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Future Critical Issues and Problems Facing Technology and Engineering Education in the Commonwealth of Virginia

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Articles

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The word *crisis* is not always presented as having a negative connotation. John F. Kennedy once said, “When written in Chinese, the word “crisis” is composed of two characters - one represents danger and the other opportunity” (John F. Kennedy Presidential Library and Museum, 1959). Some may feel that the technology and engineering profession is in a crisis, but in the midst of this crisis, opportunities exist. As Sanders suggested, “A series of circumstances has once more created an opportunity for technology educators to develop and implement new integrative approaches to STEM education” (2009, p. 20). STEM education is just one of many potential technology and engineering education opportunities; however, concerns, as well as opportunities, must be identified and prioritized in order to ensure the profession correctly progresses into the future.

Evolving from manual arts, vocational education, and industrial arts, technology and engineering education in the United States is the result of an evolutionary process that spans two centuries. Changing philosophy concerning what these programs should teach students drove much of that evolution. Among others, the philosophical points of view documented by Woodward, Dewey, Warner, Olson, Snyder & Hales, and the *Standards for Technological Literacy* (ITEA/ITEEA, 2000/2002/2007) guided curriculum development. It is widely accepted that technology and engineering education should continue to evolve in order to meet future requirements (Kelley & Kellam, 2009; Kozak, 1992; Lewis, 2005). In response to the changing face of technology, in 1992 the Virginia Council on Technology Education for the 21st Century published *The Technology Education Curriculum K-12*. This document addressed the concerns of the day. The preface stated:

> In less than 80 years, the western world has moved from an economy primarily based on agriculture through an industrial age to a contemporary society based largely on information and technology. Technology has become the dynamic, driving force in modern life and has achieved such a high level of sophistication that many people are unable to comprehend its economic, social, and cultural impact. Consequently, citizens often feel they lack control over their daily lives because they do not understand

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> technological changes or the reasons for them.
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> Schools today must prepare students to understand technological innovation, the productivity of technology, the impact of technology on the quality of life, and the need for critical evaluation of the social changes resulting from technological changes. Educators must ensure that graduates are prepared to live knowledgeably in a technology-based society and contribute productively to it. (Willcox & Van Dyke, 1992, p. iii)

As theoretical program changes occurred in the past, curricula also changed to meet program goals and objectives. Creating curricula that address philosophical program changes presents a challenge. McCabe and Litowitz indicated that "one of the major obstacles hindering the continued growth of technology education is the lack of a curriculum development aptitude by secondary level teachers to create and implement curricular change" (as cited in Wicklein, 1993b, p. 66).

Wicklein (1993a, 2005) and Ritz (2009) performed studies in an effort to help guide future needs of the technology education profession. Wicklein's (1993a, 2005) studies on the critical issues and problems in technology education laid the foundation for this study. Ritz's (2009) *A New Generation of Goals for Technology Education* study provided additional information "to develop meaningful instructional programs for technology education" (p. 50). Indeed, every profession requires periodic program assessment. Hoepfl and Lindstrom (2007) indicated that assessments are necessary to maintain viable technology and engineering programs. Day and Schwaller (2007) identified ten principles of program assessment in technology education. Principle number three stated, "Assessment works best when the program it seeks to improve has clear, explicitly stated purposes" (p. 253).

The International Technology and Engineering Educators Association (ITEEA)—formerly ITEA—provided program evaluation guidance in their *Realizing Excellence: Structuring Technology Programs* (2005) document. The document stated, "Evaluation refers to the process of collecting and processing information and data to determine how well a program and its various components meet the requirements and provide direction for improvements" (ITEA/ITEEA, 2005, p. 8).

Purpose

The purpose of this research was to determine the future critical issues and problems facing the K-12 technology and engineering education profession in the Commonwealth of Virginia. This study was based on the Wicklein nationwide studies (1993a, 2005). Even though this study did not exactly replicate the Wicklein studies—since it was limited to the Commonwealth of Virginia—the method and questions used were identical.

