	DTE (Distinguished Technology Educator) High School Teacher Reviewer for *Standards for Technological Literacy* Mr. Dearing has Bachelors and Masters degrees in Technology Education from Illinois State University. He serves as president of the Technology Education Association of Illinois and serves on the advisory board for the Technology department at Illinois State University.
Mr. Steve Price* Riverdale High School	DTE, Riverdale High School (GA) Teacher and Department Chair was involved with the Technology for All Americans project and was part of the assessment standards team at ITEA. 2002-2003 ITEA Region I Director. 2001 Assessment Standards Team.
Patrick McDonald Technology Lab Facilitator Bingham High School	2005 ITEA Teacher Excellence Award Recipient; 2008-2009 ITEA Region IV Director, Technology Teacher at Bingham High School in Utah
Larry Dunekack Technology Education Teacher Pittsburg High School	1987-1989,2009-2010 President Kansas Technology Education Association. 40 years teaching technology education. Past curriculum supervisor and curriculum development specialist. National presenter in multiple states/conferences with regard to technology education and science education. Completed a contemporary high school lab renovation in 2009. 1985/1995 KS Teacher of the Year, 2005 ITEA Program Excellence Award. 1996/2002 PSU Outstanding Cooperating Teacher

Alternatives and Non-Contacts

Mr. Michael Fitzgerald Indiana Department of Education, IN	State Supervisor Declined
Mr. Dennis Soboleski* Instructional Facilitator Technology Education Brevard Public Schools	School Administrator Could not locate
Mr. Britton Hart Assistant Principal Emporia High School, KS	School Administrator Alternate Did not contact
Mr. Doug Miller State Supervisor Technology Education Missouri Department of Elementary and Secondary Education	Alternate Did not contact
Bullerman Thomas Technology Education- Chair Chesapeake High School	International Technology Education Assocation's Program of Excellence Award 2009. Attempted voice and email contact 11/24, Did not respond
Ray Parsons Technology Teacher, Department Chair	ITEA Program of Excellence Award 2008 Program includes biotechnology, computer IT and networking, digital media design and animation, Environmental and conservation science, video and tv production, commercial photography, engineering, etc. Attempted voice and email contact 11/24, Did not respond
Ms. Susan Presley* North Cobb High School, GA	High School Teacher Could not locate
Mr. Michael Gray* Carrol County High School, MD	High School Teacher Could not locate
Mr. Doug Livingston Bingham High School, UT	High School Teacher Alternate Not contacted
Mr. Stephen Myers	High School Teacher who created a

Brillion High School	new design and build high school technology program in Brillion, Wisconsin. Worked with local industry to develop the program. Attempted to contact 11/18, 11/20 and 11/30, no response
Dr. Phillip Reed Old Dominion University, VA	Teacher Educator Alternate Did not contact

Appendix C

Round One Letter to Participants

Andrew M. Klenke
1701 S. Broadway, W105b KTC
Pittsburg State University
Pittsburg, KS 66762
Current Date

Mr. Survey Completer
Technology Education Teacher
12345 Technology Lane
Somewhere High School
Somewhere, USA 12345

Dear Survey Completer:

Thank you for agreeing to participate in this study. I appreciate your involvement, professionalism, and the time you will spend completing this project. I will remind you that participation in this study is voluntary and no compensation is given for your participation. It should also be noted that only group responses will be reported and *all personal information will remain confidential*. Each participant will be issued a code number located at the top of the survey instrument. All information for each participant will be referenced to that code throughout the modified Delphi process.

The purpose of the study is to determine what a contemporary technology education facility should have with regard to equipment, tools, software, hardware and curricular projects which are needed to teach a standards-based technology education program. In essence, you should be able to do design, build, test and present anything in this model facility. To accomplish this, a modified Delphi technique will be used to arrive at a consensus among a group of selected experts in the field, of which you are a part. To date, there has been no identified agreement on what a contemporary technology education facility should have for equipment, tools, software or hardware; your group will help define those attributes.

This correspondence represents Round One of a three round Delphi procedure. The purpose of this round is to list what tools, equipment, software, hardware and curricular project needs would be necessary to teach a "standards based technology education curriculum" within each of the content standards. The standards can be accessed and reviewed electronically through the International Technology Education Association website, located at http://www.iteaconnect.org/TAA/PDFs/xstnd.pdf.

For clarity, the facility will have 3000 square feet and one technology education faculty to teach the standards based curriculum. In essence, you are defining what a model technology education program in a small high school having only one teacher would need to teach to the standards. There is no monetary amount tied to this, however space requirements might dictate your decisions on what would be included to teach each standard. In your list, you might duplicate equipment; for instance, you may need a drill press for a power and energy project for one of the standards, and in another standard you might need a drill press for a different project. These would be combined and listed as a drill press in round two.

I sincerely appreciate your time and effort. Please record your responses on the document attached to this email. Once you have completed this first round, please return the document via email to amklenke@pittstate.edu. Please respond no later than November 10th, 2009.

Sincerely,

Andrew Klenke
Graduate Student, University of Arkansas

Michael K. Daugherty, Ed.D.
Dissertation Chairperson
University of Arkansas

CODE: 000

FACILITY REQUIREMENTS FOR TEACHING A STANDARDS BASED HIGH SCHOOL TECHNOLOGY EDUCATION CURRICULUM: A DELPHI APPROACH

Round One Questionnaire

DIRECTIONS: The purpose of the study is to determine what equipment and curricular materials should be present in a contemporary standards-based technology education program. If a particular piece of equipment, tool, or software is needed in more than one standard, please list it in all necessary standards. Please list any curricular projects that would be relevant to validate the use of the equipment, tools, etc. You may list as many or as few items as necessary, however, keep in mind that the facility is restricted to 3000 square feet and has only one teacher.

Please identify in the following standards what tools, equipment, software, hardware and curricular projects are necessary to teach each standard. Please list an item only one time per standard. There are no restrictions to the number of items you can add, if more rows are necessary, press tab in the last box and a new row will appear.

STANDARD 1: Students will develop an understanding of the characteristics and scope of technology.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 2: Students will develop an understanding of the core concepts of technology.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 3: Students will develop an understanding of the relationship among technologies and the connections between technology and other fields of study.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 5: Students will develop an understanding of the effects of technology on the environment.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 6: Students will develop an understanding of the role of society in the development and use of technology.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 7: Students will develop an understanding of the influence of technology on history.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 8: Students will develop and understanding of the attributes of design.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 9: Students will develop an understanding of engineering design.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 10: Students will develop and understanding of the role of troubleshooting, research and development, innovation, and experimentation in problem solving.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 11: Students will develop the abilities to apply the design process.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 12: Students will develop the abilities to use and maintain technological products and systems.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 13: Students will develop the abilities to assess the impact of products and systems.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 14: Students will develop an understanding of and be able to select and use medical technologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 16: Students will develop an understanding of and be able to select and use energy and power technologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 17: Students will develop an understanding of and be able to select and use information and communication technologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 18: Students will develop an understanding of and be able to select and use transportation technologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 19: Students will develop an understanding of and be able to select and use manufacturing technologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

STANDARD 20: Students will develop an understanding of and be able to select and use construction technologies.

EQUIPMENT	TOOLS	HARDWARE	SOFTWARE	ACTIVITES

END OF SURVEY – THANK YOU

APPENDIX D

Round 1 Survey Aggregate Data

EQUIPMENT /STANDARD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
3D Scanner									9	10	11	12		14	15	16		18	19	20
Aerospace Engineering Learning System				4		6														
Air Compressor with lines and accessories	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Alternative Energy Training Set (Solar, Wind, Hydroelectric, Fuel Cell, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arbor Press	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Audio Trainer																				
Automatic product identification system																			19	
Bandsaw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Belt/Disc Sander	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Bench Grinder (8")	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Book Binding Equipment												12	13				17			
Box and Pan Brake	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Braille Stylus, Slate and Practice Cell															15					
Bridge/Tower Testing Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Buffer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Catapult Learning System				4		6														
CIM/FMS Trainer								8	9	10	11	12	13			16		18	19	
Civil Engineering Learning System				4		6					11								19	
Classroom Furniture (chairs, desks, book shelves, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CNC Lathe with Tooling	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CNC Mill with Tooling	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CNC Router 36"x36" Minimum (Techno, AXYX, or equiv) With 7HP Blower				4		6			9	10	11	12		14	15	16		18	19	20
CO2 Race Track (Complete system with stock)				4		6			9	10	11									
Computer-based metrology equipment (calipers, etc.)																			19	
Drill Press	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dust Collection System (5HP Minimum) to include portable shop vacs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dynomometer																16				
Earthquake simulator																				20
Electricity/Electronics Electrical Equipment/Supplies (includes oscilloscope, multimeters, function generators, probes, etc for AC/DC/Digital/Analog)					5	6					11	12				16		18		20
Environmental Learning System				4		6					11									
File cabinets				4																
Flamable Liquid Storage Cabinet				4		6														
Fluid Power Training Systems				4		6		8	9	10	11	12			15	16		18	19	
Fuel Cell Leaning System to include Cars				4							11	12						18		
Gears ID Kits or equiv				4		6			9			12		14	15			18		
Graphics learning System				4		6						12								
Greenhouse (Bio-Fuel production)															15					
Hydroponics, Aquaponics Equipment (Aquarium with pump/filters for Cultivation of plants and animals)															15					
Industrial Control Learning System				4		6					11	12				16		18		20
Injection Molder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Integrated Transportation Set (Reusable Rokenbok & Lionell RC Set to include Monorail, Forklifts, Monorail, Elevator, Crane, Loaders, Roadways, Trains, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Internal and external combustion engines																16				
Jointer									9	10	11	12		14	15	16		18	19	20
Lab Pro (Waste Management)															15					
Laser Engraver (30watt minimum with cutting table and rotary attachement)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Laser Lab Equipment				4		6														
Laser Surveying and Site Layout Instruments																				20
Lego Mindstorms				4		6						12				16		18	19	
Lithography Equipment																	17			
Material Stock (Wood, Metal, Plastics, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Materials and Processes Learning System				4		6					11	12				16			19	20
Mechanical Learning Systems				4		6					11	12				16		18	19	
Mechatronics Engineering Design Apps System (mobile robotics)				4		6		8	9	10	11	12	13		15	16		18	19	
Metal Brake	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Metal Cut-Off Saw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Metal Horizontal Band-Saw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Metal Lathe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Metal Milling Machine	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Metal Shear/Roll	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Metal Working Forging Furnace	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Microscope (Cultivation of plants and animals, Hydroponics)															15					
MIG Welder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Multisanders (oscillating spindle/belt)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Oxy/Acetyline Welding/Cutting Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Photovotaic cell experiment system																16				
Plasma Cutting and routing Machine									9	10	11	12		14	15	16		18	19	20
Plastics Oven	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
PLC/Sensor Application Trainer				4					9	10	11	12	13						19	
Pneumatics/Hydraulics Learning Systems				4		6					11	12				16		18		
Portable Treadmill, Eliptical (with digital readout) Weight Set, Flexibilty Tester, etc.			3	4	5	6	7						13	14						
Power Miter Saw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Power, Energy and Transportation Learning Systems				4		6					11	12				16		18		
Radial Arm Saw																			19	20
Rapid Prototyping Machine 8x8x10 Minimum (3D printer such as Dimension, Z-Corp)				4		6		8	9	10	11	12		14	15	16		18	19	20
Research and Design learning Systems				4		6						12				16		18		
Robotics workcell and equipment w Conveyor and Roboitic Arm				4		6			9	10	11	12	13			16		18	19	
Roll Forming Machine									9	10	11	12		14	15	16	17	18	19	20
Rotational Molder with molds				4		6		8	9	10	11	12		14	15	16		18	19	20
Router Table	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
RTF Planes																		18		
Scale Vehicles/Components (Engines, Maglev, Trucks, Planes, Watercraft, Spacecraft, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Screen Printing Equipment																	17			
Scroll Saw	1	2	3						9	10	11	12		14	15	16	17	18	19	20
Simple Machine Learning System				4		6						12								
Small Gas Engine	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Solar Vehicle Learning System				4								12						18		
Speed Radar Gun				4		6			9	10	11	12		14		16	17	18	19	
Spot (resistance) Welder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Spray Booth (Portable or equiv)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Storage System (Project, Supplies, Materials, etc.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Strip Heater	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Structural Tester (complete with apparatus, instructional kit and stock)				4		6				10									19	20
Sustainable Energy Learning System				4		6			9		11	12				16				
Table Saw	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Thickness Planer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vacuum Former (Thermoforming)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vertical Hole Punch	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Vinyl Cutter				4		6		8	9	10	11	12		14	15	16		18	19	20
Vise system (wood and swivel metal bench vices				4					9	10	11	12		14	15	16		18	19	20
Watercraft Testing Track 20' Minimum								8	9	10	11	12	13					18		
Waterjet Cutting System									9	10	11	12		14	15	16		18	19	20
Wind generation experiment systems																16				
Wind Tunnel				4		6			9	10	11	12								
Wood Lathe	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Work Benches				4		6			9	10	11	12	13	14	15	16	17	18	19	20

