Educator Resistance to Change: A Grounded Theory Study of the Technology and Engineering Education Transition

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Educator Resistance to Change: A Grounded Theory Study of the Technology and Engineering Education Transition

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Abstract

Technology and engineering education is a school discipline formulated out of the convergence of industrial arts, technology education, career and technical education, and engineering education. The problem is that the industrial arts educators have resisted the curricular transition to technology and engineering education and the discipline lacks a theoretical perspective that provides explanation for this phenomenon. The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. An exploratory, grounded theory method was used to identify new theory related to educator resistance as the current literature does not provide a theoretical perspective as to why the industrial arts educators have resisted the change. The sampling frame was derived from a database of 379 secondary technology and engineering education teachers in the state of Kansas. Theoretical sampling was utilized in order to make adjustments as needed according to the evolving theory through the on-going data collection and analysis. A sample size of 13 participants was needed to reach theoretical saturation of the phenomenon. The data for the study was collected through observations and face-to-face semi-structured interviews with in-service industrial education teachers. Data collected from the observations and interviews were analyzed using the three-phase classic grounded theory coding technique and the analyses resulted in the emergence of three substantive theories related to the study phenomenon: (a) inefficacious transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change. Three recommendations for professional practice included (a) differentiate current technology and engineering education curriculum from previous
modular technology curriculum, (b) articulate and include technical learning opportunities within technology and engineering education curriculum, and (c) align technology and engineering education curriculum with industry and workforce needs.

Three recommendations for future research included (a) a Delphi method study to operationalize the emergent theories, (b) a quantitative quasi-experimental or experimental study to test the three theories, and (c) a sample survey study related to the emergent theories distributed to a larger geographic population to generalize the findings.
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Change is inevitable and in the seven years since I began the dissertation journey, my life and the life of my family has experienced many changes. At times the journey has been filled with mountain highs and others with valley lows; but through it all we have endured, we have gained experience, and we have changed. This dissertation journey would not have been possible for me without the support and sacrifice of others. First, I want to thank God, the Great I AM, for your grace, hope, and love that gives me strength each and every day. To my wife Karen, the love of my life, thank you for your sacrifice that enabled me to complete this degree and your persistent nudging to continue moving forward. To my five young children, I pray that you will always seek God’s best for your life and never settle. I thank you for your patience through this journey and yes; Daddy is finally done with his big paper. To my parents, I thank you for providing me with a foundation of love, support, and drive to achieve goals. To my family, friends, and colleagues I thank you for your support and encouragement along the way. To Dr. Robin Throne, my dissertation chair, thank you for teaching me what it means to be a scholar; your firm hand and gentle voice have taught me more than you could imagine. Lastly, to the late Dr. Fred Ruda, I dedicate this work to you as the field of industrial arts and technology education was your life’s passion and you shared that passion with so many others including myself.
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Chapter 1: Introduction

Technology and engineering education is a broad-based school subject that focuses on developing technological literacy for all students. As defined by the International Technology Educators Association (2007), technology literacy is the ability to “use, manage, assess, and understand technology” (p. 9). Technology, a product of engineering, is the modification of the natural world to serve the needs and wants of the human race (Rose, 2007). Technology education was formed in the 1980s and was a result of dissatisfaction to the industrial arts curriculum (Foster & Wright, 1996; Sanders, 2001). Industrial arts—a school discipline that emphasizes skill development in the applied areas of woodworking, construction, metalworking, and drafting—has been a recognized school discipline for over a century (Volk, 1996).

In the 1980s, the industrial arts enrollments declined and the discipline came under scrutiny for its relevance in the emerging information age (Wright & Custer; 1998). In an effort to revitalize and modernize the discipline, the American Association of Industrial Arts changed its name to the International Technology Education Association in 1985 along with discipline’s program name from industrial arts to technology education (Foster & Wright, 1996). A decade later, the leaders in technology education recommended yet another transition by proposing that engineering be a part of the curricular focus for technology education (Asunda & Hill, 2008; Brophy, Klein, Portsmore, & Rogers, 2008; Kelley & Wicklein, 2009a). In 2010, the International Technology Education Association changed its name to the International Technology and Engineering Educators Association with the purpose of incorporating engineering
education into the technology education curriculum (International Technology and Engineering Educators Association, 2010).

Technology and engineering education has also been related to career and technical education, formerly known as vocational education (Wright, Washer, Watkins, & Scott, 2008). Though vocational education was developed in the early 1900s with a diametric purpose to that of industrial arts, the two disciplines were similar in their use of tools, materials, and classroom environments (Kliebard, 1999). By the mid-1900s, industrial arts began to be recognized by the vocational community. Most importantly, in the 1970s industrial arts was included in federal legislation as a sub-category of vocational education and therefore became eligible for additional funding (Arnold, 1972). The legislation influenced industrial arts educators to align their programs with the vocational requirements in order to secure funding for their schools (Sarapin, 1983).

Technology and engineering education is a school discipline that has a century-long history of being redefined (Asunda & Hill, 2008; Barlow, 1967). With each transition, the theoretical place and purpose of the discipline within the schools has been modified which has created a growing gap between the discipline’s theory and practice (Lauda, 1984; Wright et al., 2008). More specifically, the educators in the field have largely resisted the organizational changes for the discipline and therefore the practice has remained relatively consistent for the past century (Wright et al., 2008). This chapter provides an overview of the historical development of the technology education discipline, the theoretical context at key stages in its history, and the implications of those changes on the discipline. The study used a grounded theory design to explore the educator resistance to the organizational changes of the technology and engineering
education discipline in order to develop a theoretical perspective generated from the practitioners in the field.

**Background**

Technology education can trace its ancestry back to the manual training movement of the late 1800s (Spencer & Rogers, 2006). Manual training was a school discipline designed to teach students general applied skills that could be used in a future vocation. The discipline utilized a systematic set of modular-based learning to teach the students the necessary skills (Kliebard, 1999). The initial courses were developed for secondary-level boys and included subjects such as machine shop, forging, cabinetmaking, and mechanical drawing (1999). By the turn of the century, a manual training curriculum had been developed for both primary and secondary levels and included courses for both boys and girls. The theoretical perspective for the discipline was established by Runkle (1877) and Woodward (1887) who promoted manual training as a broad-based school subject intended to be an integrated part of the general education curriculum for all students in grades kindergarten through 12th grade (K-12).

During the same time period as the growth and establishment of the manual training movement, an alternative form of industrial education was developed called vocational education (Kliebard, 1999). The vocational programs, originally called trade schools, were designed to provide an alternative pathway for students to complete a public high school degree that focused on practical job skill training (1999). The advocates for the vocational programs did not support the broad-based K-12 manual training movement and instead believed that the high schools were an appropriate place to provide specific skill training for the growing demand of an industrial workforce
Vocational education received a national boost with the passing of the Smith-Hughes Act of 1917 that provided direct funding for the vocational programs in the secondary schools (Barlow, 1967). This funding created a clear distinction within the schools between vocational education and manual training. Vocational education emphasized specific skill development for career-readiness whereas manual training emphasized a broad-based curriculum of industrial literacy for the healthy development of all students (Duffy, 1960).

After World War I, the manual training educators began to place a greater emphasis on project production and career-readiness. With these changes, the discipline transitioned from manual training to industrial arts (Spencer & Rogers, 2006). Though Brown (1977) argued that industrial arts carried no lineage to manual training and was from a distinctly different theoretical base, the majority of the literature has supported the relationship (Barlow, 1967; Kliebard, 1999). Industrial arts was designed as a middle ground between the broad-based manual training and the career-specific vocational education. Warner, Bollinger, and Hutchinson (1933) described industrial arts as “a form of general or non-vocational education, which provides learners with experiences, understandings, and appreciations of materials, tools, processes, [and] products…through [the] design and construction of useful products in laboratories or shops” (p. 27). Though the industrial arts courses were inclusive to a variety of different content areas, the most popular courses were woodworking, metals, and drafting (Schmitt & Pelley, 1966).

Due to the increased emphasis in career-readiness and project production, by the 1950s, the line distinguishing between industrial arts and vocational education was no longer as clearly defined (Barlow, 1967). This was confirmed when President Nixon
signed the Education Amendments of 1972. This legislation amended the definition of vocational education to include other areas such as industrial arts (Arnold, 1972). This allowed industrial arts courses or programs that met the vocational requirements to now be eligible for vocational funding.

In the 21st century, vocational education has been heavily promoted through two mechanisms: (a) programs of study and (b) career pathways (Alfeld & Bhattacharya, 2012). The program of study initiative was established through the Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV), which provided funding for career and technical education and the career cluster and pathway initiative was established by the National Association of State Directors of Career Technical Education Consortium. The purpose of the programs of study and career pathways were to provide real-world relevance to academic content and create direct links from secondary education to post-secondary and/or the workforce (Stipanovic, Lewis, & Stringfield, 2012).

The shift toward career-readiness and the technological advancements of the 1960s and 1970s caused a group of the industrial arts professionals to develop plans for an organizational change away from the industrial arts discipline. The theoretical perspective for the new plans aligned closely with the original manual training framework from the previous century (Lux, 1983). The group recommended that the profession change its name to align more closely with the cultural emphasis on technology and promote the discipline as a broad-based program for the K12 general education curriculum (Starkweather, 1983). In 1985, the American Association of Industrial Arts changed its name to the International Technology Education Association
along with discipline’s program name from industrial arts to technology education (Foster & Wright, 1996).

During the first decade of the 21st century, leaders in technology education recommended yet another organizational change by proposing that engineering be a part of the curricular focus for technology education (Asunda & Hill, 2008; Brophy et al., 2008; Kelley & Wicklein, 2009a). Though engineering was not a recognized school discipline in itself (Harris & Rogers, 2008), engineering-related programs such as Project Lead the Way had been implemented in the secondary schools since the 1980s (Rogers, 2005). The rationale for the inclusion of engineering design into technology education was that it would elevate the academic rigor and stature of the discipline through the increased integration of math and science concepts (Wicklein, 2006). In 2010, the International Technology Education Association changed its name to the International Technology and Engineering Educators Association with the purpose of incorporating engineering education into the technology education curriculum (International Technology and Engineering Educators Association, 2010). In alignment with the name change, post-secondary and state level programs began to use titles such as technology and engineering education to describe the discipline (Fantz & Katsioloudis, 2011).

Educational systems are recognized as formal organizations (Krumm & Holmstrom, 2011), rich in culture (Awbrey, 2005), and loosely-coupled (Weick, 1976). This combination makes it very difficult for organizational-wide changes to occur due to resistance from the members (Bruckman, 2008; Yilmaz & Kilicoglu, 2013). Hambrick and Cannella (1989) categorized resistance into three different forms: (a) blind, (b) political, and (c) ideological. The identification of the type of resistance is important in
organizational change efforts as it provides a theoretical perspective on the approaches to use when interacting with the resistance to keep the change initiative moving forward (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013).

**Statement of the Problem**

The problem is the industrial arts educators have resisted the curricular transition to technology and engineering education (Katsioloudis & Moye, 2012; Kelley & Wicklein, 2009a), and the discipline lacks a theoretical perspective that provides explanation for this phenomenon (Kelley & Kellam, 2009). Even though program titles within the discipline have changed from industrial arts to technology education, there is still a significant number of secondary industrial arts educators who have continued to teach from a traditional industrial arts curriculum (Kelley & Wicklein, 2009a; Spencer & Rogers, 2006) and as a result, have resisted this transition (Sanders, 1997; Spencer & Rogers, 2006; Wright et al., 2008). Despite significant efforts from the International Technology and Engineering Education Association to establish technology education as a broad-based academic core discipline for technology literacy, it has remained as an elective under the umbrella of career and technical education (Dugger & Johnson, 1992; Wright et al., 2008). These discrepancies have created division amongst the professionals in the field and confusion as to the overall purpose of technology education (Katsioloudis & Moye, 2012; Wicklein & Hill, 1996). Though the technology education profession has yet to reconcile the differences from the first transition (i.e. industrial arts to technology education), leaders of the profession have recommended another transition to reframe the discipline as technology and engineering education (Asunda & Hill, 2008; Harris & Rogers, 2008; Pinelli & Haynie, 2010). As of 2012, 59% of the state
departments of education identified there was at least some component of engineering education in their state educational framework (Moye, Dugger, & Starkweather, 2012). Though the term *engineering* has been included in the title of a variety of technology education programs across the country, there has been little evidence that actual engineering concepts are being taught (Fantz & Katsioloudis, 2011). The incorporation of engineering education may only further complicate the already prevalent identity crisis and increase the educator resistance toward change (Katsioloudis & Moye, 2012; Spencer & Rogers, 2006; Wright et al., 2008).

**Purpose of the Study**

The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. A theoretical perspective allowed for an exploration of why these educators have resisted the organizational change to technology and engineering education (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013), and the development of new theory to explain the resistance may provide a framework for the discipline’s leadership in future organizational change efforts. Therefore, an exploratory, grounded theory design was used to identify new theory related to industrial arts educator resistance within the framework of Hambrick and Cannella’s (1989) three types of resistance theory (Babbie, 2009; Corbin & Strauss, 2008; Glaser & Strauss, 1967). The sampling frame was derived from a database of 379 secondary (i.e., grades 9-12) technology education teachers in the state of Kansas to expand on prior research in Midwestern states (Werner, Kelley, & Rogers, 2011; Wright et al., 2008). Theoretical sampling was utilized in order to make adjustments as needed according to the evolving
theory through the ongoing data collection and analysis (Corbin & Strauss, 2008). A sample size of 13 participants was needed to reach theoretical saturation of the phenomenon (Charmaz, 2006; Corbin & Strauss, 2008; Patton, 2001). The data for the study was collected through observations and face-to-face semi-structured interviews with in-service industrial arts educators (Corbin & Strauss, 2008). Data collected from the observations and interviews was analyzed using classic grounded theory coding techniques (Urquhart, 2013) and evaluated using comparative analysis operations within the MAXQDA software to identify an explanatory theory generated from the data (Corbin & Strauss, 2008; Thomas, 2011).

**Theoretical Framework**

Since the introduction of the practical learning experiences in the secondary schools there has been an on-going debate on whether or not the experiences should be oriented for vocational training or general education (Dewey, 1938). The origin of the debate was, and still is today, grounded in differing philosophies of epistemology and the intended outcomes of the applied programs in the secondary schools (Schweickhard, 1929; Steinke & Putnam, 2009). To the generalist, the purpose of schooling was to educate students through a liberal education to be successful contributors of the democratic society (Kliebard, 1999). White (1905), co-founder and first president of Cornell University, emphasized that the only republics that had survived the test of time were those that had a greater body of literate citizens than illiterate. For White (1905), the primary purpose of public education was to provide a general education for all children in order to sustain the republic.
Though the opponents of the liberal education ideology agreed with the need to educate students to be successful contributors of the democratic society, they believed the best way to achieve this was not only in the mind, but also through the development of skills for the future workforce (Barlow, 1967). Around the turn of the 20th century, two strong ideologies, social efficiency and vocationalism, emerged that emphasized workforce education. Social efficiency was a focused ideology on the successful preparation for adulthood (Drost, 1967). Within social efficiency, students were identified into particular social roles and the purpose of schooling was to prepare them to successfully perform in those tracks (Kliebard, 1999). The proponents of social efficiency believed that the same principles of productivity and efficiency that were applied to the modern industrial processes could and should be applied to the 20th century educational curriculum (Drost, 1967).

Vocationalism was the belief that all academic disciplines were subject to their relevancy to the industrial labor demands of the modern society (Kliebard, 1999). Content areas that did not have a direct link to workforce preparation were considered peripheral and ritualistic (1999). It’s important to note that though there was a relationship between vocational education and vocationalism, the two were distinct entities. Vocational education was a secondary or post-secondary educational track for students to develop workforce skills in a specific profession. Vocationalism, on the other hand, was a theoretical perspective for education that emphasized skill development over general education.

The vocational versus general debate was addressed on a national stage in 1915 via The New Republic journal in which two contradicting articles were published: one by
Snedden (1915) and the other by Dewey (1915). Snedden (1915) viewed the educational system through an industrialized worldview in which there was a growing need for a skilled labor force. The philosophy was that secondary schools could provide the vocational training needed for that workforce and provide students with the needed motivation to finish high school (Kliebard, 1999). Snedden (1915) was a strong proponent of the social efficiency ideology (as cited in Drost, 1967).

Conversely, Dewey (1915) noted that vocationally-focused training in secondary schools would only perpetuate an unjust class system and hinder students from exploring their full potential. Dewey (1915) advocated for the hands-on learning experiences of the applied fields, but believed that those learning experiences should be integrated into the general education curriculum for all students to experience. For Dewey (1938), the goal of the hands-on experience was not to develop a skill for a future vocation, but instead to allow students an opportunity to experience learning and problem solving.

The 20th century transition from industrial arts to technology education exemplified the discipline’s purpose as a broad-based general education curriculum for all students (Dugger, 2013). However, the educators teaching within the discipline had already been heavily influenced by vocationalism through the career and technical education initiatives (Dugger & Johnson, 1992; Moye et al., 2012; Spencer & Rogers, 2006; Wright et al., 2008), which tended to focus on increased student success for those with lower levels of academic achievement (Kliebard, 1999). Therefore, the transition from industrial arts to technology education was a large-scale organizational change effort that included changing the behaviors, attitudes, and values of the educators in the discipline (Burke, 2010).
The 21st century transition to include engineering as a curricular focus was another organizational change effort effecting the behaviors, attitudes, and values of the educators in the discipline. The technology education focus was intended to meet the technology literacy needs of all students including both those with low and high levels of academic achievement (Dugger, 2013; Starkweather, 1983). However, engineering as a content area includes the application of advanced levels of mathematical and scientific concepts (Custer et al., 2010). Therefore, a curricular focus on engineering could discourage those with lower levels of achievement from participating in the program (Pinelli & Haynie; 2010).

**Theories of resistance to change.** When an attempt is made to change the cultural environment of an established organization, the change is often met with some degree of resistance (Corbett, Firestone, & Rossman, 1987; Schein, 2010). Resistance can be categorized into three forms: (a) blind, (b) political, and (c) ideological (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013). Blind resistance is generated from individuals whose first response to most types of changes are negative (Yilmaz & Kilicoglu, 2013). For these individuals, there is great fear in change and therefore their immediate reaction is to reject any type of planned change and maintain the status quo. Only a small percentage of organizational members typically react in this manner and their resistance is minimized with additional information and time (Burke, 2013).

Political resistance occurs when individuals perceive the change as causing them to lose something of value such as level of authority or income (Yilmaz & Kilicoglu, 2013). Political resistance is based on the concern that the change will negatively affect
their personal experience which is why Dijk and Dick (2009) label the resistance as person-oriented resistance to change. Burke (2013) recommended the utilization of negotiations and an emphasis on the long-term value when interacting with political resistance.

Ideological resistance is generated from intellectual opinions and/or deeply held beliefs and values that are contrary to the change initiative (Yilmaz & Kilicoglu, 2013). The change recipients who express ideological resistance genuinely feel that the change initiative will not have a positive impact on the organization. Dijk and Dick (2009) label this form of resistance as principle-oriented resistance as the change recipients express concern based on principles and the potential hazards for the organization as a whole. This form of resistance is the most challenging for change agents and can be countered with strong persuasion based on data, facts, and substance (Burke, 2013).

The literature from the technology and engineering education discipline has demonstrated that even after 25 years, there is still evidence of resistance to the organizational change. However, the past research has not provided theoretical perspectives as to why the industrial arts educators have resisted the organizational change to technology and engineering education (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013). Therefore, the development of a theory grounded in the thoughts and opinions of industrial arts educators, and based on this theoretical framework, may provide clarification for the organization’s leadership, which can be used to guide future change initiatives and bring unity to the discipline.