When introducing this study to participants, the researchers defined the terms *critical issue, critical problem,* and *future*. The following excerpt from

Wicklein's 1993 study identifies how those terms were defined and how these researchers used the term to conduct the study.

> A critical issue was defined as: Of crucial importance relating to at least two points of view that are debatable or in dispute within technology education. A critical problem was defined as: A crucial impediment to the progress or survivability of technology education…. The term "future" was defined as: A projected period of time of 3-5 years in the future. This span of time was judged as appropriate based on current strategic planning procedures used by the ITEA (5 year increments). Based upon identified critical issues and problems the leadership of the technology education profession could more accurately design a path to achieve the primary mission of advancing technological literacy. (Wicklein, 1993a, p. 56)

This study focused on two of the four research questions found in Wicklein's study.

- What are the critical issues that most probably will impact on the technology education discipline in the future (3-5 years)? (1993a, p. 56).
- What are the critical problems that most probably will impact on the technology education discipline in the future (3-5 years)? (1993a, p. 56).

During the 2009 Virginia Governor's STEM education conference, technology and engineering education stakeholders held a breakout session to discuss the future of the profession in the Commonwealth of Virginia. Whereas there was a tremendous amount of information conveyed, no definitive focus arose. The Virginia Career and Technical Education Supervisors organization sponsored a second meeting, held in Henrico County. Third and fourth meetings were held in Richmond. After the meetings, there was still no clear focus. It was the opinion of several group members that a study should be performed to determine what Commonwealth of Virginia stakeholders felt were the most pressing issues and problems facing Virginia programs. Based on study results, the group could then devise a plan to address future technology and engineering education curriculum and program needs. Wicklein (1993a) recognized that data driven decisions are essential when planning for the future.

> The need to plan for the future is critical to the overall health of any organization. However, planning is often biased by the opinions of a select group of individuals who may not possess the knowledge and/or empirical data to formulate a plan that could address the most critical current and future concerns and issues facing the agency/institution. (p. 54)

This study utilized the input of a group of informed technology and engineering education stakeholders, as suggested by Wicklein in both of his studies (1993a, 2005).

Methodology

The purpose of this research was to determine the future critical issues and problems facing the technology and engineering education profession in the Commonwealth of Virginia. Hsu and Stanford (2007) identified that "The Delphi technique is a widely used and accepted method for gathering data from respondents within their domain of expertise" (p. 1). Wicklein (1993a) recognized that "the primary objective of a Delphi inquiry is to obtain a consensus of opinion from a group of respondents" (p. 56). The Delphi technique was used to consult a body of experts, gather information, and formulate a group consensus, while limiting the complications and disadvantages of face-to-face group interaction (Isaac & Michael, 1981). An electronic Delphi study was used to reduce the potential for a panel member dominating the interaction or distortions arising from decisions based on panel member feedback (Clayton, 1997).

Anonymity, interaction with controlled feedback, and statistical group responses were used in the study. Through the Delphi technique, participant anonymity was secured, allowing individuals to change their opinion on the subject matter, while also preventing them from being persuaded or inhibited by other participants (Clayton, 1997). Group consensus was an essential component for the Delphi process, since it is a function of the validity and quality of the initial competency selection process through the literature review (Custer, Scarcella, & Stewart, 1999). Researchers used a modified Delphi (three round) study to ask Commonwealth of Virginia technology and engineering education stakeholders, hereafter referred to as panelists, what they felt were the future critical issues and problems concerning Virginia technology and engineering education programs.