TOOLS (HAND/POWER/LAB)																				
Applied Science tools (Density Kits, Gravity Tester, Force Motion Tester, Optics, Laser Transmitter, Sound Test Equipment, Audio test equipment, etc.		2	3	4		6	7	8	9	10	11	12		14	15	16				
Barcode or similar scanner																			19	
Biotechnology General Lab Equipment (Artificial Light Source, Planting Tool Set, Potting Trays, hot plate, microwave, beakers, flasks, graduated cylinders, petri dishes, box fan, etc.)															15					
Construction Tools (Wheelbarrows, Surveying tools, Form stakes, hammers, chalklines, belts, framing squares, shovels, hoes, trowels, floats, saw horses, extension cords, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Electronics Tools and kits (soldering irons, multimeters, motors, lamps, propane torch, wire, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Fabrication Measurement Tools (Dial calipers, micrometers, tri-squares, Framing Square, quick square, rulers, angle, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Fastener System (Screws, Bolts, Nails, Nuts, Washers, Brackets, Round and Flat Stock, Dowles, wire, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
General Chemistry Tools (selected bio-related activities)															15					
Hand Drafting Equipment (Boards, triangles, t-squares, etc)				4		6	7	8	9		11	12			15	16	17		19	20
Measuring Devices (graphing calculators, Infrared head detectors, light meter, thermometers, digital scale, Gravity Tester, Heat Expansion Gage, Prism, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Medical equipment (Stethoscope, Weight/Height Scale, Human Body Model, Blood Pressure Tester, Audio testing, etc)		2	3	4		6	7	8	9	10	11	12		14	15					
Misc Fabrication Power Tools (cordless drills, sanders, routers, recip saw, circular saw, jig saw, soldering irons, rotary engravers, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Misc Fabrication Tools (wood and metal chisels, files, wrenches, sockets, drill bits, nail/punch sets, hammers, clamps, screwdriver sets, vices, , hammers, punches, files, wrenches, sockets, clamps, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Non-contact tachometer																		18		
Office Equipment (Scissors, paper cutters, rulers, staplers, CD storage, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Plastics Tools (strip heater, buffer, welder, scrapers, etc)									9	10	11	12	13	14	15	16	17		19	
Pnuematic tools (stapler, brad nailer, finish nailer, framing nailer, etc.)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		19	
Safety Related Equipment (Flammable Storage Cabinets, Hearing protection, safety glasses and cabinet, lab coats, specialty gloves, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sound Level Meter (Noise Pollution)															15					
HARDWARE																				
Classroom Student Project Server	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Classroom/Lab Sound System	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Color Laser Printer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Desktop Computers with flat screen monitors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Digital Cameras with Tri-pods and Portable Lighting System	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Digital Video Recorder	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Electronic Presentation Board (i.e. Smartboard or equiv)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Flatscreen HDTV 42" Minimum	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
GPS Units																		18		
Instructor Laptop Computer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Laptop Computer Set with storage cart	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Laser Printer (Print presentations, reports)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Projector for Whole Class Presentation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Scanner	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Student Response System	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Video Camcorders with Tri-pods	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Wide Format Printer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Wireless Handheld Microphones and Lapel Microphones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SOFTWARE																				
2D CAD	1	2	3					8	9	10	11	12	13	14	15	16	17		19	
3D Building Design such as Chief Architect, or Revit						6														20
3D CAD such as Solidworks with Solid Professor, Rhino, etc.		2		4		6		8	9	10	11	12	13	14	15	16	17		19	
Air Quality Analysis															15					
Animation Software (Alice, Animation Master, etc)																	17			
Audio Editing/Production Software					5												17			
Barcode generation software and reading software.																			19	
Bridge Design Software such as Westpoint Bridge Builder																		18		20
Building Information Modelling (BIM) Software																				20
CAM Software such as MasterCAM, CamWorks, or equiv to produce G-code																			19	
Chemical Analysis for Hydroponics, DNA															15					
Computer Software to enable the automatic control of a land based transportation system																		18		

Computer Software to monitor the performance of land-based, water-based, and air-based vehicles																		18		
Programmable Logic Control software for motors, lights, sensors, etc.																		18		
Desktop Publishing Software such as Illustrator, In-Design, CorelDraw, Etc.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
EKG Analysis for Electrophoresis															15					
Electrical circuit simulation such as Electronic Circuit Designer, Digital Works, TINA, Edison, etc.																16				
Electronic White Board Software	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Floor Planner Free		2	3	4			7	8	9	10	11	12	13	14	15			18		
Computer Game Development Software such as Game Studio 3D authoring		2	3	4			7	8	9	10	11	12	13	14	15			18		
Internet Connection	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Office Software for word processing, databases, spreadsheets, presentations, etc)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Photo Manipulation Software such as Photoshop or equiv				4		6	7	8	9	10		12	13	14	15	16	17	18		
Plant layout/simulation software																			19	
RobotC or equiv Programming language for NXT and VEX		2	3	4			7	8	9	10	11	12	13	14	15			18		
Sim City Software				4																20
Sim Farm Software					5															
Sketchup from Google		2	3	4			7	8	9	10	11	12	13	14	15			18		
Smart Draw Visual Communication Software		2	3	4			7	8	9	10	11	12	13	14	15			18		
Soil pH Analysis for waste management															15					
Statistical process analysis software.																			19	
Vernier Software for Cultivation of plants and animals, Aquaponics															15					
Video Editing Software such as Adobe Premiere, Final Cut, i-Movie, Studio, or Equiv.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Water Quality/Analysis Test Kits for Aquaponics, Water quality															15					
Waterjet Software for OMAX Layout																			19	
Web 2.0 tools Free		2	3	4			7	8	9	10	11	12	13	14	15			18		
Web Design Software such as Dreamweaver w/flash or equiv.				4	5	6	7	8	9	10		12	13	14	15		17	18		

ACTIVITIES/ STANDARD	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Preparing and Presenting Projects (printed and oral)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Design - Market and Profit Project	1																		19	
Students will be assigned a specific contemporary product to research "backwards." Students are to develop a timeline of development for the product function, such as a cordless drill, tracing its history back to the bow and stick drill. Each student team will develop an illustrated presentation and report to be presented to the class.	1																			

Extemporaneous Presentation - Participants give a three to five minute speech, fifteen minutes after having drawn a card on which a the characteristics of technology on it. Then a speech is written.	1																			
Debating Technological Issues - Participants debate against a team/s on the characteristics and scope of technology. The teams are instructed on site to take either the pro or con side of the topic.	1																			
Monitoring demand and consumption patterns: dorm/residence energy and water consumption data collection and reporting.		2	3	4	5							12	13					18		
Control and sensor systems: an environmental sensing & monitoring: temperature, wind speed, insulation, etc., various parameters in the aquatic environment		2																18		
Students (in teams) identify a common small household appliance and map the following for an illustrated formal presentation: Systems, sub-systems, materials used in fabrication of parts, identified trade-offs of materials, impact on disposal, constraints of product, energy impact, and the process of design and re-design of product.		2																		
Essays on Technology - Participants conduct research in the core concepts of technology using the knowledge and personal insights gained from this research, write a persuasive essay.		2																		
Appropriate Technology Design Problem		2																		
Students will design and develop a scale model of a sustainable residential dwelling for a client. It will include b. PV, solar thermal, & wind systems (for wind especially - non-conventional, i.e., systems other than traditional horizontal-axis systems)			3	4			7											18		

Students will be assigned a "simple" product to re-develop with one or more innovative features. Output of this project will be freehand sketches of new concepts and a presentation to the class.			3																	
Prepared Presentation - Participants deliver an oral presentation that includes audio and/or visual enhancement based on the technologies and the connections between technology and other fields of study			3																	
Future Technology Teacher - Participants research and select three accredited colleges or universities that offer technology education or engineering technology teacher preparation as a major. Each participant must write a one page simulated college essay about the wish to become a teacher in either major. Participants also develop and present a lesson plan.			3																	
Apollo 13 "Square Peg in Round Hole" Design Problem			3																	
Historical Artifacts Re-Design Project				4		6	7													
Design a Civilization				4		6														
Ethics/Laws Debate… RE: Technology				4		6														
Students will identify some of the changes in society as the product has changed over the years, including trade-offs, ethical considerations, and effects on other cultures.				4																
On Demand Video – Participants write, shoot, and edit a video about social, economic, and political effects of technology.				4																
Electronic Research and Experimentation - Participants research, plan, design, and construct an electronic device. Projects are evaluated on quality of research, ingenuity and complexity of the device, and effectiveness of the exhibit display.				4																

The study of alternative energy systems - Students will build working models of all these systems at various scales					5		7									16		18		
Bio-fuel production					5										15	16				
Water quality					5										15					
Alternative Fuels Project					5											16				
Student teams, using a given technology such as an air conditioner (HVAC) or a gas powered lawn mower, will research the positive and negative effects on the environment. Teams will present an illustrated demonstration of these effects to the class.					5															
E-Scrap recycling project					5															
Project on recycling landfill trash into energy (billion dollar secret on You-tube)					5															
Imaging Technology - Participants capture images and process photographic and digital prints for display that depict the current year's published theme. Students participate in an on-site event in which they record digital images and utilize multimedia software to prepare a storyboard/outline and media presentation of newsworthy TSA activities and events.					5															
Music Production - Participants produce a musical piece that is designed to be played during the national TSA conference opening or closing general sessions					5															
Local Pollution Study and Tech Survey					5															
Farming 101 an exercise in farm management					5															
Student teams, using a given technology such as an air conditioner (HVAC) or a gas powered lawn mower, will research the positive and negative effects on the environment of this technology on two or more societies other than the United States. Teams will present an illustrated demonstration of these effects to the class.						6														

Elecrronic ediquitte in email, texting, etc.						6														
Report on new injuries and health issues which occur because of new technologies						6														
Project on technological societal demands and adaptations						6														
Engineering Design - Participants work as part of a team to solve a design problem. Through use of a model/prototype, display, and design notebook, the team explains in detail how it has solved the problem and the solution's impact on society and the environment. Students then demonstrate the problem and solution in a timed presentation.						6														
Fashion Design - Participants research, develop and create garment designs, garment mock-ups, and portfolios that reflect the current year's published theme. Students participate in an on-site event in which they present their potential garment designs to the judges on a TSA runway.						6														
Students will be assigned a specific contemporary product to research "backwards" which will include the influence of their technology at each historical change in that technology. Students are to develop a timeline of development for the product function, such as a cordless drill, tracing its history back to the bow and stick drill. Each student team will develop an illustrated presentation and report to be presented to the class.							7													
Film - Participants develop a film that focuses on the influence of technology on history. Sound may accompany the film/video.							7													
Rube-Goldberg Challenges								8	9	10						16				
Participation in a Robotics competition such as FIRST First Tech Challenge, FIRST Robotics Challenge, VEX competition, Parallax or TETRIX								8	9	10								18		

Students will participate in an Electrathon competition within their region. This is a design and build to include monitors for various parameters (acceleration, video, CO2, etc)								8	9	10								18		
Rocketry: Students will design and build rockets which incorporate sensors which monitor various parameters such as altitude, acceleration, etc.)								8	9	10								18		
Creating virtual models: Utilize PTC and AutoDesk competitions and include in other activities listed.								8	9		11									
Dragster Design - Participants design, produce working drawings for, and build a CO2-powered dragster.								8	9									18		
Mousetrap Car								8	9									18		
Computer-Aided Design (CAD), Architecture with Animation - Participants create representations, such as foundation and/or floor plans, and/or elevation drawings, and/or details of architectural ornamentation or cabinetry. Students may be expected to animate a presentation of their entry.								8	9											
Civil Engineering Project								8	9											
Students will develop a technological solution with at least three concepts, to a given problem using the design process, based on limited criteria and constraints.								8												
Technical Sketching and Application - Participants demonstrate their ability to solve on-site engineering graphics problems using standard drafting techniques.								8												
Computer-Aided Design (CAD), Engineering with Animation Participants create 3D computer model(s) of an engineering or machine object, such as a machine part, tool, device, or manufactured product. Students may be expected to animate a portion of their model.								8												

Students will incorporate engineering principles in the design process. Students will develop/fabricate a model, mockup, and/or a prototype of their final solution.									9											
Mousetrap Boat									9											
During process of designing solution to design problem, students will use various research and testing procedures to determine best possible solution.										10										
Re-Engineering Projects										10										
Transportation Modeling - Participants using only certain materials and following required specifications, design and produce a CO2-powered scale model of a vehicle that fits the annual design problem and that takes appearance and performance into consideration.										10										
Electronic Game Design - Participants develop an E-rated game that focuses on the subject of their choice.										10										
Boat Design Challenge										10										
Car Design										10										
Technology Dare - Participants design, fabricate, and demonstrate the application and control of mechanical, fluid, and electrical power by applying power and energy principles to move balls with a pneumatic flow. Evaluation is based on a demonstration of the application of mechanical, fluid and electrical energy principles, and craftsmanship.											11					16				
Flight Endurance - Participants analyze flight principles with a rubber band-powered model aircraft.											11									
Residential Maintenance Project												12								

System Control Technology - Participants work as part of a team on site to develop a computer-controlled model-solution to a problem, typically one from an industrial setting. Teams analyze the problem, build a computer-controlled mechanical model, program the model, explain the program and mechanical features of the model-solution, and leave instructions for evaluators to operate the device.											12				16				
BalloonSat: A NASA sponsored event. Students will monitor flight tracking, near space sensing and package retrieval.											12						18		
Students will research and develop a documentation manual for the product they have designed and fabricated, to include maintenance and repair service, a parts list, and appropriate diagrams.											12								
Promotional Graphics - Participants develop and present a graphic design that can be used as a TSA recruitment tool and that includes the theme for the next year's conference.											12								
Engine maintenance											12								
Students will develop an environmental impact report their product will have from manufacturing to disposal.												13							
Cyberspace Pursuit - Participants are required to design, build and launch a web site that features the school's career and technology education program, the TSA chapter, and the chapter's ability to research topics pertaining to technology.												13							
Technology Bowl complete a written, objective test the an oral question/response, head-to-head team competition.												13							
Technological Forecasting												13							
Global warming…fact or junk science, impacts of technology												13							

Biomolecular Modeling: Utilize "Smart Teams from the Center for BioMolecular modeling.														14	15					
Students will be assigned a physical impairment which they will research, then design, model, and test a product solution addressing the impairment.														14						
Scientific and Technical Visualization (SCIVIZ) - Participants develop a visualization focusing on a medical technology subject or topic														14						
Medical Technology - Participants conduct research on a contemporary medical technology problem of their choosing, document their research, and create a display. The information gathered may be student-performed research or a re-creation or simulation of research performed by the scientific community. A model or prototype of the solution must be included in the display.														14						
Robot Surgery modeling														14						
Folk, native and alternative medicine project														14						
Vaccine Analysis														14						
Prosthetics Project														14						
Facility/workplace safety															15				19	20
Regulation & safety															15				19	20
Cultivation of plants and Animals: Hydroponics															15					
Cultivation of plants & animals: Aquaponics															15					
DNA electrophoresis															15					
Waste Management															15					
Bio-engineering: Physical Enhancement															15					
EKG															15					
The students will research, design and model a greenhouse capable of supplying fresh produce for a family of four annually. The greenhouse will be self-sustaining.															15					

Agriculture and Biotechnology Design - Participants conduct research on a contemporary agriculture or related biotechnology problem of their choosing, document their research, and create a display. The information gathered may be student-performed research or a re-creation or simulation of research performed by the scientific community. If appropriate, a model or prototype of the solution may be included in the display.															15					
Desktop Publishing Participants develop a notebook that includes a tri-fold pamphlet, a three-column newsletter, and a poster then work to solve an on-site problem that demonstrates their abilities to use the computer to design, edit, and print materials for publication.															15					
Farm Implement Identification, selection, use, care and storage															15					
Organic vs Inorganic Gardening															15					
GMOs, what are they?															15					
Why more health problems today?															15					
Experiments on engine efficiency																16				
Experiments to determine the efficiency and cost of various fuel mixtures.																16				
Design and build a system to meet the specifications of a design problem in power and energy																16				
Students will design and develop a scale model hybrid system for a single family house using as many renewable energy sources as possible with an emergency back-up generator system.																16				
Creating energy efficient communities project																16				

