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Critical Success Factors for Reskilling and Upskilling Engineer Leaders in Customized Executive Education Programs

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This is to certify that the doctoral dissertation by

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2022

Abstract

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by

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MA, Walden University, 2020

MA, University of Phoenix, 2004

BA, Arizona State University, 2001

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Sparse research on customized executive education programs leaves a gap in the extant literature on the critical success factors needed for reskilling and upskilling engineers in leadership development. The purpose of this qualitative multiple case study was to describe executive education program experts' views on the critical success factors needed in customized executive education programs for reskilling and upskilling engineers in leadership development. To meet this study's purpose, a multiple case study design was used to collect data from a purposeful sample of 11 executive education program experts. Semistructured interviews, archival data, and reflective field notes supported the trustworthiness of the study's findings through data triangulation. Three conceptual models framed this study: Rottmann et al.'s concept of engineering leadership, Fung's concept of reskilling and upskilling the workforce, and Retana and Rodriguez-Lluesma's concept of customized executive programs. The data analysis gleaned 20 themes from the five coding categories: (a) customized executive education in the postpandemic era, (b) cocreation of academic–corporate partnership for customized executive education programs, (c) academic–corporate partnership goals for engineer leadership education, (d) critical success factors for a customized executive education program for engineers, and (e) critical success factors for academic–corporate collaborations for reskilling and upskilling engineer leaders. This study contributes to positive social change by identifying the critical success factors for reskilling and upskilling engineers in leadership development to support their midcareer transitions and ensure livelihoods amidst disruptive global events.

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Dedication

I dedicate this to my wonderful children, Payson and Winslow, thank you for all your love and understanding at your young age. To my family, (Mom, Dad, Josh, Rick and Lynne), nieces and nephews (Braylon, Kaelynn, Charlotte, Camden, and Cason), and close friends (Rotha, Anna, and Alicia), thank you for supporting me throughout my journey and always believing in me. I thank each and every one of you for your continuous support, invaluable advice, understanding, and endless encouragement.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

The COVID-19 pandemic has illuminated the lack of mechanisms to train engineer leaders through midcareer transitions imposed on their profession due to the labor market demands of the Fourth Industrial Revolution (Klassen et al., 2020; O'Heir, 2021). The Reskilling Revolution program launched by the World Economic Forum in January 2020 estimated that 1 billion people need to be provided with a renewed education process to gain new skills and upgrade existing ones by 2030 (Diaz & Halkias, 2021a; World Economic Forum, 2022), with engineers needing to engage in regular reskilling throughout their careers (O'Heir, 2021). The engineering and management literature mentions the overall research gaps on what makes leaders effective or how leaders become leaders (Skibniewski & Kim, 2022). Consequently, organizational leaders have sparse information on the preferred alternatives for executive education programs for reskilling and upskilling engineers in customized leadership development and training relevant to the engineering profession (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022).

Despite the relevance of customized executive education programs for leadership development between organizations and business schools, there remains a literature gap on the criteria that make these collaborations successful (Diaz et al., 2022; Roos, 2022). Further empirical research that includes the views of scholar-practitioners is needed to drive social change by identifying the critical success factors (CSFs) of executive education programs for reskilling and upskilling engineers in leadership development to support their midcareer transitions and ensure livelihoods amidst disruptive global events (Rottmann & Kendall, 2022; Tiberius et al., 2021).

Chapter 1 presents an introduction and background of the study, the problem and purpose of the study, the research question, the conceptual framework, and the study's nature. The chapter also includes definitions, assumptions, the scope and delimitations, limitations, and the significance of this study to practice, theory, and positive social change.

Background of the Study

The engineering, technology, and construction industry (OTC) is a trillion-dollar industry and has become a fundamental part of organizations to support a fast-changing global world (Farler & Haan, 2021). The comprehensive information technology (IT) field continues to demand skilled engineers to meet technology changes (Beckhusen, 2016). Engineers in leadership positions are vital in bringing new ideas and technological advances to customers in the field (Perri et al., 2019) and play a key role in promoting sustainability, improving the triple bottom line, and successfully leading future engineers (Farler & Haan, 2021).

Educational reform in the United States has called for organizational leaders to provide industry insights for higher education leaders to better prepare engineers for their future roles in professional practice (Rottmann et al., 2016). The Accreditation Board for Engineering and Technology (ABET) has started preparing engineer students as leaders, and the Center for the Advancement of Engineering Education (CAEE) seeks studies that support the development of leadership skills in engineering education (Florez, 2019).

Early engineering leadership scholars examined effective engineering leaders' skills, traits, and styles. Mallette (2005) discussed the effective leadership style of managers who worked with engineers and recognized their distinct nature within the profession. Mallette worked with aerospace engineers for 30 years and developed a theory called Theory Pi. Mallette encouraged others to customize their leadership approach to meet their personality style and work habits.

In 2004, the National Academy of Engineering (NAE), in a publication titled *The Engineer of 2020*, reported a national call for all engineers to develop leadership skills, and several scholars claimed that this launched the beginning of engineering leadership education (Graham et al., 2009; NAE, 2013). Following this, entrepreneur and philanthropist Bernie Gordon established several multimillion-dollar endowments to implement programs and institutes in engineering universities across the United States (Klassen et al., 2020). The body of engineering leadership literature expanded as researchers examined several aspects of the engineer.

Significant investments have been made to address the need to develop the engineering workforce (National Aeronautics and Space Administration [NASA], 2019). For example, NASA (2019) reported that 50% of its science and engineering workforce was over 50 years old, and 28% were eligible to retire within the next 5 years. In 2019, Global Space Economy’s total revenue was $360 billion, and $277 billion was from the satellite industry (Satellite Industry Association, 2019). Human resource managers in space and satellite industries have reported difficulty recruiting, hiring, and retaining workers due to limited interest in developing early engineers (Ensley, 2017). In today’s highly innovative market, engineering leadership is essential for preparing entry-level engineers (Ensley, 2017), such as manufacturing engineers, to solve complex problems collaboratively (Florez, 2019). Higher education institutions have integrated nontechnical leadership programs and courses into various engineering disciplines (Ensley, 2017; Knight & Novoselich, 2017).

Engineering leadership scholars who have argued for the need for engineers to balance technical training with interpersonal skills have investigated engineers' domain-specific skills, traits, and behaviors (Farr & Brazil, 2009; Hartmann et al., 2017; Rottmann et al., 2015). Farr and Brazil (2009) identified nine key professional skills and traits of effective leaders: big thinker, ethical and courageous, masters change, risk-taker, a mission that matters, decision-maker, uses power wisely, team builder, and good communicator. Hartmann et al. (2017) explored the meaning of leadership from industry representatives from 982 entry-level job postings and found that strong communication, teamwork, and interpersonal skills were essential.

Rottmann et al. (2016) established the first framework for engineering leadership following an earlier study that revealed the distinct nature of engineers and grounded model in the professional identities and influences of engineers at different career levels situated into three main orientations: (a) technical competency, (b) collaboration within global teams, and (c) innovation management. Rottmann called for additional domain-specific skills, traits, and behaviors of engineers around the globe to establish a more comprehensive definition of engineering leadership and expand the growing body of literature. Kalliamvakou et al. (2017) and Kendall et al. (2021) called for further investigation of engineering leaders' perceptions and real-life experiences of skills in various career roles to support the need to develop an effective leadership pipeline and lead the next generation of engineers.

Problem Statement

The global pandemic put pressure on organizational leaders to address the challenges of interdisciplinarity in training engineers in leadership development to meet the needs of the technology-driven Fourth Industrial Revolution (Rovida & Zafferri, 2022; Roy & Roy, 2021). The Reskilling Revolution program launched by the World Economic Forum in January 2020 estimated that 1 billion people need to be provided with better education, new skills, and better work by 2030 (Diaz & Halkias, 2021a; World Economic Forum, 2022), with engineers needing to engage in regular reskilling throughout their careers (O'Heir, 2021). Most executive education approaches to developing leadership in engineers show mixed results in the long-term translation of these learning outcomes into professionals holding leadership roles in the workplace or viewing themselves as leaders (Roos, 2022; Schell et al., 2021). The social problem is that organizational leaders cannot identify effective leadership development programs customized for engineers without practitioner-based empirical research on CSFs of executive education programs (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022).

Executive education customized by business schools for engineers plays a pivotal role in leadership development by reskilling and upskilling abilities such as collaboration, conflict management, and personal and organizational transformation (American Society of Mechanical Engineers [ASME], 2022; Siegelman et al., 2021). Despite the relevance of customized executive education programs for leadership development, scholars still ignore the essential criteria that make these collaborations successful (Diaz et al., 2022; Roos, 2022). The lack of empirical research on customized executive education programs leaves a gap in the extant literature on the CSFs needed for effective reskilling and upskilling of engineers in leadership development and highlights the need for further empirical research from strategy-as-practice scholars (Rottmann & Kendall, 2022; Tiberius et al., 2021). The specific management problem is that organizational leaders have sparse information on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development (Retana & Rodriguez-Lluesma, 2022; Richardson & McCain, 2022; Rottmann & Kendall, 2022).

Purpose of the Study

The purpose of this qualitative, multiple case study was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. CSFs are not equivalent to a standard set of measures (e.g., key indicators); CSFs can be identified from the perspective of strategy-as-practice scholars (Aminy et al., 2019) and are widely adopted as a concept in information management systems studies (e.g., Bele, 2019; Yeoh & Koronios, 2010). The open nature of expert interviews involves collecting data from experts' breadth of knowledge and experience in research fields that still need exploring (Littig & Pöchhacker, 2014). To meet the purpose of this subject matter expert study and be consistent with the qualitative paradigm, a multiple case study design (Yin, 2017) was used to collect data from a purposeful sample of executive education program experts who successfully delivered programs for reskilling and upskilling engineers in leadership development.

I conducted an inductive multiple-case study (Yin, 2017) for three reasons. First, research on the cocreation dynamics in customized executive education programs between academic and corporate partners and their success and failure factors was very scarce (Retana & Rodriguez-Lluesma, 2022). Second, the study's research question was a process that called for capturing in detail phenomena that evolve over time (Langley & Abdallah, 2015). Third, and more generally, comparing comparable cases allows for developing more precise and parsimonious theories than other methods (Eisenhardt & Graebner, 2007). Semistructured interviews (Yin, 2017), archival data, and reflective field notes (Merriam & Tisdell, 2015) drove the trustworthiness of the multiple case study's findings through data triangulation (Guion et al., 2011; Halkias et al., 2022).

Research Question

How do executive education program experts describe the critical success factors needed in customized executive education programs for reskilling and upskilling engineers in leadership development?

Conceptual Framework

This study was framed by three key conceptual models that aligned with the purpose of the study, which was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: (a) Rottmann et al.'s (2015) concept of *engineering leadership*, (b) Fung's (2020) concept of *reskilling and upskilling the workforce*, and (c) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs.*

Engineering Leadership

Rottmann et al. (2015) defined and conceptualized "'engineering leadership" in an analytically clear manner through the works of Farr, Mallette, and Robledo, which was grounded in the seminal research of Farr and Brazil (2009), Farr et al. (1997), Mallette (2005), and Robledo et al. (2012). While Rottmann et al.'s (2015) engineering leadership concept was grounded in Farr et al.'s scholarly works for a discipline-specific theory of engineering leadership, Rottmann extended Farr et al.'s work when she noted that it tended to focus on how best to lead engineers, not how engineers lead.

Reskilling and Upskilling the Workforce

Fung (2020) grounded his conceptual work on reskilling and upskilling on definitions gleaned from previous labor market literature. *Reskilling* (learning new skills to do a different job) can help corporations improve job security and foster a more productive and stable work environment (Gagnidze, 2020). Incorporating *upskilling* (teaching and learning additional skills for one's present job) and executive education allows organizations and employees to stay relevant (Gratton, 2019).

Fung (2020) studied how educators must consider a range of megatrends affecting today's business environment, with the foremost being those related to demographics, innovation, sustainable development, and technology, and how these trends will consistently alter the state of the global workforce. Such studies are grounded in empowerment theory (Perkins & Zimmerman, 1995), which addresses the partnership between a learner and the teacher, where the teacher takes the role of collaborator instead of commanding authority. Other studies on the topic, such as de Vries et al.'s (2020) research on strategic challenges in executive education, are grounded in adult learning theory **(**Knowles, 1973; Knowles et al., 2020).