Population

As in Wicklein's study (1993a), "the success of the Delphi Technique relies upon the use of informed opinion; random selection was not considered when selecting the Delphi participants" (p. 57). The researchers of this study emailed 56 technology and engineering education stakeholders, who had been actively involved in technology and engineering education, and asked if they would agree to participate in this study. Of the 56 stakeholders asked to participate, 30 agreed. The participating panelists consisted of six state and district level technology and engineering education administrators, 11 former Virginia Technology Education Association (VTEA) State or Regional Presidents, four current or past members of the VTEA Board of Directors, two Virginia technology and engineering education teachers of the year, five technology and engineering teachers that have been very involved the Virginia Technology Student Association, and two technology and engineering education teacher educators. Eight of the 30 panelists were female. Potential panelists were provided with an overview of the study and specific study questions that they would be asked to answer.

Procedure

Round one of this Delphi study commenced when researchers emailed panelists the background and purpose of the study. The researchers provided the definitions of the terms *critical issues* and *critical problems*. The first round asked panelists to identify as many future issues and problems as they deemed necessary. Using qualitative research coding procedures, the researchers categorized the issues and problems into key descriptors (Patton, 2002, p. 127). Round two asked panelists to rate the key descriptors using a Likert-type scale. Round three asked panelists to identify key descriptors that they felt were *essential* or *non-essential* for profession leaders to address when planning future technology and engineering program guidance.

Analysis of Findings

Delphi I

Via an online survey tool, panelists were asked to provide as many answers as possible to the following questions; those questions were:

1. What are the critical issues that most probably will impact the technology and engineering education discipline in Virginia in the future (3-5 years)?
2. What are the critical problems that most probably will impact the technology and engineering education discipline in Virginia in the future (3-5 years)?

Panelists were also provided the following definitions:

- A critical issue was defined as: Of crucial importance relating to at least two points of view that are debatable or in dispute within technology education (Wicklein, 1993a, p. 56).
- A critical problem was defined as: A crucial impediment to the progress or survivability of technology education (Wicklein, 1993a, p. 56).

Twenty-nine of the 30 panelists responded. Those 29 panelists provided 63 future issues and 75 future problems facing the future of technology and engineering education in Virginia. The researchers classified and coded these 63 issues and 75 problems into key descriptors, which resulted in 21 future issue and 20 future problem key descriptors. These key descriptors formed the basis for rounds two and three of this study.

Delphi II

Researchers asked panelists to consider the same two questions when rating the critical issues and problems in round two. The researchers asked participants to use the Likert-type scale (*strongly disagree, disagree, neutral, agree,* or *strongly agree*) when responding to the 21 future issue and 20 future problem key descriptors. Twenty-eight panelists rated the critical issue key descriptors in question one and 29 rated most of the critical problem key descriptors in question two. Table 1 identifies key descriptors and how panelists felt those descriptors represented future critical issues facing technology and engineering education in Virginia.

Table 1 (continued on next page)
Future Critical Issues Key Descriptors Ratings and Response Frequencies

	Future Critical Issues	**Number of Responses**					
Delphi II	**Key Descriptor**	***Mean***	***SD***	***D***	***N***	***A***	***SA***
1	Technology and engineering education (TEE) programs are not always defined in a correct manner	4.29	1	0	0	16	11
2	There is a TEE teacher shortage	4.11	1	0	6	9	12
3	TEE courses need to become core courses	4.11	1	0	6	9	12
4	There is a lack of funding to support TEE	4.11	0	1	6	10	11
5	TEE is not equally represented in student scheduling	4.11	0	1	7	8	12
6	TEE programs do not always receive appropriate value	4.07	1	1	2	15	9
7	There is an increasing number of secondary TEE program closures	3.93	0	2	4	16	6
8	TEE curriculum development/standardization/ to include STEM, needs to be improved	3.82	2	2	3	13	8
9	TEE teacher college prep programs must be improved	3.82	1	0	8	13	6
10	The Science profession is competing with TEE programs	3.68	0	4	6	13	5
11	TEE is viewed as for males, not females	3.61	1	3	8	10	6