**Research Questions**

Empirical studies from the past two decades have indicated that a significant
percentage of technology educators have failed to adopt the technology and engineering education curriculum and have continued to teach an industrial arts-based program (Kelley & Wicklein, 2009a; Rogers, 1992). However, there was an absence of studies that examined the contributing factors as to why industrial arts educators resisted the transition to technology and engineering education and became evident by identifying the types of resistance within Hambrick and Cannella’s (1989) framework on the three types of resistance. Consistent with a grounded theory research design, the study was broadly guided by the following two research questions:

**Q1.** What types of resistance have the Kansas industrial arts educators demonstrated toward the transition to technology and engineering education?

**Q2.** Why have the Kansas industrial arts educators resisted the organizational change to technology and engineering education?

**Nature of the Study**

The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. An exploratory, grounded theory method was used to identify new theory related to educator resistance within the framework of Hambrick and Cannella’s (1989) three-types of resistance theory (Babbie, 2009; Corbin & Strauss, 2008; Glaser & Strauss, 1967). The study included a target population of secondary (grades 9–12) industrial arts educators in Kansas. The initial participants were selected using a stratified method in order to include participants from each of the different regions and from different sizes of schools. Theoretical sampling was utilized in order to make adjustments as needed according to the evolving theory through the on-going data collection and analysis.
(Corbin & Strauss, 2008). A sample size of 13 participants was needed to reach theoretical saturation of the phenomenon (Charmaz, 2006; Corbin & Strauss, 2008; Patton, 2001).

In the study, observations and face-to-face interviews were used to explore the industrial arts educator resistance toward the transition to technology and engineering education. As recommended by Corbin and Strauss (2008), semi-structured interviews were utilized in the interviewing process for the grounded theory study. The semi-structured nature of the interviews provided consistency from one interview to the next while still allowing for the flexibility needed to properly investigate each unique situation. Following the interviews, the data collected was analyzed using the MAXQDA qualitative analysis software with the classic three-phase grounded theory coding technique, which provided a microanalysis of the text for the purpose of identifying emergent theory grounded in the data (Glaser, 1978; Glaser 2005; Glaser & Strauss, 1967; Urquhart, 2013).

**Significance of the Study**

The recommended technology and engineering education transition that has occurred over the past three decades has been a movement away from the vocational-oriented curriculum to more of a broad-based general education program (International Technology Education Association, 2003); however, this transition has been largely resisted by the educators in the field (Fantz & Katsioloudis, 2011). The resistance has resulted in a significant number of secondary educators continuing to teach from a traditional industrial arts curriculum (Kelley & Wicklein, 2009a; Spencer & Rogers, 2006). Though the leadership professionals in the International Technology and
Engineering Educators Association have recommended a movement away from the vocational-oriented programs, the academic community as a whole has placed a greater emphasis on vocational programs through career and technical education (Stipanovic et al., 2012).

Current industrial arts educators have a difficult decision when it comes to the recommended curriculum for their programs. Not only do they have to balance the needs and recommendations of their local constituents (Kliebard, 1999), but they also need to align with a national set of standards and program objectives. Industrial arts educators can choose to follow the International Technology and Engineering Educators Association’s recommendation and create a broad-based technological literacy program, they can follow the Perkins IV recommendations and create a pathway-based program, they can continue with a traditional shop-based industrial arts program, or they can create some type of blended program using the aforementioned philosophies.

Previous research has identified that the diversity of philosophies has created division amongst the professionals in the field and confusion for the recommended curriculum in the secondary schools (Custer, Daugherty, & Meyer, 2010). Additionally, since the International Technology and Engineering Educators Association initiated the transition from industrial arts to technology education in 1985, the industrial arts educators have lost their voice in the academic community (Volk, 1996). However, the previous research has not identified the contributing factors as to why the educators have resisted the transition. This study was significant because it collected the experiences of in-the-field industrial arts educators in order to determine the types of resistance exerted toward the organizational change initiative. The emergent theories grounded in the data
provided a theoretical perspective of why the educators resisted the organizational change and could be used by leadership to guide future changes for the discipline.

**Definition of Key Terms**

**Blind resistance.** Blind resistance is resistance motivated out of an immediate fear of any kind of change and strong desire to maintain the status quo. Blind resistance is not based on knowledge, opinions, or values but can easily be changed with time and further information (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013).

**Career and technical education.** Career and technical education, formerly known as vocational education, is an educational program that focuses on career-readiness through the combination of rigorous academic content and workplace skill development in order to prepare students for post-secondary degree attainment and/or direct entry into an occupational setting (Withington et al., 2012).

**Engineering education.** Engineering education is a study of engineering which provides an opportunity for students to learn about the processes and knowledge related to engineering design, analysis, and communication (International Technology Education Association, 2009).

**Ideological resistance.** Ideological resistance is resistance generated from intellectual opinions and/or deeply held beliefs and values that are contrary to the change initiative. Individuals who express ideological resistance genuinely feel that the change initiative will not have a positive impact on the organization (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013).
**Industrial arts.** Industrial arts is a school discipline that consists of traditional shop courses which emphasize skill development in the applied areas such as woodworking, construction, metalworking, and drafting (Volk, 1996).

**Political resistance.** Political resistance is resistance generated when individuals perceive the change as causing them to lose something of value such as level of authority or income. Political resistance is based on the concern that the change will negatively affect an individual’s personal experience (Burke, 2013; Hambrick & Cannella, 1989; Yilmaz & Kilicoglu, 2013).

**STEM.** STEM is an acronym used to describe the nationwide educational initiative developed to increase the integration of science, technology, engineering, and math (STEM) concepts into the K12 curricular areas for the purpose of increasing student performance levels and encouraging students to pursue careers in STEM-related occupations (International Technology Education Association, 2009).

**Technology and engineering education.** Technology and engineering education is an educational program that focuses on the design, production, and use of technological products and systems through hands-on activities that incorporate STEM concepts (International Technology Education Association, 2009).

**Technology education.** Technology education is a broad-based school subject that focuses on processes and conceptual learning with the purpose of developing technology literacy for all students (International Technology Education Association, 2003).

**Vocational education.** Vocational education is an educational program focused on the development of knowledge and skills for a specific trade, craft, and/or career. At
the secondary level, vocational education was traditionally an alternative track curriculum for students who were not planning to pursue a post-secondary degree (Kliebard, 1999; Withington et al., 2012).

Summary

The industrial arts programs have a long national heritage in the secondary schools which have been connected with a century-old debate on the exact objectives and purpose of the programs (Barlow, 1967; Drost, 1967; Kliebard, 1999; Schweickhard; 1929; Volk, 1996). The evidence from the literature has indicated the organizational change from industrial arts to technology education initiated in 1985 was largely unsuccessful (Kelley & Wicklein, 2009a; Rogers, 1992). The educator resistance was not properly addressed throughout the organizational change, which resulted in only artificial changes for the discipline. The inconsistency has created division amongst the professionals in the field and confusion for the recommended curriculum in the secondary schools (Custer et al., 2010).

A qualitative grounded theory methodology was used in the study in order to explore the intricate details of the industrial arts educator beliefs and values related to the organizational change (Babbie, 2009; Corbin & Strauss, 2008; Schein, 2010). The study included a target population of secondary industrial arts educators in Kansas with a sample size of 13 participants, and data collected via observations of industrial arts classrooms and semi-structured interviews with the educators. The qualitative data was analyzed using the three-phase grounded theory coding technique and the MAXQDA qualitative analysis software (Glaser, 1978; Glaser 2005; Glaser & Strauss, 1967; Urquhart, 2013).
The previous research has identified that the industrial arts educators resisted the transition toward the technology and engineering education curriculum (Kelley & Wicklein, 2009a; Rogers, 1992). However, the research did not identify the contributing factors as to why the educators have resisted the transition. The significance of this study was it collected the experiences and practices of in-the-field industrial arts educators in order to determine the types of resistance exerted throughout the organizational change. The emergent theories grounded in the data provided a theoretical perspective of why the educators resisted the organizational change and could be used by future leadership to guide changes for the discipline.
Chapter 2: Literature Review

Technology and engineering education is a school discipline formulated out of the convergence of industrial arts, technology education, career and technical education, and engineering education (Asunda & Hill, 2008; Foster & Wright, 1996; Kelley & Wicklein, 2009a). The problem is that a significant percentage of the disciplines’ educators have resisted the curricular transition to technology and engineering education and instead have continued to teach an industrial arts based curriculum under the umbrella of career and technical education (Sanders, 1997; Spencer & Rogers, 2006; Wright et al., 2008). The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education.

To understand the context of the study phenomenon, a comprehensive literature review was conducted on the technology and engineering education discipline including the influences from the content areas of industrial arts, technology education, career and technical education, and engineering education. Additionally, an examination of the literature relating to organization change and educator resistance to change was also conducted. The literature was reviewed through the theoretical lens of Hambrick and Cannella’s (1989) three-types of resistance theory, which categorized resistance into three forms: (a) blind, (b) political, and (c) ideological.

In examining the industrial arts educators’ resistance to the curricular transition to technology and engineering education, a thorough investigation of the historical and current context of industrial education and its variances was conducted in order to better understand the evolution of industrial education in the United States. The examination
clarified the vocabulary, theories, and methods that have converged over time and resulted in the phenomenon that exists today. A concept-based organization scheme was used to categorize the major themes of the literature review into the following areas: (a) historical overview, (b) current status of technology and engineering education, (c) evolving role and purpose of technology and engineering education, (d) engineering design as the curricular focus, (e) career and technical education as the curricular focus, (f) technology and engineering education organizational culture, (g) managing organizational change, and (h) gap in the literature for educator resistance to change.

**Documentation**

Database and print investigations were conducted to search for literature related to the study phenomenon. Online database searches were conducted through ProQuest™, EBSCOhost™, ProQuest™ Dissertations & Theses Full Text, Fort Hays State University Forsyth Library online catalog, and the Virginia Tech Digital Library. Key words and phrases used during the search processes included: *industrial arts, technology education, engineering education, vocational education, career and technical education, career pathways, educator resistance, and organizational culture*. The search was exhaustive in that as much breadth was covered as feasible but the search was selective in limiting the results to published books, articles published in journals, and reports published by nationally recognized organizations. Relevant resources identified in the reference sections of the literature were also searched. The rationale for exclusion of other references such as dissertations and unpublished works was based on the Northcentral University dissertation proposal guidelines.
Historical Overview

The technological advancements of the 1970s and 1980s placed the industrial arts discipline in a unique position. It was clear that the industrial age had ended and the culture had transitioned to the information age driven by the advancement in communication technologies. This transition made some of the educational leaders of the industrial arts discipline and the general public question whether or not the field had become outdated or old-fashioned (DeVore & Lauda, 1976; Dixon & Dugger, 1980; Starkweather, 1983). In 1981, a symposium of 21 industrial arts professionals was held to address the concerns and warning signs of the future of the industrial arts discipline (Hales & Snyder, 1982). The symposium resulted in the development of an industrial arts curriculum theory and a plan for the profession to move forward. The Jackson’s Mill industrial arts curriculum theory indicated that the curricular content for the industrial arts discipline should derive from four technological systems: (a) communication, (b) construction, (c) manufacturing, and (d) transportation (1982). The curriculum outlined that a broad-based technology literacy curriculum should be provided for all students in the primary and middle school grades and then at the secondary level, more specific skill development in the four technological system areas.

In continuation of the focus on technological literacy from the industrial arts curriculum theory, in 1983 the board of directors of the American Industrial Arts Association developed a three-year plan that clearly articulated the directors’ intention to change the organization from an industrial arts-based association to a technology education-based association (Starkweather, 1983). In 1985, the name of the American Industrial Arts Association was changed to the International Technology Education...
Association along with discipline’s official title from industrial arts to technology education (Foster & Wright, 1996). The name change articulated the transition of the discipline’s knowledge base from the study of industry to the study of technology (Bensen, 1984). The name technology education also provided the association a platform by which it could market a more broad-based discipline appropriate for inclusion into the general education curriculum at the elementary, middle, and secondary levels (Starkweather, 1983).

Though the name change was well articulated through journal publications, there was also clear evidence of resistance prior to the change (Benson, 1984; Blankenbaker, 1984; Lux, 1983; Swanson; 1984) and in the decades that followed (Rogers, 1992; Rogers; 2005; Volk, 1996). The resistance led to an identity crisis in the discipline and confusion for both the educators and the public at large (Clark, 1989; Sanders, 1997). Akmal, Oaks, and Barker (2002) found after surveying the technology education state supervisors within the departments of education that even though there were no state supervisors who reported using the term industrial arts for technology education, 34 out of 39 state supervisors reported that traditional industrial arts programs operated concurrently with the technology education programs. This phenomenon remained consistent throughout the 1990s and 2000s as researchers continued to find evidence that even though the official titles had changed from industrial arts to technology education, there were still a significant number of secondary teachers who continued to teach the industrial arts curriculum within the schools (Akmal et al., 2002; Clark, 1989; Rogers, 1992; Spencer & Rogers, 2006; Volk; 1996).
Current Status of Technology and Engineering Education

Multiple attempts have been made over the past decade to record the number of technology and engineering education teachers in the United States (Dugger, 2007; Moye, 2009; Moye et al., 2012; Ndahi & Ritz, 2003; Newberry, 2001). In 2012, Moye et al. distributed the fourth triennial inquiry on the status of technology and engineering education. The inquiry utilized a 14-question online survey emailed to each of the 50 state supervisors. A follow-up request was made a month after the initial invitation and a follow-up telephone call was made a month after the second request to non-respondents. Even with the multi-phase effort to collect information from all states, only 42 states participated. When asked to identify the total number of technology and engineering education teachers, only 32 responses were collected totaling 17,141. Overall, the researchers concluded that many of the responses were estimates due to the absence of concrete data within the state departments of education (2012).

In 2009, Moye found there were approximately 28,310 technology education teachers in the United States. All 50 state supervisors were reported as responding (Moye et al., 2012), but the published data tables list at least one state where data was not available and nine states where less than 30 high school level teachers were reported (Moye, 2009). Though the publication did not describe the data collection methods or if other data was collected in the process, the findings were consistent with Dugger’s (2007) third inquiry on the status of technology education in the United States which reported a total of 25,258 technology education teachers. However, the Moye (2009) and Dugger (2007) studies reported a far lower number of teachers as compared to the earlier publications from Meade and Dugger (2004) with 35,909; Ndahi and Ritz (2003) with
36,261; and Newberry (2001) with 38,537. The evidence from the literature has indicated either a decline in the number of technology and engineering education teachers over the past decade and/or a decline in the accuracy reported by the state departments of education.

The potential declination of technology and engineering education teachers has been a documented concern for the past decade (Dugger, 2007; Gray & Daugherty; 2004; Katsioloudis & Moye, 2012; Moye et al., 2012). Katsioloudis and Moye (2012) utilized a three-phase Delphi technique to gather a consensus of opinion from technology and engineering education professionals on the future critical issues and problems for the discipline. The researchers defined critical issues as debatable points of view currently in dispute and critical problems as impediments to the future success of technology and engineering education (2012). An electronic Delphi study was used to reduce dominance and peer persuasion along with maintaining anonymity throughout the study. A total of 30 stakeholders of technology and engineering education agreed to participate in the study. After three rounds of data collection, coding, and review; the panelists identified 12 future critical issues and 13 future critical problems. The shortage of technology and engineering education teachers was the fifth highest ranked future problem reported (2012). The shortage of technology and engineering education teachers has a direct link to the decline in the number of teacher preparation programs in the United States (Wright & Custer; 1998). The lack of programs was the fourth highest ranked future problem reported in the Katsioloudis and Moye (2012) study.

The limited number of postsecondary teacher preparation programs in technology and engineering education along with the shortage of teachers has resulted in declining
enrollments in the secondary technology and engineering education programs. Katsioloudis and Moye (2012) documented this as the second highest ranked future problem for the discipline. Moye et al. (2012) found that only seven states required some form of technology and engineering education. This was a reduction from the previous cycles which reported 12 in 2007 (Dugger), 12 in 2004 (Meade & Dugger), and 14 in 2001 (Newberry).

**Evolving Role and Purpose of Technology and Engineering Education**

The highest ranked future critical problem reported in the Katsioloudis and Moye (2012) study was related to school counselors not understanding technology and engineering education. This was not surprising as Kelley and Wicklein (2009a) emphasized that technology education has a history of generating new program titles with little curricular changes. As compared to other disciplines such as agricultural education or music education—which have had the same name for over a century—the technology and engineering education discipline has changed names many times. What started as manual training in the 1880s changed to manual arts in the early 1900s, then to industrial arts in the 1930s, then to industrial technology in 1970s, then to technology education in the 1980s, and then most recently to technology and engineering education in the 2000s (Katsioloudis & Moye, 2012). The curricular focus and content was modified with each name change which created ambiguity and confusion for all stakeholders involved in the discipline (2012).

During the past decade, the International Technology Education Association developed multiple publications to clearly articulate its purpose and focus for the discipline centered on educating all students for technology literacy. The majority of the
resources were developed and distributed through a grant project from the National Science Foundation and the National Aeronautics and Space Administration called the Technology for All Americans Project (Dugger, 2013). During the first phase of the project a rationale document was created that articulated the knowledge base for technology education and emphasized the need for all students to develop technology literacy through technology education courses.

The second phase of the project focused on the development of standards for technology education. The standards were developed by a variety of writing teams consisting of educators, administrators, and curriculum developers and were published as the *Standards for Technological Literacy: Content for the Study of Technology* (International Technology Education Association, 2007). The standards provided a common set of expectations relating to what students should know and be able to do in relation to technology at each of the different stages of the K12 curriculum (Dugger, 2013). The standards were not intended to be used as a curriculum or a specific basis on what should occur in the classroom, but instead as a framework for educators to use during the development of the local curriculum (2013).

During the third phase of the Technology for All Americans Project, the International Technology Education Association published additional standards that specifically related to student assessment, professional development, and program enhancement along with a series of addenda for the previous two publications (Dugger, 2013). The additional publications provided additional information and resources relating to student assessment, programs, curricula, and professional development for technology education. Overall, the Technology for All Americans Project was an 11-year
comprehensive research project that produced multiple publications all with the purpose of advancing technology education in the K12 school curriculum (2013).

The *Standards for Technological Literacy: Content for the Study of Technology* (International Technology Education Association, 2007) were the first set of curriculum standards developed for the discipline. The emphasis on standards transitioned the focus of the discipline to the content needed to achieve technological literacy and away from the overall goals which have had an evolutionary existence in the discipline for the past century (Ritz, 2009). Therefore, Ritz (2009) conducted a modified Delphi study with the members of the leadership boards of the International Technology Education Association with the purpose of articulating goals for the K12 technological literacy programs.

Of the 33 members on the various boards, 18 (i.e. 55%) responded to the email invitation for participation in the study and provided two to five goals that were important to guide curriculum and instruction for K12 technological literacy (Ritz, 2009). The first set of submitted goals were reduced into 21 statements by the study panel and resent to the original 33 members for modification. Ten members (i.e. 30%) replied to the second round request. The study panel again analyzed the statements and reduced the list to a total of 12 goal statements (2009).

In the third round, the list of 12 goals were sent to the original 33 members using a five point Likert-type scale to determine the level of agreement each of the members had with 12 goals. Seventeen of the 33 members (i.e. 52%) participated in the third round. Lastly, in the fourth round, a rank-ordered list of the 12 goals including the mean values was sent to the 16 members of the Board of Directors of the International Technology Education Association for a final review. The Board of Directors were asked
to categorize each of the 12 goals as either must have or not essential. Fifteen of the 16 members participated in the fourth round. The top five essential goals for technological literacy programs identified in the Ritz’s (2009) study included:

1. Describe social, ethical, and environmental impacts associated with the use of technology.
2. Become educated consumers of technology for personal, professional, and societal use.
3. Apply design principles that solve engineering and technological problems.
4. Use technological systems and devices.
5. Use technology to solve problems. (p. 59)

Each of the top five goals—and only the top five goals—met the 80% agreement criterion established by the researcher (2009).