Customized Executive Education Programs

Retana and Rodriguez-Lluesma (2022) defined customized executive education programs as a joint response by which firms and training providers craft specific solutions to "unique problems." In these programs, firms and training providers codesign a learning experience through the choice of topics, methods, instructors, and locations (Büchel & Antunes, 2007). As discussed by seminal and contemporary scholars in the psychology of work and management education, customized executive programs play a pivotal role in leadership development (e.g., Crossan et al., 2013; Kets De Vries & Korotov, 2007; Retana & Rodriguez-Lluesma, 2022).

Retana and Rodriguez-Lluesma (2022) grounded their study in Argyris and Schön's (1996) theoretical works on organizational learning and hypothesized that when executives exchange knowledge to reformulate their mental schemas, they may generate new knowledge. Retana and Rodriguez-Lluesma recommended that future empirical research validate their grounded model in customized executive education programs conducted, and abundant literature exists to design research that extends this line of theoretical work.

A detailed discussion of the fit and rationale of the conceptual framework in relation to the study approach and central research question is presented in Chapter 2.

Nature of the Study

The nature of this study was qualitative to best align with the purpose of the research. Qualitative researchers explore how humans construct reality filtered through individual experiences and social and cultural settings (Cooper & White, 2012). Conversely, a researcher might attempt to identify a statistical association between variables to test hypotheses and theories (Harkiolakis, 2017). Quantitative research was not my choice for this study because I was not studying comparisons or correlations of numerical relationships but rather attempting to understand and explore human experiences and phenomena from the vantage point of the constructivist researcher (Cooper & White, 2012). Finally, a long tradition exists of using case studies in business research to generate detailed and holistic knowledge using multiple sources in an information-rich context (Klenke, 2016; Yin, 2017).

To meet the study's purpose, a study of experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development, and consistent with the qualitative paradigm, a multiple case study design (Yin, 2017) was used to collect data from a purposeful sample of executive education program experts. Compared to the single case study design, the multiple case study design allows the comparison of collected data between multiple cases and provides an in-depth understanding of a study's problem (Halkias et al., 2022). Using case studies, researchers can examine a transformation or development of a new topic of interest in the extant literature, and the research question focuses on "how" questions and theories are applied and examined in a natural context (Yin, 2017).

Each case in a multiple case study stands on its own and serves as a unit of analysis, allowing the exploration of social phenomena using replication logic and comparing and contrasting results between cases to extend theory (Eisenhardt & Graebner, 2007; Yin, 2017). Yin (2017) noted that within a multiple case study design, the unit of analysis can be an individual in a specific context and that the research question relates to the unit of analysis. This study's central phenomenon was the individual, and the context was the executive education program expert. In developing a study of individuals living within a community and not the whole of the community itself, the most appropriate qualitative design goal for theory extension is an exploratory and inductive multiple-case study design (see Eisenhardt & Graebner, 2007; Halkias & Neubert, 2020). The executive education program expert was the unit of analysis in this multiple case study.

My sampling strategy included purposeful, criterion, and network sampling (Merriam & Tisdell, 2015). I recruited 10 experts knowledgeable about the topic of interest for individual in-depth interviews until data saturation was reached. Participants were screened based on the following inclusion criteria: (a) adult over the age of 18, (b) executive education program educator with a minimum of 5 years of experience delivering reskilling and upskilling programs for engineers in leadership development, (c) had published at least two articles in a peer-reviewed or practitioner-based journal on executive education ecosystems, (d) had a terminal degree from an accredited institution, and (e) possessed in-depth expert knowledge regarding the central topic of study (see Merriam & Tisdell, 2015).

As a data analysis technique, I applied a cross-case synthesis method used in multiple case studies to compare and contrast the data within and between the cases until patterns, themes, and ideas emerged (Yin, 2017). The cross-case synthesis method retains case integrity to extend theory in multiple case studies (Halkias et al., 2022). Data triangulation between the collected data from the semistructured interviews, archival data, and reflective field notes strengthened the trustworthiness of the study results (Farquhar et al., 2020; Halkias & Neubert, 2020).

Definitions

Critical success factors (CSFs): This term refers to activities not equivalent to a standard set of measures (e.g., key indicators); CSFs can be identified from the perspective of strategy-as-practice scholars (Aminy et al., 2019).

Customized executive education programs: This term refers to a joint response by which firms and training providers craft specific solutions to "unique problems" (Retana & Rodriguez-Lluesma, 2022).

Engineering leadership: This term refers to an approach that defines how engineers influence others to collaborate and solve problems effectively and requires technical expertise, authenticity, personal effectiveness, and the ability to synthesize diverse expertise and skillsets (Rottmann et al., 2015).

Joint training: This term refers to an organizational approach to solving training-related issues through capacity-building programs while the business school executes customized training programs (Diaz & Halkias, 2021a).

Professional development response: This term refers to the collaborative effort that firms and training providers use to create custom solutions to specific problems (Retana & Rodriguez-Lluesma, 2022) by developing codesigned learning experiences from chosen topics, methods, instructors, and locations (Büchel & Antunes, 2007).

Reskilling: This term refers to learning new skills to do different jobs to support corporations in improving job security and more productive and stable work environments (Gagnidze, 2020).

Upskilling: This term refers to teaching and learning additional skills for one's present job alongside executive education, enabling organizations and employees to remain relevant in the marketplace (Gratton, 2019).

Assumptions

A researcher must openly communicate taken assumptions to readers to improve the quality of a study's findings and conclusions (Theofanidis & Fountouki, 2018). This study was based on the following four assumptions.

The first assumption was that this research had the rigor to appease common concerns about the validity and reliability of case study designs (see Runfola et al., 2017). The second assumption was that the recruited participants engaged actively, answered the interview questions truthfully, and knew the research topic. The latter was managed using inclusion criteria to screen participants about their qualifications. A detailed interview protocol and data triangulation further strengthened the trustworthiness of the study results (Merriam & Tisdell, 2015; Yin, 2017).

The third assumption concerned the specific use of expert interviews. Due to their high level of knowledge, experts might frame an issue in a particular way and influence the understanding of a less knowledgeable researcher (Bogner et al., 2018). Therefore, the third assumption was that experts presented their special knowledge comprehensively and coherently. The fourth and final assumption was that my personal bias toward this research was sufficiently managed throughout the research. I remained mindful of my reflexivity by interviewing experts unknown to me before undertaking this research and bringing varied perspectives to the study (Eisenhardt & Graebner, 2007). Data triangulation added further depth to the data collection and helped to reduce my researcher bias (Guion et al., 2011).

Scope and Delimitations

A study's scope and delimitations describe the extent to which the research area is explored and specify the study's boundaries (Tracy, 2019). A study’s limitations and delimitations are consciously chosen and narrow the research within the scope of the study and derive from the selected sample’s inclusion and exclusion criteria when the replication process of a case study is started (Yin, 2017). The replication process of this multiple case study began with selecting the experts on the topic of interest. A *subject matter expert* is defined as a person who possesses knowledge in a specific subject matter beyond that of many of their collegial peers due to their education, training, length and type of work experience, publications, awards, and peer recognition (Hopkins & Unger, 2017, p. 227).

In this research study, the experts were recruited via network and criterion sampling, both more specific forms of purposeful sampling, and were defined with the following inclusion criteria: (a) adult over the age of 18, (b) executive education program educator with a minimum of 5 years of experience delivering reskilling and upskilling programs for engineers in leadership development, (c) had published at least two articles in a peer-reviewed or practitioner-based journal on executive education ecosystems, (d) had a terminal degree from an accredited institution; and (e) possessed in-depth expert knowledge regarding the central topic of study (see Merriam & Tisdell, 2015).

Limitations

Research limitations are study circumstances that a researcher cannot control and may influence the interpretation of the findings in case study research (Yin, 2017). One limitation of this and any qualitative study includes the participants' truthfulness and the trustworthiness of the study results. A researcher increases the likelihood of producing a credible record by facilitating the creation of an open, friendly, and supportive environment for interviews. To further increase credibility, I inspected the transcripts for evidence of assumption and bias, and I performed follow-up and verification contacts with the participants (Merriam & Grenier, 2019). A detailed audit trail was provided in the narrative of the study’s design. Data collected from interviews, archival data, and reflective field notes were used to collect accurate data to support the study results

(Guion et al., 2011). A comprehensive literature review was included in this document to present that my research strategy was reliable and supported by scientific literature.

A second limitation of this study was selecting participants due to specific inclusion criteria that might have limited the recruitment to reflect a good representation of the targeted population. To mitigate this issue, I followed Schram's (2006) recommendation that researchers recruit between five and 10 participants for a qualitative study because a larger sample size can lead to weaker research results and compromise the production of detailed, thick descriptions of the phenomena under study. I mitigated the above-stated limitations by demonstrating robust methodological rigor by documenting an audit trail, data triangulation between the semistructured interviews, archival data, and reflective field notes. A comprehensive literature review further supported the study's findings and interpretations.

The third and final limitation regarding the interview process was that the interviewees might not have engaged truthfully with me, and their responses might have been influenced by bias, nervousness, or concerns (Merriam & Tisdell, 2015). I attempted to establish a bond of trust with the participants to manage this limitation. Any qualitative researcher is limited by the difficulty of extending the findings to a broader population with the same degree of certainty as quantitative approaches. This study used a multiple case study approach to allow a more exhaustive exploration of the research question and ensured trustworthiness to mitigate the qualitative research limitation and extend the theory (Eisenhardt & Graebner, 2007; Halkias & Neubert, 2020).

Significance of the Study

Significance to Practice

Engineering leadership education has become increasingly popular over the past decade in response to national calls for another type of social change: educational change (Kendall & Rottmann, 2022; Rottmann et al., 2016). As the pandemic has brought new homeostasis to world labor markets, industry and professional bodies have reasserted the importance of "nontechnical" skills, which has created openings for a leadership resurgence in engineering (Klassen et al., 2020). Workers across industries must figure out how to adapt to rapidly changing conditions, and leaders must learn how to match those workers to new roles and activities (Fung, 2020).

Hickman and Akdere (2018) described how leadership development in engineering remains understudied, and the increasing importance of IT across all organizations emphasizes how leadership is highly context-bound. Reskilling and upskilling engineers in leadership development are more than leading corporate initiatives for innovative technology and artificial intelligence. Today's professional leaders must access ever-evolving reskill and upskill training and education programs to support their workforce and deliver new business models in the postpandemic era (Halkias et al., 2020). This study may be significant to practice in that it may inform organizational leaders on the CSFs of customized executive education programs to prepare engineers for leadership roles required within their profession to support their midcareer transitions and ensure livelihoods amidst disruptive global events (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022).

Significance to Theory

The findings from this study have potential implications that support the expansion of engineering leadership theories (Kalliamvakou et al., 2017; Rottmann et al., 2016) and add insight into the application of Katz's (1955) model of effective leadership to various levels of leadership. Engineering leaders in the IT field may apply the data from this study to support the development of effective engineering leadership for mid- and senior-level leaders and managers. Strategy-as-practice scholars call for further empirical research to fill a literature gap on the CSFs needed for effective reskilling and upskilling of engineers in leadership development and highlight the need for further empirical research from practitioner-scholars (Rottmann & Kendall, 2022).

This study may be significant to theory by contributing original qualitative data to the foundational theories supporting my conceptual framework (Fung, 2020; Retana & Rodriguez-Lluesma, 2022; Rottmann et al., 2015). Such empirical results describing executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development may extend theory to other related areas within the management, leadership, executive education, and reskilling/upskilling literature.

Significance to Social Change

Social change is a fundamental approach to providing opportunities for communities to receive support in their development, such as in engineering education (Rottmann et al., 2016). By recruiting engineers with leadership qualities within a professional project, a project's stakeholders are more likely to feel the positive impact of a successful project. Projects can also progress more smoothly and efficiently, achieving positive results in less time with competent engineers educated in leadership (Bakht, 2018).