12	Secondary TEE teacher professional development needs to be improved	3.61	0	4	8	11	5
13	There is no clear focus for the future of TEE programs	3.54	1	3	6	16	2
14	There is a lack of TEE dual enrollment opportunities	3.54	0	5	9	8	6
15	TEE programs/courses need standardized testing	3.50	2	2	10	8	6
16	TEE needs to have an industry credentialing plan/focus	3.48	1	0	12	13	1
17	TEE has a lack of administrative support	3.43	1	4	11	6	6
18	TEE teachers are not adequately prepared to teach engineering	3.21	1	6	9	10	2
19	TEE teachers do not know industry needs	3.18	1	6	9	11	1
20	TEE class sizes are too large	3.14	0	6	14	6	2
21	There are too many TEE courses available to students	2.61	2	13	9	2	2

Table 2 identifies key descriptors and how panelists felt those descriptors represented future critical problems facing technology and engineering education in Virginia.

Table 2 (continued on next page)
Future Critical Problems Key Descriptors Ratings and Response Frequencies

	Future Critical Problems		Number of Responses				
Delphi II	**Key Descriptor**	***Mean***	***SD***	***D***	***N***	***A***	***SA***
1	Technology and Engineering Education (TEE) needs to be better marketed	4.57	0	0	0	12	16
2	School counselors do not understand TEE	4.50	0	0	2	10	16
3	Some TEE courses need to have AP status	4.07	0	1	5	14	9
4	There is a lack of TEE teachers	4.07	1	0	5	13	10
5	There is a lack of TEE teacher preparation programs	4.03	0	0	8	12	9

6	There is not enough room for TEE electives in students' schedules	3.97	1	1	6	11	10
7	College TEE teacher preparation programs need to be improved	3.97	0	1	8	11	9
8	There is a lack of TEE teacher involvement in Technology Student Association	3.86	0	2	5	17	5
9	TEE should have standardized STEM curriculum	3.79	1	2	7	11	8
10	TEE teachers should receive competitive pay	3.76	0	4	6	12	7
11	There is a lack of research identifying the benefits of TEE	3.69	1	3	5	15	5
12	There are too many secondary TEE programs closing	3.69	0	1	10	15	3
13	There is a lack of effective TEE professional development	3.59	1	2	10	11	5
14	Declining secondary TEE student enrollment	3.52	0	4	9	13	3
15	TEE teachers not adapting to new curriculum needs	3.45	1	2	10	15	1
16	TEE teachers not prepared to teach engineering	3.34	1	6	8	10	4
17	TEE programs have inadequate lab space	3.21	0	6	13	8	2
18	TEE teachers' lack of understanding/use of correct terminology	3.11	2	6	9	9	2
19	TEE teachers have a lack of understanding for future industry needs	2.97	1	7	13	8	0
20	Lack of support from VTEA, VDOE, and Universities	2.90	3	9	5	12	0

Delphi III

In round two, panelists rated all key descriptors that they had identified in round one. For round three, the researchers identified key descriptors that received a 3.5 or higher rating in round two. Based on a Likert-type scale of 1 to 5, the mean of 3.5 and above implied that panelists' generally *agreed* or *strongly agreed* about those key descriptors. For each key descriptor, panelists were asked to indicate if they felt that the descriptors were *essential* or *non-essential* for technology and engineering education leaders to address. Twenty-nine panelists responded; however, not all responded to each key descriptor. Using the mean of 3.5 and above criterion for panelists to indicate that a key descriptor was *essential*, this study found that the panelists felt that there were 12 future critical issues and 13 future critical problems facing technology and engineering education in Virginia. Using the criterion of 50% of more, Table 3 lists the future critical issues that the panelists considered *essential* and the percentage of participants who felt those issues were *essential.* Table 4 provides the same information concerning future critical problems. Both Tables 3 and 4 identify similarities between this study and the results found in the Wicklein study (1993a).