A comparison between the Ritz (2009) study and the data collected by Bame and Miller (1980) as part of the Standards for Industrial Arts Programs project clearly articulated the differences between the former industrial arts purposes and the modern goals for technology education as identified by the leaders of the International Technology Education Association. The middle and high school industrial arts teachers identified the following as the top two purposes for industrial arts in the Bame and Miller (1980) study: (a) develop skill in using tools and machines and (b) provide technical knowledge and skill. The emphasis of the industrial arts curriculum was clearly on skill development. On the other hand, the top two goals for technology education as identified in the Ritz (2009) study were broad-based, knowledge-oriented goals relating to technology.

Though the International Technology Education Association has developed and published multiple resources over the past decade articulating the leaderships’ future vision for the discipline, the century long debate as to its role and purpose in the school
system has continued with the practitioners in the schools (Kelley & Kellam, 2009). In order to examine this phenomenon, Wright et al. (2008) invited participants through email to participate in an online survey to identify the current perceptions of educators regarding the role of technology education. The email contacts were generated from a variety of professional organizational listservs including groups from the International Technology Education Association, Association of Career and Technical Education, state departments of education, and school administrators. Approximately half of the listservs utilized were Missouri-based organizations (2008).

Due to the fluctuation of emails on the listservs, an exact number of email invitations were not attainable and therefore random sampling was not used in the study (Wright et al., 2008). The researchers acknowledged that broader generalizations could not be used and the results limited to the participants in the study. Usable data from 381 respondents were collected with over 2/3 of the respondents consisting of an even distribution of principals, high school technology education teachers, and postsecondary teacher educators (2008). Middle school teachers, school directors, counselors, and state supervisors were also represented groups.

In the online survey, respondents were prompted to identify the historical purpose of technology education, the projected theoretical purpose of technology education, and the current in-practice purpose of technology education. The primary purpose identified by all respondent groups at the historical, theoretical, and in practice levels was as a career and technical education program (Wright et al., 2008). A Chi square test indicated significance at \( p = .000 \) with no significance between the respondent groups. There was a significant difference in what was identified as the primary purpose when the responses
were compared between members from the International Technology Education Association and members from the Association of Career and Technical Education. Both groups still identified career and technical education as the primary purpose, there was just a much larger percentage from the members of the Association of Career and Technical Education (2008).

The identification of career and technical education as the primary purpose, especially from the members of the International Technology Education Association, was noteworthy. One of the primary purposes of the 1985 name change from industrial arts to technology education was to solidify the discipline’s separation from vocational education and adhere it to the academic general education program within the schools (International Technology Education Association, 2009). Since that time, the International Technology and Engineering Education Association has developed and promoted a variety of standards, curriculum, and publications articulating the separation from career and technical education (2009). However, the Wright et al. (2008) study demonstrated even after two decades past the name change, the discipline was still battling between two opposing views on the purpose of technology and engineering education: education for all students or education for career and technical education (Kelley & Kellam, 2009).

In an attempt to neutralize the two opposing views; Kelley and Kellam (2009) introduced a new theoretical framework for the technology and engineering education discipline. The framework was illustrated as an archway with two columns resting on top of two foundations. The first level foundation consisted of a pragmatic philosophy representing the approaches used by the discipline’s early theorist such as Woodward
(1890) and Dewey (1916). The authors made clear their alignment with Woodward’s (1890) and Dewey’s (1916) belief that the discipline is for all learners not just those looking to develop skills for a future vocation (Kelley & Kellam, 2009).

The second level foundation consisted of a constructivist approach to learning where students are actively building new levels of understanding as they experience the curriculum (Kelley & Kellam, 2009). The first column included contextual learning and problem-based instruction which highlighted the importance of making the curriculum contextually relevant through real-world problems. The second column consisted of project-based instruction emphasizing the need for integrated projects throughout the curriculum.

The two archways included engineering design and systems thinking which lead to the peak of the structure resulting in student learning (Kelley & Kellam, 2009). The systems thinking archway highlighted the importance of a top-down approach of focusing on the entire system and the interrelating subsystems. The engineering design archway articulated the discipline’s role in developing students’ ability to analyze a problem, design a solution within constraints, and communicate the solution to other team members. The combination of systems thinking and engineering design develops concepts and skills applicable for all students and transcends all vocations.

The theoretical framework established by Kelley and Kellam (2009) is one of the few, if not the only, published theoretical frameworks for the discipline since the Jackson’s Mill Industrial Arts Curriculum Theory in 1982 (Hales & Snyder). A closer comparison to the two theoretical frameworks identified many similarities including an avocational constructivist approach to learning for all students, emphasis on problem-
based and project-based learning, and inclusion of technological systems. The significant
difference was that the Kelley and Kellam (2009) framework specifically articulated
engineering design whereas the concepts were only indirectly included in the Jackson’s
Mill Industrial Arts Curriculum Theory (Hales & Snyder, 1982). Though Kelley and
Kellam (2009) assert their theoretical framework embraces the best of both of the
opposing views (e.i. education for all versus career and technical education), the
framework clearly emphasizes a broad-based education for all students and de-emphasizes knowledge and skill development for specific future careers.

**Engineering Design as the Curricular Focus**

Throughout the 21st century, during the same time the International Technology
Education Association leadership was articulating the discipline’s role and purpose in
teaching technology literacy, the leadership also began to introduce an additional
curricular focus for technology education: engineering (Asunda & Hill, 2008; Harris &
Rogers, 2008; Pinelli & Haynie, 2010; Wicklein, Smith, & Kim, 2009). In 2008, the
International Technology Education Association board of directors distributed an online
survey to the 2,347 voting members related to the topic of including engineering in the
association’s name and future content (Starkweather, 2008). The leaders received a 35%
response rate (i.e. 829 members) with a majority of the responses indicating a favorable
position in support of engineering (2008). For example, when asked what the future
content teachers in the profession should be teaching, 61% indicated engineering as the
second highest and only one percentage point lower than technology. Additionally, when
asked how a name change including the word engineering would affect the profession,
63% of the respondents indicated it would affect it positively (2008).
Due to the positive feedback from the 2008 survey, the board of directors distributed a ballot in 2009 to the voting members of the association to change the name to include engineering (International, 2010). However, only 65% of the members voted in favor of the name change which was one percentage point short according to the association’s bylaws. The close vote in 2009 prompted the board of directors to send another ballot in 2010. The second ballot received the two-thirds vote in favor of a name change and therefore the association’s name changed to the International Technology and Engineering Educators Association (2010).

The addition of engineering was promoted as a way to elevate the academic rigor of the discipline, secure technology education’s position in the general curriculum, and participate in the national agenda of better educating and increasing the number of STEM professionals (Custer et al., 2010; Denson, Kelley, & Wicklein, 2009; Williams, 2009). Though the STEM movement had existed for over a decade, it received national attention with the passing of the America COMPETES Act in 2007 which was designed specifically to increase STEM education in the K12 school system. The inclusion of engineering in the association’s title and future focus allowed the leaders of the profession to lay claim to the T and E of the STEM initiatives (International Technology and Engineering Educators Association, 2010; Sanders, 2009).

To better understand engineering education and its relationship to technology education, Wicklein et al. (2009) conducted a four round Delphi study with engineering experts with the purpose of identifying the essential concepts of the engineering design process. The initial round included 15 participants and generated a total of 234 responses to the four open-ended research questions used in the study. By the final round, the
responses were narrowed to 48 responses that met the validity criteria established by the researchers which included inter-round mean shift percentages for stability, median scores for level of agreement, and interquartile ranges for consensus (2009).

The first research question collected data on the aspects of engineering design best utilized for equipping secondary students. The top three responses included (a) the ability to solve open-ended problems, (b) acceptance of multiple solutions, and (c) systems thinking (Wicklein et al., 2009). The second research question collected data on the essential mathematics concepts related to the engineering design process. The top three specific math concepts included (a) basic algebra, (b) geometry, and (c) trigonometry (2009). The third research question collected data on the essential science principles related to the engineering design process. The top three responses included (a) Newton’s laws, (b) types of energy, and (c) summation of forces (2009).

The results of the Wicklein et al. (2009) study provided the technology and engineering education community a research-based framework for curriculum development. The authors noted there was not a current framework for implementing engineering design in technology education and emphasized the importance of using a research-based framework developed by experts in engineering (2009). Based on their research, Wicklein et al. (2009) articulated seven conclusions/future recommendations for the technology and engineering education discipline:

1. The future curriculum would best be served by a consistent framework on engineering design.
2. The integration of engineering design concepts could provide increased rigor to the curriculum.
3. The integration of engineering design could increase students’ ability to synthesize a variety of variables to open-ended problems.
4. The future curriculum should emphasize a variety of communication mechanisms.
5. The future curriculum should emphasize teamwork and person ethics.
6. The future curriculum should apply aspects of math and science for solving problems.
7. The future curriculum should include hands-on learning.

Custer et al. (2010) conducted a similar study to Wicklein et al. (2009) but utilized an emergent qualitative research design to identify the key concepts of engineering education. The study began with a documents analysis approach of philosophical writings, curricula, standards, and research studies related to engineering. In the first phase, two of the three researchers reviewed each of the documents and identified the engineering themes. In the second phase, the themes were then further analyzed to identify the specific engineering concepts which were described as abstract labels or organizing ideas that provided meaning within the texts. The findings of their study resulted in the identification of 13 engineering concepts generated from over 100 original themes: (a) analysis, (b) constraints, (c) design, (d) efficiency, (e) experimentation, (f) functionality, (g) innovation, (h) modeling, (i) optimization, (j) prototyping, (k) systems, (l) trade-offs, and (m) visualization (2010).

The Custer et al. (2010) study helped clarify the relationship between technology and engineering which had been a topic of debate throughout the previous decade (Dearing & Daugherty; 2004; Rogers, 2005; Wicklein, 2006). The evidence from Custer et al. (2010) indicated the greatest correlation between technology and engineering was in the promotion and focus on design. However, the very thing that related the two areas together was also found to be the critical differentiation as the technology design process was different from the engineering design process. The engineering design process has a greater emphasis on prediction, mathematic analysis to test the prediction, and optimization to improve the prediction prior to solution implementation (Williams, 2009).
Whereas the technology design process includes a more trial-and-error method where the problem is identified, a solution is implemented, and evaluations are made on the success of the solution (2009). In order for technology education to appropriately integrate a focus on engineering education, the curriculum would need to incorporate a higher level of scientific and mathematical concepts particularly in the areas of statics, dynamics, thermodynamics, stresses, deflections, and loads (Custer et al., 2010). Unfortunately, Kelley and Wicklein (2009a) found there was little evidence of the application of upper level math and engineering sciences in the technology education curriculum.

Kelley and Wicklein (2009a; 2009b; 2009c) designed a three-part study to examine the degree of engineering design in the technology education curriculum. The first part of the study examined the inclusion of engineering design content in the curriculum, the second part examined the engineering design assessment practices, and the third part examined the teacher challenges to implementing engineering design. The population for the study included the 1043 secondary teachers who were members of the International Technology Education Association at the time of the study. An email invitation was sent to all of the teachers in the database with a link to an online questionnaire. Sampling strategies were not utilized in the study due to the expected rate of return and goal of 285 participants in the study.

The first part of the questionnaire utilized engineering concepts previously developed and validated by Childress and Rhodes (2008). Of the seven engineering categories included in the questionnaire, the inclusion of engineering design was identified by the participants as most included in the curriculum (Kelley & Wicklein, 2009a). However, further examination of the study data revealed a minimal emphasis on
predictive mathematics, scientific optimization, and analysis which are key concepts for the engineering design process. These results indicated that even though the educators identified the inclusion of engineering design in the curriculum, the actual engineering design process may not have been properly taught (2009a).

The second part of Kelley and Wicklein’s (2009b) questionnaire utilized elements of Asunda and Hill’s (2007) rubric for assessing engineering design activities. The educator participants were asked to identify the frequency of use of eight assessment practices for engineering design projects. The top three assessment practices included (a) provide evidence of idea generation strategies, (b) develop a prototype model, and (c) work on a design team (Kelley & Wicklein, 2009b). The assessment practice that received the lowest emphasis was the use of mathematical models to optimize, describe, and/or predict results.

In relation to engineering design, this was noteworthy as analysis and optimization was a key component and the greatest differentiator between the technology design process and the engineering design process (Custer et al., 2010; Williams, 2009). The evidence once again confirmed the question of the actual degree of engineering concepts in the curriculum and provided validation to the accusation against technology education and its history of changing names without actually changing the curricular content (Clark, 1989; Kelley & Wicklein, 2009b).

The third part of the Kelley and Wicklein (2009c) questionnaire collected data from the educators relating to the challenges of implementing engineering design into the curriculum. The questionnaire included 14 specific challenges adopted from the Gattie and Wicklein (2007) study and included one additional open-ended question for the
educators to identify other challenges. The top three challenges identified by the educators were related to the integration of math and science in the curriculum, the selection of appropriate engineering design equipment, and the acquisition of funds to purchase additional tools and equipment to teach engineering design (Kelley & Wicklein, 2009c). The results of the open-ended question further supported the previously listed challenges and also included the lack of support from other professionals, the lack of a clear and concise curriculum, and anxiety to the potential negative effects of implementing engineering design (2009c).

Though Kelley and Wicklein’s (2009a; 2009b; 2009c) three-part questionnaire provided a substantial amount of information relating to the inclusion of engineering design into technology education, the study results had limitations as only 226 teachers (i.e. 22%) responded to the questionnaire. This did not meet the 285 participant size needed for generalization to the larger population; therefore the results were limited to the participants in the study. However, the authors emphasized that the demographic results were similar to other related generalizable studies indicating the results were representative to the population (2009a; 2009b).

Similar to Kelley and Wicklein’s (2009a, 2009b, 2009c), Denson et al. (2009) examined the integration of engineering design in the Georgia technology education programs. The sample frame for the study included all middle school and high school technology education teachers in the state of Georgia which consisted of 605 teachers. An online survey was developed and emailed to all of the teachers requesting participation in the study. The survey was designed primarily to collect quantitative data but also included a section for qualitative narrative data. Of the 605 teachers included in
the database, 214 teachers (i.e. 35%) submitted usable survey data which was analyzed using statistical analysis software and nonparametric tests.

Eighty percent of the participant teachers identified they were currently teaching topics/courses related to engineering design (Denson et al., 2009). However, unlike the data from the Kelley and Wicklein (2009a) study, the degree of inclusion of engineering design concepts was not identified in the study. The teachers were also asked to report on their instructional needs in order to teach engineering design (Denson et al., 2009). Similar to the challenges identified in the Kelley and Wicklein (2009c) study, the teachers indicated the appropriate types of tools and test equipment, the appropriate type of laboratory layout and space, and the appropriate levels of mathematics and science as the top three needs to teach engineering design (Denson et al., 2009). Lastly the teachers were asked to report on the overall program value of a curriculum focused on engineering design (2009). The teachers identified that a curriculum focused on engineering design would elevate technology education to higher academic levels, provide a platform for integration with other school subjects, and increase student interest and appreciation for mathematics and science (2009).

In alignment with the inclusion of engineering in the professional association’s name (i.e. International Technology and Engineering Educators Association), certain teacher preparation programs also changed their program names to include engineering. However, as noted by Kelley and Wicklein (2009a), technology education has a history of generating new program titles with little curricular changes. Therefore, though the program titles were changed to include engineering, it was not necessarily an assurance of the program’s inclusion of engineering into the curriculum.
Fantz and Katsioloudis (2011) examined this phenomenon by comparing the inclusion of engineering concepts between teacher preparation programs with engineering in the program title and programs without. The sample frame for the study included the 49 different postsecondary technology education institutional members of the International Technology and Engineering Educators Association during the fall of 2010. Out of the 49 programs, eight included engineering in the program title and were therefore included in the study. Of the remaining programs without engineering in the title, 11 were selected at random for inclusion in the study. The researchers examined the course titles from the postsecondary course catalogs and created a database including the number of technology credit hours, engineering credit hours, and if the program was housed within a college of engineering or not.

The data was analyzed in a statistical software package using nonparametric tests including Mann-Whitney tests, Cohen’s $r$, and factorial ANOVA tests. According to Fantz and Katsioloudis (2011), the programs with engineering in the title “did not significantly differ in their engineering content from programs without a change in name…[which] could indicate that some programs have adopted the term engineering into their title without increasing the engineering content of their program” (p. 28). This would initially confirm Kelley and Wicklein’s (2009b) assertion on the lack of curricular changes for programs which have made changes in the name. This was critical as it demonstrated the possibility that students graduating from a degree program with engineering in the title may not have received any formal training in engineering (Fantz & Katsioloudis, 2011). However, a study based on course titles alone has limitations as
the actual content learned throughout a course may or may not be representative of the course title.

Recognizing the significance and key role of professional development in the transition process, Asunda and Hill (2008) described a process for preparing technology education teachers to teach engineering design. The researchers conducted a qualitative case study of technology education teachers who completed engineering design professional development summer workshops. Because the sample frame was small, the researchers utilized a convenience sample and interviewed 15 participants from the workshops including middle school teachers, high school teachers, and post-secondary teacher educators (2008).

Grounded theory strategies were used to analyze the interview content. A comparative analysis of the data resulted in a core theme of professional development. The professional development was a way for educators to learn new knowledge and skills related to engineering design and enhance the current practices in the classroom. Additional sub-themes were identified and related to planning, the learning environment, relevancy, and assessment (Asunda & Hill, 2008). Based on the data from the participants, a summary of the process for conducting effective professional development for infusing engineering design in technology education included (a) need analysis based on research, (b) brainstorm possible solutions to meet the needs, (c) plan the professional development to meet the needs, (d) invite participants based on the needs, (e) conduct the professional development according to a planned schedule over a period of time, and (f) evaluate the delivery and administration of the professional development through group discussions, participant evaluations, and project assessments (2008).
The professional development theme generated from the data in the Asunda and Hill (2008) study was consistent with the findings from Denson et al. (2009) and Kelley and Wicklein (2009c). From the educators’ viewpoints, in order to successfully transition the curricular focus of the discipline to include engineering, a significant amount of professional development was needed in the areas of integrating math and science concepts in the instructional content (Asunda & Hill, 2008; Denson et al., 2009; Kelley & Wicklein, 2009c). The importance of the Asunda and Hill (2008) study was that it provided a framework for identifying the content and delivery strategies for effective professional development relating to the inclusion of engineering in the technology education curriculum.

**Career and Technical Education as the Curricular Focus**

As formerly mentioned, the technology and engineering education discipline has battled two opposing views on the purpose of technology and engineering education: education for all students or education for career and technical education (Kelley & Kellam, 2009). Career and technical education, formerly known as vocational education, has had a very real, yet covert relationship with technology and engineering education. The hidden relationship has most notably been due to the fact that the leaders of the technology and engineering education have worked for decades to differentiate and separate the two content areas (Kelley & Wicklein, 2009a). A literature search through the prominent technology and engineering education journals (e.g. *Journal of Technology Education, Journal of Industrial Teacher Education, Technology and Engineering Teacher*, etc.) demonstrated very few articles published with career and technical education in the title. However, evidence from the empirical studies included in the
journal articles has demonstrated a strong connection between technology and engineering education teachers and career and technical education (Kelley & Kellam, 2009; Kelley and Wicklein, 2009a; Moye et al., 2012; Wright et al., 2008).

As previously noted, Wright et al. (2008) found in their national survey on the purpose of technology education that the primary purpose identified by all respondent groups at the historical, theoretical, and in practice levels was as a career and technical education program (2008). This is not surprising as the majority of state departments of education have categorized technology and engineering education as a sub-category under the umbrella of career and technical education for several decades (Dugger & Johnson, 1992; Moye et al., 2012; Spencer & Rogers, 2006). Another example of the relationship between career and technical education and technology and engineering education surfaced in the Kelley and Wicklein (2009a) study as they examined the inclusion of engineering design in the technology education curriculum. The participants reported that the application of engineering design through the development of basic skills using tools was emphasized and not the application of math and science. Kelley and Wicklein (2009a) interpreted this to indicate that a significant percentage of technology educators had not transitioned to the recommended broad-based engineering design curriculum and instead emphasized tool skill development more closely related with career and technical education.