Customized executive education programs present a collaborative response by which firms and training providers develop specific solutions to unique problems of reskilling and upskilling within a given professional context to ensure livelihoods in the turbulent future of labor markets (Diaz & Halkias, 2022; Retana & Rodriguez-Lluesma, 2022). Customized executive education can prepare engineers for leadership roles by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management, yet organizational leaders have little information on what makes these programs between business schools and employers successful (Diaz et al., 2022; Roos, 2022). Further empirical research that includes scholar-practitioners' views is needed to drive social change by identifying the CSFs of executive education programs for reskilling and upskilling engineers in leadership development required during the Fourth Industrial Revolution (Rottmann & Kendall, 2022).

Summary and Transition

The specific management problem is that organizational leaders have sparse information on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development (Retana & Rodriguez-Lluesma, 2022; Richardson & McCain, 2022; Rottmann & Kendall, 2022).

The purpose of this qualitative, multiple case study was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. To meet the purpose of the study and be consistent with the qualitative paradigm, a multiple case study design (see Yin, 2017) was used to collect data from a purposeful sample of design thinking experts. The open nature of expert interviews allowed experts' breadth of knowledge to contribute to research fields that still need exploring (Littig & Pöchhacker, 2014). Semistructured interviews, archival data, and reflective field notes (Merriam & Tisdell, 2015) were triangulated to support the trustworthiness of the study findings (Farquhar et al., 2020). This study is significant to theory, practice, and social change as it contributes to a deeper understanding of the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development.

Chapter 2 of this study focuses on the appropriate literature search strategy developed for the study. I provide an expanded view of the current literature and the theories and conceptual frameworks that further support the purpose of the study.

Chapter 2: Literature Review

Without practitioner-based empirical research on CSFs of executive education programs, organizational leaders cannot identify effective leadership development programs customized for engineers (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022). The literature gaps on what makes leaders effective or how leaders become leaders are mentioned throughout the engineering and management literature (Skibniewski & Kim, 2022). The specific management problem addressed in this study is that organizational leaders have sparse information on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development (Retana & Rodriguez-Lluesma, 2022; Richardson & McCain, 2022; Rottmann & Kendall, 2022).

Engineering leadership education has become increasingly popular over the past decade in response to national calls for another type of social change: educational change (Kendall & Rottmann, 2022; Rottmann et al., 2016;). As world labor markets shift towards reskilling and upskilling professionals to meet the challenges of the Fourth Industrial Revolution, industry and professional bodies have reasserted the importance of "nontechnical" skills, driving calls for renewed leadership development training in engineering (Klassen et al., 2020). Organizational leaders employing engineers across all specialization sectors must now rapidly adjust to changing market conditions, driving the need for customized professional training for engineer leaders (Fung, 2020; Retana & Rodriguez-Lluesma, 2022).

Additionally, organizational leaders report having little information on what makes executive education programs for engineers in leadership development effective and successful (Richardson & McCain, 2022; Rottmann & Kendall, 2022). The purpose of this qualitative, multiple case study was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development.

Chapter 2 presents the literature search strategy and the concepts that guided this empirical study. The literature review in this chapter includes a synthesis of knowledge and scholarly work regarding the following topics: design thinking, design thinking tools, the effect of organizational culture on design thinking, innovation and competitive advantage in the context of design thinking, the design integration challenges of SME leaders in the manufacturing sector, design thinking buy-in, design thinking and cross-functional teams, and design thinking and profit.

Literature Search Strategy

The purpose of the study led me to find current and seminal publications related to the topic of interest. Using multiple resources to find relevant literature, I accessed the Thoreau databases using the online Walden University Library, SAGE Journals, ABI/INFORM Collection, Emerald Insight, ProQuest Central, SAGE Journals, Springer e-books, Taylor and Francis Online, Google Scholar, Google Books, and the generic Google Search engine. The online Walden University library databases were Business Source Complete, Emerald Insight, Science Direct, IEEE Xplore Digital Library, Complementary Index, Directory of Open Access Journals, ProQuest, Dissertations & Theses @ Walden University, SAGE, and Emerald Insight.

Using citation mining, I used Google Scholar to identify peer-reviewed papers on the first findings or locate other publications with similar topics. I employed the generic Google search engine to identify search phrases and considered the different sources' nature. All found publications were checked for authenticity using Ulrich's Periodicals Directory (*Ulrich's Periodicals Directory*, n.d.). Out of a total of 214 references, the literature review encompassed 128 (60%) publications, of which 109 (85%) were peer reviewed, and 105 (82%) were published between 2017 and 2022 (Table 1). To remain current with newly published literature, I created search notifications in the online Walden Library and Google Scholar, including keywords such as *engineering leadership*, *engineering leader*, *engineering manager*, *software engineering*, *information technology (IT) and engineering*, *engineering skills*, *engineering traits*, *engineering behaviors*, *Industry 4.0*, *Fourth Industrial Revolution*, *reskilling and upskilling*, *executive education*, and *leadership development.*

Table 1

References by Type and Publication Year

Publication year	2022–2017	2016–2011	2010–2000	1999–1911
Peer-reviewed articles	84	12	9	4
Non-peer-reviewed articles	12	1	0	0
Books	2	0	0	2
Theses/Dissertations	2	0	0	0
Total	100	13	9	6

My literature research focused on current and seminal publications relevant to the study's purpose and the research's methodology. The initial search terms used with the Thoreau databases and Google Scholar were *qualitative research*, *case studies*, *multiple case study*, *interviewing*, *expert interviews*, *thematic analysis*, *dependability*, *credibility*, *purposive sampling*, *transferability*, *the trustworthiness of results,* and *cross-case synthesis analysis.* Table 2 presents all found literature (Chapters 1–3) across the core topics of the study.

Table 2

Numbers of Journal Articles, Books, and Student Dissertations by Topic

	Journals		Reports	Books	Dissertations
	Peer-reviewed	Not peer-reviewed			
Engineering leadership	40	6	1	1	1
Fourth Industrial Revolution, Industry 4.0	24	7	2	1	0
Executive education	11	5	0	1	0
Reskilling and upskilling	8	4	1	1	0
Leadership development & skills	25	3	0	3	1
Theory	8	0	0	4	0
Methodology	33	0	0	23	0
Total	149	25	4	34	2

Conceptual Framework

This study was framed by three key conceptual models that aligned with the purpose of the study, which was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: (a) Rottmann et al.'s (2015) concept of *engineering leadership*, (b) Fung's (2020) concept of *reskilling and upskilling the workforce*, and (c) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs*.

Engineering Leadership

Rottmann et al. (2015) defined and conceptualized “engineering leadership” in an analytically clear manner through the works of Farr, Mallette, and Robledo, whose work was grounded in the seminal research of Farr and Brazil (2009), Farr et al. (1997), Mallette (2005), and Robledo et al. (2012). Farr and his colleagues reviewed seminal studies to identify nine key leadership qualities relevant to engineers: big thinker, ethical and courageous, masters change, risk-taker, a mission that matters, decision-maker, uses power wisely, team builder, and good communicator. Mallette’s research was the outcome of 30 years’ experience in the aerospace industry to construct a leadership style best suited to the management of engineers. Robledo et al. proposed a three-vector model of leadership to accommodate the creative work of scientists and engineers.

While Rottmann et al.’s (2015) engineering leadership concept was based on Farr et al.’s (1997) groundwork for a discipline-specific theory of engineering leadership, she extended Farr et al.’s work when she noted that it tended to focus on how best to lead engineers, not how engineers lead. Rottmann et al. (2016) later identified a knowledge gap in the framework needed to connect engineers’ roles in professional practice to the definition of engineering leadership. In the face of disruptive world events on the arbor market, Rottmann and Kendall (2022) recently extended Rottmann’s original work in engineering leadership by investigating the future of engineering leadership through the lens of four key purposes: the pursuit of knowledge, personal growth, professional preparation, and social transformation.

Reskilling and Upskilling the Workforce

Fung (2020) grounded his conceptual work on reskilling and upskilling on definitions gleaned from previous labor market literature. *Reskilling* (learning new skills to do a different job) can help corporations improve job security and create a more productive and stable work environment (Gagnidze, 2020). Incorporating *upskilling* (teaching and learning additional skills for one's present job) and executive education allows organizations and employees to stay relevant (Gratton, 2019). Fung's study on reskilling and upskilling the global workforce was based on the SkillsFuture Singapore program started in 2015, where thousands of employees over 3 years were reskilled in eight emerging and priority skills domains: data analytics, finance, tech-enabled services, digital media, cybersecurity, entrepreneurship, advanced manufacturing, and urban solutions.

SkillsFuture Singapore (SSG) worked closely with stakeholders such as government agencies, institutes of higher learning, and employers to ensure that skills training and upgrading for individuals continued to be readily accessible throughout their lives. Higher education institutions worked with employers and private training providers to form a powerful partnership to deliver continuing education and training. By the end of 2018, more than 30,000 Singaporeans had attended courses in the SkillsFuture Series (SSG, 2019).

Fung (2020) studied how educators must consider a range of megatrends affecting today's business environment, with the foremost involving demographics, innovation, sustainable development, and technology, and how these trends will consistently alter the state of the global workforce. Such studies are grounded in empowerment theory (Perkins & Zimmerman, 1995), which addresses the partnership between a learner and teacher, where the teacher takes the role of collaborator instead of commanding authority. Updated applications of empowerment theory, such as in Vinayan et al.'s (2020) investigation of reskilling and upskilling the workforce in Malaysia, aim to develop a process that supports industry-driven training by adopting heutagogical approaches to promote lifelong and independent adult learning. Other studies on the topic, such as de Vries et al.'s (2020) research on strategic challenges in executive education, are grounded in adult learning theory (Knowles, 1973). Adult learning theory and its updated extensions hypothesize that adults tend to learn differently than children and adolescents and that adults typically need to know why they are learning something, want to learn things that are of immediate relevance, and are looking for practical, problem-centered approaches to learning (Knowles et al., 2020).

Scholars have found little consistent information in the scholarly or practitioner-based literature guiding business schools to develop an executive education model that reskills/upskills leaders to successfully manage the future's changing workforce (Diaz & Halkias, 2021b; Fung, 2020). Fung (2020) concluded his study by stating that in the future of work, the shelf life of skills is anticipated to be approximately 5 years, with individuals expected to update and refresh their skills six times throughout a 30-year career to remain relevant in their workplace, while employability will depend more heavily on lifelong learning and skills development than initial qualifications.

Customized Executive Education Programs

Retana and Rodriguez-Lluesma (2022) defined customized executive education programs as a joint response by which firms and training providers craft specific solutions to "unique problems." In these programs, firms and training providers codesign a learning experience through the choice of topics, methods, instructors, and locations (Büchel & Antunes, 2007). As discussed by seminal and contemporary scholars in the psychology of work and management education, customized executive programs play a pivotal role in leadership development because they foster abilities such as collaboration, conflict management, and personal and organizational transformation (e.g., Crossan et al., 2013; Kets De Vries & Korotov, 2007; Retana & Rodriguez-Lluesma, 2022).

Retana and Rodriguez-Lluesma (2022) grounded their study in Argyris and Schön's (1996) theoretical works on organizational learning and hypothesized that when executives exchange knowledge to reformulate their mental schemas, they may generate new knowledge. By way of exchanging tacit knowledge ("externalization") and the construction of knowledge ("internalization"), this learning may lead to transformation into valuable behaviors for the organization (Argyris & Schön, 1996). Retana and Rodriguez-Lluesma followed established techniques and procedures to construct a grounded theory (Glaser & Strauss, 1967) of how customized executive education programs function. Their emerging theory suggests that four conceptually distinct but interrelated behaviors foster successful customized executive education programs: (a) brokerage by program directors, (b) boundary-crossing, (c) case script enactment through role switching in veiling and unveiling of the organization, and (d) diagnostic and codesign and delivery. As predicted by the researchers in their case-based grounded theory study, the most popular request by firms in customized executive programming was that of leadership development (Retana & Rodriguez-Lluesma, 2022).