Table 3 (continued on next page)
Essential Future Critical Issues Facing Technology and Engineering Education in Virginia

Delphi III	Key Descriptor	Number Considering Essential	Percentage	Wicklein 1993a Study Findings
1	Technology and Engineering Education (TEE) programs are not always defined in a correct manner	24 of 28	85.7%	Poor and/or inadequate public relations for technology ed.
2	TEE programs do not always receive appropriate value	23 of 28	82.1%	General populous ignorant regarding technology and the discipline of technology ed.
3	TEE curriculum development/ standardization/to include STEM, needs to be improved	22 of 29	75.9%	Non-unified curriculum for technology ed.; Curriculum development paradigms for technology ed.

4	There is no clear focus for the future of TEE programs	21 of 28	72.4%	Lack of consensus of curriculum content for technology ed.
5	TEE is not equally represented in student scheduling	20 of 28	71.4%	HS graduation requirements reduce opportunities for technology ed. courses
6	There is a lack of funding to support TEE	20 of 28	71.4%	Insufficient funding of technology ed. programs; Funding of technology ed.
7	There is a TEE teacher shortage	20 of 29	69.0%	Insufficient quantities of technology ed. teachers; Elimination of teacher education programs in technology ed.
8	There are an increasing number of secondary TEE program closures	17 of 27	63.0%	Elimination of technology ed. programs
9	TEE courses need to become core courses	18 of 29	62.1%	No similar issues or problems
10	TEE college prep programs must be improved	16 of 28	57.9%	Inappropriate certification procedures for technology ed.
11	TEE is viewed as for males, not females	16 of 29	55.2%	Number of females in technology ed.
12	Secondary TEE teacher professional development needs to be improved	15 of 28	53.6%	Inferior in-service training for technology ed.

Note: Not all panelists responded to every key descriptor.

Table 4 (continued on next page)
Essential Future Critical Problems Facing Technology and Engineering Education in Virginia

Delphi III	Key Descriptor	Number Considering Essential	Percentage	Wicklein 1993a Study Findings
1	School counselors do not understand technology and engineering education (TEE)	27 of 29	93.1%	Inaccurate understanding and support of technology ed. by administrators and counselors
2	Secondary TEE enrollment is declining	25 of 28	89.3%	Recruitment of students and teachers in technology ed.; Declining enrollments in technology ed. courses
3	TEE needs to be better marketed	22 of 27	81.5%	Inadequate marketing and public relations of technology ed.
4	There is a lack of TEE teacher preparation programs	22 of 28	78.6%	Insufficient quantities of technology ed. teachers; Elimination of teacher education programs in technology ed.
5	There is a lack of TEE teachers	22 of 29	75.9%	Insufficient quantities of technology ed. teachers; Elimination of teacher education programs in technology ed.
6	There is a lack of research identifying the benefits of TEE	21 of 28	75.0%	Inadequate research base for technology ed.; No clear research agenda for technology ed.; Defining measurable outcomes for technology ed. students; Research agenda for technology ed.
7	There is not enough room for TEE electives in students' schedules	19 of 28	67.9%	High school graduation requirement restrictions on technology ed.

8	There are too many secondary TEE programs closing	19 of 28	67.9%	Elimination of technology ed. programs; Program closings and eliminations in technology ed.
9	College TEE teacher preparation programs need to be improved	18 of 28	64.3%	Inappropriate certification procedures for technology ed.
10	TEE should have standardized STEM curriculum	18 of 28	64.3%	Non-unified curriculum for technology ed.
11	There is a lack of TEE teacher involvement in Technology Student Association	17 of 29	58.6%	No similar issue or problem identified
12	Some TEE courses need to have AP status	16 of 29	55.2%	No similar issue or problem identified
13	TEE teachers should receive competitive pay	15 of 28	53.6%	Insufficient funding of technology ed. programs

Note: Not all panelists responded to every key descriptor.