The alignment with career and technical education has been critical for the technology and engineering education programs as it has positioned the schools to be recipients of additional funding through career and technical education legislation (Wright et al., 2008). Since the majority of funding for technology and engineering
education comes through career and technical education (Moye et al., 2012), the programs are required to meet the career and technical education criteria including the types of skill development and curricular content for each of the courses (Wright et al., 2008). The competency-based career and technical education programs are very different from the content and goals set forth by the International Technology and Engineering Educators Association.

The funding for career and technical education was reauthorized in 2006 through the Carl. D. Perkins Career and Technical Education Act, also known as Perkins IV (Castellano, Sundell, Overman, Aliaga, 2012). The Act increased the accountability of the previous vocational education initiatives of integrating higher levels of academic and technical standards (2012). A major component of the Act was a nationally recognized name change from vocational education to career and technical education. The Perkins IV Act (2006) defined career and technical education as “organized educational activities that offer a sequence of courses that provides individuals with coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers…” (§ 3.5.A.i). The purpose of the name change was to decrease the social negative connotation of vocational education and emphasize the role of career and technical education in college and career readiness for all students (Withington et al., 2012). The term career and technical education was intended to represent a heightened level of academic and technical rigor over vocational education which tended to represent a narrow set of courses for a specific job (2012).
The Perkins IV (2006) legislation advanced the national conversation on the need for students to develop career-readiness along with college-readiness (Alfeld & Bhattacharya, 2012). One of the major components of the Perkins IV (2006) legislation was the requirement for schools to develop programs of study in order to be eligible for career and technical education funds. The programs of study were a continuation from the former Tech-Prep programs that required a non-duplicative sequence of courses from the secondary to post-secondary experience (Alfeld & Bhattacharya, 2012). The more current programs of study were required to include rigorous academic and technical content, the opportunity for dual or concurrent enrollment, and the possibility to earn an industry-recognized credential such as a certificate or an associate degree (2012).

The National Association of State Directors of Career Technical Education Consortium utilized the programs of study model to develop the career cluster and pathway initiative. The career pathways had many similarities to programs of study, but were differentiated by the increase in detail and the inclusion of a career-specific roadmap of courses for students to follow through high school and college (Stipanovic et al., 2012). As part of the initiative, 16 career clusters were created to organize related occupations into categories. Within each cluster, specific career pathways were created to describe the knowledge and skills needed for the particular field. Each pathway was further articulated to include a recommended sequence of secondary and postsecondary courses and set of competencies for each course. Students who completed the sequence of courses were referred to as concentrators (Withington et al., 2012).

In 2005, South Carolina passed the Education and Economic Development Act with the purpose of increasing student achievement, college and career readiness, and
career pathway programs of study for all students in public education (Withington et al., 2012). The Education and Economic Development Act (2005) has been identified as the most comprehensive and aggressive state-wide mandate for college and career readiness (Withington et al., 2012). In elementary, students were made aware of the career clusters through various integrated activities. In middle school, students were to explore the various career opportunities and by the end of the eighth grade year, identify a preferred cluster of study within an individual graduation plan that was signed by both the parent/guardian and school counselor. Lastly, in high school students were to receive preparation in their identified career major through a sequence of four courses and other work-based learning programs including mentoring, job shadowing, service learning, and internships (2012).

The integration of the Education and Economic Development Act (2005) was to occur in stages and be fully implemented in all South Carolina public schools by July of 2011. Withington et al. (2012) conducted a five-year longitudinal study that examined key variables amongst career and technical education participants, non-participants, and concentrators (i.e. students who had completed three or more career and technical education courses) in the South Carolina schools following the enactment of the Education and Economic Development Act (2005). The researchers found that the students with greater exposure to career and technical education courses had more job or career identification activities and an increase in work-based learning experiences (Withington et al., 2012).

Though several publications have promoted that the development of thorough career pathways and programs of study can greatly benefit students (McCharen & High;
2010), the empirical evidence from the 21st century on the efficacy of the career and technical education programs has been limited with mixed results (Alfeld & Bhattacharya, 2012). Studies examining the achievement levels of students (e.g. grade point averages, graduation, postsecondary enrollment, etc.) have demonstrated little to no difference from career and technical education participants and non-participants (Castellano, Stringfield, & Stone, 2007; Lekes et al., 2007). Castellano et al. (2007) did find that schools which offered more career and technical education courses had lower dropout rates; however, the sample size of their longitudinal study was very small.

Technology and Engineering Education Organizational Culture

The organizational culture is a critical variable that needs examination before, during, and after an organizational change initiative (Corbett et al., 1987; Schein, 2010). Schein (2010) developed a three-level model for identifying and understanding organizational culture: (a) artifacts, (b) organizational values and (c) basic assumptions. The artifacts are the visible operations and behaviors that are found within the organization including the programs, policies, and publications. The first-level artifacts represent the organizational characteristics that are readily visible to an outside observer (2010). In an educational setting such as the technology and engineering education discipline, the artifacts may include the course titles, curriculum, projects, and technologies used to deliver the content. Because the artifacts are the readily available visible components, they are the areas that get changed the most. However, Schein (2010) warned that simply adjusting the artifacts without addressing the other two levels would result in un-sustained changes.
The values are the second level and include the organizational philosophies and understandings. The philosophies and understandings drive the visible actions within the organization such as how and what was communicated. In a school setting, the educational program is a direct reflection of the values within the organizational culture (Ratcliff, 1997). These values are expressed within the school setting through mission statements, strategic plans, and school improvement initiatives. The organizational change from industrial arts to technology and engineering education was a significant transition in the values of the discipline from an emphasis on technical knowledge and skill to a broad-based emphasis on technology literacy (Bame & Miller, 1980; Ritz, 2009).

The third level included the basic assumptions which are individual level beliefs and values that guide behaviors without words or speech. The basic assumptions dictate the deepest level of culture and if changed, transform how individuals see and understand the organization (Schein, 2010). The assumptions within the organization represent the underlying beliefs and perceptions of the individual members. These assumptions are covert thoughts and feelings that drive the overt behaviors and are established through the historical experiences of the organization. Over time the experiences become the tacit premises by which the individuals approach new experiences from within the organization and also from external environments (2010). The shared tacit assumptions dictate the deepest level of culture and if changed, transform how individuals see and understand the organization. The current evidence from the literature has demonstrated that a significant number of the technology and engineering education teachers have maintained basic assumptions that align most closely with the industrial arts curriculum.
(Kelley & Wicklein, 2009a; Spencer & Rogers, 2006) and therefore have not changed the way they see or understand the role and purpose of the discipline.

Taking into account the three levels of organizational culture and building upon Lewin’s (1947) three-step change theory, Schein (2010) further clarified the three stages that organizations must go through in order to create sustainable changes. In the first stage, what Lewin (1947) described as unfreezing the status quo equilibrium, the following three processes need to occur: (a) the motivation for change must be created by an establishment of disconfirming data to cause significant discomfort, (b) the connection between the disconfirming data and strategic goals needs to cause anxiety and/or guilt, and (c) a psychological safety needs to be created through a workable solution that does not jeopardize the integrity or identity of the organization (Lewin, 1947; Schein, 2010). The disconfirmation demonstrates the evidence that the strategic goals are not being met and creates a sense of survival anxiety where the members of the organization recognize that changes are a necessity for the future success of the organization (Schein, 2010).

The creation of survival anxiety however can create learning anxiety where the members of the organization develop fear that they cannot learn the new knowledge and skills required for the changes needed (Schein, 2010). The learning anxiety may be based on a fear of loss of power or position, a fear of temporary incompetence, a fear of punishment for incompetence, a fear of loss of personal identify, and/or a fear of loss of group membership—all of which can lead to a resistance to change (2010). Schein identified that in order to minimize resistance during the disconfirmation stage, the “survival anxiety or guilt must be greater than the learning anxiety…[and the] learning anxiety must be reduced rather than increasing survival anxiety” (p. 305). Therefore, the
psychological safety must provide the members with the reassurance that the processes needed for the change to occur are both possible and achievable.

The second stage of an organizational change initiative involves the development of new concepts, new meanings, and new standards of evaluation (Schein, 2010). Lewin (1947) described this stage as moving the organization to a new level of equilibrium. In this stage, members of an organization can learn the new concepts and meanings by imitating a lead role model in the organization or inventing their own solutions through the trial and error process (Schein, 2010). The leaders in the organization must establish the standards for the new processes and clarify the evaluation mechanisms in order to provide feedback on the new processes (2010). Burke (2010) also emphasized the importance of maintaining the momentum during this second stage. Inevitably, challenges and problems will arise as the new processes are implemented and it is critical that these problems are fixed as quickly as possible so that they do not prevent the momentum from moving forward.

In the third and final stage, the change goals are analyzed to determine if the new processes put in place were successful (Schein, 2010). If the processes were not successful, modifications to the change initiative will need to be made or a whole new initiative developed. Persistence is important in change initiatives and leaders must be willing to try various methods in order to achieve the intended goals (Burke, 2010). If the processes were successful, the organization needs re-frozen allowing the organization can move forward based on the new level of equilibrium (Lewin, 1947). Burke (2010) encouraged leaders to take time and celebrate the successful milestones at this stage as
and to recognize the organizational members who contributed to the success of those events.

**Managing Organizational Change**

The technological advancements of the information age have caused the rate of change to rapidly increase (Boohene & Williams, 2012; Dijk & Dick, 2009). The traditional norms that were once barriers, whether physical or perceptual, have been either weakened or eliminated altogether due to the rate of social changes (Bruckman, 2008). Formal organizations, which includes educational entities (Krumm & Holmstrom, 2011), have been forced to adapt to the external changing environments along with initiating internal changes as well. The 20th century transition from industrial arts to technology education and the 21st century transition to include engineering were organizational change initiatives directed by the discipline’s leadership in an effort to modernize the curriculum and stay current with the external changing culture (Foster & Wright, 1996; Kelley & Wicklien, 2009a). Boohene and Williams (2012) defined organizational change as a “reconfiguration of components of an organization to increase efficiency and effectiveness” (p. 136). The success of organizations has been largely dependent upon its leaders’ ability to manage both internal change initiatives as well as uninvited changes from the external environment (Bruckman, 2008).

As demonstrated by the change initiative of the technology and engineering education discipline, one of the major contributing variables to the success or failure of a large-scale change initiative is whether the members of the organization support and implement the change initiative or whether the members resist and defy the change (Bruckman, 2008). Resistance to change can occur for a variety of reasons such as
threats to the status quo, threats to beliefs and values, selective perception, fear and anxiety, perceived loss of freedom or pay, and distrust or resentment toward the leadership (Bruckman, 2008; Yilmaz & Kilicoglu, 2013). In organizations like the technology and engineering education discipline where the organization has a loosely coupled structure, resistance can have a significantly negative impact on the change initiative.

Loosely coupled systems are those that have a variety of inputs, processes, and outputs with a complex set of flexible connections that hold the system together (Birnbaum, 1989; Weick, 1976). Additionally, loosely coupled systems also have decentralized roles of authority where the professionals throughout the system maintain a degree of autonomous control (Greenwood & Hinings, 1996; Weick, 1976). The decentralized authority makes it very easy for professionals to resist change initiatives and continue in the status quo (Awbrey, 2005; Birnbaum, 1989; Burke, 2010). The technology and engineering education discipline is a good example of a loosely coupled system where there are multiple inputs (e.g. students, educators, leadership professionals, industry professionals, etc.), multiple processes (e.g. teaching, learning, research, professional development, etc.), and multiple outputs (e.g. graduates, publications, conferences, service, etc.). The relationship amongst the members of the discipline are loosely connected and each of the educators have the autonomous authority to teach the content and curriculum as they see best fit for their individual district. Therefore, even though the leadership can make clear the intended curriculum and purpose for the discipline, the individual teachers could easily resist the change and implement their own content and projects contrary to the recommended curriculum.
During the 21st century, the resistance to change has been examined through a different lens as compared to the previous 20th century (Burke, 2010; Dijk & Dick, 2009; Ford, Ford, D’Amelio, 2008). In the former, resistance was considered negative energy detrimental to the change process and rebellious behavior against the change leader (Dijk & Dick, 2009). During the organizational change process, leaders were trained to identify the sources of resistance and overcome them as quickly as possible (Burke, 2010). However, the literature from the 21st century has identified the existence of various forms of resistance and emphasized its importance in the organizational development process (Ford et al., 2008).

The 21st century literature on resistance to change has attempted to align the resistance with the situational circumstances and not solely on the individuals themselves (Bruckman, 2008; Burke, 2010). For example, most employees would not resist a change that involved an increase in their salary or hourly wage. Therefore, it is detrimental to simply label organizational members as change resistant without clarifying the specific circumstances being resisted. Further, the current literature has identified that the resistance to change is not a singular event that needs managed but instead an on-going relational dynamic between the members of the organization (Ford et al., 2008). The leadership’s ability to nurture the dynamic relationships through the change initiative is critical.

It is common for change agents, those initiating the changes, to be perceived as doing the right thing while the change recipients, those expected to change, are perceived as wrongly establishing negative barriers to the change (Dijk & Dick, 2009). This change agent-centric bias as described by Ford et al. (2008) establishes a false tension
between the change agents and change recipients and can lead to a failure in the organizational change initiative. In fact, the *change agent-centric* perspective can actually generate the resistance in the form of a self-fulfilling prophecy (2008). If a change agent approaches a situation with the expectation of encountering and overcoming resistance, it is possible that the actions of the change agent will actually generate the resistance from the change recipients when it would otherwise have not existed. For example, under the *change agent-centric* perspective, when the change recipients express thoughts, concerns, and/or questions to the change initiative, the change agent can perceive the feedback as attacks against the initiative and defensively refute the feedback creating resistance from the recipients.

Contrary to the *change agent-centric* perspective, resistance to change can be perceived as the product of rational wisdom and thoughtful ambivalence (Burke, 2010; Ford et al., 2008). As the change recipients communicate feedback to the change initiative, the change agent can embrace the feedback and utilize a dynamic dialog on the plan and procedures for the future initiative. Therefore, change agents can utilize resistance to generate positive energy and improvement for the change initiative. The evidence from the literature describing the change initiative of the 20th century transition from industrial arts to technology education and the 21st century transition from technology education to technology and engineering education does not necessarily demonstrate an on-going dynamic dialog between the leadership and the teachers in the field and may explain why so many of the educators did not support and implement the change initiative.
The general rhetoric from the scholarly literature has indicated that upwards of 70% of large-scale organizational change initiatives have been unsuccessful due to resistance (Burke, 2010; Bruckman, 2008; Choi, 2011; Grady & Grady, 2013). However, this percentage has been contested by Hughes (2011) who analyzed five different references typically utilized in citing the failure rate and found that none of the five references which spanned over the past two decades provided the scholarly methodology or empirical evidence validating their claims. This is reflective of the literature as a whole as there are a substantial number of publications with anecdotal information regarding resistance to change but only a limited number of current empirical studies (2011).

Utilizing the social identity theory and self-categorization theory, Dijk and Dick (2009) examined the motivations behind employee resistance during an organizational merger of two equal partner law firms. The researchers utilized a mixed method research design which included questionnaires distributed to all of the employees and semi-structured interviews with key stakeholders from both of the law firms. Descriptive statistics were used to analyze the quantitative questionnaire data and textual analysis was used to code the qualitative interview data (2009).

After analyzing both the quantitative and qualitative data, Dijk and Dick (2009) found that the top-level partners, those who had the highest degree of influence and decision-making authority, demonstrated significantly lower levels of resistance. Additionally, those who identified more with the identity of the new post-merger firm also demonstrated lower levels of resistance. The data also demonstrated a clear gap between how the leaders perceived the success of the merger and how the employees
perceived the process (2009). For example, in one of the firms, 40% of the leaders believed employees had no problems with the merger whereas 82% of employees reported problems. Another example was evident in the area of communication. Though employees were encouraged to suggest alternative solutions to problems throughout the merger process, in one of the firms only 2% of the employees reported that their ideas were ever discussed (2009).

Overall, the data from the Dijk and Dick (2009) study emphasized the importance of organizational participation and open communication for reducing resistance to organizational change. This was consistent with previous recommendations from Bruckman (2008) and Ford et al. (2008). The researchers also summarized the limitations in viewing resistance as a linear process where change occurs, which results in resistance, and then resistance management strategies are implemented. Instead, Dijk and Dick (2009), in alignment with recommendations from Bruckman (2008) and Ford et al. (2008), also emphasized the importance of viewing resistance as an on-going process where the leaders can dynamically engage the employees in the change initiative rather than attempting to overcome resistance that emerges from the change process.

In another example, Boohene and Williams (2012) examined the resistance to organizational change amongst stakeholders within the Oti-Yeboah Complex Limited company in Ghana. The company, which employed approximately 1600 workers, transitioned from sawmilling to plywood production in 2008. The researchers collected data using structured questionnaires and face-to-face interviews to examine how employee participation in decision-making, employee motivation, management communication, and employee trust in management affected resistance to the
organizational change (2012). The researchers utilized a stratified sampling technique and included 217 participants in the study in order to achieve a 95% confidence level. The sample was limited to full-time employees who had been with the company for a minimum of five years.

The survey data for the Boohene and Williams (2012) study was analyzed using bi-variate correlations, regression analysis, and T-tests. The researchers found through their first hypothesis that employee participation in the decision-making significantly reduced the resistance to change. The analysis from the second hypothesis demonstrated a negative relationship between motivation and resistance, which indicated as motivation decreased, resistance to change increased. The analysis of the third hypothesis demonstrated a relationship between communication and resistance. When proper channels of communication were established, employee resistance decreased. Lastly, the fourth hypothesis demonstrated a positive relationship between trust in management and resistance. Employees who had low levels of trust demonstrated high levels of resistance to change. Overall, the Boohene and Williams (2012) study emphasized how employee participation, employee motivation, management communication, and employee trust in management affects the level of employee resistance to organizational change initiatives. These findings were in alignment and further confirmed previous studies and recommendations made by Bruckman (2008), Ford et al. (2008), Dijk and Dick (2009), and Burke (2010).

Related to education, Krumm and Holmstrom (2011) conducted a yearlong mixed methods case study over a single school to examine teacher collaboration through an elementary reading change initiative. Though the primary purpose of the case study was
for theory elaboration related to organizational sensemaking, the study provided a
detailed analysis of the change process within the school. The data from the study
indicated that the success of the change initiative was related to several factors that
included a condition of crisis, a de-emphasis of top-down directed change, an emphasis
of bottom-up emergent change directives, and a dynamic change process (2011). A key
finding from the study clarified the importance of creating an open, emergent process for
the internal members as compared to an articulated comprehensive plan and scope from
the external constituents.

**Gaps in Literature**

As demonstrated in the previous section, there has been ample theoretical
literature on the organizational change effort. However, there is a much smaller amount
of empirical-based studies that have examined the success of the organizational change
process and/or resistance to change and an even smaller amount of empirical evidence
related to the educational change process and educator resistance to change. A scholarly
journal search through the EBSCO Host and ProQuest databases with the exact query of
*educator resistance to change* resulted in zero entries found. With the exact query
removed, only eight results were retrieved from EBSCO Host and none of the references
significantly related to educator resistance to change.

Baldridge and Deal (1975) acknowledged there was a gap in the literature
specifically related to the change process in educational organizations and that the
theoretical literature was largely irrelevant for school administrators. The irrelevancy
was due to the fact that the literature was typically too individualist and not related to
complex organizations, there was an emphasis on non-manipulable factors, there was
neglect toward policy, and too many one-size-fits-all conclusions (1975). In 1987, Corbett et al. also confirmed the gap and noted that the term *resistance* had all but disappeared from the literature and instead the focus had switched to managing the change process. As part of their study, Corbett et al. (1987) conducted qualitative case studies on three separate high schools experiencing the change process. The data was collected through in-depth interviews and observations and analyzed using a cross-case comparison approach. The researchers found that changes of any magnitude collided with the cultural norms of the schools and each schools’ culture were individually unique. Corbett et al. (1987) concluded that the degree of educator resistance was dependent upon the alignment of the school’s culture and the proposed change. If the changes were to be successful, the change-agents would need to first understand how the school culture would be affected and interact with the educators on that cultural level.