Executive education program directors play an important role in defining the CSFs of the program delivered (Diaz et al., 2022). Companies and business schools have different syntactic, semantic, and pragmatic approaches, but they can cocreate a project with common objectives through joint collaboration. On the one hand, the company aims to solve a training problem through a capacity-building program; on the other hand, the business school has experience carrying out tailor-made training programs (Diaz & Halkias, 2021a). Retana and Rodriguez-Lluesma (2022) recommended that future empirical research validate their grounded model in customized executive education programs, and abundant literature exists to design research that extends this line of theoretical work.

Literature Review

The Evolution of Engineering Leadership

Recognizing the complex interactions of management and leadership in engineering and technology (Rottmann & Kendall, 2022). The defined management criteria for engineering leadership were first established by Taylor (1911) and involved an understanding of critical issues in management; there are various definitions , but they all collectively describe a task-oriented framework that includes planning, organization, coordination, and control activities. The emergence of project management in the 1960s led to a new area of research associated with project-driven technical activities. This early depiction of management represented a collection of administrative activities that later required a proactive role in complex systems by the mid 1980s (Kocaoglu, 1986).

Since the turn of the century, rapid technological changes have merged the roles, and research has focused on engineering leaders' and managers' skills, traits, behaviors, and styles (Rottmann et al., 2018; Sydorenko, 2020). This transition changed how management and leadership were distinguished (Ebert & Duarte, 2018). Three broad bodies of literature surround the development of effective engineering leadership, including the engineer's career paths and transitions, professional identities, and industry engineers' perspectives on effective engineering leadership (Rottmann et al., 2018).

Foundational Research Streams Defining Engineering Leadership

The skillset of engineering leadership has become very important and is essential in today's highly entrepreneurial market for engineers (O'Heir, 2021). Engineering leadership represents an established body of knowledge in engineering education with a focus on academic inquiry. There are five streams of engineering leadership trending in the field: the demand for engineers to embody a leadership role, engineering leadership programs, competency-based representations of influential engineering leaders, industry-based empirical studies of engineering leadership, and conceptual investigations of leadership from the perspective of engineers. The five streams are intertwined throughout undergraduate education with competency-based representations of influential engineering leaders and research studies of engineering leadership in the industry (Rottmann et al., 2016; Rottmann et al.,2018).

Early engineering leadership scholars grounded their work in Katz's (1955) three-skills effective leadership model. Katz's model of leadership skills is an acquired proficiency within three distinct skill sets, technical, human, and conceptual, that vary in importance by organizational level. Katz's theory bypassed the research that investigated a definitive list of traits to define leadership and addressed leadership as a set of developable skills. Katz argued that a leader's traits (innate characteristics) define who a person is, whereas a leader's skills (knowledge and abilities) can be learned and developed (Katz, 2009).

Robert Katz's seminal article was first published in *Harvard Business Review* in 1955, titled "Skills of an Effective Administrator." Katz's model was rooted in administration field research and contained his firsthand observations of executives in the workplace (1955, p. 34). Katz's findings suggested that effective administration (leadership) depends on technical, human, and conceptual skills. Katz defined *technical skills* as knowledge and proficiency in a specific work or activity, including competencies in a specialized area, analytical ability, and the ability to use appropriate tools and techniques. Technical skills were most important at lower and middle levels of management and not essential to higher-level managers such as presidents, senior officers, and chief executive officers (CEOs) (Katz, 1955).

Katz (1955) defined *human skills* as the ability to work with others and demonstrated through self-reflection and emotional awareness of self and the responses and behaviors of others. Katz noted how human skills are essential at all levels of management and suggested further development in self-awareness, the awareness of others, communication, and empathy. Katz suggested that researchers and leaders apply case study analysis to real-life situations to improve human organizational skills through formal training, coaching, and self-assessments. Later clarifications were presented that stated human skills were developed as intragroup skills at the lower management level and applied as intergroup skills at the higher management level (Katz, 2009).

Katz (1955) identified the third and final conceptual skill set to see the organization from a holistic perspective. Katz acknowledged how the demand for each of the three skills varies at the three levels of management: supervisory, middle, and top management. Katz explained how leaders in higher-level management positions need conceptual skills to view big picture thinking and interconnecting systems such as establishing a vision, defining objectives, and executing decisions in the best interest of its stakeholders. Katz suggested that leaders develop conceptual skills through formal training, mentor coaching, and job exchange to develop critical thinking skills. Revised claims regarding the importance of conceptual skills were identified at all levels of management (Katz, 2009; Mumford et al., 2000).

Katz's (1955) model has been reinforced and expanded by modern leadership research beginning with Mumford et al. (2000) proposition that leadership effectiveness depends on the leader's ability to solve complex organizational problems. Mumford et al. maintained a set of competencies leaders needed to include problem-solving skills (conceptual), social judgment skills (human skills), and knowledge (technical skills), which largely overlap the original framework of Katz. Mumford's model further expands on organizational leadership skill sets essential to leaders, including cognitive, business, and strategic skills.

Mumford et al. (2002) confirmed Katz's (1955) original notion that there is relative importance to some skills versus other skills based on leadership level based on the tasks accomplished and complex problems addressed by engineers and scientists. A study by Robledo et al. (2012) considered engineers' work by integrating the five stages of creative projects (scanning, elaboration, development, appraisal, and implementation into a flow chart (Mumford et al., 2000). Robledo et al. (2012) introduced a scientific leadership model focused on three key vectors where engineers and scientists demonstrated impact: in a group, at work, and throughout an organization. Accounting for how leaders in these professions influence operations and people in a socio-technical context, the model was designed to guide leaders' creativity (Robledo et al., 2012).

To support leaders in engineering, Robledo et al. (2012) proposed five interventions: training existing leaders, developing scientists and engineers to become leaders, promoting stakeholder integration, utilizing survey feedback, and modifying management procedures and processes. Researchers have applied Katz's three-skills model as a generic framework across several disciplines (Uhr, 2017), but limited research has connected the three-skills model to engineering leadership (Medcof, 2017). In addition to the engineering leadership literature, an important report by Katz (1993) argued the importance of engineering students refining their focus in their entry-level engineering job roles to develop engineering leadership that enables enhanced communication from experiential learning toward language proficiency. In engineering leadership, clear and precise communication is critical for interacting with managers and peers, providing effective presentations, improving business-related writing skills, and communicating cross-culturally (Ismail & Fathi, 2018; Rottmann et al., 2016).

Building an engineering mindset is essential for engineering students entering the industry, and their technical skills are increasingly crucial in academia, government, industry, and non-profit organizations (Jamieson & Donald, 2020; Perry et al., 2017). In many universities, engineering leadership skills are being improved through project management training that includes developing personal management and organizational skills that will add value to teamwork-related skills, confidence, empowering early development of leadership styles such as transformational leadership (Jamieson & Donald, 2020; Rottmann et al., 2016). Nevertheless, these valuable skills are being taught in training programs and lack skill-based approaches to drive real-world application (Harrison et al., 2017; Nix & Bigham, 2015).

Northouse (2018) explained the importance of distinguishing between a trait, behavioral, and skill-based approach. The trait approach is focused on personality characteristics and is understood as innate characteristics that represent who we are (Northouse, 2018). The behavior approach emphasizes the patterns of behaviors and their influence on leadership, such as transformation and charisma (Mumford et al., 2000). The skilled approach of Katz's (1955) three-skills model, evolved by Mumford et al., considers leadership a collection of capabilities across technical, human, and conceptual areas. Although Northouse (2018) recognized that the skill-based approach has yet to apply to training programs for leadership positions, researchers have applied these to leadership development, highlighting the importance of management skills to understand how to apply practical leadership skills (Knowles, 2021).

Researchers have utilized the skills model approach, alongside Northouse's (2018) skill-based leadership framework, to understand how leadership skills development improves leadership abilities (Harrison et al., 2017; Hickman & Akdere, 2018; Uhr, 2017; Yuan et al., 2019). Nix and Bigham (2015) conducted a case study in higher education and applied Katz's (1955) three-skills model and Northouse's (2018) skill-based leadership approach. The study focused on the skills needed for effective leadership, and researchers identified the skills: experience, flexibility, balance, positive attitude, problem-solving skills, and willingness (Nix & Bigham, 2015). Nix and Bigham (2015) noted the importance of technical, human, and conceptual skills when hiring influential leaders.

Uhr (2017) analyzed three leadership archetypes that align the intraorganizational ideals in crisis management. The three ideals of conceptual leadership frameworks related to personal traits, principal leadership styles and behaviors, and Katz's three-skills approach. Uhr (2017) explained how Katz's three-skills approach might enable leaders to improve leadership by attaining technical, human, and conceptual skills. Yuan et al. (2019) proposed a framework partnership between the public and private sectors and guided the selection of an appropriate partnership method as an ongoing engagement strategy in cyberspace. Yuan et al. proposed a framework that acknowledged several advantages, including developing efficient and effective leaders who can lead in any environment.

Harrison et al. (2017) conducted a qualitative study and applied Katz's three-skills model approach later led to Mumford et al. (2000) expanding the model approach from an entrepreneurial perspective exploring leadership. Harrison et al. (2017) identified specific technical, human, and conceptual skills leaders would utilize in leadership positions, but as noted earlier, the skill-based approach has yet to apply to training programs for leaders in leadership positions (Northouse, 2018). It is important to understand how leaders utilize technical, human, and conceptual skills to understand how the engineering leadership literature connects leadership development, leadership skills, and effective leadership (Hirudayaraj et al., 2021).

Engineers as Leaders

Early scholars Farr et al. (1997) identified the initial leadership qualities of engineers that included having effective communication skills, establishing a purposeful mission, balancing their hierarchies, being a good decision-maker, and demonstrating their ability to be a big thinker, a change master, teambuilder, risk-taker, that is ethical and courageous (Farr & Brazil, 2009). In 2005, Goodale proposed a set of traits such as influence, courage, pride, honesty, competence, and adaptability alongside a set of leadership skills that engineers interested in business settings that reflected their ability to communicate, team build, mentor, problem-solve, delegate, manage, and generate a vision (Goodale, 2005).

In the review of the existing engineering literature, Bergeron (2001) and Kirschenman (2011) explained the importance of every engineer having the ability to lead in response to management challenges that may arise during their role at the practical level. In an increasingly globalized economy, engineers must be prepared to address the challenges that arise, confident that they have the tools to serve society (Yates & Murphy, 2022). Engineers are employed throughout the globe, and they must have the leadership to identify the need to act in high-risk situations with short response times and resolve various issues such as disasters and limited resources (Bracio & Szarucki, 2020).

Programs associated with engineering research are prevalent topics in the literature interconnected by calls across various disciplines, including national and state policymakers, professional affiliations, and acting bodies throughout educational sectors (Rottmann et al., 2016). In the engineering leadership literature, executive program evaluations across institutional contexts constitute non-empirical descriptions of the program and curricular initiatives in three prominent foci of engineering leadership programs: entrepreneurship and innovation (Hsiao, 2013; Stewart, 2005), personal and professional growth (Colcleugh & Reeve, 2013), and global citizenship (McMartin, 2013).

Faculty members, instructors, and other industry professionals have partnered to ensure they deliver a vast range of instructional strategies that enable student engagement toward developing their leadership style while allowing for their development as leaders to be assessed (Williams, 2022). However, engineering educators' wide range of foci, program structures, institutional locations, and instructional strategies has diversified the curricular and non-curricular offerings in many North American engineering faculties (Rottmann et al., 2016). These two attributes may be linked to effective engineering leadership, but it is unclear how the authors methodologically factored engineering into their research (Rottmann et al., 2015).

Engineers are motivated by tasks, respond well to hands-off leaders with expert technical knowledge, use logical reasoning to resolve conflicts, and expect job performance primarily based on product quality (O'Heir, 2021). A list of recommendations for those managing engineers, whom he regarded as laissez-faire leaders instead of a theory of engineering leadership (Mallette, 2005). Engineers in the industry have identified three orientations to engineering leadership: technical mastery, collaborative optimization, and organizational innovation (Rottmann et al., 2015). While the grounded theory study by Rottmann et al. (2016) approached leadership from the view of actual engineers, the work still failed to connect the varied roles of engineers with an official engineering leadership definition, and unanswered questions remain in the literature for further inquiry regarding educational improvement in programs focused on engineering (Rottmann & Kendall, 2022).