Animatronics - Participants demonstrate knowledge of mechanical and control systems by designing, fabricating and controlling an animatronics device that will communicate, entertain, inform, demonstrate and/or illustrate a topic, idea, subject or concept. Sound, lights and a surrounding environment must accompany the device.																16				
City Power Grid Project																16				
Students will research, develop and deliver an advertising campaign with print, radio, and video promotion spots.																	17			
Creating web pages																	17			
Creating videos																	17			
Digital photo editing																	17			
Creating Animations																	17			
Chapter Team - Participants take a written parliamentary procedures test then proceed to the next level where teams perform an opening ceremony, dispose of three items of business, and perform a closing ceremony within a specified time period.																	17			
Career Comparisons – Participants thoroughly research various technology-related careers that are associated with one of the following technology areas: Biotechnology, Communications, Energy and Power, Engineering, Manufacturing, Medical Technology, Technology Education Teaching, Transportation, or Construction. After documenting the research, each student submits a cover letter and resume for the selected career and completes a formal job application the take part in an on-site mock interview.																	17			
Design and build a computer controlled land-based transportation system																		18		
Design and build an efficient water-based transportation vehicle																		18		

Design and build an efficient air-based transportation vehicle																		18		
Students will research, develop and model a transportation system(s) that demonstrates the transportation of raw and stock materials to manufacturing facility(ies) and the distribution of the finished product developed in the Standards 8-11 projects, including the packaging of the product for shipping and retail sell.																		18		
Report asking comparisons of different transportation technologies																		18		
Competing in a super mileage challenge (google IMSTEA)																		18		
Technology Problem Solving - Participants use problem solving skills and limited materials to develop a solution to a problem given on site																		18		
Radio Controlled Transportation - Participants design, fabricate, test, and demonstrate the use of a radio-controlled vehicle that collects and distributes a load during a five minute demonstration. Evaluation is based on performance, vehicle craftsmanship, and documentation of design efforts.																		18		
Ham Radio Project																		18		
Fiber Optics Design																		18		
BluePrint Reading																		18		
Message Incription																		18		
Transport History Model Analysis																		18		
Quality control																			19	20
Research																			19	20
Design Portfolio (drawings, dimensioning, sketching, keeping engineering notebooks)																			19	
Prototyping																			19	
Fixture development																			19	
Mass production																			19	

Marketing																			19	
Product service																			19	
Design and produce a production system that incorporates automation																			19	
Design and implement a quality inspection system consistent with statistical process control.																			19	
Using the product developed in Standards 8-11, students will research, design, develop, and operate a manufacturing cell to fabricate the product (alternatively, a packaging process system for the product).																			19	
Enterprise approach to teaching manufacturing																			19	
Programming CNC Equipment																			19	
Creating problem based automated cells																			19	
Manufacturing Prototype - Participants design and manufacture a prototype of a product and provide a description of how the product could be manufactured in a state-of-the-art American manufacturing facility.																			19	
Structural Engineering - Participants work as part of a team, on site with supplied materials, to build a model of a structure that is destructively tested to determine design efficiency.																			19	
Puzzle Projects - six piece burr, etc.																			19	
Materials Analysis/stress testing																			19	
Site Layout																				20
Building Design and Construction																				20
Alternative Shelter Design and Build																				20
Construction Cost Estimating																				20
Designing insulating panels																				20
Structure design and testing																				20

Students will research the various building systems used in the design and construction of a small structure (house, workshop, retail store, etc.). Upon completion of the research, the students will construct a ¾" = 1'-0" scale model, beginning with the excavation and ending with the finished surfaces. Framing, wiring, HVAC, etc. will be included.																				20
Solar Communities																				20
City Planning using simulation software																				20
Architectural Model - Participants develop a set of architectural plans and related materials for an annual architectural design challenge and construct an architectural model to accurately depict the design.																				20
Construction Systems Participants complete a written test on general construction systems knowledge then demonstrate their knowledge by solving an on-site construction systems problem.																				20
Electricity 101 Project																				20
Plumbing 101 Project																				20

APPENDIX E

Round 2 Letter to Participants

Andrew M. Klenke
1701 S. Broadway, W105b KTC
Pittsburg State University
Pittsburg, KS 66762
July 12, 2010

Mr. Survey Completer
Technology Education Teacher
12345 Technology Lane
Somewhere High School
Somewhere, USA 12345

Dear Survey Completer:

Thank you for agreeing to participate in this study. I appreciate your involvement, professionalism, and the time you will spend completing this project. I will remind you that participation in this study is voluntary and no compensation is given for your participation. It should also be noted that only group responses will be reported and all personal information will remain confidential. Each participant will be issued a code number which will be located at the top of the returned survey instrument. All information for each participant will be referenced to that code throughout the Delphi process.
To refresh your memory, the purpose of the study is to determine what a contemporary technology education facility should have with regard to equipment, tools, software and hardware to teach a standards-based technology education program. To accomplish this, a Delphi technique will be used to arrive at a consensus among a group of selected experts in the field, of which you are a part of. To date, there has been no agreement on what a contemporary technology education facility should have for equipment, tools, software or hardware to meet all *Standards for Technological Literacy*; your group will help define those attributes.

This correspondence represents Round Two of a three round Delphi procedure. The information provided in Round 1 was reviewed and converged into this survey. The purpose of this round is to begin to build consensus of what tools, equipment, software and hardware needs would be necessary to teach a "standards based technology education curriculum" within each of the content standards. The standards can be accessed and reviewed electronically through the International Technology Education Association website, located at http://www.iteaconnect.org/TAA/PDFs/xstnd.pdf. The on-line instrument will utilize a 5 point Likert scale to record your responses and can be found at the link listed at the end of this letter. There are four sections to the survey; equipment, tools, electronic hardware and software with each requiring a varied number of responses.

The first round was labor and time intensive; however, this round should take approximately 30 minutes to complete depending upon how fast you read.

Remember, for clarity, the facility has 3000 square feet and one technology education faculty to teach the *standards-based* curriculum. In essence, you are defining what a model technology education program in a small high school having only one teacher would need to teach to the standards.

Please record your responses on the website http://www.surveymonkey.com/s/GYJ83VP. If you have any questions, feel free to call or email. Please complete the survey no later than July 26th, 2010.

Sincerely,

Andrew Klenke
Graduate Student, University of Arkansas

Michael K. Daugherty, PhD.
Dissertation Chairperson
University of Arkansas

Appendix F

Round Two Survey Instrument

TE FACILITY DELPHI ROUND 2

1. EQUIPMENT

Below is a listing of the equipment which was collected from the Round 1 survey. Please select the appropriate response which indicates your perception of how important the piece of equipment is in a standards-based HS Technology Education lab. Please note that the numbers within the parenthesis indicate which standards were identified with that particular piece of equipment.

1. Scanner (9,10,11,12,14,15,16,18,19,20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

2. Aerospace Engineering Learning System (4,6)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

3. Air Compressor with lines and accessories (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

4. Alternative Energy Training Set with Solar, Wind, Hydroelectric, Fuel Cell, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

5. Arbor Press (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

6. Audio Trainer (17)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

7. Automatic Product Identification System (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

8. Band Saw (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

TE FACILITY DELPHI ROUND 2

9. Belt/Disc Sander (1-20)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

10. Bench Grinder 8" (1-20)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

11. Blower (4,6,9-12, 14-16, 18-20)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

12. Book Binding System (12,13, 17)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

13. Box and Pan Brake (1-20)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

14. Braille Stylus, Slate and Practice Cell (15)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

15. Bridge/Tower Testing Equipment (1-20)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

16. Buffing Wheel (1-20)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

17. Catapult Learning System (4,6)

- ◯ Unimportant
- ◯ Of Little Importance
- ◯ Moderately Important
- ◯ Important
- ◯ Very Important

TE FACILITY DELPHI ROUND 2

18. CIM/FMS Trainer (8-13, 16, 18, 19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

19. Civil Engineering Learning System (4,6,11,19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

20. Classroom Furniture (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

21. CNC Metal Lathe with tooling (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

22. CNC Metal Milling Machine with tooling (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

23. CO2 Race Track with supplies (4,6, 9-11)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

24. Computer-based metrology equipment (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

25. Drill Press (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

26. Dust Collection System (5HP Minimum) to include portable shop vacs (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

27. Dynomometer (16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

TE FACILITY DELPHI ROUND 2

28. Electricity/Electronics Electrical Equipment/Supplies including oscilloscope, multimeters, function generators, probes, etc for AC/DC/Digital/Analog (5,6,11,12,16,18,20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

29. Environmental Learning System (4,6,11)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

30. Filing System/Cabinets (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

31. Flammable Cabinet (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

32. Fluid Power Training System (4,6,8-12, 15,16,18,19)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

33. Fuel Cell Leaning System to include Cars (4,11,12,18)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

34. Gears ID Kits or Equivalent (4,6,9,12,14,15,18)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

35. Graphics Learning Systems (4,6,12)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

36. Greenhouse for Bio-Tech/Bio-Fuel (15)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

TE FACILITY DELPHI ROUND 2

37. Hydroponics, Aquaponics Equipment to include Aquarium with pump/filters for Cultivation of plants and animals (15)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

38. Industrial Controls learning System (4,6,11,12,16,1,20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

39. Injection Molder (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

40. Integrated Transportation System to include Reusable Rokenbok RC Set & Lionell Train Set to include Monorail, Forklifts, Monorail, Elevator, Crane, Loaders, Roadways, Trains, Rails, Beams, Roadways, Connectors, etc (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

41. Internal and External Combustion Engines (16)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

42. Jointer (9-12,14-16, 18-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

43. Lab Pro Waste Management System (15)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

44. Laser Engraver minimum 30watt with cutting table and rotary attachment (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

45. Laser Lab Equipment (4,6)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

TE FACILITY DELPHI ROUND 2

46. Laser Surveying and Site layout Instruments (20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

47. Lego Mindstorms (4,6,12,16,18,19)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

48. Lithography Equipment (17)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

49. Material Stock including wood, metal, plastic supplies, etc. (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

50. Materials and Processes Learning System (4,6,11,12,16,19,20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

51. Mechanical Learning Systems (4,6,11,12,16,18,19)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

52. Mechatronics Engineering Design Apps System to include mobile robotic systems (4,6,8-13, 15,16,18,19)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

53. Metal Brake (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

54. Metal Cut-Off Saw (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

55. Metal Horizontal Band Saw (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

56. Metal Lathe (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

57. Metal Milling Machine (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

58. Metal Shear/Roll (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

59. Metal Working Forging Furnace (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

60. Microscope with Video Connection (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

61. MIG Welder (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

62. Multi-sander with oscillating spindle/belt (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

63. Oxygen/Acetyline Welding/Cutting Equipment (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

64. Photovoltaic Cell Experiment System (16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

65. Plasma Cutting and Routing Machine (9-12,14-16,18-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

TE FACILITY DELPHI ROUND 2

66. Plastics Oven (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

67. PLC/Sensor Application Trainer (4, 9-13,19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

68. Pneumatics/Hydraulics Learning System (4,6,11,12,16,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

69. Portable Treadmill or Eliptical (with digital readout) Weight Set, Flexibilty Tester, etc. (3-7,13,14)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

70. Power Miter Saw (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

71. Power, Energy and Transportation Learning System (4,6,11,12,16,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

72. Radial Arm Saw (19-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

73. Rapid Prototyping Machine 8x8x10 Minimum 3D printer such as Dimension, Z-Corp (4,6, 8-12, 14-16, 18-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

74. Research and Design Learning Systems (4,6,12,16,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

TE FACILITY DELPHI ROUND 2

75. Robotics workcell and equipment w Conveyor and Robotic Arm (4,6,9-13,16,18,19)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

76. Roll Forming Machine (9-12, 14-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

77. Rotational Molder with Molds (4,6,8-12,14-15,19)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

78. Router Table or Shaper (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

79. Ready To Fly/RTF Planes (18)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

80. Scale Vehicles/Components to include Engines, Maglev, Trucks, Planes, Watercraft, Spacecraft, etc. Can be used for instruction, demonstration or activities (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

81. Screen Printing Equipment (17)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

82. Scroll Saw (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

83. Simple Machine Learning System (4,6,12)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

84. Small Gas Engine (1-20)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

TE FACILITY DELPHI ROUND 2

85. Solar Vehicle Learning System (4,12,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

86. Speed Radar Gun (4,6,9-12,14,16-19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

87. Spot/Resistance Welder (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

88. Spray Booth, Portable or equivalent (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

89. Storage System for Projects, Supplies, Materials, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

90. Strip Heater (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

91. Structural Tester complete with apparatus, instruction kit and stock (4,6,9,11,12,16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

92. Sustainable Energy Learning System 4,6,9,11,12,16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

93. Table Saw (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

94. Thickness Planer (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

95. Vacuum Former/Thermoformer (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

96. Vertical Hole Punch (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

97. Vinyl Cutter (4,6,8-12,14-16,18-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

98. Vise System, wood and metal (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

99. Watercraft Testing Track, 20' Minimum (8-13,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

100. Waterjet Cutting System (9-12,14-16, 18-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

101. Wind Generation Experiment System (16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

102. Wind Tunnel (4,6,6-12,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

103. Wood Lathe (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

104. Work Benches (4,6,9-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

TE FACILITY DELPHI ROUND 2

2. TOOLS

Below is a listing of the tools or groups of tools which were collected from the Round 1 survey. Please select the appropriate response which indicates your perception of how important the tool or group of tools is in a standards-based HS Technology Education lab. Please note that the numbers within the parenthesis indicate which standards were identified in the first survey with that particular tool or group of tools.