The only current literature found with a title directly related to educator resistance to change was a study conducted by Berkovich (2011) who conducted a descriptive documentary case study of the teachers’ union resistance to the changes initiated by the Israeli government. Due to the changes put in place, the teachers participated in a 64-day strike that left 550,000 students and teachers out of school (2011). However, the focus of the study was related to the use of digital media by the educators in the political campaigns rejecting the educational reform as compared to providing empirical evidence on the types of resistance from the educators.

**Summary**

The educational discipline of technology and engineering education has been created out of a convergence of industrial arts, technology education, career and technical
education, and engineering education (Asunda & Hill, 2008; Foster & Wright, 1996; Kelley & Wicklein, 2009a). Since the discipline changed its name in 1985 from industrial arts to technology education, there has been a steady decline in the number of students enrolled in the discipline, the number of educators teaching in the discipline, and the number of teacher education programs available (Dugger, 2007; Katsioloudis & Moye, 2012; Moye, 2009; Moye et al, 2012; Ndahi & Ritz, 2003; Newberry, 2001). The name change coincided with a transition in the overall purpose of the discipline as the former industrial arts curriculum focused on technical knowledge and skill development in the industrial areas (Bame & Miller, 1980) whereas the more modern technology education curriculum focused an emphasis on broad-based technology literacy (Kelley & Kellam, 2009; Ritz, 2009). The purpose was again altered in 2009 when the discipline incorporated engineering as a curricular focus (Asunda & Hill, 2008; Harris & Rogers, 2008; Pinelli & Haynie, 2010; Wicklein et al., 2009). However, empirical evidence identified that a significant percentage of the educators resisted the transition to technology and engineering education (Kelley & Wicklein, 2009a; Sanders, 1997; Spencer & Rogers, 2006; Wright et al., 2008) and have continued to teach a career and technical education curriculum focused on knowledge and skill development for a future vocation (Wright et al., 2008).

Though the International Technology and Engineering Educators Association has spent over two decades attempting to remove the industrial arts and career and technical education influence from the discipline (Dugger & Johnson, 1992; Kelley & Wicklein, 2009a; Moye et. al., 2012; Spencer & Rogers, 2006), that change has not occurred. Instead, the educators have resisted the transition to technology and engineering
education and have continued to teach an industrial arts or career and technical education based curriculum (Kelley & Wicklein, 2009a; Sanders, 1997; Spencer & Rogers, 2006; Wright et al, 2008). However, gaps within the literature exist to explain educator resistance to the organizational change. This is consistent with the literature as a whole as there is a gap of empirical-based evidence related to the types of educator resistance toward organizational changes (Baldridge & Deal, 1975; Corbett et al., 1987).
Chapter 3: Research Method

The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. The problem is the industrial arts educators resisted the curricular transition to technology and engineering education (Sanders, 1997; Spencer & Rogers, 2006; Wright et al., 2008) and even though the program titles within the discipline changed from industrial arts to technology education, there has remained a significant number of secondary industrial arts educators who continued to teach from a traditional industrial arts curriculum (Kelley & Wicklein, 2009a; Spencer & Rogers, 2006). Consistent with a grounded theory research design, the study was broadly guided by the following two research questions:

Q1. What types of resistance have the Kansas industrial arts educators demonstrated toward the transition to technology and engineering education?

Q2. Why have the Kansas industrial arts educators resisted the organizational change to technology and engineering education?

This chapter provides a detailed description of the study’s methods and design. The chapter clarifies the need for the qualitative grounded theory methodology to appropriately investigate the specific research topic. The study’s population and sample is described along with the methods for recruiting participants. Additionally, a detailed description of the data collection and analysis process is included. The chapter ends with a section describing the ethical concerns for the study and a summary of the key points from the chapter.
Research Method and Design

An exploratory, grounded theory method was used to identify new theory related to educator resistance within the framework of Hambrick and Cannella’s (1989) three types of resistance theory (Babbie, 2009; Corbin & Strauss, 2008; Glaser & Strauss, 1967). Resistance can be discovered through purposeful investigations such as observations and face-to-face interviews (Schein, 2010) and in order to adequately study the cultural dynamics of the industrial arts educators and their resistance to the technology and engineering education transition, a qualitative research design was needed. Qualitative research methods are appropriate when the objective is to understand the meaning of a phenomenon and when attempting to identify intricate details such as feelings, thought processes, and emotions (Corbin & Strauss, 2008). This type of information is more accurately gathered through observations and interviews than quantifiable surveys or other numeric data used in quantitative research (Patton, 2001). The data collected through the observations and interviews is recorded in textual, verbal form instead of numeric, and qualitative research uses a method of comparative analysis in order to generate findings as compared to statistical analysis used in quantitative research (Babbie, 2009). The qualitative method was most appropriate for this study as it allowed for the collection of the thoughts and feelings related to the educator resistance to change (Corbin & Strauss, 2008; Patton, 2001).

Grounded theory, ethnographies, case studies, and phenomenological studies are the four major qualitative research designs (Kolb, 2012), and grounded theory is distinct from ethnographies, case studies, and phenomenological studies as the emphasis is on theory development (Denzin & Lincoln, 2005). A grounded theory research design is
often used for the purpose of building theory rather than testing it (Glaser & Strauss, 1967; Urquhart, 2013), and was most appropriate for the current study on the resistance of industrial arts educators transition to technology and engineering education as the current literature base did not include a theoretical perspective for this phenomenon. Therefore, without a developed theoretical perspective, a quantitative research method was not an appropriate method to examine the study phenomenon.

Grounded theory research is formative where each stage of the research builds on and dictates the next stage (Charmaz, 2006). The data analysis is integrated throughout the research process and begins directly after the first collection of raw data (Bickman & Rog, 2008). The results of each comparative analysis direct what types of data to collect next until theoretical saturation is achieved (Charmaz, 2006; Corbin & Strauss, 2008). Therefore, the grounded theory design steps are fluid in nature so as to not hinder the development of the emergent theory. Even though the grounded theory process is created for flexibility, there are three general stages that make the grounded theory design steps: (a) data collection, (b) comparative analysis, and (c) verification (Corbin & Strauss, 2008). An emergent theory grounded in the data may provide a theoretical perspective on the types of resistance exerted by the educators. This theoretical perspective could then be tested by further quantitative research and made generalizable to the larger population of technology and engineering education teachers.

Population

The target population for the study was the licensed industrial arts and/or technology education teachers in the state of Kansas. Due to Kansas’s licensure changes over the past several decades, the population included educators with one of the
following endorsements: (a) comprehensive industrial technology, (b) industrial arts comprehensive, (c) technology education, and/or (d) general industrial technology. The sampling frame was derived from a database of 379 Kansas secondary industrial arts/technology education teachers maintained at Fort Hays University.

Sample

A three-stage non-probability, purposeful sampling technique was utilized in the study (Patton, 2001). The sampling frame for the study was derived from a database of secondary industrial arts/technology education educators. The database has been updated annually and managed by the Institute of Applied Technology at Fort Hays State University and contained contact information for 379 Kansas industrial arts/technology education teachers.

The purpose of the first stage of the sampling process was to identify potential participants for the study through a self-selection sampling method (Babbie, 2009). An initial email (see Appendix C) was sent to all contacts in the Kansas database as an invitation to participate in the study. The email request included the purpose of the study, the need for industrial arts educator participants, and a description of involvement. Interested educators were asked to reply back and provide their contact information and any limitations to their availability. Of the 379 educators sampled from the database and received email invitations, 96 educators responded and 77 met the study requirements.

In order to focus on information-rich cases related to the study purpose, the second sampling stage involved a maximum variation purposeful sampling technique (Patton, 2001). The purpose of the maximum variation sampling was to account for the potential heterogeneity of the industrial arts educators across the state. Since the cultural
dynamics of the industrial arts educators may differ based on the size and location of the school in which they teach, a maximum variation sampling technique helped account for the variation. This provided context-rich descriptions of each case while at the same time allowing the emergent theory to be developed across the various school programs (Patton, 2001). Therefore, from the educators who indicated they were available and willing to participate in the study, select educators were contacted based on the variations of size and location of the schools. The variation sampling technique increased the potential for naturalistic generalization and extrapolation of the study findings to the larger population of industrial arts educators in the state of Kansas (Patton, 2001).

Consistent with grounded theory methodology, theoretical sampling was used in the third sampling stage (Charmaz, 2006; Corbin & Strauss, 2008, Patton, 2001). The purpose of theoretical sampling was to select study participants that generated the greatest theoretical return and provided related variations to the concepts emerging in the data (Corbin & Strauss, 2008). Theoretical sampling allowed the researcher to maximize on comparisons and make adjustments as needed according to the evolving theory through the on-going data collection and analysis process (Kolb, 2012). The researcher continued to collect and analyze the data until theoretical saturation was achieved—the point at which no new information was collected and redundancy occurred (Corbin & Strauss, 2008). A sample size of 13 participants was needed to reach theoretical saturation of the phenomenon.

**Materials/Instruments**

As recommended by Corbin and Strauss (2008), semi-structured interviews were utilized for the grounded theory study. The semi-structured nature of the interviews
provided a degree of consistency and organization from one interview to the next, but also allowed the flexibility needed to properly investigate each unique situation as needed. An interview guide (see Appendix A) was utilized in order to direct the administration and documentation of the face-to-face interviews, observational tour, field notes, and memos (Kvale and Brinkmann, 2009; Lofland, Snow, Anderson, & Lofland, 2005). The interview guide was validated via a field test with an expert panel of 2 professionals who reviewed the interview guide for face and construct validity. The interview guide was revised as needed based on the experts’ feedback.

Four software applications were used in the data collection and analysis process. First, the audio recording software GarageBand was used to record the interviews. The recorded interviews were saved and secured as .mp3 files on the researcher’s computer. Second, the audio files were imported into the f5 transcription software. Third, the Dragon Dictate speech recognition software was used in conjunction with f5. Because speech recognition software is speaker dependent, the researcher re-spoke the interview recordings back into the f5 software, which transcribed the audio verbally instead of through typing. Last, the transcribed text, field notes, and researcher memos were imported into MAXQDA—a computer-assisted qualitative data analysis software that allows for the organization, categorization, and coding of the imported data.

**Data Collection, Processing, and Analysis**

In the grounded theory study, face-to-face interviews and observations were used to explore the industrial arts educator resistance toward the transition to technology and engineering education. The interview times and locations were scheduled to allow for
both an observational tour of the educator’s facility along with a face-to-face interview. This allowed for multiple methods of data collection during the on-site visit.

The first type of data was collected through a face-to-face semi-structured interview. The general interview questions followed the interview guide (see Appendix A) in order to maintain consistency but the contextual information was explored and discussed as needed (Corbin & Strauss, 2008; Kvale & Brinkmann, 2009; Patton, 2001). The interviews were audio recorded and then transcribed verbatim into text files for analysis. The purpose of the face-to-face interview was to uncover the deeper level beliefs and values in order to identify the type of resistance. These cultural dynamics are often not visible on the surface and only discovered through purposeful investigation (Schein, 2010).

The second type of data was collected in the form of observational field notes (see Appendix A) taken by the researcher during the onsite tour. Observational field notes are one of the most critical and important types of data collected in a qualitative study as it provides a description of the setting that was observed and a perspective of the meaning of what was observed (Patton, 2001). Specific to this study, the researcher collected information during the on-site tour related to the types of labs, layout of the labs, equipment in the labs, condition of the labs, and the projects created in the labs. The data collected during the tours were recorded as field notes (see Appendix A) and included in the analysis. The observational data was organized and analyzed using the following categories: (a) lab type, (b) lab equipment, (c) lab condition, and (d) projects created. These constructs were related back to the research questions to further clarify to what
degree the educator had transitioned from an industrial education to technology and engineering education program (Kelley & Wicklein, 2009a).

Because grounded theory researchers are considered integral parts of the study, the researcher’s reflections and interpretations are an important source of data relating to the phenomenon (Charmaz, 2006; Corbin & Strauss, 2008; Urquhart, 2013). The researcher’s thoughts were recorded as analytic memos throughout the analysis process and were coded and categorized along with the other forms of data (Saldaña, 2013). Birks, Chapman, and Francis (2008) identified that analytic memo writing is important for extracting meaning from the data and maintaining momentum throughout the analysis process.

Consistent with grounded theory research, the transcribed audio from the interviews, field notes, and researcher memos were analyzed following each interview (Corbin & Strauss, 2008; Urquhart, 2013). The collected data was converted into digital form and imported into the MAXQDA software for comparative analysis and theory generation (Saldaña, 2013; Urquhart, 2013). The concepts generated from each interview were used to guide the subsequent interviews and continued until theoretical saturation of the phenomenon was reached (Charmaz, 2006). The three types of data allowed for triangulation of the collected information in order to maximize on the validation of the conclusions made about the phenomenon (Maxwell, 2005).

The data was analyzed using Glaser’s (1967, 1978, 2005) classic three-phase grounded theory coding technique: (a) open coding, (b) selective coding, and (c) theoretical coding. The coding process provided a microanalysis of the data for the purpose of identifying theory grounded in the data (Charmaz, 2006; Corbin & Strauss,
The key difference in the coding process of a grounded theory method versus other qualitative coding is the emphasis on relating the categories to generate theory (Urquhart, 2013).

The first phase of the grounded theory coding technique involved open coding which included the organization of concepts into identifiable codes (Charmaz, 2006; Urquhart, 2013). The codes were generated inductively from the text and labeled within the MAXQDA software. Next, the individual codes were grouped into more abstract categories during the selective coding process. In the final phase of coding, theoretical coding, the relationships between the categories were identified and related to other theoretical codes from the literature (Glaser, 2005).

Assumptions

Assumptions are necessary starting points that are statements about the nature of particular phenomena (Neuman, 2009). In inductive theorizing, qualitative researchers begin with a limited number of basic assumptions and allow the theory to emerge through the on-going comparative analysis of the collected data (Kolb 2012; Neuman, 2009). The design assumptions for this grounded theory study aligned with those of foundational qualitative research: (a) the purposeful investigation of naturally occurring phenomena, (b) an emphasis on the information-rich context, and (c) the effectiveness of inductive analysis of data collected through direct contact with the phenomena (Patton, 2001). These foundational statements are used to guide the study design and helped to ensure that the study results were meaningful for the participants involved, the larger population of stakeholders, and the academic community.
An assumption for the sample was that an estimated 15 participants would be needed in order to reach theoretical saturation of the phenomenon. This assumption was supported in the texts of qualitative research methods (Charmaz, 2006; Corbin & Strauss, 2008; Patton, 2001). Additionally, a literature search was conducted using the EBSCOhost database for recently published journal articles that contained research studies using grounded theory. Of the 7 most recent peer-reviewed, full-text journal articles listed, the following sample sizes were needed in order to reach theoretical saturation: 13, 16, 8, 11, 13, 11, and 29 (Boyanton, 2011; Duncan & Holtslander, 2012; Ellis & Chen, 2013; Gambetti, Graffigna, & Biraghi, 2012; Hachtmann, 2012; Thompson, Cole, & Nitzarim, 2012; Williamson, Carnahan, & Jacobs, 2012). These studies supported the estimated 15 participants for this study.

Lastly, there was an assumption for the interview questions in how they guided the participants to communicate about their resistance and provide honest information about their current experiences. Kvale and Brinkmann (2009) emphasized that good research questions should contribute both thematically and dynamically. Thematically in that they build upon the theoretical conceptions of study purpose and progressively lead the participant to clarify the meanings of their responses and dynamically in that they promote a positive relationship between the researcher and participant (2009). The questions were written to be interactive, have a continuous flow, and enable the participant to share their true thoughts and feelings toward the phenomenon. These strategies assisted the interview process in generating both accurate and truthful information.
Limitations

The study limitations included the sample size, (b) geographic limitations of the sample, and (c) the honesty and accuracy of the participant feedback. Due to the study design, a small number of participants were selected for participation in the study. The small number allowed for an in-depth investigation of each participant, which provided information-rich data for the study (Corbin & Strauss, 2008) but limited the statistical generalizability of the study to only the included participants (Patton, 2001).

A second area of limitation was the honesty and accuracy of the participant feedback during the interviews. Participant comments during an interview are subject to recall error, reactivity error, and self-serving response error (Patton, 2001). The use of an interview guide, the development of questions that were both thematically and dynamically supportive, and the use of three different sources of data collection (i.e. interviews, field notes, and memos) helped to compensate for these potential errors and maintain the construct validity of the study.

Delimitations

The study was delimited based on geographic region, participants certified as industrial arts/technology education teachers, and the data collection. Participants for the study were delimited to secondary industrial arts educators in the state of Kansas with at least five years of teaching experience in the field. Since the study was focused on the types of resistance to the organizational change, the study was delimited to educators who had not significantly transitioned their programs to technology and engineering education. The data collection methods for the study were delimited to three different types: (a) interviews, (b) field notes, and (c) memos. The use of three different data
collection sources helped balance the strengths and weaknesses of each individual data type and increased the overall validity of the study (Patton, 2001).

**Ethical Assurances**

Consistent with grounded theory research, the study utilized face-to-face interviews and observations of industrial education educators in their local school facilities. Face-to-face interviews and observations are personal interactions which can affect the interviewee in multiple ways and therefore the major ethical concerns involved in the study included (a) voluntary participation, (b) no harm to participants, (c) anonymity and confidentiality, and (d) deception (Babbie, 2009). The study on the educator resistance to transition to technology and engineering education was conducted using voluntary participation. Educators were contacted (see Appendix C) and asked if they were willing and available to participate in the study. At the beginning of the face-to-face interviews, the participants were given a consent form (see Appendix B) identifying the purpose, methodology, risks, and reporting of the research. The participants were given time to read and sign the consent form prior to starting the interview.

The study was designed to eliminate any potential harm for the participants. The purpose of the study was to identify resistance to the organizational change and not intended to collect information relating to deviant behavior or personal moral issues that may cause considerable distress. Further, the study did not involve any physical adaptation to the participant so no physical harm was foreseeable in the study design. As part of the consent form, participants were aware of the beneficence of the study
including possible risks of involvement and the expected benefits of the study (Kvale & Brinkman, 2009).

Due to the inclusion of face-to-face interviews in the study, the participants in the study were not anonymous; but confidentiality of the collected data was ensured. In order to ensure the confidentiality of participants, pseudonyms were used in the data collection, analysis, and reporting processes (Patton, 2001). The collected data was recorded and secured in the researcher’s office, which remained locked when not in use. The field notes and memos were organized and secured in a notebook and the audio recordings were secured on a single recorder. The collected data was converted into digital form and imported into the MAXQDA software for comparative analysis and theory generation (Saldaña, 2013). The digital information was stored at all times on the researcher’s password-protected computer. The master document containing participant contact information, interview schedule information, and pseudonyms was kept separate from the collected data.

The last ethical issue identified by Babbie (2009) involved deception. Though some research projects are designed with some degree of deception, the study on the educator resistance to transition did not include deception and the participants were made fully aware of the purpose, methodologies, and reporting of the study. Deception can also occur in a research study in the form of researcher bias (Patton, 2001). Since, qualitative researchers are integral parts of the data collection, analysis, and reporting processes—there is the possibility that the researcher’s bias, beliefs, and assumptions could influence the data (Patton, 2001). Corbin and Strauss (2008) emphasized that it is not possible for researchers to be completely free of bias and therefore it is important the
researcher balance an objective viewpoint of the collected data while at the same time maintaining sensitivity in order to recognize the conceptual relationships (Patton, 2001).

Throughout the research method planning process, multiple protocols were followed in order to ensure the study ethical concerns were accounted for and the methods were appropriate. First, the researcher successfully completed a Collaborative Institutional Training Initiative course on the protection of human research subjects. Secondly, permission was obtained from the Executive Director of the Institute of Applied Technology in order to use the department’s database (see Appendix D) and an Institutional Review Board application was submitted and approved with Fort Hay State University to obtain full permission to use the institution’s database. Lastly, the full dissertation proposal was submitted to the Northcentral University Institutional Review Board to provide a professional-level validation that the research proposal would not subject the study participants to undue risk or harm (Babbie, 2009).