Reskilling and Upskilling Leaders for The Fourth Industrial Revolution

Technological advancements, environmental changes, demographic shifts, and the impact of COVID-19 have illuminated global calls for workforce reskilling and redesign of education and training programs to meet these demands (Peña-Cabrera et al., 2019). The pandemic created an exacerbated career shock that amplified the impact of context-related factors resulting in mixed outcomes for the individual's career (Akkermans et al., 2020). In 2016, The World Economic Forum (WEC) identified a technological shift resulting in a Fourth Industrial Revolution (4IR) impacting the globe. The technology-driven world has entered a dynamic reorganization of skills, and the Organization for Economic Co-operation and Development (OECD) estimated that 1.1 billion jobs would be transformed by technology within the next decade (WEC, 2022). In January 2020, the WEC launched the Reskilling Revolution program to prepare the global workforce, estimating that 1 billion people will receive renewed education, skills, and economic opportunities by 2030 (Diaz & Halkias, 2021a; WEC, 2022).

Human resource management is being transformed in the labor market, and workers must be qualified to work collaboratively in transition with other individuals, machines, and technologies (Jerman et al., 2020). Consequently, technological intelligence has led to complex data systems requiring highly qualified individuals to manage them across various disciplines (Cagliano et al., 2019; Jerman et al., 2020). Digital disruptions and the emergence of innovative technologies and business models are essential to sustain a competitive advantage, continue to grow, and create value at macro and micro levels (Meske & Junglas, 2020; Zaki, 2019).

Adopting disruptive technologies linked with the Fourth Industrial Revolution, also named Industry 4.0, has changed how people interact, learn, recruit, manage, and lead (Matt et al., 2020). Industry 4.0 emerged from the evolution of digitalization and robotics by interconnecting physical and cybernetic environments through digital technology (Liu & Xu, 2017). These digital technologies include artificial intelligence (AI), cyber-physical systems, big data, and the Cloud causing disruptive changes in the workforce labeled a socio-technical revolution (Sony et al., 2020). Traditional tasks will be left for digital automation to ensure timely, precise, and intelligent analysis (Jerman et al., 2020).

Companies such as Microsoft and Amazon have accelerated since they were already investing in internal workforce development initiatives pre-pandemic by focusing on digital transformation reskilling and upskilling to mitigate skill gap concerns (Newman, 2020). A large majority of the population has experienced career path fractures and hiring pattern uncertainty resulting from the rapid and pervasive disruptions of cloud computing, IoT, machine learning, artificial intelligence, robotics, 3D printing, mixed reality, and blockchain have disabled career paths and created uncertainty in hiring patterns (Microsoft, 2021). Surveyed employers projected that 70% of their employees will require reskilling and upskilling by 2025 (World Economic Forum, 2020). Reskilling is learning new skills to do different jobs (Gagnidze, 2020). Upskilling refers to teaching and learning additional skills for one's present job (Gratton, 2019). Reskilling and upskilling are essential to prepare the global workforce to meet future challenges (Fung, 2020).

Recent surveys, such as the Gartner survey, revealed that 80% of the workforce, 92% of managers, and 77% of senior leaders already felt poorly prepared for the future (Wiles, 2020). Reports surrounding the changing landscape of skills and the new capabilities they demand remind industry leaders to be future-ready (Edmonson, 2020). Edmonson (2020) proposed that high-quality discussion processes, agility, and adaptability will be required to improve strategic decision-making, sensemaking, social intelligence, 21st-century adaptive thinking: cross-cultural competency, computational thinking, new-media literacy, transdisciplinary, design mindset, cognitive load management, and virtual collaboration.

Automation alone will require technical and human skills such as creativity and adaptability (Towers-Clark, 2020). Although the nature of work is transforming rapidly, more research is needed to examine the future strategies and mindsets required for the workforce to meet the soft skills needs of Industry 4.0 (Low et al., 2019). Reskilling and upskilling programs must follow a three-step process that first identifies the skills needed to address business reality, a clear understanding that distinguishes the role of the needed skill in the new model, and a collection of providers capable of supporting the needs of lifelong learning (Agrawal et al. 2020).

Customized Executive Education Programs: Academic–Industry Partnerships

In customized executive education, partners from companies and business schools assume different roles in designing and delivering the program (Retana & Rodriguez-Lluesma, 2022). Business schools and corporate development officers within the firm that identify organizational issues can work through a cocreation process to codesign the contents of a program. Faculty members highly specialized in their specific area of expertise deliver customized education programs and lead executives on a path toward career development within their companies (Kets De Vries & Korotov, 2007).

It is crucial for business schools to enable access to their internal knowledge and eccentricities to foster the critical process of building trust (Retana & Rodriguez-Lluesma, 2022). Two of the core challenges in development are (1) maintaining an exchange of information between a company and a business school and (2) applying nonsystematic interaction to articulate the needs of a company (Diaz et al., 2022). Executive education program directors must integrate a firm's expectations and faculty members' skills in a collaborative curriculum construction process by selecting appropriate cases based on the insight collected from clients, posing a potential risk in decision-making (Christensen & Carlile, 2009).

Another challenge in this academic-corporate partnership is that custom executive education trainers must lead discussions to reveal a company's problems without impugning the individuals present (Retana & Rodriguez-Lluesma, 2022). There may be clear benefits for academic and corporate partners involved in a custom executive education program, including enabling networking, establishing close relations between professionals, and sharing knowledge of proficient executives who belong to the same or different organizational cultures, among others (Montgomery, 2016). Customized executive education tends to be the most effective solution within business schools' executive education programs because of the specificity of the solution (Retana & Rodriguez-Lluesma, 2022; Tiberius et al., 2021).

Today's postpandemic world requires 4IR leaders to support their workforce and deliver new business models by providing access to ever-evolving reskill and upskill training and education programs (Agrawal et al., 2020; Halkias et al., 2020). Leaders must align their workers to new roles and activities as the world learns to adapt to these ever-evolving conditions (Fung, 2020). Business school leaders have been responsible for reshaping leaders to address economic and social change (Christ & Burritt, 2019).

Executive education programs originated in the United States. In 1984, Harvard Business School introduced the Advanced Management Program (AMP) (Amdam, 2016). In 1951, other elite schools such as Northwestern University, Kellogg School of Management, and Columbia Business School were also established. These programs were the foundation that drove other business schools to develop varied programs and degree offerings for students and industry professionals. (Amdam, 2016). In the 1990s, a shift occurred as other learning and development alternatives emerged and corporate universities resolved the larger corporation's skills development (Chen et al., 2019).

Academic and industry leaders and researchers are working to redefine executive education toward enabling the opportunity for business schools to work as partners to redefine innovative business school ecosystems committed to innovation and experimentation (Halkias et al., 2020; Horn & Dunagan, 2018). This involves redesigning the roles of business education providers to become Executive Education providers that work to develop relevant, digitally driven, and sustainable executive education ecosystems (Caratozzolo et al., 2020; Horn, 2020). Partnerships with corporate clients aim to network universities with other key drivers such as educational platforms, certification programs, corporate universities, and other professional bodies and synthesize solutions (Rotatori et al., 2021; Caratozzolo et al., 2020).

Urgent attention is needed as the extensive skills gap widens (Agrawal et al., 2020), and potential skill obsolescence is on the rise as AI is projected to create new jobs that will require a collaborative and structured partnership approach to find solutions (Caratozzolo et al., 2020; Diaz & Halkias, 2021b). In conjunction with the overall uncertainty surrounding the future nature of jobs and their required skills (Sukovataia et al., 2020), the need for organizations to advance innovation and learning is becoming a worldwide concern (Crisp, 2019).

As the world turns toward a postpandemic future, 50% of the labor force will need to reskill, and online education continues to shape workforce learning and development (ASME, 2022). While the world is in transition, it is essential for business schools to empower education-corporate partnerships to collaboratively design innovative education ecosystem models (Diaz & Halkias, 2021b; Moldoveanu & Narayandas, 2019). Established partnerships between education providers and industry leaders can co-design ecosystem models that offer the preparedness and agility needed to reskill and upskill 4IR leaders' changing workforce (Diaz & Halkias, 2021a).

Business and Engineering universities such as California State University, Chico, Nanyang Business School, Singapore, Stanford University, Chicago Booth School of Business, and Berkely, are working to integrate programs offering courses that provide general conceptual skill-building to customized education for developing students and early, mid, and senior-level professionals seeking to reskill and upskill (Diaz et al., 2022). These programs offer opportunities to learn in-person, remotely, or in a hybrid model to gain skills from interactive lectures, projects, and simulations to case discussions and activity-based workshops to generate creative solutions. Researchers and industry leaders have forecasted ideas for leadership development, including the Hybrid Era, a leadership development framework that replaces the three areas of leadership development with the pathways between them through sensemaking, experimentation, and self-discovery (Birkinshaw et al., 2022). At the same time, researchers have suggested the importance of applying fundamental learning principles such as the adult learning theory (Knowles, 1973; Knowles et al., 2020) when designing and improving a leadership development program (de Vries et al., 2020).

Although these programs appear to offer the solution, scarce and differentiated practitioner-based empirical research on the CSFs of executive education (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022). Despite the relevance of customized executive education programs for leadership development between organizations and business schools, there remains a literature gap on the criteria that make these collaborations successful (Diaz et al., 2022; Roos, 2022).

Leadership Practices Among Entry-Level Engineers

Engineering leadership literature includes the fewest publications in leadership (Rottmann et al., 2016). Rather than accepting leadership standards from other disciplines for engineers, researchers such as Mallette (2005) and Rottmann et al. (2016) studied leadership from an engineering perspective. Drawing from 30 years of experience in aerospace, Mallette (2005) advanced "Theory Pi," a leadership style best adapted to the management of engineers. In contrast to "Theory X" and "Theory Y," Mallette developed Theory Pi by building on transformational and transactional leadership theories.

Engineering leadership is based on the precise theoretical work of Rottmann et al. (2015), stating that engineering leadership is based on grounding leadership theory, especially in engineers in whom professional identities have been identified. Three distinct orientations influence engineering leadership to leadership: technical mastery, collaborative optimization, and organizational innovation. Building on this, Klassen et al. (2017; 2020) developed a framework highlighting how engineers express these orientations in varying degrees throughout their careers due to their learning, mobility, and changing organizational roles. Reeve et al.'s (2015) survey of 175 engineers revealed that most of those with up to two years of experience had a stronger orientation toward collaborative optimization, contrasting with the Klassen et al. (2020) study that evidenced more focus on technical mastery.

An in-depth single-case study by Alvesson and Jonsson (2016) of a middle manager in a large, international manufacturing company presents helpful perspectives on the practice of engineering leadership. The research revealed fragmentation between the manager's ideas and practice of leadership and striking differences between believed leadership meanings and their actual application in practice. Following ten interviews and eight manager observations in meetings, the authors found evidence challenging dominant leadership perceptions based on "assumptions of coherence, integration, context, and direction" (Alvesson & Jonsson, 2016, p.13). While this research deepens the understanding of leadership, its focus on an engineer in a leadership position does not offer more regarding how leadership develops in the early stages of a career. Such studies point to which engineering leadership orientations to search for in engineers support that leadership is not a fixed concept, particularly for engineers, and underline that even one person can have opposing perspectives regarding their leadership (Klassen et al., 2017; 2020).

Technical, Human, and Conceptual Skills for Engineer Leaders

Several researchers have attempted to define these soft skills using other terms such as non-technical, human, and people skills (Matteson et al., 2016; Pócsová et al., 2020; Touloumakos, 2020). A closer look at the studies rooted in the seminal work of Farr et al. (1997) and Katz (1955) have revealed similarities and differences across the research based on the type of skills needed and the lens used to examine effective engineering leadership. For example, although Perry et al. (2017) and Racine (2015) agreed on technical competence and conceptual skill such as big-picture thinking in effective engineering leadership success, the suggested approach is different research paths. Racine (2015) suggested meeting the needs of followers through group and organization vectors that enact interaction, communication, and collaboration. At the same time, Perry et al. (2017) suggested that the two big-picture concepts necessary for engineering leaders included boundary-breaking collaboration and orchestrated commercialization. Boundary-breaking collaboration involves sharing information across the industry, and orchestrated commercialization extends technical competence to commercial pipelines (Pedersen, 2020; Perry et al., 2017).