105. Applied Science tools (Density Kits, Gravity Tester, Force Motion Tester, Optics, Laser Transmitter, Sound Test Equipment, Audio test equipment, etc. (2-4,6-12,14-16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

106. Barcode or Similar Scanner (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

107. Biotechnology General Lab Equipment to include an artificial light source, planting tool set, potting trays, hot plate, microwave, beakers, flasks, graduated cylinders, petri dishes, box fan, etc. (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

108. Construction Tools such as wheelbarrows, surveying tools, form stakes, hammers, chalklines, belts, framing squares, shovels, hoes, trowels, floats, saw horses, extension cords, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

109. Electronics Tools and kits to include soldering irons, multimeters, motors, lamps, propane torch, wire, components, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

110. Fabrication Measurement Tools such as dial calipers, micrometers, tri-squares, quick square, rulers, angle, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

111. Fastener Supply to include screws, bolts, nails, nuts, washers, brackets, round and flat stock, dowels, wire, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

112. General Chemistry Tools for selected bio-related activities (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

113. Hand Drafting Tools such as boards, triangles, t-squares, templates, etc. (4, 6-9, 11,12,15-17,19,20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

114. Measuring Devices such as graphing calculators, infrared head detectors, light meter, thermometers, digital scale, gravity tester, heat expansion gage, prism, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

115. Medical equipment to include stethoscope, weight/height scale, human body model, blood pressure tester, audio testing, etc. (2-4, 6-12,14,15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

116. Misc Fabrication Tools such as metal and wood chisels, hammers, punches, files, wrenches, sockets, drill bits, clamps, vices, files, wrenches, sockets, nail/punch sets, hammers, clamps, screwdriver sets, vices, etc.(1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

117. Misc Fabrication Power Tools (cordless drills, sanders, routers, recip saw, circular saw, jig saw, soldering irons, rotary engravers, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

118. Non-contact Tachometer (18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

119. Office Equipment such as scissors, paper cutters, rulers, staplers, CD storage, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

120. Plastics Tools such as a welder, scrapers, etc. (9-17,19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

121. Pnuematic tools such as a stapler, brad nailer, finish nailer, framing nailer, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

122. Safety Related Equipment such as a flammable storage cabinets, hearing protection, safety glasses and cabinet, lab coats, aprons, specialty gloves, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

123. Sound Level Meter for noise pollution monitoring (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

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3. ELECTRONIC HARDWARE

Below is a listing of the electronic hardware which was collected from the Round 1 survey. Please select the appropriate response which indicates your perception of how important the listed electronic equipment is in a standards-based HS Technology Education lab. Please note that the numbers within the parenthesis indicate which standards were identified in the first survey with that particular electronic device.

124. Classroom Student Project Server (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

125. Classroom/Lab Sound System (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

126. Color Laser Printer (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

127. Desktop Computers With Flat Screen Monitors (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

128. Digital Cameras with Tri-pods and Portable Lighting System (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

129. Digital Video Recorder (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

130. Electronic Presentation Board Could Be Smartboard or equiv. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

131. Flatscreen HDTV 42" Minimum (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

132. GPS Units (18

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

133. Instructor Laptop Computer (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

134. Laptop Computer Set with storage cart (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

135. Laser Printer For Printing presentations and Reports (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

136. Projector for Whole Class Presentation (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

137. Scanner (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

138. Student Response System (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

139. Video Camcorders with Tri-pods (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

140. Wide Format Printer (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

141. Wireless Handheld Microphones and Lapel Microphones (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

4. SOFTWARE

Below is a listing of the software which was collected from the Round 1 survey. Please select the appropriate response which indicates your perception of how important the listed software is in a standards-based HS Technology Education lab. Please note that the numbers within the parenthesis indicate which standards were identified in the first survey with that particular software.

142. 2D CAD (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

143. 3D Building Design such as Chief Architect, or Revit (6,20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

144. 3D CAD such as Solidworks with Solid Professor, Inventor, Rhino, etc. (2,4,6,8-17,19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

145. Air Quality Analysis (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

146. Animation Software such as Alice, Animation Master, etc. (17)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

147. Audio Editing/Production Software (5,17)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

148. Barcode generation software and reading software (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

149. Bridge Design Software such as Westpoint Bridge Builder (18,20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

150. Building Information Modelling (BIM) Software (20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

151. CAM Software such as MasterCAM, CamWorks, or equiv to produce G-code (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

152. Chemical Analysis for Hydroponics, DNA (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

153. Computer Game Development Software such as Game Studio 3D authoring (2-4,7-15,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

154. Computer Software to enable the automatic control of a land based transportation system (18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

155. Computer Software to monitor the performance of land-based, water-based, and air-based vehicles (18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

156. Programmable Logic Control software for motors, lights, sensors, etc. (18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

157. Desktop Publishing Software such as Illustrator, In-Design, CorelDraw, Etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

158. EKG Analysis for Electrophoresis (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

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159. Electrical circuit simulation such as Electronic Circuit Designer, Digital Works, TINA, Edison, etc. (16)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

160. Electronic White Board Software (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

161. Floor Plan Software such as Free Floor Planner (2-4,7-15,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

162. Internet Connection (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

163. Office Software for word processing, databases, spreadsheets, presentations, etc. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

164. Photo Manipulation Software such as Photoshop or equiv (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

165. Plant Layout Simulation Software (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

166. Robotics Control Graphics Based Software such as RobotC or equiv Programming language for NXT and VEX (2-4,7-15,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

167. Sim City Software (4,20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

TE FACILITY DELPHI ROUND 2

168. Sim Farm Software (5)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

169. Sketchup from Google (2-4,7-15,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

170. Smart Draw Visual Communication Software (2-4,7-15,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

171. Soil pH Analysis Software for Waste Management (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

172. Statistical Process Analysis Software (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

173. Vernier Software for Cultivation of plants and animals, Aquaponics (15

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

174. Video Editing Software such as Adobe Premiere, Final Cut, i-Movie, Studio, or Equiv. (1-20)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

175. Water Quality/Analysis Test Kits for Aquaponics, Water quality (15)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

176. Waterjet Software for OMAX Layout (19)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

177. Web 2.0 tools Free (2-4,7-15,18)

◯ Unimportant ◯ Of Little Importance ◯ Moderately Important ◯ Important ◯ Very Important

178. Web Design Software such as Dreamweaver w/flash or equiv. (4-10,12-15,17,18)

○ Unimportant ○ Of Little Importance ○ Moderately Important ○ Important ○ Very Important

APPENDIX G

Round Two Aggregate Data

ID NUMBER	004	007	012	003	008	006	001	005	011	002	010	009		STATISTICS	
GROUP	P	A	T	P	T	P	P	P	T	A	T	T		MEAN	STANDARD DEVIATION
QUESTION															
1 - Scanner	4	3	5	5	3	5	4	4	5	3	4	3		4.00	0.85
2 – Aerospace LS	2	2	5	4	4	4	4	3	3	3	3	2		3.25	0.97
3 – Air Compressor	4	3	5	5	5	5	4	5	5	2	4	4		4.25	0.97
4 – Alt Energy Training Set	4	4	5	4	4	5	4	4	4	4	4	3		4.08	0.51
5 – Arbor Press	2	2	4	3	3	3	3	4	2	2	3	4		2.92	0.79
6 – Audio Trainer	3	2	4	4	3	4	4	3	3	2	4	2		3.17	0.83
7 – Auto Product ID System	3	3	2	3	2	4	4	4	4	2	3	3		3.08	0.79
8 – Band Saw	4	5	5	5	5	5	4	5	4	2	4	5		4.42	0.90
9 – Belt/Disc Sander	4	5	5	5	5	4	3	5	4	3	4	4		4.25	0.75
10 – Bench Grinder 8"	3	4	5	5	5	2	3	5	4	3	3	4		3.83	1.03
11 – Blower	2	3	2	5	3	5	4	4	3	3	4	4		3.50	1.00
12 – Book Binding System	1	2	3	1	2	2	3	3	3	2	3	3		2.33	0.78
13 – Box and Pan Brake	2	3	5	2	4	2	4	5	3	2	3	4		3.25	1.14
14 – Braille Stylus, slate, etc.	2	2	1	2	2	2	3	2	2	2	2	3		2.08	0.51
15 – Bridge/ Tower Tester	4	4	5	5	4	5	3	4	5	4	4	3		4.17	0.72
16 – Buffing Wheel	3	2	5	3	3	2	3	4	2	3	3	3		3.00	0.85
17 – Catapult LS	2	3	5	4	3	4	3	3	3	3	3	2		3.17	0.83
18 – CIM/FMS Trainer	4	3	5	5	4	5	3	4	4	4	4	3		4.00	0.74
19 – Civil Engineering LS	2	3	5	5	4	4	3	4	4	4	3	2		3.58	1.00
20 – Classroom Furniture	5	5	5	5	5	5	5	5	5	4	4	4		4.75	0.45
21 – CNC Metal Lathe & Tooling	4	4	4	5	5	3	4	5	4	3	3	4		4.00	0.74
22 – CNC Metal Mill & Tooling	4	5	4	5	5	3	4	5	4	3	3	4		4.08	0.79
23 – CO2 Race Track w/Supply	4	5	4	5	4	5	3	3	3	3	3	3		3.75	0.87
24 – Computer Metrology Equip	3	5	2	3	3	4	3	5	3	3	3	3		3.33	0.89
25 – Drill Press	4	3	5	5	5	5	4	5	5	3	4	5		4.42	0.79
26 – 5HP Dust Collection/Vacs	4	5	5	5	5	5	4	5	5	4	4	5		4.67	0.49
27 – Dyno-mometer	2	3	1	3	3	3	3	3	3	3	3	2		2.67	0.65
28 – Elect Equip w oscilloscope	3	5	5	5	5	5	4	5	5	4	4	4		4.50	0.67
29 – EnvironmentLS	4	3	5	4	4	4	4	4		3	3	3		3.73	0.65
30 – Filing System/Cabinets	4	5	5	4	4	5	4	4	5	3	4	4		4.25	0.62

31 – Flammable Cabinet	4	5	5	5	5	5	3	5	5	5	3	5		4.58	0.79
32 – Fluid Power Training System	2	4	5	5	5	4	4	4	4	3	4	2		3.83	1.03
33 – Fuel Cell LS w/Cars	2	4	5	5	4	4	4	4	2	3	4	3		3.67	0.98
34 – Gears ID Kits or Equiv	3	4	5	5	5	5	4	5	3	3	4	4		4.17	0.83
35 – Graphics LS	2	3	5	5	3	4	4	5	4	3	4	4		3.83	0.94
36 –Greenhouse for Biotech/Fuel	4	5	3	4	4	4	4	4	3	3	3	3		3.67	0.65
37 –Hydroponics Aquaponic Equip	5	3	5	4	4	4	4	3	3	3	2	3		3.58	0.90
38 – Industrial Controls LS	3	4	5	5	3	4	4	4	4	4	3	2		3.75	0.87
39 – Injection Molder	4	3	5	4	4	4	4	5	4	3	3	4		3.92	0.67
40 – Rokenbok Integ Trans Syst	2	3	5	3	4	4	4	4	3	3	2	3		3.33	0.89
41 – Internal & Ext Cobust Engin	1	3	5	3	4	2	4	3	3	3	3	4		3.17	1.03
42 – Jointer	4	4	3	1	4	2	2	5	4	2	2	4		3.08	1.24
43 – Lab Pro Waste Mgmt Sys	4		4	3	3	4	2	3	3	3	2	4		3.18	0.75
44 – Min 30watt Laser Engraver	5	3	5	5	3	5	4	5	5	2	4	3		4.08	1.08
45 – Laser Lab Equip	3	3	5	4	4	4	4	5	4	3	3	3		3.75	0.75
46 – Laser Survey Equip	2	3	5	3	3	4	3		3	3	3	3		3.18	0.75
47 – Lego Mindstorms	3	3	5	5	4	5	3	4	5	3	4	3		3.92	0.90
48 – Lithography equip	1	2	1	2	2	2	2	3	2	2	3	2		2.00	0.60
49 – Material Stock (various)	5		5	5	5	5	4	5	5	4	3	5		4.64	0.67
50 – Material & Processes LS	4	4	5	5	4	4	4	4	4	4	3	2		3.92	0.79
51 – Mechanical LS	4	4	5	5	4	4	4	5	4	4	4	2		4.08	0.79
52–Mecharonics LS	4	4	5	5	3	4	3	3	5	4	4	3		3.92	0.79
53 – Metal Brake	3	4	5	1	4	2	4	5	2	2	2	4		3.17	1.34
54 – Metal Cut-off Saw	3	2	5	2	4	2	4	5	2	2	2	5		3.17	1.34
55 – Metal Band Saw Horizontal	3	2	5	2	4	2	4	5	2	2	2	4		3.08	1.24
56 – Metal Lathe	4	2	5	3	4	2	4	5	2	2	2	4		3.25	1.22
57 – Metal Mill	3	2	5	3	4	2	4	4	3	2	2	4		3.17	1.03
58 – Metal Shear/Roll	3	4	5	1	4	2	4	5	3	2	2	4		3.25	1.29
59 – Metal Forge Furnace	1	2	5	1	4	2	3	3	2	2	2	3		2.50	1.17
60 – Microscope with video	4	3	5	4	3	4	4	5	3	4	3	3		3.75	0.75
61 – MIG Welder	3	3	5	2	4	2	3	4	3	2	3	3		3.08	0.90
62 –Multisander Oscillating	4	2	5	5	4	3	4	5	4	3	3	3		3.75	0.97
63 –Weld/cut Oxy/Acetylene	3	2	5	2	5	2	4	4	3	2	2	4		3.17	1.19
64 – Photovoltaic Cell LS	3	5	5	5	4	4	3	4	3		3	3		3.82	0.87
65 – Plasma Cut/ Routing System	4	3	3	3	3	3	3	3	3	4	3	2		3.08	0.51
66 – Plastics Oven	4	3	5	5	3	3	4	4	4	3	2	3		3.58	0.90