Summary

The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. An exploratory, grounded theory method was used to identify new theory related to educator resistance within the framework of Hambrick and Cannella’s (1989) three types of resistance theory (Babbie, 2009; Corbin & Strauss, 2008; Glaser & Strauss, 1967). A grounded theory research design was used for the purpose of building theory (Glaser & Strauss, 1967; Urquhart, 2013) and was appropriate for this study as the current literature base did not include a theoretical perspective for this phenomenon. The study population consisted of in-service industrial arts educators in the state of Kansas,
and a current database of industrial arts educators in Kansas was used as the sampling frame. In alignment with grounded theory procedures, theoretical sampling was used in the study with an inclusion of 13 participants (Charmaz, 2006; Corbin & Strauss, 2008; Patton, 2001).

The study data was collected through semi-structured interviews, observational field notes, and analytical memos (Corbin & Strauss, 2008). Following each interview, the data was analyzed using the three-phase classic grounded theory coding technique (Glaser, 1978; Glaser 2005; Glaser & Strauss, 1967; Urquhart, 2013). The concepts generated from the coding analysis were used to guide the theoretical sampling process and ultimately led to the development of theory grounded in the data. The study was designed to develop new theory as to educator resistance to the transition to technology and engineering education, and to provide an emergent theoretical perspective for leadership.
Chapter 4: Findings

The purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. The data collection for the study was guided by the following two research questions:

Q1. What types of resistance have the Kansas industrial arts educators demonstrated toward the transition to technology and engineering education?

Q2. Why have the Kansas industrial arts educators resisted the organizational change to technology and engineering education?

The data collected from the participants documented the educators’ beliefs, values, and experiences of the discipline along with their opinions toward the organizational change to technology and engineering education. This chapter will discuss the results of the data and evaluation of findings as provided by the 13 participants in the study. The two research questions were used as guiding inquiries for the study (Urquhart, 2013), and the analysis of the data was inclusive for the whole study and the results were the generation of three substantive theories—therefore, the chapter is organized by each emergent theory.

The primary intent of the researcher was to develop new theory explaining why the educators have resisted the organizational change. To this end, 13 semi-structured interviews were conducted with secondary industrial/technology education teachers across the state of Kansas. A three-stage non-probability, purposeful sampling technique was utilized to identify and interview the participants. In the first stage, a sampling frame derived from a database of 379 secondary industrial education/technology education
teachers in the state of Kansas was used to identify potential participants for the study through a self-selection sampling method (Babbie, 2009). An initial email (see Appendix C) was sent to all contacts in the Kansas database as an invitation to participate in the study.

In order to focus on information-rich cases related to the study purpose, the second sampling stage involved a maximum variation purposeful sampling technique (Patton, 2001). From the educators who replied to the initial email invitations, met the study criteria, and were willing to participate; the teachers were categorized based on the variations of size and location of the schools. The variation sampling technique was used to increase the potential for naturalistic generalization and extrapolation of the study findings to the larger population of industrial arts educators in the state of Kansas (Patton, 2001).

Consistent with grounded theory methodology, theoretical sampling was used in the third sampling stage (Charmaz, 2006; Corbin & Strauss, 2008, Patton, 2001). The theoretical sampling allowed for the selection of participants that would generate the greatest theoretical return and provide related variations to the concepts emerging in the data (Corbin & Strauss, 2008). Of the 379 educators who received email invitations, 96 educators responded, of which 77 respondents met the study requirements and were then categorized by region and size of school. A final sample size of 13 participants was needed to reach theoretical saturation of the phenomenon. Figure 1 illustrates the approximate location for each of the interviews across the state of Kansas totaling over 2300 miles traveled to conduct the interviews.

Results

A field test was conducted to validate the interview guide (see Appendix A) and the semi-structured interview questions. Two expert professionals, one from a related postsecondary field and a secondary-level industrial education teacher with more than 30 years of experience, reviewed the interview guide and provided feedback. Based on the experts’ feedback and prior to data collection, two of the interview questions were reworded for better alignment to the study phenomenon, and the interview questions were emailed to the participants 48 hours prior to the face-to-face interview.

Demographic characteristics. The demographic characteristics are provided to demonstrate the maximum variation sampling technique utilized in the study to account for the potential diversity of programs across the state of Kansas (Patton, 2001). All of the participants in the study were male (100%) and 69% of the educators had between
20–29 years of teaching experience. Participants reported they taught in schools ranging in classification size as follows: 1A (15.4%), 2A (23%), 3A (15.4%), 4A (15.4%), 5A (15.4%), and 6A (15.4%). Frequency tables for the demographic characteristics are presented in Appendix E.

**Coding procedures.** Following the classic grounded theory coding procedures, the data—including the transcribed interviews, observation notes, and researcher memos—were analyzed as an aggregate dataset in three stages: open, selective, and theoretical (Glaser, 1978; Glaser, 2005; Glaser & Strauss, 1967; Urquhart, 2013). Initially, 68 open codes were created from the first interview, which were then grouped into eight substantive categories in the first selective coding stage. The open and selective coding processes were repeated with each subsequent interview. In total, 387 open codes and 8 selective codes were generated from the 13 interviews (see Appendix F).

As the analysis progressed, the eight categories were sorted into three more generalized core categories. In the first phase of the theoretical coding stage the relationships between the three core categories and two research questions were analyzed and resulted in the emergence of three substantive theories (see Table 1) related to the study phenomenon: (a) inefficacious transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change. In the second phase of theoretical coding, linkages between the three substantive theories were analyzed for the emergence or alignment of a more generalizable theoretical code for the research questions and were found to align with the classic theoretical code *autopoiesis* (Glaser, 2005).
Table 1

**Emergent Theories for Research Questions 1 and 2**

<table>
<thead>
<tr>
<th>Theory</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inefficacious transition to technology and engineering education</td>
<td>13</td>
<td>100%</td>
</tr>
<tr>
<td>2. Value for technical learning</td>
<td>13</td>
<td>100%</td>
</tr>
<tr>
<td>3. Industry demand-based change</td>
<td>13</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Note: N=13.*

**Emergent theory 1: Inefficacious transition to technology and engineering education**

Though study participants described potential strengths in the technology and engineering education curriculum, their past experience with modular technology and current unfamiliarity with engineering education caused the participants to doubt the efficacy of technology and engineering education curriculum. All 13 participants (100%) had experience in the transition from industrial arts to technology education through the modular technology initiatives, and no participants (0%) have continued to teach using the method. The study constructs (see Table 2) identified by participants when describing the transition to technology and engineering education included (a) exploratory, (b) short-term, (c) expensive, and (d) unfamiliar.

Table 2

**Constructs for Technology and Engineering Education**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Exploratory</td>
<td>7</td>
<td>54%</td>
</tr>
<tr>
<td>2. Short-term</td>
<td>10</td>
<td>77%</td>
</tr>
<tr>
<td>3. Expensive</td>
<td>6</td>
<td>46%</td>
</tr>
<tr>
<td>4. Unfamiliar</td>
<td>7</td>
<td>54%</td>
</tr>
</tbody>
</table>

*Note: N=13.*
The participants described the modular initiative through technology education as an effective way to explore a variety of technologies and careers appropriate for students at the junior high level. Participant 8 described the modules as “exciting” where students could explore “electricity, pneumatics, small engines, all kinds of stuff, and it was great fun,” and Participant 6 said, “I think the strengths were that most of the modules kind of interested the students.” As reported by Participant 5, “The strengths were that there were tons of things the kids could do…plenty of activities and projects.” However, the participants also noted that the interest and excitement was short-lived because each modular unit only lasted one or two weeks. Therefore, students would get a wide variety of exploratory learning but not a lot of depth. Participant 5 described the curriculum as “a lot of quantity but not a lot of quality.”

The participants shared disappointment in the teaching and learning methods of the modular programs. For example, Participant 11 reflected how the “teacher is not a teacher…[but] a facilitator” in a modular-based program. According to Participant 5, the teacher started the students on the first day of the module and then came back on the fifth day to check the students’ work. This type of teaching was labeled “glorified babysitting” by Participant 3, and Participants 6, 8, and 13 also identified how the modular program was a challenge for classroom management, and reported problems of early finishers. Participant 13 explained, “There is such a disparity in the amount of work that [it] took to complete them. We had some students who…would be done in two or three days and it’s a 10-day rotation,” while Participant 6 described the same situation when students who “were really top-notch in the class and they would finish that stuff”
quick. So what do you do with them then? It’s a nightmare.” Finally, Participant 8 labeled the overall experience as a “bad time”.

As for the learning, Participant 11 noted how there was a lack for higher-order thinking and “everything…[was] pretty minimum.” Participant 3 described the student experience as, “You set down, you tinker with something, and you go on. You really don’t get to see…the problem solving.” Participant 12 reflected, “I don’t think they were getting enough hands-on…I don’t think it [was] a great learning experience.” Another concern for the Participants was how the students would become interested in the modules and would want to do more, but could not once the individual module was over and they had to move on to the next one. Participant 9 reflected, “If you have somebody who’s really interested…we didn’t have anything to follow up. It gave us kind of a dead end. Even though students might have found something…and wanted to pursue it, we couldn’t help them.”

To transition to a modular technology program, the participants described how schools had to make significant investments in the initial purchase and continued maintenance of the furniture and equipment for the modules. For example, Participant 5 estimated the school spent “close to $350,000 to get the program off the ground.” But once the initial purchase was made, there was still a significant yearly investment to maintain and update the modules. Participant 5 described the modules as needing a “ton of maintenance” and Participant 1 estimated the schools needing to invest $30,000 every year just to keep the modules current. When asked why the school no longer taught using the modular technology, Participant 11 attributed the termination of the program to “the
money it takes to keep it up…after a while it became too expensive” and Participant 10 said, “The equipment wore out and it became difficult to get the approval to replace it.”

When describing the overall experience of the transition from industrial arts to technology education through the modular programs, the participants described concern in the initial stages and disappointment in the latter stages. Initially, the participants were concerned with schools replacing the traditional shops with the modular classrooms. For example, Participant 1 remembered a nearby school that “basically wiped out their whole woodshop…[and] went to all modules” and Participant 8 reflected, “All around me I was watching all these other schools selling all their shop equipment and go to the mini modules.” Participant 13 shared:

I had some big concerns at one point because schools were jumping on the bandwagon of modular and just doing away with shop areas completely. No manual arts, no industrial education whatsoever. Then it seemed like some of those folks who had done away with everything backpedaled a few years later and tried to re-implement the shops again but some of them obviously couldn’t afford it.

In some schools, the modular programs lasted approximately 10 years but in other schools they were removed much quicker. For example, Participant 12 reflected how the modular programs “came in fast and left just as fast as [they] came in.” Overall, the participants shared disappointment for the modular programs and when asked what the phrase technology education meant to Participant 3, the participant simply said, “I think it’s a dirty word.”

When asked about the potential integration of engineering within the current programs, multiple participants shared concern that it would be too expensive and not fit well with the type of students in their programs. For example, Participant 12 related the engineering expenses to those of the modular programs and didn’t believe the school
could afford the additional expenses needed to properly incorporate engineering into the curriculum. As for the students participation in an engineering-based curriculum, Participant 2 said, “I’m not sure the students have the skill level to do it” and Participant 10 believed it would only be relevant “to a select number of our students.” Participant 1 shared that an increase in engineering concepts in the program would discourage the students who need to take the technical courses from doing so because there would be an increase in theoretical concepts and a decrease in hands-on activities.

Two of the participants, both primarily drafting/CAD instructors, were open, receptive, and familiar with current engineering education. Both participants believed they were already incorporating engineering concepts into their programs. Participant 7 emphasized;

Well I have always been engineering…[and] we really haven’t changed that much. If we are true to our philosophy then we have been progressing all along with technology because technology is just a facilitator. Engineering hasn’t changed it’s that technology has been used as a resource to help facilitate engineering.

Participants 5 and 7 articulated that a blend between industrial education, technology education, and engineering education was the best curriculum for students. They described it as a balance between knowledge-based engineering concepts and hands-on technical learning skills.

**Emergent theory 2: Value for technical learning.** The study participants stressed the importance of teaching students technical knowledge and skills through project-based learning. All 13 participants (100%) identified a strong value in technical learning. The participants described technical learning as broad-based educational experiences that incorporate both the knowledge and skills needed to manipulate
resources into useful products. Constructs described by the participants included (a) project-based, (b) skills, (c) hands-on, (d) broad-based, and (e) life-long learning.

Table 3

Constructs for Technical Learning

<table>
<thead>
<tr>
<th>Construct</th>
<th>Word Frequency</th>
<th>Participant Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Project-based</td>
<td>96</td>
<td>13</td>
<td>100%</td>
</tr>
<tr>
<td>2. Skills</td>
<td>69</td>
<td>13</td>
<td>100%</td>
</tr>
<tr>
<td>3. Hands-on</td>
<td>65</td>
<td>11</td>
<td>85%</td>
</tr>
<tr>
<td>4. Broad-based/exploratory</td>
<td>29</td>
<td>10</td>
<td>80%</td>
</tr>
<tr>
<td>5. Life-long</td>
<td>19</td>
<td>8</td>
<td>62%</td>
</tr>
</tbody>
</table>

Note: N=13.

The most widely used term throughout the transcripts in relation to technical learning was the root word *project* (f=96). All 13 participants (100%) incorporated projects as major components in their curriculum. For example, Participant 6 emphasized the importance for students to “still do projects that they see something from start to finish” and Participant 3 stressed, “these kids have to see something with their hands that they can create on their own otherwise we lose them. We need to spark interest with what they’re good at.”

The projects implemented into the programs were tangible real-world products designed, created, and kept by the students. For example, Participant 1 contrasted the difference between projects created in an industrial education course versus a general education course: “…the biggest thing about industrial education is…[students] come out with a project at the end that’s…usable and you actually have 20 or 30 years down the road” and Participant 12 said;
We’ve built a lot of stuff the kids are going to use for the rest of their life. I tell the kids to write down your name, your year, and the school on the bottom or back of your project so when your grandkids are fighting over it, they know when it was built.

Reflecting on the value of the projects, Participant 9 said, “…the satisfaction that I see students get here on seeing something built with their own two hands [and] the pride the parents have in the piece of furniture is priceless.”

All 13 participants (100%) described the importance of teaching students some degree of technical skills. The root word *skill* was used 69 times throughout the transcripts. Participant 2 described the importance of applied skills and identified “the problem is none of the kids know how to build anything and that’s where we are really short in our schools. We don’t have kids who know how to build stuff…they don’t have the applied skills.” Participant 9 emphasized that the students “have to have the manual skills, those hands-on skills.” The participants described a strong connection between skill development and future employability and related their roles in education to teaching students skills for a future career. For example, Participant 5 noted, “I’m responsible for putting kids out there that can go to work, can get a job, and keep a job. I’m teaching them skills…to get jobs.” Participant 4 provided multiple examples of how the skills the students learned in the program contributed to their future career successes. In describing one of the students, the Participant said, “…so those old skills helped him because now he works in Washington, D.C. He has a five-axis CNC router that cost half a million dollars and he’s the only one that sets it up.”

Eleven out of 13 participants (85%) emphasized the importance of hands-on learning within industrial education. The root word *hand* was used 65 times throughout the transcripts. Participant 6 identified the purpose of industrial education as a program
to “teach students the workings of machines…anything that involves working with your hands.” Participant 4 described industrial education as “teaching people how to use their hands” and Participant 1 described it as “more hands-on for kids to do something with their hands.” Participant 10 was passionate about the hands-on component of the curriculum and exclaimed, “Darn it, we still have kids that…love to work with their hands! They love to build something. They love to build things. They are eager to get out and make money and they can do that.” As for a future curriculum, Participant 6 shared concern that “we don’t stray too far away from some hands-on skills versus the technology side of things.”

When discussing labor needs, Participant 5 discussed the need for workers “who know how to use their hands and build things.” In the community, Participant 1 described how local companies “can’t find enough workers that want to do stuff with their hands and work” and Participant 10 said, “We still need people to build our houses. We still need people to work on our cars. We still need people to weld. There [will] always be a need for that type of education.”

The root word *broad* or *explore* was used 29 times throughout the interview transcripts. Participant 3 identified the broad-based construct as providing the students with a strong technical foundation at the secondary level that could then be mastered in a specific area at the post-secondary level. Participant 7 described broad-based technical learning as teaching students “level 1” knowledge and skills and believed the more refined “level 2” and “level 3” skillsets were more appropriate for the post-secondary level. Participant 9 defined the industrial education curriculum as “exploratory skill building” and described the importance of teaching students a variety of technical
experiences that could be transferrable to multiple future career fields. Participant 12 defined the industrial education curriculum as “preparing students with a wide-base knowledge that will give them a step ahead either when they go to a college, or vo-tech, or straight out to the working world.” Components of the broad-based curriculum described by the participants included the (a) use of tools, (b) use of machines, (c) different materials, (d) safety, (e) use of technology, (f) problem-solving, and (e) design.

The root word *life* was used 19 times throughout the interview transcripts. The life-long learning construct was evident by the participants as they described how the industrial education programs helped students learn future life skills. For example, Participant 8 identified industrial education as a “life learning tool” and Participant 6 described it as developing a “sense of craftsmanship.” Participant 8 reflected, “…just teaching them something they can use for the rest of their lives just really makes my life.” Participant 13 believed one of the values in the industrial education curriculum was providing students with knowledge and skills to do their own maintenance and repair. The participant said, “I’ve always heard anything a person can do for themselves they don’t have to pay somebody else to do it later.” In Participant 12’s program the students were expected to demonstrate a strong work ethic and give 100% every day for the whole class. The Participant reflected, “I’d say the one thing that I give my students is pride in what they can do. I think that’ll take them a long way in life.”

**Emergent theory 3: Industry demand-based change.** The study participants were most responsive to external change initiatives that were in alignment with changes made in industry, and constructs described by the participants included (a) industry-based
technologies, (b) Kansas career pathways, and (c) computer numeric control (CNC) machine.

Table 4

Constructs for Industry Demand-Based Change

<table>
<thead>
<tr>
<th>Construct</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Industry-based technologies</td>
<td>9</td>
<td>69%</td>
</tr>
<tr>
<td>2. Kansas career pathways</td>
<td>10</td>
<td>77%</td>
</tr>
<tr>
<td>3. CNC machine</td>
<td>11</td>
<td>92%</td>
</tr>
</tbody>
</table>

Note: N=13.

All 13 participants’ (100%) programs reflected similarities to traditional industrial education-based programs. For example, Participant 9 described the courses as “pretty traditional project-oriented classes that you would see in most industrial arts programs,” and nine of the 13 participants (69%) described how their teaching and curriculum was heavily influenced by the manner of instruction they themselves had in high school or college. For example, Participant 6 explained, “You teach how you were taught. I think back to what I learned from [previous instructors] and I probably followed through with most of that…I still go back instinctively to what I learned there,” and Participant 4 reflected, “Well I’ve done this for 49 years. I [teach] just like how I was taught in high school and college. I demonstrate and they pay attention.”

Although all of the programs had similarities to traditional industrial education, all 13 participants (100%) described the inclusion, or need for greater inclusion, of current industrial-based technologies within the programs. Nine of the 13 participants (69%) specifically identified making changes based on the current demands of industry. Participant 7 discussed the influence industry should have on the curriculum and stressed how the industrial education courses should “move along with industry” and Participant 5
emphasized, “Industry guides what I do in my classroom. I don’t teach these kids something that they won’t be able to step into and start running with. Getting [students] ready for industry is my biggest concern.”

The remaining four participants (31%) who did not specifically identify making changes based on the demands of industry, did however describe the influence of the state’s career pathways initiative on their curriculum. For example, Participants 1 and 6 said, “The state funding pretty much dictates the courses anymore” and “Right now the biggest influence is the state, the funding, and the pathways.” When changes did occur, participants reported they were most comfortable with incremental changes. Participant 9 described it as “an evolution at a snail’s pace,” and Participant 6 agreed and said, “We are slowly changing.”