Boyatzis et al.'s (2017) qualitative study explored engineers positively linked interpersonal skills and effectiveness. Harrison et al. (2017) examined leadership skills through the entrepreneurial lens and concluded that engineers in a leadership roles needed technical, human, and conceptual skills and suggested further research was needed. Overall, the research did not follow the same path and suggested further research specific to the individualized engineering field. Several qualitative studies grounded in theories found common themes regarding technical skills in engineering leadership (Perry et al., 2017; Rottmann et al., 2016).

Rottmann et al. (2016) emphasized technical competence in engineering leadership, and Racine (2015) found that managers did have the needed technical competence when transitioning into leadership roles but lacked other skills. A mixed-methods study conducted by Perry et al. (2017) also acknowledged the technical competence present in engineering managers and proposed a model to facilitate the development of other skills he called leadership skills. Perry et al., Racine et al., and Rottmann et al. acknowledged technical competence as a critical engineering skill and the value of combining technical competence and additional leadership competence to meet the goals of an organization.

Further, Rottmann et al.'s (2016) extended research also confirmed the importance of technical competence. However, it explored engineering leadership from various roles (engineers, human resources professionals, entrepreneurs, politicians, and interns) based on competencies and leadership skills, providing a broader view of engineering leadership (Boyatzis et al., 2017). Scholars agreed on the importance of technical competence. Disagreement existed on the skill's importance at different levels of management. For example, Kalliamvakou et al. (2017) conducted a qualitative study and found that engineering leaders perceived interpersonal skills as more important than technical skills. Medcof's (2017) findings suggested conceptual skills utilized at lower levels of management but various levels, but the research did not reveal the presence of conceptual utilization at middle and upper levels of management. Kalliamvakou et al.

(2017) and Rottmann et al. (2016) suggested the importance of engineers in developing conceptual skills such as problem-solving and driving alignment.

Medcof (2017) and Rottmann et al. (2016) explained the importance of conceptual skillsets to include a vision perspective related to innovation, anticipated trends, and calculated risk-taking. Further research may provide additional insights and knowledge to support the body of engineering leadership literature based on research discrepancies and the complex concepts surrounding effective engineering leadership. While Medcof's (2017) engineering management review study found that leaders utilized skills at various levels of management, discrepancies were found in how conceptual skills were utilized.

Medcof's (2017) findings suggested conceptual skills utilized at lower levels of management but various levels, but the research did not reveal the presence of conceptual utilization at middle and upper levels of management. Kalliamvakou et al. (2017) and Rottmann et al. (2016) suggested the importance of engineers in developing conceptual skills such as problem-solving and driving alignment. The importance of conceptual skillsets includes a vision perspective related to innovation, anticipated trends, and calculated risk-taking. Based on the discrepancies among researchers and the complex concepts surrounding effective engineering leadership, further research may provide additional insights and knowledge to support the engineering leadership literature Rottmann & Kendall (2022).

Changing dynamics in the global economy and rising demand for soft skills such as communication and collaboration beyond borders have significantly impacted modern engineering practice (Bakht, 2018). Oral communication, business writing, cross-cultural communication, and presentation skills fall under the domain of required communication skills and should be integrated into undergraduate-level engineering programs. Good communication skills are necessary for successful leadership, and proficiency in a foreign language and cross-cultural awareness and experience are needed for global business activities (Hirudayaraj et al., 2021). Nevertheless, students of engineering programs still lack adequate exposure to multidisciplinary teams due in part to existing challenges with learning goals and assessments surrounding interdisciplinary education (Van den Beemt et al., 2020).

Insufficient attention on the part of engineering education to the needs of today's business world still largely graduates 21st-century engineering students as individual technical contributors rather than team players (Kendall & Rottmann, 2022). Organizational leaders have limited information on the preferred alternatives for customized executive education programs for reskilling and upskilling engineers in customized leadership development and training relevant to the engineering profession (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022). Consequently, research gaps remain throughout the engineering and management literature regarding what represents an effective leader or how leaders have become leaders (Skibniewski & Kim, 2022).

Reskilling and Upskilling Engineer Leaders

It is evident that the engineering and technology fields are at the face of digital transformation, and their skill sets need to demonstrate strategic and innovative approaches that will add value (Flores et al., 2020). The global pandemic heightened the need for organizational leaders to face interdisciplinarity challenges and train engineers in leadership development to combat these demands (Rovida & Zafferri, 2022; Roy & Roy, 2021). Engineers must continuously engage in reskilling throughout their careers (ASME, 2022; O'Heir, 2021). Despite the revolutionary changes, intrinsic human skills are the key to ensuring practical application and optimal usability of digital technologies (Romero et al., 2020; Sakurada et al., 2020).

The global pandemic has tested businesses' resiliency, leadership, and organizational management capabilities worldwide (Iñiguez & Lorange, 2022). Amid the uncertainty, engineering companies have invested in training their existing workforce to keep pace with the accelerated digital transformations. Remote workplaces enabled increased online learning platforms globally that supported the upskilling and reskilling of the engineering workforce (ASME, 2022; Huber et al., 2020).

Workers across industries must figure out how they can adapt to rapidly changing conditions, and leaders are responsible for learning how to match those workers to new roles and activities (Fung, 2020). Engineers face continuous challenges in overcoming skills-based technological change and will be required to reskill and upskill throughout their careers (Caratozzolo et al., 2020; O'Heir, 2021). The United States Bureau of Labor Statistics projects employment growth for engineers, with nearly 140,000 new jobs expected from 2016 to 2026 (Torpey, 2018), with mechanical engineering job projection second at 25,300 to civil engineers in first with 32,200 projected new jobs (ASME, 2022).

Future engineer leaders need to quickly adapt to the changes and transformations by constantly acquiring and updating the necessary knowledge and skills to perform in constantly evolving situations effectively. (Pistoia et al., 2021).

Effective leadership drives projects and organizational success through rapid reskilling and upskilling of engineers' skills as needed to enhance their abilities to continuously learn and use new knowledge for their employability and a sustainable world (Pistoia et al., 2021). The benefit of upskilling is an investment in building relevant and competitive organizations that reduce turnover and increases employee satisfaction and engagement. It is essential for industries and institutions to collaborate and successfully assimilate new technologies interdisciplinarity into the engineering curriculum (Diaz & Halkias, 2021b; Roy & Roy, 2021). Interdisciplinarity enables integrative learning, creative problem-solving, and critical thinking experiences needed to develop creative solutions to the future's changing technological problems (Retana, & Rodriguez-Lluesma, 2022; Roy & Roy, 2021).

Higher education institutions and online learning play a significant role in reskilling and upskilling the workforce and are essential in developing a robust pipeline of skilled engineers (Paullet et al., 2020; Skibniewski & Kim, 2022). The COVID-19 pandemic has compounded the need to develop engineering leaders to meet the demands of the 4IR (O'Heir, 2021; Klassen et al., 2020), and customized executive education programs present a collaborative response (Diaz & Halkias, 2022; Retana & Rodriguez-Lluesma, 2022). A professional engineer is expected to transition into leadership roles throughout one's career by integrating communication, interpersonal, and leadership skills into their technical knowledge base (Pistoia et al., 2021; Rottmann et al., 2018). Nevertheless, there has been mixed consensus drawn from the research on the professional identities of engineers ranging from those that embrace the leadership role to those that resist it as a role or partially accept the leadership identity (Rottmann et al., 2018).

Several engineer scholars share that leadership does not align with their professional identity as an engineer but that there are engineers in the workplace that successfully lead others through their identified roles situated in the three orientations of the engineer's identity (Skibniewski & Kim, 2022). Each of the three orientation of engineering leadership aligns with the identity, or role the engineer embodies and include: technical mastery (integrated communication, creative problem solving, and pattern recognition), collaborative optimization (building and developing high-performing teams through the strategic balance of technical and interpersonal aspects of the field), and organizational innovation (applying technical and scientific-based solutions into practice and later market as new technological processes, patents, and jobs) (Rottmann et al., 2015; Skibniewski & Kim, 2022). The idea of engineering leadership identity is being used in engineering education to support students learning leadership skills or embodying leadership traits to bridge the gap by developing a data-driven understanding of how undergraduate engineers develop as leaders through the lens of identity constructs (Schell et al., 2021).

As the demand for engineering leaders grows in our global economy, future research in engineering education aims to examine the educational pipeline to understand how the concept of engineering identity might change over time (Rodriguez et al., 2018; Schell et al., 2021). Empirical research that includes scholar-practitioners views is limited. Identifying the CSFs of customized executive education programs for reskilling and upskilling engineers in leadership development is needed to drive social change that supports midcareer transitions and ensures livelihoods amidst disruptive global events (Rottmann & Kendall, 2022). Lifelong learning remains essential for the engineering workforce to develop versatile, agile, creative, and positive learning mindsets to solve complex problems that lie ahead (Diaz & Halkias, 2021b; Fung, 2020).

Custom Executive Education Programs for Engineering Leadership: Gaps in the Literature

Engineering education has yet to master the multidisciplinary and collaborative programs needed to develop the engineer to communicate, negotiate and lead in a complex technology-driven society (Caratozzolo et al., 2020; O'Heir, 2021). Executive education approaches to develop leadership in engineers have shown mixed results in the slow transition of these learning outcomes toward accepting leadership identities and holding professional leadership positions (Roos, 2022; Schell et al., 2021). Several gaps exist in engineering and management literature surrounding effective leadership and its development, resulting in limited resources relevant to the engineering profession (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022; Skibniewski & Kim, 2022). Customized executive education programs offer a collaborative solution to prepare engineers for leadership roles required within their profession by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management (ASME, 2022; Retana & Rodriguez-Lluesma, 2022).

The emphasis on engineering leaders having technical and non-technical skills to meet organizational goals shows the importance of considering the reskilling and upskilling of engineering leaders to adjust to the Fourth Revolution market demands in their profession (O'Heir, 2021). Recent research has compiled a list of soft critical skills for engineer leaders and includes social and emotional learning competencies such as critical thinking/problem solving, creativity, communication skills, and collaboration (de Campos et al., 2020; Montandon et al., 2021; Pócsová et al., 2020).

Ongoing debates in the literature argue about the importance of specific skills over others and whether they are necessary for leadership roles (Tiberius et al., 2021). Researchers focused on engineering leaders, and managers found that engineers who transitioned into leadership roles lacked the necessary leadership skills to succeed (Capretz & Ahmed, 2018; Kappelman et al., 2017; Perry et al., 2017; Racine, 2015). Other researchers agree that using technical skills in general engineering positions is needed but argue whether the skill level is required in leadership positions (Kalliamvakou et al., 2017; Kappelman et al., 2017; Minh et al., 2017). Due to the increasing and constant evolution of technology, identifying the skills needed to drive change can be challenging in organizations with technical leadership roles (Kappelman et al., 2017). Although strong technical skills always have distinguished engineers from their peers, the research gathered revealed the need for engineers to develop more than technical skills based on the assumption that engineers will most likely progress into leadership positions (Capretz & Ahmed, 2018).

From the early days of engineering leadership research, seminal scholars have offered various descriptions of non-technical skills for a successful engineering career (Farr et al., 1997; Katz, 1955; Matteson et al., 2016; Northouse, 2018). The important seminal work of Farr et al. (1997) allowed researchers to examine engineering through the lens of leadership. Farr et al. agreed with Katz's (1955) seminal review of management skills that suggested a need for technical and human skills in leadership positions. Both Farr et al. and Katz agreed that technical and human skills were necessary for lower management positions, but Farr et al. failed to mention conceptual skills, while Katz asserted that conceptual skills are when the leader makes connections within the organization to drive decisions for the best interest of stakeholders.

Cross-disciplinary research has become increasingly challenging, and several software engineering scholars have called for further research on human challenges such as communication, diversity, and team culture (Gren & Ralph, 2022; Fazli & Bittner, 2017; Menezes & Prikladnicki, 2018). Since software engineering is intrinsically interdisciplinary, the only way to effectively understand, explain, predict, and prescribe software engineering phenomena is by appreciating research from other disciplines (Gren & Ralph, 2022; Wagner & Ruhe, 2018).