67 – PLC/Sensor App Trainer	3	4	5	5	3	5	4	4	3	3	3	2		3.67	0.98
68 – Pneumatic/ Hydraulic LS	3	4	5	5	4	4	4	4	4	4	4	2		3.92	0.79
69 – Fitness Equipment	4	2	3	1	2	3	3	3	3	4	2	3		2.75	0.87
70 – Power Miter Saw	4	5	5	5	5	5	4	5	5	3	3	5		4.50	0.80
71 – Power/ Energy/Trans LS	4	4	5	5	4	4	4	3	3	4	4	2		3.83	0.83
72 – Radial Arm Saw	3	3	3	1	4	1	2	5	4	3	3	4		3.00	1.21
73 –8x8x10 Min Rapid Prototype	5	3	5	5	4	5	3	5	4	4	4	4		4.25	0.75
74 – R&D LS	4	3	5	5	5	5	3	3	3	3	3	2		3.67	1.07
75 – Robotics Workcell	5	3	3	5	4	5	3	4	5	4	4	4		4.08	0.79
76 – Roll Forming Equip	3	1	5	3	2	1	3	5	2	3	2	3		2.75	1.29
77 – Rotational Molder w/molds	3	1	3	4	3	3	3	4	3	3	2	3		2.92	0.79
78 – Router Table/Shaper	4	3	5	3	3	3	4	5	3	3	3	4		3.58	0.79
79 - RTF Planes	2		5	4	3	4	3	3	3	1	2	2		2.91	1.14
80 – Scale Trans Vehicles	2	4	5	5	3	5	3		2	2	3	2		3.27	1.27
81 - Screen Print equipment	3	3	5	3	3	2	3	4	4	2	3	2		3.08	0.90
82 – Scroll Saw	4	3	5	5	5	4	4	5	3	2	3	5		4.00	1.04
83 – Simple Machines LS	3	2	5	5	4	5	4	5	3	2	4	2		3.67	1.23
84 – Small Gas Engines	2	3	5	3	4	2	3	3	3	2	3	3		3.00	0.85
85 – Solar Vehicle LS	4	3	5	5	4	4	3		3	3	2	2		3.45	1.04
86 – Speed Radar Gun	3	2	5	4	2		3	3	4	2	3	2		3.00	1.00
87 – Spot/Resist Welder	3	3	5	3	4	2	4	5	3	2	2	3		3.25	1.06
88 – Portable Spray Booth	4	4	5	5	3	1	4	5	3	3	2	3		3.50	1.24
89 – Project Storage System	5	5	5	5	4	5	4	5	5	4	4	5		4.67	0.49
90 - Strip Heater	3	3	5	5	3	4	4	5	4	3	2	3		3.67	0.98
91 – Structural Tester	4	4	5	5	3	5	4	5	4	4	4	3		4.17	0.72
92 – Sustainable Energy LS	4	4	5	5	4	5	3	3	3	4	3	2		3.75	0.97
93 – Table Saw	4	5	5	5	5	5	4	5	4	3	2	5		4.33	0.98
94 – Thickness Planer	4	3	5	1	3	2	4	5	2	2	2	3		3.00	1.28
95 – Vacuum/ Thermo Former	4	3	5	4	4	4	4		4	3	2	3		3.64	0.81
96 - Vertical Hole Punch	2	1	5	4	2	3	3	4	4	2	2	3		2.92	1.16
97 – Vinyl Cutter	3	3	5	4	2	3	4	4	4	3	4	2		3.42	0.90
98 – Vise System	5	5	5	5	5	4	4	5	4	3	2	5		4.33	0.98
99 – Watercraft Test Track 20’	4	3	5	4	3	4	3		3	3	3	3		3.45	0.69
100 – Waterjet Cutting System	4	2	3	3	2	4	3	2	2	2	2	2		2.58	0.79
101 – Wind Generation LS	4	3	5	4	4	5	3	3	3	3	3	2		3.50	0.90
102 – Wind Tunnel	4	3	5	5	4	5	3	5	4	4	3	3		4.00	0.85
103 – Wood Lathe	4	2	5	2	5	2	3	5	2	3	2	4		3.25	1.29
104 – Work Benches	5	5	5	5	5	5	4	5	4	4	3	5		4.58	0.67

105 – Applied Science Tools	4	2	5	5	5	5	4	4	3	5	3	2		3.92	1.16
106 – Barcode Scanner (equiv)	3	3	3	4	3	5	3	5	4	3	3	2		3.42	0.90
107 – Biotech Gen Lab Equip	5	3	5	4	5	5	4	4		4	3	3		4.09	0.83
108 – Const. Tools	3	3	5	3	5	5	4	3	3	3	3	3		3.58	0.90
109 – Electron Tools	4	5	5	4	5	5	4	5	4	4	4	3		4.33	0.65
110 - Fabrication Msmt Tools	5	5	5	4	5	5	4	5	5	5	3	3		4.50	0.80
111 - Fastener Supply	5	5	5	4	5		4	5	4	4	3	5		4.45	0.69
112 - General Chem Tools	5	2	5	4	4	4	4	5	3	4	3	3		3.83	0.94
113 - Hand Draft Tools	3	1	5	4	4	4	3	1	2	4	4	3		3.17	1.27
114 - Measuring Devices	4	5	5	4	5	5	4	5	5	5	4	4		4.58	0.51
115 - Medical Equipment	4		5	4	4	4	4	3	3	3	3	2		3.55	0.82
116 - Misc Tools Fabrication	5	5	5	4	5	5	4	5	5	4	4	4		4.58	0.51
117 – Misc Fab Power Tools	5	5	5	4	5	4	4	5	5	4	4	4		4.50	0.52
118-Tachometer Non Contact	3	4	5	3	3	2	3	2	2	3	2	3		2.92	0.90
119-Office Equipment	5	5	5	5	5		4	5	5	4	4	3		4.55	0.69
120-Plastic Tools	4	3	5	4	4	4	4	5	4	3	3	3		3.83	0.72
121 – Pneumatic Tools	4	4	5	4	4	3	4	3	4	3	3	3		3.67	0.65
122 – Safety Equipment	5	5	5	5	5	5	4	5	5	5	3	5		4.75	0.62
123 – Sound Level Meter	4	3	5	4	3	4	3	4	4	4	3	3		3.67	0.65
124 – Classroom Project Server	4	3	4	4	3	5	4	5	5	5	4	4		4.17	0.72
125- Classroom/ Lab Sound Sys	5	2	5	4	3	3	4	5	5	2	4	3		3.75	1.14
126 – Color Laser Printer	4	4	5	5	3	5	4	5	5	3	4	3		4.17	0.83
127 – Dektop Computer	5	4	5	5	4	5	4	5	5	5	5	2		4.50	0.90
128- Dig Camera Tripods/lights	4	4	5	5	3	5	4	5	5	3	5	2		4.17	1.03
129 –Digital Video Recorder	4	4	5	5	3	5	4	5	5	3	5	4		4.33	0.78
130 – Elect Present Board	4	2	5	3	4	5	4	5	4	5	5	4		4.17	0.94
131 – 42" min HDTV	3	4	5	4	4	5	4	5	3	3	5	2		3.92	1.00
132 – GPS Units	3	4	5	4	3	5	3	4	3	4	4	3		3.75	0.75
133 – Instructor Laptop Comp	5	4	5	5	5	5	4	5	5	4	4	5		4.67	0.49
134 – Laptop Comp Set/Cart	4	4	5	5	4	5	3	4	4	4	4	4		4.17	0.58
135 – Laser Printer	5	4	5	5	4	5	4	5	5	5	5	3		4.58	0.67
136 – Projector	5	5	5	5	5	5	4	5	5	5	4	3		4.67	0.65
137 – Scanner	5	4	5	5	4	5	3	5	5	3	4	3		4.25	0.87
138 – Student Response Syst	5	2	3	4	2	5	3	3	4	3	3	3		3.33	0.98
139 – Video Camcoders	4	4	5	5	3	5	4	5	5	2	4	4		4.17	0.94
140 – Wide Format Printer	3	4	5	4	4	5	3	5	5	3	3	3		3.92	0.90
141 – Wireless Microphones	3	2	5	4	2	5	3	4	4	2	3	3		3.33	1.07

142 – 2D CAD	4	3	5	5	5	4	3	3	3	3	4	2		3.67	0.98
143 – 3D Arch Building Design	4	5	5	5	5	5	3	5	5	5	3	3		4.42	0.90
144 – 3D CAD	5	5	5	5	5	5	3	5	5	5	4	4		4.67	0.65
145 – Air Quality Analysis Softwr	4	3	4	4	3		3	4	3	3	3	3		3.36	0.50
146 – Animation Software	4	3	5	4	4	5	3	4	4	2	3	3		3.67	0.89
147- Audio Edit/ Prod. Software	4	4	5	4	3	5	4	4	4	2	4	3		3.83	0.83
148 – Barcode Gen Software	3	4	3	3	3	5	3	5	4	3	3	2		3.42	0.90
149 – Bridge Design Software	4	4	5	4	5	5	3	4	4	3	4	3		4.00	0.74
150 – BIM Software	3	4	4	4	3	5	3	4	3	3	3	3		3.50	0.67
151 – CAM Software	5	4	2	5	5	5	3	5	5	4	4	3		4.17	1.03
152 – Chem Analysis Softwr	5	4	4	4	3	5	3	5	3	4	3	3		3.83	0.83
153-Game Dev Software	4		5	4	3	5	3	4	4	2	3	3		3.64	0.92
154 - Land Based Auto Cntrl	3	3	5	4	3	5	3	5	4	3	3	3		3.67	0.89
155- Mon Sftwr Land Base Trns	4	3	5	4	3	5	3	5	3	3	3	3		3.67	0.89
156 – PLC Software	3	4	5	4	5	5	3	5	4	4	4	4		4.17	0.72
157 – Desktop Pub Software	5	4	5	5	4	5	4	5	5	3	4	3		4.33	0.78
158 – EKG Analysis Softwr	4	2	3	4	3	4	3	4	3	3	2	2		3.08	0.79
159 – Elec Circuit Software	3	4	5	4	4		3	5	5	4	4	3		4.00	0.77
160 – White Board Software	4	2	5	4	3	5	4	4	4	4	3	3		3.75	0.87
161 – Floor Plan Software	4	4	5	4	3	5	3	3	4	2	3	3		3.58	0.90
162 – Internet Connection	5	5	5	5	5	5	5	5	5	5	5	5		5.00	0.00
163 - MS Office Software (equiv)	5	5	5	5	5	5	4	5	5	4	4	4		4.67	0.49
164 –Photoshop or equiv	4	5	5	5	4	5	4	5	5	4	4	4		4.50	0.52
165 – Plant layout software	3	3	4	4	3	5	3	3	3	3	3	2		3.25	0.75
166 – Robot Control Softwr	4	3	3	5	3	5	3	5	4	4	4	3		3.83	0.83
167 – Sim City Software	3	2	3	3	3	5	3	2	3	2	3	2		2.83	0.83
168 – Sim Farm Software	3	2	3	3	3	5	3	2	3	2	2	2		2.75	0.87
169 – Google Sketchup	4	5	5	4	5	5	3	2	4	2	3	4		3.83	1.11
170 – Smart Draw Software	3	2	2	4	3	5	3	2	4	2	3	3		3.00	0.95
171 – Soil pH Software	4	2	5	3	3	4	3	4	3	3	2	2		3.17	0.94
172 – Stat Process Softwr	4	3	2	3	3	5	3	5	3	4	2	3		3.33	0.98
173 – Vernier Software	5	4	5	3	3	4	4	5	3	4	2	3		3.75	0.97
174 – Video Editing Software	4	5	5	4	4	5	4	5	4	2	4	4		4.17	0.83
175 – Water Quality Software	5	3	5	4	3	4		5	3	4	2	3		3.73	1.01
176 – Waterjet Software	4		2	3	3	4	3	2	2	3	2	2		2.73	0.79
177 - Web 2.0 Tools Free	4	2	3	3	3	5	3	5	3	2	3	5		3.42	1.08
178 – Web Design Software	4	5	5	5	4	4	3	5	4	2	4	2		3.92	1.08

APPENDIX H

Round 3 Letter to Participants

Andrew M. Klenke
1701 S. Broadway, W105b KTC
Pittsburg State University
Pittsburg, KS 66762
July 12, 2010

Mr. Survey Completer
Technology Education Teacher
12345 Technology Lane
Somewhere High School
Somewhere, USA 12345

Dear Survey Completer:
Thank you for agreeing to participate in hopefully the final survey in this study. It should be the final survey unless directed by my dissertation committee to do something else, although I don't expect that at this time. I appreciate the time you have given during this process. I will remind you that participation in this study is voluntary and no compensation is given for your participation. It should also be noted that only group responses will be reported and all personal information will remain confidential. Each participant will be issued a code number which will be located at the top of the returned survey instrument. All information for each participant will be referenced to that code throughout the Delphi process.

This correspondence represents Round three of the Delphi procedure. The information provided in Round 2 was reviewed and basic statistics were calculated and placed into this survey. The purpose of this round is to *build consensus* of what tools, equipment, software and hardware needs would be necessary to teach a "standards based technology education curriculum" within each of the Technology Education content standards. (http://www.iteaconnect.org/TAA/PDFs/xstnd.pdf)

The on-line instrument is similar to round two and can be found at the link listed at the end of this letter. The major difference in this survey and round two is that the following descriptive statistics are incorporated into the third survey.

> Mean: Statistical average of all responses from the group.
>
> Standard Deviation: how spread the data is. A larger standard deviation means there is more variance on the answers, while a smaller number indicates that the group responses were similar and that the group was in agreement with the marking of an item.

Here are two examples of the type of information you will see on the survey followed by an explanation.

01 Space Shuttle Console
Group Mean 3.25-----Your Response 1-----Standard Deviation 1.34

02 Mars Rover
Group Mean 4.05-----Your Response 3-----Standard Deviation .47

The information in example 01 indicates that as a group the Space Shuttle Console is a moderately important item to have in a Technology Education lab. However, the standard deviation shows that there a large spread in the answers, meaning that the group does not agree to the importance of this item. In example 02, the group has a much stronger agreement on the importance of having a Mars Rover in the lab, as the standard deviation is much smaller. In either case, you would either agree or disagree with the results. If you agree with the group, your answer would move toward the mean. In example 01, you would select 3 or moderately important; while in the second example, you would select 4 or important. If you disagree with the group, you would continue to answer the question as you think the item should be marked.

It is important that you review the provided statistical information before responding to each of the questions.

This round should take approximately 30 minutes to complete depending upon how fast you read.

Remember, for clarity, the facility has 3000 square feet and one technology education faculty to teach the *standards-based* curriculum. In essence, you are defining what a model technology education program in a small high school having only one teacher would need to teach to the standards.

Please record your responses on the website http://www.surveymonkey.com/s/ABC123. If you have any questions, feel free to call or email. Please complete the survey no later than August 24th, 2010.

Sincerely,

Andrew Klenke
Graduate Student, University of Arkansas

Michael K. Daugherty, PhD.
Dissertation Chairperson
University of Arkansas

APPENDIX I

Round 3 Survey Instrument (only first page shown to save space)

001 TE FACILITY DELPHI ROUND 3

1. EQUIPMENT

Below is an updated survey from the Round 2. Review the mean and standard deviation for each question derived from round 2 responses. As a quick review, the mean is the mathematical average, while the standard deviation is how spread the data is. A larger standard deviation means there is more variance on the answers, while a smaller number indicates that group answers were closer to being the same. This statistical information will allow you to see how others have responded in the round 2 survey and give you an opportunity to revise your response in order to form a consensus, as a group, on each particular piece of equipment.