In order for specific problems and issues to make the final list (Tables 3 and 4), at least 50% of participants had to indicate that they felt those problems and issues were essential to take into consideration when planning the future of technology and engineering education in Virginia. This process is consistent with cut-rates reported in other educational research studies, such as Lewis, Green, Mitzel, Baum, and Patz (1996) and Mitzel, Lewis, Patz, and Green (2001). Table 5 provides a comparison of the top five indicators (above 75%) found in the three studies, including Wicklein's 1993 and 2005 studies and Katsioloudis and Moye's study from 2011. The top five indicators showed that further correlation exists between the three studies. Even though the indicators do not share the same position in the hierarchy, they suggest that the problems facing the technology and engineering education profession have remained very similar for the past two decades.

Table 5
Comparison of Top Five Issues and Problems –Wicklein (1993, 2005) and Katsioloudis and Moye (2011)

	Future Problems (Wicklein, 1993)	**Problems (Wicklein, 2005)**	**Critical Issues and Problems (Katsioloudis & Moye, 2011)**
1	Insufficient quantities of technology education teachers and elimination of teacher education programs in technology education	Insufficient quantities of qualified technology education teachers	School counselors do not understand technology and engineering education (TEE)
2	Loss of technology education identity, absorbed within other disciplines	Inadequate understanding by administrators and counselors concerning technology education	Secondary TEE enrollment is declining
3	Poor and/or inadequate public relations for technology education	Inadequate understanding by general populace concerning technology education	TEE needs to be better marketed
4	Insufficient funding of technology education programs	Lack of consensus of curriculum content for technology education	There is a lack of TEE teacher preparation programs
5	Non-unified curriculum for technology education	Inadequate financial support for technology education programs	There is a lack of TEE teachers

Discussion

The purpose of this research was to determine the future critical issues and problems facing the technology and engineering education profession in the Commonwealth of Virginia. The modified Delphi research design was used to draw consensus among technology and engineering education experts in the Commonwealth of Virginia. Seventy-five percent of the participants agreed with one another concerning the top five critical problems and issues that Virginia leaders should consider when planning future programs (see Table 4).

The participants agreed (93%) that the most pressing problem is that school counselors do not understand technology and engineering education (TEE). This finding indicates that technology and engineering educators and school counselors need to improve their relationships. Perhaps leaders from both professions should become more familiar with each other through meetings and presentations. These meetings and presentations could occur at the national, state, local, and school levels. Promoting awareness of the technology and engineering education courses and profession and its benefits could improve counselors and students' knowledge of what these programs have to offer. Discussion could eliminate misconceptions about technology and engineering education programs, as well as further identify how these programs can benefit students in their effort to become more technologically literate and more college and career ready.

Almost ninety percent (89%) of the participants identified the fact that secondary technology and engineering education enrollment is declining as a critical problem. This decline could be attributed to several issues. One of the most pressing issues is the lack of available technology and engineering education teachers (Moye, 2009; Ndahi & Ritz, 2003; Weston, 1997). If a school district cannot find a teacher to fill a position in tight budgetary times, that position may be eliminated in order to save scarce and valuable funds. It is difficult to imagine that once a program closes it will be reopened again in the future (Volk, 1997).

Participants (81.5%) felt that technology and engineering education needs to be better marketed. This ranked third of the most critical issues and problems, but could be considered one of the most critical points to consider. If the technology and engineering education profession is to gain creditability amongst other secondary education programs, leaders must devise plans to illustrate the benefits of the programs, as well as advertise program successes. If we, the profession's leaders, rest on our proverbial laurels, we will continue to experience the slow demise that Volk (1997) described. A possible solution is to provide awareness and knowledge diffusion to the general public. Educating parents and school faculty about the benefits and options that technology and engineering education has to offer will help stymie the negative "shop" perception that continues to exist.