Software engineering teams are key players in productivity and the human side of the job (Hoffmann et al., 2022). Although the study’s results warrant that a higher degree of virtualization of teams leads to increased certain challenges, further evidence is needed to establish solutions to the human challenges in software engineering (Gren & Ralph, 2022; Hoffmann et al., 2022). Effective leadership in agile software development teams depends on the shared effort of dynamic team members who identify as a team and accept responsibility for exercising cultural awareness. Therefore, researchers have recommended that more software engineering researchers integrate theories from referenced disciplines and seek ways to collaborate directly with scientists outside the discipline (Gren & Ralph, 2022).

Business school industry partnerships will enable opportunities to develop a partnership of technology, knowledge, and organizational transfer to support digital skill development critical for success (Diaz & Halkias, 2021b). Scholars have suggested that the opportunity to customize digital technologies will strengthen entrepreneurial intention and deepen relations within the entrepreneurial ecosystem (Ben Youssef et al., 2021; Snihur et al., 2021; Treanor et al., 2021). Research has shown that interactions via e-learning platforms should increase enrollment of student entrepreneurs in university courses to fill any training gaps and urged universities to teach e-skills as part of their entrepreneurship training (Lamine et al., 2021).

Ben Youssef et al. (2021) argued that digital technologies could impact entrepreneurial intent, defined as a person's decision to take action in the processes that exploit new business opportunities. Information and communication technologies enable students to develop soft skills specific to entrepreneurship (Ben Youssef et al., 2021; Lamine et al., 2021). By applying a design thinking approach to entrepreneurship education, science and engineering students will gain immediate access to developing practical skills in digitalization (Lamine et al., 2021; Snihur et al., 2021). Researchers have explored the educational frameworks and practices applicable to the exploitation of entrepreneurship (Snihur et al., 2021; Treanor et al., 2021).

It is beneficial for engineers to broaden their understanding of BM design through systematic thinking to enable the frameworks to improve engineering commercial and entrepreneurial skills to develop advanced technologies (Snihur et al., 2021; Treanor et al., 2021). Snihur et al. (2021) addressed three educational frameworks and practices helpful in teaching engineers to develop new business models (BM) that exploit entrepreneurial opportunities in this new era of the digital economy: the Blue Ocean, the Business Model Canvas, and the Business Model Innovation Framework. While Treanor et al. (2021) focused on the impact entrepreneurship training programs had on the long-term career outcomes among biotechnology early career researchers.

Findings regarding BM-related education allowed the educator to transform into a coach that can resolve student and manager issues by creating a learning cycle that combines an explanatory-experiential-based learning tool (Snihur et al., 2021). Treanor et al.'s (2021) study provided evidence regarding the efficacy of the tailored pedagogical aspects of the entrepreneurship education program for developing longer-term entrepreneurial outcomes through short-term competence development in science and technology. Although creative limitations and challenges with prototyping new BMs in real-time were found, the theoretical implications for educating engineers in technology entrepreneurship are needed to integrate business concepts such as BMs and creativity-related prototyping practices in digitalization (Snihur et al., 2021; Lamine et al., 2021).

Summary and Conclusions

In this chapter, a literature review and critical analysis were conducted about scholarly research on the main concepts of engineering leadership and reskilling and upskilling and executive education programs. It included the knowledge gap in engineering and management literature surrounding effective leadership and its development, resulting in limited resources relevant to the engineering profession (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022; Skibniewski & Kim, 2022). Previous software engineering scholars have called for further research on human challenges such as communication, diversity, and team culture (Gren & Ralph, 2022; Fazli & Bittner, 2017; Menezes & Prikladnicki, 2018).

Customized executive education programs offer a collaborative solution to prepare engineers for leadership roles required within their profession by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management (ASME, 2022; Retana & Rodriguez-Lluesma, 2022). Since effective leadership in software development teams is highly dependent on the shared effort of dynamic team members, further evidence is needed to establish solutions to the human challenges in software engineering (Gren & Ralph, 2022; Hoffmann et al., 2022). Key search terms were identified for the literature search strategy and the databases and journals utilized for the literature review. With the intent to align the study's purpose with describing executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: 1) Rottmann et al.'s (2015) concept of engineering leadership,

2) Fung's (2020) concept of reskilling and upskilling the workforce, and 3) Retana and Rodriguez-Lluesma's (2022) concept of customized executive programs.

Organizational leaders report having little on what makes executive education programs for engineers in leadership development effective and successful (Richardson & McCain, 2022; Rottmann & Kendall, 2022). Without practitioner-based empirical research on CSFs of executive education programs, organizational leaders cannot identify effective leadership development programs customized for engineers (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022). In response to national calls for educational change in engineering (Rottmann et al., 2016; Kendall & Rottmann, 2022), organizational leaders throughout all specialization sectors employing engineers must adjust quickly to changing market conditions driving the need for professional training customized for engineer leaders (Fung, 2020; Retana & Rodriguez-Lluesma, 2022).

In Chapter 3, the research method for qualitative, multiple case study research. The recruitment, participation, and data collection procedures are presented and applied to the current research strategy. The data analysis plan is addressed, and ethical procedures and the trustworthiness of data within the study are addressed.

Chapter 3: Research Method

The purpose of this qualitative multiple case study was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. To meet the purpose of this subject matter expert study and be consistent with the qualitative paradigm, a multiple case study design (Yin, 2017) was used to collect data from a purposeful sample of executive education program experts. The engineering and management literature mentions the overall research gaps on what makes leaders effective or how leaders become leaders (Skibniewski & Kim, 2022). Consequently, organizational leaders have little practitioner-based knowledge of effective, customized executive education programs for reskilling and upskilling engineers in customized leadership development and training (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022).

This study may be significant to practice by informing organizational leaders on the CSFs of customized executive education programs to prepare engineers for leadership roles required within their profession in support of midcareer transitions amidst disruptive geopolitical shifts in the global labor market (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022). I aimed to design a research study to extend theory and academic knowledge on customized executive education programs to prepare engineers for leadership roles through subject matter experts' views. The open nature of expert interviews allowed me to collect data from experts' breadth of knowledge and experience in research fields that still need exploring (see Littig & Pöchhacker, 2014).

Chapter 3 provides detailed information on the research method, the rationale for conducting an exploratory and inductive multiple case study, and the central research question (CRQ) guiding this empirical investigation. This chapter presents a foundational rationale for the participant selection strategy, data collection strategies, data analysis, the role of the researcher, ethical considerations, and a summary of the main points of the research method.

Research Design and Rationale

Browne and Keeley (2014) recommended that a researcher ask the right questions in qualitative research to address the purpose of their study and drive the research strategy. Research questions ground methodology and drive the research design process (Kross & Giust, 2019). Consistent with the purpose of this study, the CRQ was as follows: How do executive education program experts describe the critical success factors needed in customized executive education programs for reskilling and upskilling engineers in leadership development?

Engineering leadership has evolved, yet there remain limited perspectives on how engineers can develop technical, interpersonal, and conceptual skills for their careers (Farler & Haan, 2021; Hickman & Akdere, 2018). Understanding the dynamic skills of innovation leaders has not received sufficient evidence to define engineering leadership (Rottmann & Kendall, 2022). Additionally, organizational leaders report having little information on what makes executive education programs for engineers in leadership development effective and successful (Richardson & McCain, 2022; Rottmann & Kendall, 2022). Without practitioner-based empirical research on CSFs of executive education programs, organizational leaders cannot identify effective leadership development programs customized for engineers (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022).

The nature of this study was qualitative to align with the purpose of the research (see Halkias & Neubert, 2020). When applied to an empirical investigation, the qualitative approach is consistent with the social constructivist paradigm (Cooper & White, 2012). The social constructivist explores how people construct meanings from their daily life experiences. Other qualitative designs were considered as research designs for this study. Both phenomenology and narrative inquiry were considered ineffective in answering the research question due to the methodological limitations of uncritical personal storytelling and exploring the meaning of lived experiences (Tracy, 2019).

An inductive multiple case study (Yin, 2017) was used to meet the study's purpose to understand better executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. Yin (2017) wrote that an inductive multiple-case study is appropriate in three situations: when there is scarce information on a research topic, when the study's research question is a process one that calls for capturing in detail the phenomena that evolve over time (Langley & Abdallah, 2015), and when cross-case synthesis may allow for theory (Eisenhardt & Graebner, 2007; Halkias & Neubert, 2020).

A multiple case study is focused on exploring a phenomenon within real-world settings (Eisenhardt & Graebner, 2007), and expert interviews are now frequently considered a standard qualitative research method (Bogner et al., 2018). A multiple case study can involve individuals within a social context of the phenomenon as separate units of study (Stake, 2006; Yin, 2017). Compared to other research designs, multiple case studies differ from surveys and experiments for exploring management behaviors across different contexts in a global economy (Halkias & Neubert, 2020). The design of multiple case studies includes the use of replication of different cases to collect data. Case study methodologists describe the multiple case study as a comprehensive, holistic, within-case, and cross-case analysis for building a broad experience, which made it the best approach for this study (Halkias et al., 2022; Yin, 2017).

To address this study's problem, the multiple case study and the selection of the cases were categorized into two types of selection, namely *literal replication* and *theoretical replication*—the multiple case study design was selected to bring forth convergent and divergent results across cases. In a multiple case study, the "case" may be a person, an event, an entity, or other units of analysis (Halkias & Neubert, 2020). In a multiple case study, a cross-case data analysis method begins by synthesizing details for a general explanation of the phenomenon after the data collection from all cases is compared for similarities and differences (Eisenhardt & Graebner, 2007; Yin, 2017). Study results emerging from a cross-case data analysis method and the replication process are considered robust and reliable and may be used in extending theory from cases within the management domain (Halkias & Neubert, 2020; Welch et al., 2020)

Role of the Researcher

My primary instrumental role as a researcher throughout multiple case design data collection and analysis processes involved maintaining a code of ethics. Bias was managed through a strategic process of reflexivity that included carefully organizing and designing the study's research questions (Merriam & Tisdell, 2015). Beneficence was practiced throughout the study's process to protect participants from potential physical and psychological harm (Tracy, 2019).

The role of the researcher in managing personal bias is crucial, and I collected varied resources and keywords in the literature review that offered multiple perspectives on the topic (Dowd & Johnson, 2020). I paid close attention to ensure that my study's intentions were supported by clear instructions and avoided asking questions or providing explanations that might lead to biased participant responses. It was critical for me as the researcher to establish and maintain equal power roles with the study's participants, free from a social-formative supervisory role (Kee & Schrock, 2020). To limit undue bias while observing study participants, I collected, maintained, and analyzed data and asked for participant feedback throughout the process.

To ensure trustworthiness, prior to data collection, participants accepted the received terms of the agreement, including a detailed explanation of the research study's purpose, reciprocity, and the risk assessment analysis provided (see Merriam & Tisdell, 2015). Data confidentiality was respected at all times, and I provided details relating to the study's ethical versus legal responsibilities to ensure trustworthiness by participant acceptance of the informed consent terms (Yin, 2017). Participants were provided access to all data sources and data collected between me and the individual participants. The informed consent included a "terms of use" section that outlined participants' protection and privacy regarding any information that might be collected from websites and used as an instrument in the study, accompanied by a comprehensive understanding of its purpose and expectations of use (Gelinas et al., 2017; Halkias et al., 2022).

Throughout the sem-structured interview process, I enacted ethical behaviors based on the principles of respect for people, beneficence, and justice (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1978). I supported participant responses through active listening and offered participant feedback, which was maintained in a detailed audit trail (Mann, 2016; Merriam & Tisdell, 2015). The action was taken to maintain participant privacy and avoid breaching trust while encouraging participants to speak honestly about their experiences (Halkias et al., 2022). I ensured anonymity and confidentiality by reassuring participants of their concealed identity and implementing identifiers as needed if controversial or culturally sensitive topics arose (Yin, 2017). External influences were avoided during participant responses to the study's research questions (Yin, 2017).

Methodology

A multiple case study is designed for a researcher to investigate a social phenomenon by comparing and contrasting differences in data collected between cases, relating to each participant as a separate entity (Yin, 2017). With qualitative research, researchers can describe and discover complex concepts and relationships and understand the processes and patterns of organizational or individual behavior (Tsang, 2013). For this study, the cases were analyzed using replication logic to compare the data, with each case as a separate entity, and the potential for future evaluations of theoretical constructs and recommendations for further research (Eisenhardt & Graebner, 2007; Gehman et al., 2018).