* 1. Scanner (9,10,11,12,14,15,16,18,19,20)
GROUP MEAN 4.00-----YOUR RESPONSE 4-----STANDARD DEVIATION .85

◯ [1] Unimportant ◯ [2] Little Importance ◯ [3] Moderately Important ◯ [4] Important ◯ [5] Very Important

* 2. Aerospace Engineering Learning System (4,6)
GROUP MEAN 3.22-----YOUR RESPONSE 4-----STANDARD DEVIATION .97

◯ [1] Unimportant ◯ [2] Little Importance ◯ [3] Moderately Important ◯ [4] Important ◯ [5] Very Important

* 3. Air Compressor with lines and accessories (1-20)
GROUP MEAN 4.25-----YOUR RESPONSE 4-----STANDARD DEVIATION .97

◯ [1] Unimportant ◯ [2] Little Importance ◯ [3] Moderately Important ◯ [4] Important ◯ [5] Very Important

* 4. Alternative Energy Training Set with Solar, Wind, Hydroelectric, Fuel Cell, etc. (1-20)
GROUP MEAN 4.08-----YOUR RESPONSE 4-----STANDARD DEVIATION .51

◯ [1] Unimportant ◯ [2] Little Importance ◯ [3] Moderately Important ◯ [4] Important ◯ [5] Very Important

* 5. Arbor Press (1-20)
GROUP MEAN 2.92-----YOUR RESPONSE 3-----STANDARD DEVIATION .79

◯ [1] Unimportant ◯ [2] Little Importance ◯ [3] Moderately Important ◯ [4] Important ◯ [5] Very Important

* 6. Audio Trainer (17)
GROUP MEAN 3.17-----YOUR RESPONSE 4-----STANDARD DEVIATION .83

◯ [1] Unimportant ◯ [2] Little Importance ◯ [3] Moderately Important ◯ [4] Important ◯ [5] Very Important

APPENDIX J

Round 3 Aggregate Data

ID NUMBER	007	002	001	003	004	006	005	012	011	008	010	009		STATISTICS	
GROUP	A	A	P	P	P	P	P	T	T	T	T	T		MEAN	STANDARD DEVIATION
QUESTION															
1 - Scanner	4	4	4	4	4	5	4	5	4	4	4	3		4.08	0.51
2 – Aerospace LS	3	3	4	3	3	4	3	4	3	3	3	2		3.17	0.58
3 – Air Compressor	4	4	4	5	4	5	5	5	5	4	4	4		4.42	0.51
4 – Alt Energy Training Set	4	4	4	4	4	5	4	4	4	4	4	3		4.00	0.43
5 – Arbor Press	2	2	3	3	2	2	3	3	2	3	3	3		2.58	0.51
6 – Audio Trainer	2	3	3	3	3	3	3	4	3	3	4	2		3.00	0.60
7 – Auto Product ID System	3	3	3	3	3	4	3	3	4	3	3	3		3.17	0.39
8 – Band Saw	5	4	4	5	4	4	4	5	4	5	4	5		4.42	0.51
9 – Belt/Disc Sander	5	4	4	5	4	4	4	5	4	5	4	4		4.33	0.49
10 – Bench Grinder 8”	4	4	4	4	4	3	4	5	4	5	3	4		4.00	0.60
11 – Blower	3	3	4	3	3	4	3	3	3	3	3	4		3.25	0.45
12 – Book Binding System	2	2	3	2	2	2	3	3	3	2	2	2		2.33	0.49
13 – Box and Pan Brake	3	3	4	3	3	3	4	5	3	3	3	4		3.42	0.67
14 – Braille Stylus, slate, etc.	2	2	2	2	2	2	2	2	2	2	2	2		2.00	0.00
15 – Bridge/ Tower Tester	4	4	4	4	4	4	4	5	5	4	4	3		4.08	0.51
16 – Buffing Wheel	3	3	3	3	3	2	4	4	2	3	3	3		3.00	0.60
17 – Catapult LS	3	3	3	3	3	4	3	4	3	3	3	2		3.08	0.51
18 – CIM/FMS Trainer	3	4	4	4	4	4	4	4	4	4	4	3		3.83	0.39
19 – Civil Engineering LS	3	4	4	4	3	4	3	4	4	4	3	2		3.50	0.67
20 – Classroom Furniture	5	5	5	5	5	5	5	5	5	5	4	4		4.83	0.39
21 – CNC Metal Lathe & Tooling	4	4	4	4	4	4	4	5	4	4	3	4		4.00	0.43
22 – CNC Metal Mill & Tooling	5	4	4	4	4	4	4	5	4	4	3	4		4.08	0.51
23 – CO2 Race Track w/Supply	5	3	3	3	4	4	3	5	3	4	3	3		3.58	0.79
24 – Computer Metrology Equip	4	3	3	3	3	3	4	3	3	3	3	3		3.17	0.39
25 – Drill Press	5	4	4	5	4	4	4	5	5	5	4	5		4.50	0.52
26 – 5HP Dust Collection/Vacs	5	4	4	5	5	5	5	5	5	5	4	5		4.75	0.45
27 – Dyno-mometer	3	3	3	3	2	3	3	2	3	3	3	2		2.75	0.45
28 – Elect Equip w oscilloscope	5	4	4	5	4	5	4	5	5	5	4	4		4.50	0.52
29 – EnvironmentLS	3	4	4	4	4	4	4	4	4	4	4	3		3.83	0.39
30 – Filing System/Cabinets	4	4	4	4	4	5	4	5	5	4	4	4		4.25	0.45

31 – Flammable Cabinet	5	5	4	5	4	5	5	5	5	5	3	5		4.67	0.65
32 – Fluid Power Training System	4	3	4	4	3	4	3	5	4	4	4	2		3.67	0.78
33 – Fuel Cell LS w/Cars	4	3	4	4	3	4	3	5	2	4	4	3		3.58	0.79
34 – Gears ID Kits or Equiv	4	4	4	4	4	4	4	5	3	4	4	4		4.00	0.43
35 – Graphics LS	4	3	4	4	3	4	4	5	4	4	4	4		3.92	0.51
36 –Greenhouse for Biotech/Fuel	4	3	4	4	4	4	3	4	3	4	3	3		3.58	0.51
37 –Hydroponics Aquaponic Equip	3	3	4	3	5	3	3	5	3	4	3	3		3.50	0.80
38 – Industrial Controls LS	4	4	4	4	3	3	4	5	4	4	3	3		3.75	0.62
39 – Injection Molder	4	4	4	4	4	4	4	5	4	4	4	4		4.08	0.29
40 – Rokenbok Integ Trans Syst	3	3	4	3	3	3	3	4	3	3	3	3		3.17	0.39
41 – Internal & Ext Cobust Engin	3	3	3	3	2	3	3	4	3	3	3	3		3.00	0.43
42 – Jointer	3	3	3	2	4	3	3	3	4	3	3	3		3.08	0.51
43 – Lab Pro Waste Mgmt Sys	3	3	3	3	4	3	3	3	3	3	3	4		3.17	0.39
44 – Min 30watt Laser Engraver	5	4	4	4	5	4	4	5	4	4	4	3		4.17	0.58
45 – Laser Lab Equip	3	4	4	4	4	3	4	4	4	4	3	3		3.67	0.49
46 – Laser Survey Equip	3	3	3	3	3	3	3	4	3	3	3	3		3.08	0.29
47 – Lego Mindstorms	3	4	4	4	4	4	4	5	4	4	4	3		3.92	0.51
48 – Lithography equip	2	2	2	2	2	2	2	2	2	2	3	2		2.08	0.29
49 – Material Stock (various)	5	4	4	5	5	5	5	5	5	5	3	5		4.67	0.65
50 – Material & Processes LS	4	4	4	5	4	3	4	5	4	4	3	2		3.83	0.83
51 – Mechanical LS	4	4	4	4	4	4	4	5	4	4	4	2		3.92	0.67
52–Mecharonics LS	4	4	4	4	4	4	4	5	5	4	4	3		4.08	0.51
53 – Metal Brake	3	3	4	3	3	3	4	5	2	3	2	4		3.25	0.87
54 – Metal Cut-off Saw	3	3	3	2	3	3	3	5	2	3	3	4		3.08	0.79
55 – Metal Band Saw Horizontal	3	3	3	2	3	3	3	5	2	3	2	4		3.00	0.85
56 – Metal Lathe	3	3	4	3	3	2	3	5	2	4	2	4		3.17	0.94
57 – Metal Mill	3	3	4	4	3	2	3	5	3	4	2	4		3.33	0.89
58 – Metal Shear/Roll	3	3	4	2	3	2	4	5	3	3	2	4		3.17	0.94
59 – Metal Forge Furnace	2	2	3	2	2	2	2	3	2	3	2	3		2.33	0.49
60 – Microscope with video	3	4	4	4	4	3	4	4	3	4	3	3		3.58	0.51
61 – MIG Welder	3	3	3	3	3	3	3	4	3	3	3	3		3.08	0.29
62 –Multisander Oscillating	4	3	4	4	4	4	4	5	4	4	3	3		3.83	0.58
63 –Weld/cut Oxy/Acetylene	3	3	3	2	3	2	3	5	3	3	3	3		3.00	0.74
64 –Photovoltaic Cell LS	4	4	4	4	3	3	4	5	3	4	3	3		3.67	0.65
65 – Plasma Cut/ Routing System	3	4	3	3	3	3	3	3	3	3	3	2		3.00	0.43
66 – Plastics Oven	4	3	4	4	4	3	3	5	4	4	3	3		3.67	0.65
67 – PLC/Sensor App Trainer	4	3	4	4	3	4	4	5	3	4	3	2		3.58	0.79

68 – Pneumatic/ Hydraulic LS	4	4	4	4	4	4	4	5	4	4	4	2		3.92	0.67
69 – Fitness Equipment	2	4	3	2	4	2	3	3	3	3	2	3		2.83	0.72
70 – Power Miter Saw	5	4	4	5	4	4	5	5	5	5	4	5		4.58	0.51
71 – Power/ Energy/Trans LS	4	4	4	4	4	4	4	4	3	4	4	2		3.75	0.62
72 – Radial Arm Saw	3	3	3	3	3	2	4	3	4	3	3	3		3.08	0.51
73 –8x8x10 Min Rapid Prototype	5	4	4	4	5	4	5	5	4	4	4	4		4.33	0.49
74 – R&D LS	3	3	3	4	4	4	4	4	4	4	3	2		3.50	0.67
75 – Robotics Workcell	5	4	3	4	4	4	4	3	4	4	4	4		3.92	0.51
76 – Roll Forming Equip	1	3	3	3	3	2	3	5	2	3	2	3		2.75	0.97
77 – Rotational Molder w/molds	3	3	3	3	3	3	3	3	3	3	2	3		2.92	0.29
78 – Router Table/Shaper	2	3	4	4	4	4	4	5	3	4	3	3		3.58	0.79
79 - RTF Planes	3	3	3	3	3	2	2	5	3	3	2	2		2.83	0.83
80 – Scale Trans Vehicles	3	3	3	4	3	4	3	5	3	3	3	2		3.25	0.75
81 - Screen Print equipment	3	3	3	3	3	3	3	5	3	3	3	2		3.08	0.67
82 – Scroll Saw	4	4	4	4	4	4	4	5	4	4	3	5		4.08	0.51
83 – Simple Machines LS	2	3	4	4	4	4	4	5	3	4	4	2		3.58	0.90
84 – Small Gas Engines	3	3	3	3	2	3	3	4	3	3	3	3		3.00	0.43
85 – Solar Vehicle LS	3	3	3	4	4	3	4	4	3	3	3	2		3.25	0.62
86 – Speed Radar Gun	3	3	3	3	3	3	3	4	3	3	3	2		3.00	0.43
87 – Spot/Resist Welder	3	3	4	4	3	3	4	5	3	3	2	3		3.33	0.78
88 – Portable Spray Booth	4	3	4	4	4	2	4	5	4	4	3	3		3.67	0.78
89 – Project Storage System	5	4	4	5	5	5	5	5	5	5	5	5		4.83	0.39
90 - Strip Heater	4	3	4	4	4	4	4	5	4	4	3	3		3.83	0.58
91 – Structural Tester	4	4	4	4	4	4	4	5	4	4	4	3		4.00	0.43
92 – Sustainable Energy LS	4	4	4	4	4	4	3	5	3	4	3	2		3.67	0.78
93 – Table Saw	4	4	4	5	4	4	4	5	4	5	3	5		4.25	0.62
94 – Thickness Planer	3	3	3	2	4	3	3	5	2	3	2	3		3.00	0.85
95 – Vacuum/ Thermo Former	4	3	4	4	4	4	4	5	4	4	3	3		3.83	0.58
96 - Vertical Hole Punch	2	3	3	3	2	2	3	3	4	3	2	3		2.75	0.62
97 – Vinyl Cutter	3	3	4	3	3	3	4	5	4	3	4	2		3.42	0.79
98 – Vise System	5	4	4	5	5	4	5	5	4	5	3	5		4.50	0.67
99 – Watercraft Test Track 20’	3	3	3	4	4	3	4	4	3	3	3	3		3.33	0.49
100 – Waterjet Cutting System	2	3	3	3	3	3	2	3	2	2	2	2		2.50	0.52
101 – Wind Generation LS	3	3	3	4	4	4	3	5	3	4	3	2		3.42	0.79
102 – Wind Tunnel	4	4	4	4	4	5	4	5	4	4	3	4		4.08	0.51
103 – Wood Lathe	3	3	3	2	4	3	4	4	3	4	2	4		3.25	0.75
104 – Work Benches	5	4	4	5	5	5	5	5	4	5	4	5		4.67	0.49