Seventy-nine percent of the participants felt that a major issue is the lack of technology and engineering education teacher preparation programs. Again, this is not a new concern (Moye, 2009; Ndahi & Ritz, 2003; Volk, 1997; Weston, 1997). These feelings are an indication that participants felt that the lack of programs will have a negative impact on the profession in Virginia. This situation is true is all areas of the United States. Illustrating the downward trend over the past decade:

> In 2004-2005, there were 34 institutions that produced 338 technology education teachers (Schmidt & Custer, 2005). In 2005-2006, 32 institutions produced 315 technology education teachers (Schmidt & Custer, 2006). Twenty-nine institutions produced 311 technology education teachers in 2006-2007 (Schmidt & Custer, 2007). Finally, in 2007-2008, 27 institutions produced 258 technology teachers (Waugh, 2008). (Moye, 2009, p. 31)

Participants (75.9%) felt that there is a lack of technology and engineering education teachers. The reason for this shortage could be due to several of the other factors that participants felt were critical, e.g. misunderstanding of technology and engineering education, declining secondary enrollment, and the decreasing number of technology and engineering teacher preparation programs. It stands to reason that if leaders adequately address the *other issues*, the number of available teachers will increase. According to Moye (2009), Weston (1997), and Volk (1997) the shortage of technology teachers is so severe that it threatens the profession's very existence.

Seventy-five percent of the participants felt that there is a lack of research identifying the benefits of technology and engineering education. According to Zuga (2004), in the United States, cognitive research about technology education for the general educational purpose of technological literacy has suffered from a lack of a coherent focus. Zuga (2004) also stated that the complacency that we have about doing or not doing research, the atheoretical stance of the profession, and the resulting process orientation make it difficult to create a research base. This may be the case, but Reed, Harrison, Moye, Opare, Ritz, and Skophammer (2008) reported that there is research that supports technology education. Technology and engineering teacher education programs are in a prime position to require their students to conduct research concerning the benefits and challenges the profession faces. Junior university faculty members should receive guidance from senior faculty concerning more cognitive research involvement.

Recommendations

Program assessments are necessary before leaders can determine what, if any, program improvement changes are needed (Day & Schwaller, 2007; Hoepfl & Lindstrom, 2007). This study identified what Virginia stakeholders felt were the most critical issues and problems facing the future of technology and engineering education programs in the Commonwealth of Virginia. Based on these results, the following recommendations are presented.

1. Technology and engineering education leaders should review these results to aid them in the determination of future program improvement/change foci. The benefits of this study are not limited to the Commonwealth of Virginia. Research has shown that certain issues remain the same (see Table 5) at a national level; therefore, action should be taken. The issues identified in this study can be used as a starting point in the process.
2. Future research should be conducted to identify if some of the areas identified in this study are (or are not) consistent with their findings.
3. An assessment instrument based on the key descriptors identified in this study should be created and used to assess technology and engineering education programs. The assessment could be similar to the Meade and Dugger (2004) and Dugger (2007) studies, but more directed to specific problems and issues that this study identified.
4. Future research should be conducted to identify if the same issues and problems exist at the national level.

Conclusion

Each of the critical issues and problems identified in this study bears further investigation and possible action to address the crisis (Wicklein, 2005). This research provides opinions of technology and engineering education teachers, administrators, and teacher educators, and it could be considered a starting point for future discussions. The profession is blessed with the ability to offer students an education that can transform how they think and act. Along with those blessings come responsibilities. A continuing assessment of the programs, and reassurance that students receive quality education, should be the main focus. The most obvious conclusion from this research is the lack of understanding of the technology education profession and its role in society. According to the strongest indicator (see table 4), school counselors do not understand technology and engineering education. Wicklein (1993a, 2005) also found this as one of the most critical indicators. Also found in all three studies is the insufficient number of certified technology education teachers. The general lack of knowledge about the technology and engineering education profession exacerbates the lack of interest and the limited number of secondary and post-secondary students. The problem exists from the beginning of the pipeline— lack of secondary students will cause the lack of technology and engineering teacher education candidates, which ultimately decreases the number of certified technology and engineering education teachers.

Technology and engineering education professionals at all levels across the United States must address the very basic issues and problems identified in this study. Without a serious and immediate effort to address these needs, the profession will cease to exist in the near future (Wicklein, 2005). Or said differently, our profession may very well be "Going, Going, Gone." (Volk, 1997, p. 66).

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