The most common current industrial technology identified by the participants was the inclusion, or the desire to include, a CNC machine. Participant 2 explained, “We incorporate a lot of CNC routing. From very simple stuff [like] inlays and 3D carvings to total projects from start to finish. That’s kind of the biggest difference from what we did quite a while ago” as well as Participant 1 who said, “We incorporate a lot more CNC router work.” Participants 3 and 9 did not have CNC machines but shared, “I would like to add a little bit more technology like a CNC with our woodworking” and “I would really like to bring in some CNC equipment…to add to the expertise of the kids coming out of here and being able to see how the CNC is used in industry.” As for the need for more industrial technologies, Participant 7 stressed, “It’s absurd that we don’t have a CNC. It’s absurd that we don’t have more advanced technology.”
Six of the 13 participants (46%) currently utilized a CNC machine and of the remaining seven participants, six (46%) identified the desire to acquire and incorporate a CNC machine but had not yet because of funding. Participant 3 identified the lack of funding as a contributing factor for not being able to change the curriculum, and compared current courses to those taught several years ago, and said, “The courses are fairly similar. The main reason they haven’t changed is because you always get from the administration, ‘We don’t have the money to do this or do that.’ So there’s no way to really branch out.” This lack was further elaborated by Participant 6, who said, “I wish I at least had some sort of tabletop CNC router or a plasma burn table. I put in for [them] over the years but you know how it is—money’s tight.” Participant 10 also noted how “technology is going to continue to evolve and education has never been good about keeping up with that because of the cost.”

Even though the name of the discipline as a whole had changed twice during the participants’ tenure, the name change had little effect on their curriculum as Participant 5 emphasized, “It doesn’t really matter what they call it…my common goal [is] for putting kids out there that can go to work,” and Participant 7 said, “Personally, I don’t see it as different. For whatever reason…the word industrial or career tech has created a dirty [connotation] and that my son or daughter is not going into those fields because maybe I’m a white-collar worker.” Participant 9 described the changes as “name changes for the sake of trying to define who we are,” while Participant 11 rationalized the name change as an “attempt from the state to bring up the quality of students in drafting.”
Evaluation of Findings

Three emergent theories for both research questions 1 and 2 were generated from the data analysis and aligned with the classic theoretical code autopoiesis. The substantive theories included (a) inefficacious transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change. A comparison of the findings from this study with the other related literature is provided below. Due to the inductive nature of the grounded theory study, the findings are organized by the three substantive theories that emerged from data analysis and addressed the two research questions.

**Emergent theory 1: Inefficacious transition to technology and engineering education.** The emergent theory 1 related to the guiding research question 2: Why have the Kansas industrial arts educators resisted the organizational change to technology and engineering education? This finding indicated industrial arts educators attempted a transition to the modular technology, and, due to a lack in overall success and increase in overall expense, the educators stopped program implementation, which was consistent with perspectives provided by Pullias (1997) who identified the modules as dead-end, lower level learning, mediocre, and expensive.

The transition to technology and engineering education began in the 1980s, but was most evident in the 1990s with the integration of the modular technology units. The degree of inclusion of at least some modular technology throughout the United States varied from state to state (Brusic & LaPorte, 2000; Harris, 2005) and in the current study, all 13 participants (100%) had experience in the modular technology inclusion and no participants (0%) continued the method; thus, the decline of integration of modular
programs reported was consistent with the overall decline throughout the nation and is evident by the absence of current literature. While the Harris (2005) study was the most recent study located in the literature related to modular technology education, no studies were located that documented the decline in the use of modular units in technology and engineering education and Carter (2013) identified the implementation of the modular programs as a trend in the latter decades of the 20th century.

Previous studies that examined the strengths of the modular units identified the advantages of the program as having a wider range of appeal, teaching more universal skills, reflecting more current technologies, and enhanced relationships with math, science, and technology (Degraw & Smallwood, 1997; Brusic & LaPorte, 2000; Harris, 2005). The evidence from emergent theory 1 was similar to the strengths identified by the previous studies, which explored the breadth of current technologies in the modular programs. Harris (2005) also noted educators teaching with modular programs had a positive perception of the modules and believed the programs were a better fit for themselves and their students, and indicated that 84% of the teachers believed the modular programs were better than conventional technical laboratories. These findings contrasted with emergent theory 1 as the educators in the current study identified the content and type of learning incorporated in the modular programs as contrary to their beliefs and values of what was important for students to learn. Conversely, theory 1 was consistent with Brusic and LaPorte (2002) who found that 64% of the sampled teacher educators disliked the modular technology programs and Weymer (2002) who found that the modular programs were difficult for non-analytical and unmotivated students.
**Emergent theory 2: Value for technical learning.** The emergent theory 2 related to the guiding research question 2: why have the Kansas industrial arts educators resisted the organizational change to technology and engineering education? As noted by Kelley and Wicklein (2009a), the recommended technology and engineering education curriculum emphasized broad-based technology literacy and not hands-on skill development in the technical fields. The evidence from the current study identified the emphasis in broad-based technology literacy was contrary to the beliefs and values of the educators in the current study and therefore they resisted the transition and continued to teach a traditional industrial-based curriculum incorporating technical knowledge and skill development.

Technical learning is not easily defined (Hansen, 2008) and an area lacking in research (Katsioloudis & Fantz, 2012). Autio and Hansen (2002) described technical learning and thinking as a penchant for solving practical problems through experience and the constructs found in this study for technical learning included project-based, skills, hands-on, broad-based/exploratory, and life-long learning. Technical learning has been valued amongst industrial educators for several decades, which was demonstrated by Schmitt and Pelley (1966) when they conducted one of the first comprehensive studies of the industrial arts discipline. In their study, the researchers found that the top purpose of industrial arts identified by the participants was to develop student skills in tools and machines and the remaining purposes related to various aspects of technical knowledge and skills. Fourteen years later, Bame and Miller (1980) conducted a similar study and found there was little change over the previous years as the top five purposes were relatively the same—all related to emergent theory 2 (Bame & Miller, 1980).
During the remainder of the 20th century and into the 21st century, evidence consistently demonstrated, as it did in the current study, the industrial education teachers have maintained a strong value in technical learning through a traditional industrial arts-based curriculum (Daugherty, 2005; Rogers, 1992; Volk, 1996). Even in studies sought to examine the inclusion of engineering design in the technology education curriculum, evidence continued to demonstrate how the educators valued technical learning as demonstrated in emergent theory 2 (Katsioloudis & Moye, 2012; Kelley & Wicklein, 2009a; Spencer & Rogers, 2006; Wright et al., 2008). For example, Kelley and Wicklein (2009a) found that the development of basic technical skills using tools was emphasized and not the application of math and science. The researchers interpreted this to indicate that a significant percentage of technology educators had not transitioned to the recommended broad-based engineering design curriculum and instead emphasized technical skill development more closely related with industrial education. Kelley and Winklein (2009a) noted that even after decades of promoting a broad-based technology literacy program, the content in the technology education courses still emphasized the traditional technical tool skills in alignment with emergent theory 2 and similar to the findings from the Bame and Miller (1980) and Schmitt and Pelley (1966) studies.

Emergent theory 2 contrasted with recent literature from the technology and engineering education profession that emphasized engineering design as the curricular focus for the discipline. Wicklein (2006) brought the debate to the forefront by articulating five reasons why engineering design should be the curricular focus for technology education. The emphasis was strengthened when Childress and Rhodes (2008) developed engineering student outcomes for grades 9-12 and Wicklein et al.
(2009) developed concepts for engineering design. In Gattie and Wicklein’s (2007) study, which included members of the International Technology and Engineering Education Association and a 49% response rate, 90% of respondents were teaching topics/courses related to engineering design and in Denson’s et al. (2009) study, which included technology education teachers in the state of Georgia and a 36% response rate, 76% of the teachers were teaching content related to engineering. Conversely, the findings from the current study indicated that only two of 13 participants (15%) described incorporating engineering design into their courses and no participants (0%) identified it as the primary curricular focus, and instead maintained a curricular focus related to emergent theory 2.

**Emergent theory 3: Industry demand-based change.** The emergent theory 3 related to the guiding research question 1: what types of resistance have the Kansas industrial arts educators demonstrated toward the transition to technology and engineering education? Burke (2013) categorized resistance into three forms: (a) blind, (b) political, and (c) ideological; and emergent theory 3 indicated the educators resisted the transition to technology and engineering education and instead aligned their programs with industry-based career and technical education programs. The decision to resist the broad-based technology literacy initiative and willingness to incorporate an industry-based change demonstrated an ideological form of resistance toward technology and engineering education which was consistent with Lewin’s (1947) and Schein’s (2010) three-step change theory that explained in order for sustained organizational changes to occur, the underlying cultural beliefs and values would need altered.
Emergent theory 3 indicated the industrial education teachers made incremental changes in alignment with the industry-based career and technical education initiatives and not based on the recommended curriculum for technology and engineering education. These findings were consistent with Wright’s et al. (2008) study where the majority of the respondents identified career and technical education as the primary purpose for technology education. Moye et al. (2012) also found a strong connection between career and technical education and technology and engineering education when the participants in the study identified that a majority of the funding for technology and engineering education came from career and technical education and that the representatives at the state departments of education viewed technology and engineering education under the umbrella of career and technical education.

The evidence for emergent theory 3 was contrary to the Schmitt and Pelley (1966) findings in that the prevocational experiences and vocational training options were the last two purposes identified by the educators. Emergent theory 3, along with the evidence from Wright et al. (2008), Kelley and Wicklein (2009a), and Moye et al. (2012), demonstrated a change over the past half-century in the beliefs and values amongst the industrial education educators. As changes have been made, the industrial education teachers have made changes in alignment with industry-based career and technical education initiatives and not technology and engineering education initiatives.

**Autopoiesis.** In the final phase of the classic grounded theory coding technique, the emergent theories were analyzed for alignment with a more generalizable theoretical code related to the research questions. The analysis identified an alignment between the three substantive theories and the theoretical code autopoiesis described by Glaser
(2005). Autopoiesis is the process where an individual, organization, or system regulates the change process through resistance and incremental changes in order to maintain the autonomy and integrity of the established structure (Glaser, 2005). The findings from the current study demonstrated how the industrial education teachers were resilient to external pressure and instead maintained autonomy by regulating the change process through renewal of industry demand-based change and preserving the integrity of technical learning within the organization.

**Summary**

The problem investigated in this study was the industrial arts educator resistance toward the organizational change to technology and engineering education and the analyses resulted in the emergence of three substantive theories related to the study phenomenon: (a) inefficacious transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change. Emergent theory 1 developed from participant descriptions of the transition to technology and engineering education as inefficacious due to broad-based and short-term nature of the learning along with the high levels of expense and maintenance needed for the curriculum. Emergent theory 2 developed from participant reported value for technical learning through a curriculum that incorporates projects, skill development, hands-on, broad-based, and life-long learning opportunities. Emergent theory 3 developed from participant descriptions and demonstration of changes based on the demands of industry.

The evaluation of findings demonstrated the findings from the current study were both consistent and in contrast to other literature relating to the study phenomenon. There was limited current literature related to emergent theory 1 and the findings from
the current study contrasted with evidence from Harris (2005) and Brusic and LaPorte (2000) as to the efficacy of the technology modular programs but were consistent with the perspective from Pullias (1997). The findings for emergent theory 2 were consistent with findings over the past half-century from Schmitt and Pelley (1966), Bame and Miller (1980), Volk (1996), Daugherty (2005), and Kelley and Wicklein (2009a); which all indicated the strong value for technical learning amongst the educators but were not consistent with the more recent literature recommending engineering design as the curricular focus (Denson et al., 2009; Gattie & Wicklein, 2007; Wicklein, 2006; Wicklein et al., 2009). The findings for emergent theory 3 were consistent with the findings of Wright et al. (2008) and Moye et al. (2012) in that the educators resisted the change to technology and engineering education and instead demonstrated change based on the demands of industry. This type of resistance aligned with the organizational change and resistance models identified by Lewin (1947), Schein (2012), and Burke (2013). Overall, the three emergent theories aligned with the more generalizable theoretical code autopoiesis as described by Glaser (2005).
Chapter 5: Implications, Recommendations, and Conclusions

The problem investigated in this study was the significant percentage of the secondary industrial education teachers who have resisted the organizational change to technology and engineering education and instead have continued to teach a traditional industrial arts based curriculum under the umbrella of career and technical education (Kelley & Wicklein, 2009a; Sanders, 1997; Spencer & Rogers, 2006; Wright et al., 2008). Therefore, the purpose of the qualitative grounded theory study was to explore why the industrial arts educators resisted the organizational change to technology and engineering education. The study was guided by two research questions: (a) what types of resistance have the Kansas industrial arts educators demonstrated toward the transition to technology and engineering education and (b) why have the Kansas industrial arts educators resisted the organizational change to technology and engineering education?

The study utilized a classic grounded theory technique (Glaser, 1978; Glaser 2005; Glaser & Strauss, 1967; Urquhart, 2013) and resulted in the emergence of three substantive theories related to the study phenomenon: (a) inefficacious transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change.

The primary limitation of the study was the limited generalizability of the findings to the larger population. The small and purposive sampling allowed for in-depth investigations of each educator but also limited the generalizability. The findings were also limited to the perceptions of educators who were teaching an industrial-based curriculum as the educators teaching a technology and engineering-based curriculum were specifically excluded. Lastly, the findings were limited by the interpretative
analysis of the generation of 387 open codes, and used the three-stage classic grounded theory coding procedure to categorize the detailed open codes into three emergent theories, which may have limited findings to the interpretive analysis of one researcher. To reduce research bias, multiple measures were taken throughout the planning, data collection, analysis, and reporting processes in order to ensure the ethical dimensions of the study. Northcentral University Institutional Review Board approval ensured the study would not subject the study participants to undue risk or harm (Babbie, 2009), and a field test was conducted for assurances of instrumentation validity. Further, assurances for participant confidentiality included the use of pseudonyms, and secure storage of the digital and hard copy information. The remaining sections of Chapter 5 will provide the implications of the study findings and the recommendations for the practical application of the findings including future research.

Implications

The implications of this study may be significant for current practitioners, curriculum developers, and professional leaders in the industrial technology and technology and engineering education disciplines. The implications were inferred from the three emergent theories identified in the data analysis: (a) inefficacious transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change and interrelated to both research questions 1 and 2. As such, the study implications are organized and presented by each emergent theory to allow for the alignment between the emergent theories and the research questions.

Emergent theory 1: Inefficacious transition to technology and engineering education. Educators perceived the original transition from industrial arts to technology
education as inefficacious and did not see a clear difference in the more recent transition to engineering education. The implication of emergent theory 1 is it provided partial explanation as to why industrial education teachers have resisted the curricular transition to technology and engineering education (i.e. research question 2). Just as industrial educators resisted the initial transition from industrial arts to technology education (Daugherty, 2005; Kelley & Wicklein, 2009a; Rogers, 1992; Volk, 1996), the emergent theory indicated educators will continue to resist the latter changes toward engineering design unless there is a clear demonstration on the efficacy of the curriculum and changes are made in alignment with emergent theories 2 and 3.

**Emergent theory 2: Value for technical learning.** Autio and Hansen (2002) described technical learning and thinking as a penchant for solving practical problems through experience and the constructs found in this study for technical learning included project-based, skills, hands-on, broad-based/exploratory, and life-long learning. The implication of emergent theory 2 is that it indicated industrial education teachers will continue to teach an industrial-based curriculum with technical learning opportunities unless there is a forceful demand to unfreeze the previous practices and learn new concepts as described by Lewin (1947) and Schein (2010).

As for educational theory, emergent theory 2 clarified a distinction between the educational philosophies of technology and engineering education leaders and practitioners in the field in that the leaders of the discipline have built and promoted a curriculum through a theoretical lens based on a liberal education for all students whereas industrial educators have adopted a more blended approach between general education and vocational education with an emphasis in technology learning. This differentiation
provides partial explanation for the discipline’s identify crisis documented over the past three decades (Akmal et al., 2002; Clark, 1989; Katsioloudis & Moye, 2012; Sanders, 1997) and insight into the cultural beliefs and values of industrial education teachers (Schein, 2010).

**Emergent theory 3: Industry demand-based change.** Industrial educators made incremental changes in alignment with industry-based career and technical education initiatives. The implication of emergent theory 3 is that it identified the partial existence of the educational philosophy of vocationalism with industrial education teachers in Kansas. As part of the 21st century dialogue on college and career readiness through the transition from vocational education to career and technical education (Alfeld & Bhattacharya, 2012; Withington et al., 2012), the Kansas State Department of Education established multiple incentives for high schools to emphasize career readiness including additional school funding and tuition-free postsecondary credits for students enrolled in career and technical education courses.

Another implication of emergent theory 3 for the technology and engineering education discipline was it identified a greater alignment amongst industrial education teachers with vocational-oriented programs through career and technical education and not with broad-based technology literacy programs through technology and engineering education. In aligning their programs with the current demands and needs of industry, industrial educators demonstrated they were not outright resistant to change, which would have been a blind form of resistance (Burke, 2013), but instead demonstrated an ideological and cultural resistance to the technology and engineering education curriculum (Burke, 2013; Schein, 2010) as inquired by research question 1. The
educators did not perceive the recommended broad-based technology and engineering education curriculum as relevant to the industrial career paths of students and therefore resisted the transition and instead made changes in alignment with the career pathway initiatives that were in alignment with industry-based demands and statewide initiatives (Moye et al., 2012; Wright et al., 2008).

**Recommendations**

The three emergent theories supported the recommendations for practice and future research. The recommendations for practical application may provide useful information for leaders of technology and engineering education in addressing the division and identity crisis within the discipline (Akmal et al., 2002; Clark, 1989; Katsioloudis & Moye, 2012; Sanders, 1997). Recommendations for future research are also presented to provide further clarification and validation of the emergent theories and constructs presented from the current study.

**Recommendations for practice.** Based on emergent theory 1, the first recommendation for practice is for leaders of the technology and engineering discipline in the Midwestern region of the United States to evaluate the current technology and engineering education curriculum along with related statewide research (e.g. Werner, et al., 2011; Wright et al., 2008) and differentiate it with the previously recommended modular technology units. As evidenced within emergent theory 1, as long as industrial educators perceived the technology and engineering education curriculum as similar to the previous modular units that were identified as inefficacious, industrial educators continued to resist the change. Based on the constructs for emergent theory 1, technology and engineering education leaders need to focus on identifying how the technology and
The engineering education curriculum may provide long-term learning, affordability, and familiarity to previously established curriculum in the industrial education area.

The second recommendation for practice, based on emergent theory 2, is for leaders of the technology and engineering discipline in the Midwestern region of the United States to evaluate the technology and engineering education curriculum and identify opportunities for technical learning. If gaps are identified, then it is recommended for technology and engineering education leaders to pursue the development of more technical learning opportunities within the curriculum and balance the broad-based technology literacy, engineering design, and technical skill development within the curriculum. Based on the constructs identified for emergent theory 2, leaders in the discipline need to focus on project-based learning, technical skill development, hands-on activities, broad-based learning, and life-long learning opportunities.

The third recommendation for practice, based on emergent theory 3, is for leaders of the technology and engineering discipline in the Midwestern region of the United States to evaluate the technology and engineering education curriculum and identify alignments between the learning activities and the demands of industry. If gaps are identified, then it is recommended for technology and engineering education leaders to pursue the development of more industry-related learning opportunities and pursue possible partnerships between the International Technology and Engineering Educators Association and the Association for Career and Technical Education. Based on emergent theory 3, leaders in the discipline need to place an emphasis on the current technologies used in industry with a focus on CNC machining.
**Recommendations for future research.** The first recommendation for future research is to conduct a Delphi method study to develop operational definitions for the emergent theories as the convergence of opinion from a panel of experts could provide validation to the emergent theories and create a foundation for future inferential research. The Delphi method has been a common method utilized in the technology and engineering education literature (Katsioloudis & Moye, 2012; Ritz, 2009; Rossouw, Hacker, & de Vries, 2011; Wicklein et al., 2009) and also for establishing operational definitions (Rodriguez-Manas et al., 2012; Skulmoski, Hartman, & Krahn, 2007). The operational definitions developed from the Delphi study could then be used to conduct further research to expand the theoretical model begun in the current study.