105 – Applied Science Tools	4	5	4	4	4	4	4	4	4	4	4	2		3.92	0.67
106 – Barcode Scanner (equiv)	3	3	3	4	3	4	4	3	4	3	3	2		3.25	0.62
107 – Biotech Gen Lab Equip	3	4	4	4	5	4	4	5	4	4	3	3		3.92	0.67
108 – Const. Tools	3	3	4	4	3	4	3	5	3	4	3	3		3.50	0.67
109 – Electron Tools	4	4	4	4	4	4	4	5	4	4	4	3		4.00	0.43
110 - Fabrication Msmt Tools	5	5	4	5	5	5	5	5	5	5	4	4		4.75	0.45
111 - Fastener Supply	5	4	4	5	5	4	5	5	4	5	4	5		4.58	0.51
112 - General Chem Tools	3	4	4	4	5	4	4	4	4	4	3	4		3.92	0.51
113 - Hand Draft Tools	3	4	3	3	3	3	2	5	3	3	4	3		3.25	0.75
114 - Measuring Devices	5	5	4	5	5	5	5	5	5	5	4	4		4.75	0.45
115 - Medical Equipment	3	3	4	3	4	3	3	4	3	4	3	2		3.25	0.62
116 - Misc Tools Fabrication	5	4	4	5	5	4	5	5	5	5	4	4		4.58	0.51
117 – Misc Fab Power Tools	5	4	4	5	5	4	5	5	5	5	4	4		4.58	0.51
118-Tachometer Non Contact	3	3	3	3	3	3	3	4	2	3	2	3		2.92	0.51
119-Office Equipment	5	4	4	5	5	5	5	5	5	5	4	4		4.67	0.49
120-Plastic Tools	4	4	4	4	4	3	4	5	4	4	3	3		3.83	0.58
121 – Pneumatic Tools	4	4	4	4	4	3	4	5	4	4	3	3		3.83	0.58
122 – Safety Equipment	5	5	4	5	5	5	5	5	5	5	4	5		4.83	0.39
123 – Sound Level Meter	4	4	4	4	4	4	4	5	4	4	3	3		3.92	0.51
124 – Classroom Project Server	4	5	4	4	4	4	5	4	5	4	4	4		4.25	0.45
125- Classroom/ Lab Sound Sys	3	3	4	4	4	4	4	5	5	4	4	3		3.92	0.67
126 – Color Laser Printer	4	4	4	4	4	5	4	5	5	4	5	4		4.33	0.49
127 – Dektop Computer	4	5	4	5	5	5	5	5	5	5	5	2		4.58	0.90
128- Dig Camera Tripods/lights	4	4	4	4	4	4	4	5	5	4	5	2		4.08	0.79
129 –Digital Video Recorder	4	4	4	4	4	4	4	5	5	4	5	4		4.25	0.45
130 – Elect Present Board	3	5	4	4	4	4	4	5	4	4	5	4		4.17	0.58
131 – 42" min HDTV	4	4	4	4	4	4	4	5	4	4	5	2		4.00	0.74
132 – GPS Units	4	4	3	4	4	4	4	5	4	4	4	3		3.92	0.51
133 – Instructor Laptop Comp	5	4	4	5	5	5	5	5	5	5	5	5		4.83	0.39
134 – Laptop Comp Set/Cart	4	4	4	4	4	4	4	5	4	4	4	4		4.08	0.29
135 – Laser Printer	5	5	4	5	5	5	5	5	5	5	5	3		4.75	0.62
136 – Projector	5	5	4	5	5	5	5	5	5	5	4	3		4.67	0.65
137 – Scanner	4	4	4	5	5	5	4	5	5	4	4	3		4.33	0.65
138 – Student Response Syst	3	3	3	3	4	3	3	4	4	3	3	3		3.25	0.45
139 – Video Camcoders	4	4	4	4	4	4	4	5	5	4	4	4		4.17	0.39
140 – Wide Format Printer	4	4	4	4	4	4	4	4	5	4	4	3		4.00	0.43
141 – Wireless Microphones	3	3	3	3	3	4	3	4	3	3	3	3		3.17	0.39

142 – 2D CAD	4	3	3	4	4	3	3	4	4	4	3	2		3.42	0.67
143 – 3D Arch Building Design	4	5	4	5	4	4	5	5	5	4	4	3		4.33	0.65
144 – 3D CAD	5	5	4	5	5	5	5	5	5	5	4	4		4.75	0.45
145 – Air Quality Analysis Softwr	3	3	3	3	3	4	4	4	3	3	3	3		3.25	0.45
146 – Animation Software	3	3	3	4	4	4	4	4	4	4	3	3		3.58	0.51
147- Audio Edit/ Prod. Software	4	3	4	4	4	4	4	4	4	4	4	3		3.83	0.39
148 – Barcode Gen Software	3	3	3	3	3	3	4	4	4	3	3	2		3.17	0.58
149 – Bridge Design Software	4	4	4	4	4	4	4	5	4	4	4	3		4.00	0.43
150 – BIM Software	4	3	3	4	4	4	3	4	3	3	3	3		3.42	0.51
151 – CAM Software	4	4	4	5	4	4	4	4	5	4	4	3		4.08	0.51
152 – Chem Analysis Softwr	4	4	4	4	5	4	4	4	3	4	3	3		3.83	0.58
153-Game Dev Software	4	4	3	4	4	4	4	5	4	4	3	3		3.83	0.58
154 - Land Based Auto Cntrl	3	3	3	4	3	4	4	4	4	4	3	3		3.50	0.52
155- Mon Sftwr Land Base Trns	3	3	3	4	4	4	4	4	3	4	3	3		3.50	0.52
156 – PLC Software	4	4	4	4	4	4	4	5	4	4	4	4		4.08	0.29
157 – Desktop Pub Software	4	4	4	5	5	4	5	5	5	4	5	3		4.42	0.67
158 – EKG Analysis Softwr	3	3	3	3	4	3	3	3	3	3	2	2		2.92	0.51
159 – Elec Circuit Software	4	4	4	4	4	4	4	5	5	4	4	3		4.08	0.51
160 – White Board Software	3	4	4	4	4	4	4	5	4	3	3	3		3.75	0.62
161 – Floor Plan Software	4	3	3	4	4	4	3	4	4	4	3	3		3.58	0.51
162 – Internet Connection	5	5	5	5	5	5	5	5	5	5	5	5		5.00	0.00
163 - MS Office Software (equiv)	5	5	4	5	5	5	5	5	5	5	4	4		4.75	0.45
164 –Photoshop or equiv	5	4	4	5	4	4	5	5	5	4	4	4		4.42	0.51
165 – Plant layout software	3	3	3	4	3	4	3	4	3	3	3	2		3.17	0.58
166 – Robot Control Softwr	3	4	3	4	4	4	4	4	4	4	4	3		3.75	0.45
167 – Sim City Software	2	2	3	3	3	4	2	3	3	3	3	2		2.75	0.62
168 – Sim Farm Software	2	2	3	3	3	3	2	3	3	3	2	2		2.58	0.51
169 – Google Sketchup	4	2	3	4	4	4	3	5	4	4	3	4		3.67	0.78
170 – Smart Draw Software	3	3	3	3	3	4	3	3	4	3	3	3		3.17	0.39
171 – Soil pH Software	3	3	3	3	4	3	3	4	3	3	2	2		3.00	0.60
172 – Stat Process Softwr	3	4	3	3	4	4	3	3	3	3	2	3		3.17	0.58
173 – Vernier Software	4	4	4	4	4	4	4	4	3	4	2	3		3.67	0.65
174 – Video Editing Software	5	4	4	4	4	5	4	5	4	4	5	4		4.33	0.49
175 – Water Quality Software	2	4	4	4	4	4	4	4	4	4	2	3		3.58	0.79
176 – Waterjet Software	2	3	3	3	3	3	2	3	2	3	2	2		2.58	0.51

177 - Web 2.0 Tools Free	3	3	3	4	3	4	4	3	3	3	3	5		3.42	0.67
178 – Web Design Software	4	4	3	4	4	4	4	5	4	4	4	2		3.83	0.72

APPENDIX K

Round 3 ANOVA Data

		Sum of Squares	df	Mean Square	F	Sig.
1 - Scanner	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
2 – Aerospace LS	Between Groups	.467	2	.233	.656	.542
	Within Groups	3.200	9	.356		
	Total	3.667	11			
3 – Air Compressor	Between Groups	.517	2	.258	.969	.416
	Within Groups	2.400	9	.267		
	Total	2.917	11			
4 – Alt Energy Training Set	Between Groups	.400	2	.200	1.125	.366
	Within Groups	1.600	9	.178		
	Total	2.000	11			
5 – Arbor Press	Between Groups	.917	2	.458	2.062	.183
	Within Groups	2.000	9	.222		
	Total	2.917	11			
6 – Audio Trainer	Between Groups	.700	2	.350	.955	.421
	Within Groups	3.300	9	.367		
	Total	4.000	11			
7 – Auto Product ID System	Between Groups	.067	2	.033	.188	.832
	Within Groups	1.600	9	.178		
	Total	1.667	11			
8 – Band Saw	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
9 – Belt/Disc Sander	Between Groups	.167	2	.083	.300	.748
	Within Groups	2.500	9	.278		
	Total	2.667	11			
10 – Bench Grinder 8”	Between Groups	.400	2	.200	.500	.622
	Within Groups	3.600	9	.400		
	Total	4.000	11			
11 – Blower	Between Groups	.250	2	.125	.562	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			

12 – Book Binding System	Between Groups	.267	2	.133	.500	.622
	Within Groups	2.400	9	.267		
	Total	2.667	11			
13 – Box and Pan Brake	Between Groups	.517	2	.258	.528	.607
	Within Groups	4.400	9	.489		
	Total	4.917	11			
14 – Braille Stylus, slate, etc.	Between Groups	.000	2	.000	.	.
	Within Groups	.000	9	.000		
	Total	.000	11			
15 – Bridge/ Tower Tester	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
16 – Buffing Wheel	Between Groups	.000	2	.000	.000	1.000
	Within Groups	4.000	9	.444		
	Total	4.000	11			
17 – Catapult LS	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
18 – CIM/FMS Trainer	Between Groups	.367	2	.183	1.269	.327
	Within Groups	1.300	9	.144		
	Total	1.667	11			
19 – Civil Engineering LS	Between Groups	.100	2	.050	.092	.913
	Within Groups	4.900	9	.544		
	Total	5.000	11			
20 – Classroom Furniture	Between Groups	.467	2	.233	1.750	.228
	Within Groups	1.200	9	.133		
	Total	1.667	11			
21 – CNC Metal Lathe & Tooling	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		
	Total	2.000	11			
22 – CNC Metal Mill & Tooling	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
23 – CO2 Race Track w/Supply	Between Groups	.517	2	.258	.363	.705
	Within Groups	6.400	9	.711		
	Total	6.917	11			
24 – Computer Metrology	Between Groups	.367	2	.183	1.269	.327
	Within Groups	1.300	9	.144		

Equip	Total	1.667	11			
25 – Drill Press	Between Groups	.900	2	.450	1.929	.201
	Within Groups	2.100	9	.233		
	Total	3.000	11			
26 – 5HP Dust Collection/Vacs	Between Groups	.150	2	.075	.321	.733
	Within Groups	2.100	9	.233		
	Total	2.250	11			
27 – Dyno-mometer	Between Groups	.250	2	.125	.562	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
28 – Elect Equip w oscilloscope	Between Groups	.100	2	.050	.155	.859
	Within Groups	2.900	9	.322		
	Total	3.000	11			
29 – EnvironmentLS	Between Groups	.367	2	.183	1.269	.327
	Within Groups	1.300	9	.144		
	Total	1.667	11			
30 – Filing System/Cabinets	Between Groups	.250	2	.125	.563	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
31 – Flammable Cabinet	Between Groups	.267	2	.133	.273	.767
	Within Groups	4.400	9	.489		
	Total	4.667	11			
32 – Fluid Power Training System	Between Groups	.167	2	.083	.115	.892
	Within Groups	6.500	9	.722		
	Total	6.667	11			
33 – Fuel Cell LS w/Cars	Between Groups	.017	2	.008	.011	.989
	Within Groups	6.900	9	.767		
	Total	6.917	11			
34 – Gears ID Kits or Equiv	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		
	Total	2.000	11			
35 – Graphics LS	Between Groups	.817	2	.408	1.750	.228
	Within Groups	2.100	9	.233		
	Total	2.917	11			
36 – Greenhouse for Biotech/Fuel	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			

37 – Hydroponics Aquaponic Equip	Between Groups	.600	2	.300	.422	.668
	Within Groups	6.400	9	.711		
	Total	7.000	11			
38 – Industrial Controls LS	Between Groups	.250	2	.125	.281	.761
	Within Groups	4.000	9	.444		
	Total	4.250	11			
39 – Injection Molder	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			
40 – Rokenbok Integ Trans Syst	Between Groups	.067	2	.033	.188	.832
	Within Groups	1.600	9	.178		
	Total	1.667	11			
41 – Internal & Ext Cobust Engin	Between Groups	.400	2	.200	1.125	.366
	Within Groups	1.600	9	.178		
	Total	2.000	11			
42 – Jointer	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
43 – Lab Pro Waste Mgmt Sys	Between Groups	.067	2	.033	.188	.832
	Within Groups	1.600	9	.178		
	Total	1.667	11			
44 – Min 30watt Laser Engraver	Between Groups	.367	2	.183	.500	.622
	Within Groups	3.300	9	.367		
	Total	3.667	11			
45 – Laser Lab Equip	Between Groups	.167	2	.083	.300	.748
	Within Groups	2.500	9	.278		
	Total	2.667	11			
46 – Laser Survey Equip	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			
47 – Lego Mindstorms	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
48 – Lithography equip	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			
49 – Material Stock (various)	Between Groups	.167	2	.083	.167	.849
	Within Groups	4.500	9	.500		

	Total	4.667	11			
50 – Material & Processes LS	Between Groups	.467	2	.233	.292	.754
	Within Groups	7.200	9	.800		
	Total	7.667	11			
51 – Mechanical LS	Between Groups	.117	2	.058	.109	.898
	Within Groups	4.800	9	.533		
	Total	4.917	11			
52– Mecharonics LS	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
53 – Metal Brake	Between Groups	.250	2	.125	.141	.871
	Within Groups	8.000	9	.889		
	Total	8.250	11			
54 – Metal Cut-off Saw	Between Groups	.917	2	.458	.688	.527
	Within Groups	6.000	9	.667		
	Total	6.917	11			
55 – Metal Band Saw Horizontal	Between Groups	.400	2	.200	.237	.794
	Within Groups	7.600	9	.844		
	Total	8.000	11			
56 – Metal Lathe	Between Groups	.467	2	.233	.228	.800
	Within Groups	9.200	9	1.022		
	Total	9.667	11			
57 – Metal Mill	Between Groups	.667	2	.333	.375	.698
	Within Groups	8.000	9	.889		
	Total	8.667	11			
58 – Metal Shear/Roll	Between Groups	.467	2	.233	.228	.800
	Within Groups	9.200	9	1.022		
	Total	9.667	11			
59 – Metal Forge Furnace	Between Groups	.667	2	.333	1.500	.274
	Within Groups	2.000	9	.222		
	Total	2.667	11			
60 – Microscope with video	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
61 – MIG Welder	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			

62 – Multisander Oscillating	Between Groups	.367	2	.183	.500	.622
	Within Groups	3.300	9	.367		
	Total	3.667	11			
63 –Weld/cut Oxy/Acetylene	Between Groups	1.600	2	.800	1.636	.248
	Within Groups	4.400	9	.489		
	Total	6.000	11			
64 – Photovoltaic Cell LS	Between Groups	.267	2	.133	.273	.767
	Within Groups	4.400	9	.489		
	Total	4.667	11			
65 – Plasma Cut/ Routing System	Between Groups	.700	2	.350	2.423	.144
	Within Groups	1.300	9	.144		
	Total	2.000	11			
66 – Plastics Oven	Between Groups	.167	2	.083	.167	.849
	Within Groups	4.500	9	.500		
	Total	4.667	11			
67 – PLC/Sensor App Trainer	Between Groups	.417	2	.208	.288	.756
	Within Groups	6.500	9	.722		
	Total	6.917	11			
68 – Pneumatic/ Hydraulic LS	Between Groups	.117	2	.058	.109	.898
	Within Groups	4.800	9	.533		
	Total	4.917	11			
69 – Fitness Equipment	Between Groups	.067	2	.033	.054	.948
	Within Groups	5.600	9	.622		
	Total	5.667	11			
70 – Power Miter Saw	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
71 – Power/ Energy/Trans LS	Between Groups	1.050	2	.525	1.477	.279
	Within Groups	3.200	9	.356		
	Total	4.250	11			
72 – Radial Arm Saw	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
73 –8x8x10 Min Rapid Prototype	Between Groups	.167	2	.083	.300	.748
	Within Groups	2.500	9	.278		
	Total	2.667	11			
74 – R&D LS	Between Groups	1.000	2	.500	1.125	.366
	Within Groups	4.000	9	.444		

	Total	5.000	11			
75 – Robotics Workcell	Between Groups	.817	2	.408	1.750	.228
	Within Groups	2.100	9	.233		
	Total	2.917	11			
76 – Roll Forming Equip	Between Groups	1.450	2	.725	.741	.503
	Within Groups	8.800	9	.978		
	Total	10.250	11			
77 – Rotational Molder w/molds	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			
78 – Router Table/Shaper	Between Groups	3.217	2	1.608	3.912	.060
	Within Groups	3.700	9	.411		
	Total	6.917	11			
79 - RTF Planes	Between Groups	.467	2	.233	.292	.754
	Within Groups	7.200	9	.800		
	Total	7.667	11			
80 – Scale Trans Vehicles	Between Groups	.250	2	.125	.187	.832
	Within Groups	6.000	9	.667		
	Total	6.250	11			
81 - Screen Print equipment	Between Groups	.117	2	.058	.109	.898
	Within Groups	4.800	9	.533		
	Total	4.917	11			
82 – Scroll Saw	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
83 – Simple Machines LS	Between Groups	3.217	2	1.608	2.539	.134
	Within Groups	5.700	9	.633		
	Total	8.917	11			
84 – Small Gas Engines	Between Groups	.400	2	.200	1.125	.366
	Within Groups	1.600	9	.178		
	Total	2.000	11			
85 – Solar Vehicle LS	Between Groups	1.050	2	.525	1.477	.279
	Within Groups	3.200	9	.356		
	Total	4.250	11			
86 – Speed Radar Gun	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		
	Total	2.000	11			

87 – Spot/Resist Welder	Between Groups	.667	2	.333	.500	.622
	Within Groups	6.000	9	.667		
	Total	6.667	11			
88 – Portable Spray Booth	Between Groups	.167	2	.083	.115	.892
	Within Groups	6.500	9	.722		
	Total	6.667	11			
89 – Project Storage System	Between Groups	.367	2	.183	1.269	.327
	Within Groups	1.300	9	.144		
	Total	1.667	11			
90 - Strip Heater	Between Groups	.367	2	.183	.500	.622
	Within Groups	3.300	9	.367		
	Total	3.667	11			
91 – Structural Tester	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		
	Total	2.000	11			
92 – Sustainable Energy LS	Between Groups	.667	2	.333	.500	.622
	Within Groups	6.000	9	.667		
	Total	6.667	11			
93 – Table Saw	Between Groups	.250	2	.125	.281	.761
	Within Groups	4.000	9	.444		
	Total	4.250	11			
94 – Thickness Planer	Between Groups	.000	2	.000	.000	1.000
	Within Groups	8.000	9	.889		
	Total	8.000	11			
95 – Vacuum/ Thermo Former	Between Groups	.367	2	.183	.500	.622
	Within Groups	3.300	9	.367		
	Total	3.667	11			
96 - Vertical Hole Punch	Between Groups	.550	2	.275	.669	.536
	Within Groups	3.700	9	.411		
	Total	4.250	11			
97 – Vinyl Cutter	Between Groups	.517	2	.258	.363	.705
	Within Groups	6.400	9	.711		
	Total	6.917	11			
98 – Vise System	Between Groups	.100	2	.050	.092	.913
	Within Groups	4.900	9	.544		
	Total	5.000	11			
99 – Watercraft Test Track 20'	Between Groups	.667	2	.333	1.500	.274
	Within Groups	2.000	9	.222		

	Total	2.667	11			
100 – Waterjet Cutting System	Between Groups	.900	2	.450	1.929	.201
	Within Groups	2.100	9	.233		
	Total	3.000	11			
101 – Wind Generation LS	Between Groups	.517	2	.258	.363	.705
	Within Groups	6.400	9	.711		
	Total	6.917	11			
102 – Wind Tunnel	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
103 – Wood Lathe	Between Groups	.250	2	.125	.187	.832
	Within Groups	6.000	9	.667		
	Total	6.250	11			
104 – Work Benches	Between Groups	.167	2	.083	.300	.748
	Within Groups	2.500	9	.278		
	Total	2.667	11			
105 – Applied Science Tools	Between Groups	1.217	2	.608	1.480	.278
	Within Groups	3.700	9	.411		
	Total	4.917	11			
106 – Barcode Scanner (equiv)	Between Groups	1.050	2	.525	1.477	.279
	Within Groups	3.200	9	.356		
	Total	4.250	11			
107 – Biotech Gen Lab Equip	Between Groups	.817	2	.408	.896	.442
	Within Groups	4.100	9	.456		
	Total	4.917	11			
108 – Const. Tools	Between Groups	.600	2	.300	.614	.563
	Within Groups	4.400	9	.489		
	Total	5.000	11			
109 – Electron Tools	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		
	Total	2.000	11			
110 - Fabrication Msmt Tools	Between Groups	.250	2	.125	.563	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
111 - Fastener Supply	Between Groups	.017	2	.008	.026	.975
	Within Groups	2.900	9	.322		
	Total	2.917	11			

112 - General Chem Tools	Between Groups	.817	2	.408	1.750	.228
	Within Groups	2.100	9	.233		
	Total	2.917	11			
113 - Hand Draft Tools	Between Groups	1.750	2	.875	1.750	.228
	Within Groups	4.500	9	.500		
	Total	6.250	11			
114 - Measuring Devices	Between Groups	.250	2	.125	.563	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
115 - Medical Equipment	Between Groups	.250	2	.125	.281	.761
	Within Groups	4.000	9	.444		
	Total	4.250	11			
116 - Misc Tools Fabrication	Between Groups	.017	2	.008	.026	.975
	Within Groups	2.900	9	.322		
	Total	2.917	11			
117 – Misc Fab Power Tools	Between Groups	.017	2	.008	.026	.975
	Within Groups	2.900	9	.322		
	Total	2.917	11			
118-Tachometer Non Contact	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
119-Office Equipment	Between Groups	.167	2	.083	.300	.748
	Within Groups	2.500	9	.278		
	Total	2.667	11			
120-Plastic Tools	Between Groups	.067	2	.033	.083	.921
	Within Groups	3.600	9	.400		
	Total	3.667	11			
121 – Pneumatic Tools	Between Groups	.067	2	.033	.083	.921
	Within Groups	3.600	9	.400		
	Total	3.667	11			
122 – Safety Equipment	Between Groups	.067	2	.033	.188	.832
	Within Groups	1.600	9	.178		
	Total	1.667	11			
123 – Sound Level Meter	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
124 – Classroom Project Server	Between Groups	.150	2	.075	.321	.733
	Within Groups	2.100	9	.233		

	Total	2.250	11			
125-Classroom/ Lab Sound Sys	Between Groups	2.117	2	1.058	3.402	.079
	Within Groups	2.800	9	.311		
	Total	4.917	11			
126 – Color Laser Printer	Between Groups	.667	2	.333	1.500	.274
	Within Groups	2.000	9	.222		
	Total	2.667	11			
127 – Dektop Computer	Between Groups	.417	2	.208	.221	.806
	Within Groups	8.500	9	.944		
	Total	8.917	11			
128- Dig Camera Tripods/lights	Between Groups	.117	2	.058	.077	.926
	Within Groups	6.800	9	.756		
	Total	6.917	11			
129 –Digital Video Recorder	Between Groups	1.050	2	.525	3.937	.059
	Within Groups	1.200	9	.133		
	Total	2.250	11			
130 – Elect Present Board	Between Groups	.467	2	.233	.656	.542
	Within Groups	3.200	9	.356		
	Total	3.667	11			
131 – 42” min HDTV	Between Groups	.000	2	.000	.000	1.000
	Within Groups	6.000	9	.667		
	Total	6.000	11			
132 – GPS Units	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
133 – Instructor Laptop Comp	Between Groups	.367	2	.183	1.269	.327
	Within Groups	1.300	9	.144		
	Total	1.667	11			
134 – Laptop Comp Set/Cart	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			
135 – Laser Printer	Between Groups	.250	2	.125	.281	.761
	Within Groups	4.000	9	.444		
	Total	4.250	11			
136 – Projector	Between Groups	.667	2	.333	.750	.500
	Within Groups	4.000	9	.444		
	Total	4.667	11			

137 – Scanner	Between Groups	.667	2	.333	.750	.500
	Within Groups	4.000	9	.444		
	Total	4.667	11			
138 – Student Response Syst	Between Groups	.250	2	.125	.562	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
139 – Video Camcoders	Between Groups	.467	2	.233	1.750	.228
	Within Groups	1.200	9	.133		
	Total	1.667	11			
140 – Wide Format Printer	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		
	Total	2.000	11			
141 – Wireless Microphones	Between Groups	.067	2	.033	.188	.832
	Within Groups	1.600	9	.178		
	Total	1.667	11			
142 – 2D CAD	Between Groups	.017	2	.008	.015	.985
	Within Groups	4.900	9	.544		
	Total	4.917	11			
143 – 3D Arch Building Design	Between Groups	.167	2	.083	.167	.849
	Within Groups	4.500	9	.500		
	Total	4.667	11			
144 – 3D CAD	Between Groups	.250	2	.125	.563	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
145 – Air Quality Analysis Softwr	Between Groups	.250	2	.125	.562	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
146 – Animation Software	Between Groups	.917	2	.458	2.062	.183
	Within Groups	2.000	9	.222		
	Total	2.917	11			
147- Audio Edit/ Prod. Software	Between Groups	.367	2	.183	1.269	.327
	Within Groups	1.300	9	.144		
	Total	1.667	11			
148 – Barcode Gen Software	Between Groups	.067	2	.033	.083	.921
	Within Groups	3.600	9	.400		
	Total	3.667	11			
149 – Bridge Design Software	Between Groups	.000	2	.000	.000	1.000
	Within Groups	2.000	9	.222		

	Total	2.000	11			
150 – BIM Software	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
151 – CAM Software	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
152 – Chem Analysis Softwr	Between Groups	1.667	2	.833	3.750	.065
	Within Groups	2.000	9	.222		
	Total	3.667	11			
153-Game Dev Software	Between Groups	.067	2	.033	.083	.921
	Within Groups	3.600	9	.400		
	Total	3.667	11			
154 - Land Based Auto Cntrl	Between Groups	.600	2	.300	1.125	.366
	Within Groups	2.400	9	.267		
	Total	3.000	11			
155- Mon Sftwr Land Base Trns	Between Groups	1.000	2	.500	2.250	.161
	Within Groups	2.000	9	.222		
	Total	3.000	11			
156 – PLC Software	Between Groups	.117	2	.058	.656	.542
	Within Groups	.800	9	.089		
	Total	.917	11			
157 – Desktop Pub Software	Between Groups	.517	2	.258	.528	.607
	Within Groups	4.400	9	.489		
	Total	4.917	11			
158 – EKG Analysis Softwr	Between Groups	.917	2	.458	2.063	.183
	Within Groups	2.000	9	.222		
	Total	2.917	11			
159 – Elec Circuit Software	Between Groups	.117	2	.058	.188	.832
	Within Groups	2.800	9	.311		
	Total	2.917	11			
160 – White Board Software	Between Groups	.550	2	.275	.669	.536
	Within Groups	3.700	9	.411		
	Total	4.250	11			
161 – Floor Plan Software	Between Groups	.017	2	.008	.026	.975
	Within Groups	2.900	9	.322		
	Total	2.917	11			

162 – Internet Connection	Between Groups	.000	2	.000	.	.
	Within Groups	.000	9	.000		
	Total	.000	11			
163 - MS Office Software (equiv)	Between Groups	.250	2	.125	.563	.589
	Within Groups	2.000	9	.222		
	Total	2.250	11			
164 – Photoshop or equiv	Between Groups	.017	2	.008	.026	.975
	Within Groups	2.900	9	.322		
	Total	2.917	11			
165 – Plant layout software	Between Groups	.467	2	.233	.656	.542
	Within Groups	3.200	9	.356		
	Total	3.667	11			
166 – Robot Control Softwr	Between Groups	.150	2	.075	.321	.733
	Within Groups	2.100	9	.233		
	Total	2.250	11			
167 – Sim City Software	Between Groups	1.450	2	.725	2.330	.153
	Within Groups	2.800	9	.311		
	Total	4.250	11			
168 – Sim Farm Software	Between Groups	.917	2	.458	2.062	.183
	Within Groups	2.000	9	.222		
	Total	2.917	11			
169 – Google Sketchup	Between Groups	1.467	2	.733	1.269	.327
	Within Groups	5.200	9	.578		
	Total	6.667	11			
170 – Smart Draw Software	Between Groups	.067	2	.033	.188	.832
	Within Groups	1.600	9	.178		
	Total	1.667	11			
171 – Soil pH Software	Between Groups	.400	2	.200	.500	.622
	Within Groups	3.600	9	.400		
	Total	4.000	11			
172 – Stat Process Softwr	Between Groups	1.167	2	.583	2.100	.178
	Within Groups	2.500	9	.278		
	Total	3.667	11			
173 – Vernier Software	Between Groups	1.867	2	.933	3.000	.100
	Within Groups	2.800	9	.311		
	Total	4.667	11			
174 – Video Editing Software	Between Groups	.167	2	.083	.300	.748
	Within Groups	2.500	9	.278		

	Total	2.667	11			
175 – Water Quality Software	Between Groups	1.717	2	.858	1.486	.277
	Within Groups	5.200	9	.578		
	Total	6.917	11			
176 – Waterjet Software	Between Groups	.417	2	.208	.750	.500
	Within Groups	2.500	9	.278		
	Total	2.917	11			
177 - Web 2.0 Tools Free	Between Groups	.517	2	.258	.528	.607
	Within Groups	4.400	9	.489		
	Total	4.917	11			
178 – Web Design Software	Between Groups	.067	2	.033	.054	.948
	Within Groups	5.600	9	.622		
	Total	5.667	11			