The second recommendation for future research is to develop a quantitative quasi-experimental or experimental study to test the three theories that emerged from the current study. Hypotheses for each theory could be developed from the findings of the Delphi study and incorporated into a quasi-experimental nonequivalent-groups design with a modified curriculum based on the emergent theories (Cozby, 2009). The effects of the program could be measured with a pretest-posttest for both the students and educators and comparisons could be made between the treatment and control groups with the purpose of testing the theories. Additional longitudinal experiments could be incorporated to determine if the modifications to the curriculum were sustained and deeper level beliefs and values of the educators were changed (Schein, 2010).

The third recommendation for future research is to conduct a larger-scale quantitative study to survey a large sample of technology educators from a national perspective to generalize the findings to a larger population of educators. After field-
testing and validation, the sample survey could be distributed to collect the experiences and perceptions of educators related to the emergent theories. Data collected from a sample of educators across a larger geographic region may provide validation and generalization to the emergent theories from the current study (Urquhart, 2013). Additionally, the inclusion of both industrial educators and technology and engineering educators in the survey study would allow direct inferential comparisons of the perceptions between the two educator groups.

**Conclusions**

The problem investigated in this study was the significant percentage of secondary industrial education teachers who resisted the organizational change to technology and engineering education and instead continued to teach a traditional industrial arts based curriculum under the umbrella of career and technical education (Kelley & Wicklein, 2009a; Sanders, 1997; Spencer & Rogers, 2006; Wright et al., 2008). Therefore, the purpose of the qualitative grounded theory study was to explore the industrial education teachers’ resistance toward the organizational change to technology and engineering education. As a result of the grounded theory research, three substantive theories emerged from the data analysis: (a) ineffectuous transition to technology and engineering education, (b) value for technical learning, and (c) industry demand-based change.

Throughout the chapter, the study implications for each theory were identified and discussed. Emergent theory 1 provided partial explanation as to why industrial educators resisted the transition and indicated future resistance could be anticipated if changes were not made. Emergent theory 2 clarified a distinction between the education philosophies
of technology and engineering education leaders and the industrial education practitioners in the field. Lastly, emergent theory 3 identified the prevalence of vocationalism in industrial educators and a form of ideological resistance to the technology and engineering education transition.

The chapter concluded with three recommendations for practice and two recommendations for future research. It was recommended that the leaders of the technology and engineering education discipline differentiate the technology and engineering education curriculum from the previous modular technology curriculum, articulate and include technical learning opportunities with the technology and engineering education curriculum, and align the technology and engineering education curriculum with the industry and workforce needs. The three recommendations for future research included a Delphi method study to operationalize the emergent theories, a quantitative quasi-experimental or experimental study to test the three theories, and a sample survey study related to the emergent theories distributed to a larger geographic population to generalize the findings to a larger population of educators.
References


Appendixes
Appendix A: Interview Guide

1) **Demographic Facesheet**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Name:</td>
<td></td>
</tr>
<tr>
<td>b. Date:</td>
<td></td>
</tr>
<tr>
<td>c. School:</td>
<td></td>
</tr>
<tr>
<td>d. School size classification:</td>
<td></td>
</tr>
<tr>
<td>e. School geographic region:</td>
<td></td>
</tr>
<tr>
<td>f. Sex:</td>
<td></td>
</tr>
<tr>
<td>g. Age:</td>
<td></td>
</tr>
<tr>
<td>h. License/endorsements:</td>
<td></td>
</tr>
<tr>
<td>i. Post-secondary school:</td>
<td></td>
</tr>
<tr>
<td>j. Number of years teaching:</td>
<td></td>
</tr>
<tr>
<td>k. Regular courses taught:</td>
<td></td>
</tr>
</tbody>
</table>
2) Interview Questions

a. Please describe the courses that you teach and provide a general description of the content, activities, and projects in those courses?

b. How do the subjects and curriculum you teach now differ from your early teaching experiences?

c. If different, why have you changed from what you did before?

d. From your perspective, what is the purpose of the industrial arts curriculum?

e. From your perspective, what is the purpose of the technology and engineering education curriculum?

f. From your perspective, what is the purpose of the career and technical education curriculum?

g. Does your curriculum most closely reflect an industrial arts, technology and engineering education, or career and technical education program?

h. From your perspective, what are the advantages or strengths of transitioning industrial arts to technology and engineering education?

i. From your perspective, what are the disadvantages or weaknesses of transitioning industrial arts to technology and engineering education?

j. What type of courses and curriculum will be best for students in the future?

k. What type of resources, if any, would help you in transitioning to the scenario you just described?

l. Is there anything more you would like to add related to the questions we’ve just discussed?


<table>
<thead>
<tr>
<th>Interview Question</th>
<th>RQ #</th>
<th>Content</th>
<th>Tense</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Please describe the courses that you teach and provide a general description of the content, activities, and projects in those courses?</td>
<td>General</td>
<td>Experience/ Behavior</td>
<td>Present</td>
</tr>
<tr>
<td>b. How do the subjects and curriculum you teach now differ from your early teaching experiences?</td>
<td>Q1</td>
<td>Experience/ Behavior</td>
<td>Past</td>
</tr>
<tr>
<td>c. If different, why have you changed from what you did before?</td>
<td>Q1</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>d. From your perspective, what is the purpose of the industrial arts curriculum?</td>
<td>Q2</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>e. From your perspective, what is the purpose of the technology and engineering education curriculum?</td>
<td>Q2</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>f. From your perspective, what is the purpose of the career and technical education curriculum?</td>
<td>Q2</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>g. Does your curriculum most closely reflect an industrial arts, technology and engineering education, or career and technical education program?</td>
<td>Q1 &amp; Q2</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>h. From your perspective, what are the advantages or strengths of transitioning industrial arts to technology and engineering education?</td>
<td>Q1 &amp; Q2</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>i. From your perspective, what are the disadvantages or weaknesses of transitioning industrial arts to technology and engineering education?</td>
<td>Q1 &amp; Q2</td>
<td>Opinion/ Values</td>
<td>Present</td>
</tr>
<tr>
<td>j. What type of courses and curriculum will be best for students in the future?</td>
<td>General</td>
<td>Opinion/ Values</td>
<td>Future</td>
</tr>
<tr>
<td>k. What type of resources, if any, would help you in transitioning to the scenario you just described?</td>
<td>General</td>
<td>Experience/ Behavior</td>
<td>Future</td>
</tr>
<tr>
<td>l. Is there anything more you would like to add related to the questions we’ve just discussed?</td>
<td>General</td>
<td>General</td>
<td>General</td>
</tr>
</tbody>
</table>
### 4) Observation Instrument

<table>
<thead>
<tr>
<th>Concepts</th>
<th>RQ #</th>
<th>Field Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Description of types of labs in the school (e.g. metals, woods, modular, etc.)</td>
<td>Q1</td>
<td></td>
</tr>
<tr>
<td>b. Description of the equipment and/or technology in the labs (e.g. portable vs. stationary, traditional vs. computerized, etc.)</td>
<td>Q1</td>
<td></td>
</tr>
<tr>
<td>c. Description of the lab condition (e.g. safety, layout, types of posters, etc.)</td>
<td>Q1</td>
<td></td>
</tr>
<tr>
<td>d. Description of the projects created (e.g. traditional vs. tech-oriented, student-lead vs. instructor-lead, etc.)</td>
<td>Q1</td>
<td></td>
</tr>
<tr>
<td>e. Other notes</td>
<td>Open</td>
<td></td>
</tr>
</tbody>
</table>
5) Memo Format

<table>
<thead>
<tr>
<th>Memo Number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memo Date:</td>
</tr>
<tr>
<td>Memo Time:</td>
</tr>
<tr>
<td>Memo Location:</td>
</tr>
<tr>
<td>Memo Reference:</td>
</tr>
<tr>
<td>Memo:</td>
</tr>
</tbody>
</table>
Appendix B: Informed Consent Form

Educator Resistance to Change: A Grounded Theory Study of the Technology and Engineering Education Transition

**What is the study about?** You are invited to participate in a research study being conducted for a dissertation at Northcentral University in Prescott, Arizona. The study is designed to explore why some industrial arts educators have resisted the transition to technology and engineering education. You were selected because you responded to an email invitation for participation in the study. There is no deception in this study.

**What will be asked of me?** Study participation will include a face-to-face interview with you at your local school. Part of the interview will include a tour of your program’s facilities and description of the courses that you teach. The interviews will likely take approximately one hour and will be scheduled at your convenience. The interviews will be audio recorded and later transcribed as part of the interview process. The collected data will be compared with the other interview data and analyzed for consistent themes amongst the educators.

**Who is involved?** The following people are involved in this research project and may be contacted at any time: Kenny Rigler and Dr. Robin Throne.

**Are there any risks?** Although there are no known risks in this study, emotional distress may be possible if discussing your previous experiences as an educator surfaces any past negative experiences. However, you may stop the study at any time. You can also choose not to answer any question that you feel uncomfortable in answering.

**What are some benefits?** There are no direct benefits to you of participating in this research. No incentives are offered. The results will have scientific interest that may eventually have benefits for the technology and engineering education discipline.

**Is the study anonymous/confidential?** The data collected in this study are confidential. Your name or personal information is not linked to data. Only the researchers in this study will see the data. The data, including the audio files, will be destroyed after three years.

**Can I stop participating the study?** You have the right to withdraw from the study at any time without penalty. You can skip any questions on any questionnaires if you do not want to answer them.

**What if I have questions about my rights as a research participant or complaints?** If you have questions about your rights as a research participant, any complaints about your participation in the research study, or any problems that occurred in the study, please contact the researchers identified in the consent form. Or if you prefer to talk to someone outside the study team, you can contact Northcentral University’s Institutional Review Board at irb@ncu.edu or 1-888-327-2877 ext. 8014.
Contact Information

We would be happy to answer any question that may arise about the study. Please direct your questions or comments to:

Kenny Rigler
(785) 628-5812
klrigler@fhsu.edu

and/or

Dr. Robin Throne
rthrone@ncu.edu

Signatures

I have read the above description for the Educator Resistance to Change: A Grounded Theory Study of the Technology and Engineering Education Transition study. I understand what the study is about and what is being asked of me. My signature indicates that I agree to participate in the study.

Participant Printed Name: ____________________________________________________

Participant Signature: _____________________________________________________ Date: __________

Researcher Printed Name: ____________________________________________________

Researcher Signature: _____________________________________________________ Date: __________
Appendix C: Letter of Invitation to Participants

Dear Industrial Arts Educator:

I am currently involved in a doctoral research project examining why some industrial arts educators have resisted the change to technology and engineering education in the state of Kansas. This study is part of the final requirements of my Ph.D. program in Education at Northcentral University.

The purpose of the study is to examine why industrial arts educators are still teaching the traditional-based programs and have resisted the transition to technology and engineering education. In the 1980s, the leaders of the industrial arts profession initiated a purposeful transition away from industrial arts and a concentrated focus toward technology education. More recently, the leaders have initiated yet another transition to include engineering education. Despite major efforts over the past three decades from these leaders, studies indicate that a significant percentage of educators are still teaching a traditional industrial arts program under the umbrella of career and technical education.

I am writing to request your participation in the study. You qualify for participation if you are currently teaching a traditional industrial arts based program in the state of Kansas and have been teaching for a minimum of five years. Study participation will include a face-to-face interview with you at your local school. Part of the interview will include a tour of your program’s facilities and description of the courses that you teach. The interviews will likely take approximately one hour and will be scheduled at your convenience.

The purpose of this initial email is to invite you to participate in the study. If you are available and willing to participate, please reply back to this email (kligler@fhsu.edu) with your (a) contact information, (b) district information, (c) number of years of teaching experience, and (d) best times available to meet. From the group of educators that reply back, a sample will be drawn for actual inclusion in the study based on the size and location of your school district. I would greatly appreciate your willingness to participate in the study. Thank you and I look forward to hearing from you.
Appendix D: Letter of Collaboration

From: Kenneth L Rigler/FHSU
To: Kim Stewart/FHSU
Date: 06/17/2013 04:57 PM
Subject: Applied Technology Educator Database

Mr. Stewart-

For my dissertation, I am planning to conduct a qualitative grounded theory study to explore the industrial arts educator resistance toward the transition of technology and engineering education. The title of my dissertation is *Educator Resistance to Change: A Grounded Theory Study of the Technology and Engineering Education Transition*. The study participants will include current industrial arts/technology educators in the state of Kansas with a minimum of 5 years of teaching experience. Would it be possible for me to use the educator database that has been developed and maintained by the Institute of Applied Technology at Fort Hays State University? I would use the information from the database to contact (via email) the current industrial arts/technology education teachers in Kansas to ask for their willingness to participate in my study. If you would like more information about my study I would be happy to provide you with further details.

Kenny Rigler, Instructor
Davis Hall 101A
Institute of Applied Technology
Fort Hays State University
(785) 628-5812

From: Kim Stewart/FHSU
To: Kenneth L Rigler/FHSU
Date: 06/18/2013 08:11 AM
Subject: Re: Applied Technology Educator Database

Mr. Rigler,

The nature of your study is pertinent to the Institute and could benefit the progress of Technology Education in Kansas. The use of the IAT’s data base is appropriate for this study. Please contact Dar Cole and she can provide information about the data base.

Kim M. Stewart
Associate Professor, Executive Director
Institute of Applied Technology
Fort Hays State University
600 Park Street
Hays, Kansas 67601
785-628-421
Appendix E: Demographic Characteristics Frequency Tables

Table E1

Gender

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>13</td>
<td>100</td>
</tr>
<tr>
<td>Female</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


Table E2

Teaching Experience

<table>
<thead>
<tr>
<th>Experience</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 9 years</td>
<td>1</td>
<td>7.7</td>
</tr>
<tr>
<td>10 – 19 years</td>
<td>1</td>
<td>7.7</td>
</tr>
<tr>
<td>20 – 29 years</td>
<td>9</td>
<td>69.2</td>
</tr>
<tr>
<td>30 – 39 years</td>
<td>1</td>
<td>7.7</td>
</tr>
<tr>
<td>&gt; 40 years</td>
<td>1</td>
<td>7.7</td>
</tr>
</tbody>
</table>


Table E3

High School Size

<table>
<thead>
<tr>
<th>Class</th>
<th>Enrollment</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>20 – 99 students</td>
<td>2</td>
<td>15.4</td>
</tr>
<tr>
<td>2A</td>
<td>100 – 154 students</td>
<td>3</td>
<td>23.0</td>
</tr>
<tr>
<td>3A</td>
<td>156 – 249 students</td>
<td>2</td>
<td>15.4</td>
</tr>
<tr>
<td>4A</td>
<td>251 – 734 students</td>
<td>2</td>
<td>15.4</td>
</tr>
<tr>
<td>5A</td>
<td>737 – 1336 students</td>
<td>2</td>
<td>15.4</td>
</tr>
<tr>
<td>6A</td>
<td>1357 – 2258 students</td>
<td>2</td>
<td>15.4</td>
</tr>
</tbody>
</table>

Appendix F: Selective and Open Codes

Table F1

Listing of Selective and Open Codes

<table>
<thead>
<tr>
<th>Selective Codes</th>
<th>Open Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change</td>
<td>Less bookwork more projects, Teach with what you have, Smaller projects, Hard to learn new technologies, Change driven by state pathways, Change based on drive to be best as possible, Change based on student interests, Change in name not content, Change based on industry needs, More design, Incremental change, Teach how you were taught, Receptive to change early in career, Resistance based on industry contradiction, Resistance based on effort, &quot;Hard to teach an old dog new tricks&quot;, Transition to more technology, More 3D less CAD, CNC, Pressure toward modular program, &quot;Old School&quot;</td>
</tr>
<tr>
<td>Future Preparation</td>
<td>High school dual credit less quality, Material to process to product...success, Make students think about future career, More computer literate skills, 4-year college not for everyone, Cost of college, CTE is for post-secondary, CTE Pathways, Misconception toward technical professions, Need for more parent involvement, Outsource to technical colleges, Partnerships with technical colleges for concurrent credit, Push students to achieve highest possible, SB 155 - free tuition for technical courses, SB155 good for some students, Students not ready to make career choice, Tracking, Students do not stay within career track</td>
</tr>
<tr>
<td>Value in Technical Learning</td>
<td>Combine traditional with modern production, Same processes new technology, Blend of Industrial, Career, and Engineering, &quot;Sense of craftsmanship&quot;, &quot;Lifelong learning tool&quot;, Emphasis on safety, Learn by trial and error, Traditional shop/learning, Practical application of math and science, Develop problem-solving skills, Technology as practical tool, More electronics, More construction, Importance of blend between knowledge and skills, General processes, knowledge, skills, Importance of machine and tool use, More residential maintenance, Importance of drafting/design, Importance of hand drafting first, More design, Importance of skills, Importance of project-based learning, Students want hands-on project-based learning, Importance of hands-on learning, IE more hands-on and less theoretical, Importance of CTE, CTE</td>
</tr>
</tbody>
</table>
blends knowledge and skills, CTE Certification, CTE as direct job preparation, CTE specializes in an area, "eggs in one basket", Embrace programs with long-term benefits, IE for non-college bound students, Learning for lower level students, Absence of relevance in general education, Learning needs to be enjoyable

<table>
<thead>
<tr>
<th>Pathway Limitations</th>
<th>&quot;Play the game to get the money&quot;, State uses money to dictate curriculum, Freedom outside of CTE pathways, Decrease of local control, Change is based on the funding available, Increase in state control/influence through pathways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness of Industrial Education (IE)</td>
<td>Develop confidence and pride, Develop work ethic, Exploratory, IE not practical just a reward, Misconception of value and role of IE, Emphasis on IE with some CTE, Project-based learning needs practical relevance, IE is self-sustaining, High school focused on basics, Drop-out rate of engineering programs</td>
</tr>
<tr>
<td>School Limitations</td>
<td>Partnership with neighbor school, Need for better counseling, Shortage of IE teachers, Limited by funding, Change based on money available, Limited by personnel, Limited by school size, Limited by facility, Need for well-funded facility, Need for student direction, Need for more concurrent credit options, Girls only class would be beneficial, TEE would compete with upper level academic courses</td>
</tr>
<tr>
<td>Technology and Engineering Education (TEE)</td>
<td>Not practical learning, Modules good way to teach large numbers, Higher level drafting, Preparation for future engineers, Modules replaced by technology, More than just skills, Unfamiliar with current TEE, Inclusion of engineering, Related to STEM, Anyone can teach TEE, Interest in PLTW, TEE is a &quot;dirty word&quot;, TEE for a different clientele of students, Blend applied skills with math/science principles, Too much influence from math and science, Exclusiveness, Lack of model schools in TEE, Robotics, Importance of design, Middle school explorations, Evidence of TEE failure, &quot;Regurgitation of modular technology&quot;, &quot;It was a bad time&quot;, Modules were &quot;glorified babysitting&quot;, Modular failure, Modular labs were expensive and high maintenance, Modules as short-term solution, Modules had no long-term or higher order learning, &quot;nightmare&quot;, Teachers/Schools burned from modular labs, Schools replaced shops with modular labs</td>
</tr>
</tbody>
</table>
and regretted it, Revert back from modules, Technology as toy, Uncertainty toward the definition/purpose of TEE, Technology as panacea

| Decrease in Technical Ability to Work | Lack of respect for authority, Decline in quality and quantity of classroom work, Decline in IE programs, Shortage of technical workers, Limited comprehension capability of students, Lack of student dedication/motivation, Students are too busy, General ignorance to the complexity of project completion, Students no longer learn how to work at home, Student culture is less able to work with machines, tools, hand, Farm kids can use hands, handle tools, and problem-solve |

*Note.* Open codes only listed once even though identified multiple times throughout study.