Real-life phenomena can be scientifically studied in depth and within the context of their environments using case-study research. A person, a problem, an event, an organization, a group, and even an anomaly can be distinguished as a case (Ridder, 2017; Yin, 2017). Six to 10 participants through purposive sampling are sufficient for a study to identify essential themes and practical applications in qualitative research (Merriam & Tisdell, 2015). The research and interview questions were developed to gain an in-depth understanding of executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. An audit trail was kept in developing the results of this multiple case study to establish uniformity for the analysis of similarities and differences concerning the participants' views and data for answering the research question (Halkias & Neubert, 2020).

Triangulation can increase the validity and reliability of a case study and may further the study's scope, depth, and consistency (Farquhar et al., 2020). Data triangulation increases the construct validity of research projects by managing the criteria of various data sources (Halkias & Neubert, 2020). Researchers use triangulation to compare and contrast collected data across various data sources, manage bias from individual data sources, and balance viewpoints to strengthen the validity and quality of a study (Guion et al., 2011; Yin, 2017). Semistructured interviews (Halkias & Neubert, 2020), archival data, and reflective field notes (Merriam & Tisdell, 2015) were used to enhance the trustworthiness of this multiple case study's findings through data triangulation (Farquhar et al., 2020).

The research method and design define the research elements in case studies (Yin, 2017). With multiple cases, a case study protocol comprising the instrument, the procedures, and general rules becomes fundamental for the researcher to adhere to those elements (Stake, 2006). This study of the method used began with the design concerning the participant selection logic.

Participant Selection Logic

Population. A study population is a subset of the target population from which the sample is selected (Harkiolakis, 2017). Given that the purpose of this study was to develop a comprehensive description of executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development, the participants in this study were recruited from among (a) practitioners in customized executive education from the 70 top-ranked business schools for 2022 identified by *Financial Times* (2022) that offer customized executive education programs in leadership development in which engineers participate and/or (b) authors of scholarly works in the subject area of executive education in business schools and indexed on Google Scholar between 2018 and 2022. The total number of peer-reviewed scholarly publications is approximately 18,200 (Google Scholar, 2022).

A purposeful sample of 10 participants was selected for this population's multiple case study and was screened based on the following inclusion criteria: (a) adult over the age of 18, (b) executive education program educator with a minimum of 5 years of experience delivering reskilling and upskilling programs for engineers in leadership development, (c) had published at least two articles in a peer-reviewed or practitioner-based journal on executive education ecosystems, (d) had a terminal degree from an accredited institution, and (e) possessed in-depth expert knowledge regarding the central topic of study (see Merriam & Tisdell, 2015). This study's sample size was within the range of five to 15 recommended by Schram (2006) and Halkias and Neubert (2020) for an exploratory and inductive multiple case study because larger sample sizes could be a barrier to an in-depth, qualitative investigation.

Sampling strategy. The process of identifying and recruiting participants for this multiple case design was rooted in Yin’s (2017) concept of replication logic. Each case presented in the multiple case study had its unit of analysis and was considered a different experiment (Eisenhardt & Graebner, 2007). The case study method aligned with the purpose of this study to gain a deeper understanding of executive education program experts’ views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. Because case study research integrates nonrandom sampling, purposeful criterion and network sampling strategies were employed to recruit the participants for this case study. Snowball sampling may have been used to reach data saturation by requesting that previous participants who met the inclusion criteria refer to other potential participants who met the same criteria (Merriam & Tisdell, 2015). Compared to the single case study design, the multiple case study design allows data collected to be compared between multiple cases, increasing in-depth understanding of the study's problem (Halkias et al., 2022).

Sampling Criteria. In qualitative research, expert interviews have not only been recognized as a standard method (Bogner et al., 2018), but may also follow similar standardized communication patterns that quantitative (survey) research applies (Flick, 2018). Participants recruited for this study included executive education program experts who met the following inclusion criteria: (a) adult over the age of 18, (b) executive education program educator with a minimum of 5 years of experience delivering reskilling and upskilling programs for engineers in leadership development, (c) had published at least two articles in a peer-reviewed or practitioner-based journal on executive education ecosystems, (d) had a terminal degree from an accredited institution, and (e) possessed in-depth expert knowledge regarding the central topic of study (see Merriam & Tisdell, 2015). The participant selection logic was specific to ensure that all potential participants met the minimum requirements for recruitment and subsequent participation in the study through in-depth expert interviews (see Bogner et al., 2018).

Sampling Selection. To fulfill the purpose of this study, the proposed process was used to identify and select potential participants and collect data from the semistructured interviews to answer the study's central research question (Tracy, 2019). I actively engaged in purposeful criterion and network sampling to increase the opportunity to recruit participants with the potential to provide in-depth data for analysis and interpretation of findings. The case was selected based on interest, unlike quantitative logic (Stake 2005), and may include the theoretical rationale for participant selection (Eisenhardt & Graebner, 2007).

Although maximum variation (heterogeneity) sampling is employed in quantitative studies to identify possible variations when adapting to different conditions, it has also been noted as the preferred method used in constructivist inquiry (Guba & Lincoln, 1994). Yin (2017) noted that, within a multiple case study design, the unit of analysis can be an individual in a specific context and that the research question relates to the unit of analysis. This study's central phenomenon is the individual, and the context is the unit of analysis, the executive education program experts. Each case in a multiple case study stands on its own and serves as a unit of analysis, allowing the exploration of social phenomena using replication logic and comparing and contrasting results between cases to extend the theory (Eisenhardt & Graebner, 2007; Yin, 2017).

Sample Size and Saturation. For this multiple case study, I recruited 10 experts who were knowledgeable about the topic of interest and conducted individual in-depth interviews that answered the central research question of this study. To best acquire a data-rich population pool, I selected participants with a greater chance of providing data-rich responses. Compared to the single case study design, the multiple case study design allows the comparison of collected data between multiple cases and provides an in-depth understanding of the study's problem (Halkias et al., 2022). The logic that supports this approach increases validity through replication. In replication logic, by targeting constructs with precision, the relationships that emerge are confirmed from the cases, leading to improved confidence in the trustworthiness of results and extension of theory (Halkias & Neubert, 2020).

The specific design, including the purposive variation in sampling, increases the study's validity and trustworthiness while generating a more efficient data saturation (Fusch & Ness, 2015). In a multiple case study design, the researcher can maximize variation sampling by selecting managers and leaders from organizations operating in different sectors to collect data from diverse organizational contexts (Halkias & Neubert, 2020). The participants were selected from the data pool, and expert interviews were conducted to increase the dependability and credibility of the study's findings. After carefully selecting participants with the most significant opportunity for rich-data collection, I began building relationships with the participants and asked clarifying questions to increase the in-depth understanding of the phenomenon being examined. Multiple data sources were collected to provide research questions, including interviews, archived data analysis (government and media sources related to the topic), and reflective journaling (Guion et al., 2011).

In this study, the participant selection logic was established concerning other studies incorporating similar design and sampling strategies that provided data-rich participant responses toward developing a deeper understanding of the topic (Agarwal et al., 2022; Hong et al., 2022; Mosca et al., 2021). Similar studies showed a variation in effective multiple case designs based on the data collection, sampling, and data analysis approaches. All three studies used purposive sampling strategies to collect multiple data sources, and each study conducted semi-structured interviews with experts from different cases. The rationale for adopting multiple-case study research depends on the strength of replication logic and may focus on literal, theoretical replication utilized to increase the multiple-case study's reliability (Yin, 2017).

Based on Yin's (2017) methods and interpretation of multiple case studies, the case may be an individual and is often applied in business management and leadership studies. Important themes and practical applications applied purposive sampling of only 5-15 participants to ensure an in-depth investigation (Merriam & Tisdell, 2015). Agarwal et al. (2022) applied a mixed-method design using a multiple case approach to align human resource practices and policies with Industry 4.0. Furthermore, semistructured interviews with 11 experts, academicians, and industry managers were conducted to identify critical challenges toward implementing Industry 4.0 in India's emergent economy (Agarwal et al.).

Mosca et al. (2021) collected data from a purposive sample of 10 talent management experts using criterion and snowball sampling. Mosca et al. applied criterion sampling to collect talent management experts' views on innovative talent leaders' competency characteristics, increasing the richness of data collected. Hong et al. (2022) aimed to examine the role of leadership in charting the course in a crisis context and applied leadership theories toward a research-based framework by applying the multiple case study design of four target companies and conducting in-depth interviews with senior management professionals at different time periods.

Collecting multiple data sources, known for triangulation, strengthens the study's credibility by applying a balanced approach to strengths and weaknesses (Guion et al., 2011). Triangulation further enhances the robustness of data when the researcher combines reading, listening, and observing consistent data across multiple sources of evidence (Halkias & Neubert, 2020). Agarwal et al. (2022), Hong et al. (2022), and Mosca et al. (2021) collected data from multiple sources, such as semistructured interviews, journaled reflective field notes, and archival data. Hong used secondary sources, including media reports, financial statements, and company public announcements, while Mosca et al. included business and industry reports and media articles on innovative talent management.

For theoretical and actionable insights to be attained, the multiple case design enables comparison and contrast between the cases of the same social context (cross-case synthesis) that recognizes each participant as a separate experiment (Halkias & Neubert, 2020; Yin, 2017). To strengthen the trustworthiness of the data and external validity, thematic and cross-case synthesis is recommended (Merriam &Tisdell, 2015). Agarwal et al. (2022), Hong et al. (2022), and Mosca et al. (2021) varied their data analysis approaches by incorporating thematic and contextual analysis and applying cross-case synthesis to identify themes to generate fundamental value in each topic under investigation. Overall, each of the studies incorporated effective methods of a multiple case approach to generate rich data by conducting semistructured interviews with experts knowledgeable about their specific topics. used purposeful sampling to yield rich answers to the study's research question and came to conclusions based on the experts' individual perspectives and their impact on social practices in a field of action (Döringer, 2020).

Instrumentation

The goal of instrumentation in a multiple case study aims to collect data from multiple sources through an interview protocol and other data collection processes that support answering the study's research questions (Yin, 2017). Hence, gathering appropriate instrumentation that aligns with the study's purpose can contribute original data to the conceptual framework and extend theory (Halkias & Neubert, 2020). Themes on how executive education program experts describe the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development will emerge through the study's data analysis procedures.

The three sources of data collected for this study included (a) a semistructured interview protocol (Appendix B) with items that are grounded in the literature review and conceptual framework of this study and field-tested by a panel of three experts, (b) archival data in the form of industry-related reports, media articles on executive education programs for reskilling and upskilling engineers in leadership development (see Yin, 2017) and (c) reflective journal notes (see Merriam & Tisdell, 2015), which I kept throughout the data collection process. In this study, the final results section incorporated the evidence from multiple sources to drive the data triangulation process (see Guion et al., 2011).

The study results were founded on rigorously planned data collection procedures from the primary data gleaned from a semistructured interview. A standard data collection method in qualitative studies offered a tool to gain a deeper understanding of the expert participant's perspective. In this exploratory and inductive multiple case study, the interview protocol items can produce reliable data results to answer the study's CRQ: *How do executive education program experts describe the critical success factors needed in customized executive education programs for reskilling and upskilling engineers in leadership development?*

Semistructured Interview Protocol. The primary tool used in this was online semistructured interviews with open-ended, focused interview questions asked of the participants (see Yin, 2017). The semistructured interview (Appendix B) centered on five well-chosen questions grounded in the Conceptual Framework and the extant literature review presented in Chapter 2. The study's participants were invited via a recruitment letter (Appendix A) that included the nature of the study, its purpose, and an invitation to participate. The letter included the informed consent detailing the ethical and confidentiality procedures enacted throughout the study's processes and design. The participants were asked questions over a 30–40-minute timeframe and in a semistructured design (see Yin, 2017).

A preliminary field test and a quality audit were conducted to determine whether the study's interview questions would produce results to answer the central research questions (see Tracy, 2019). The field test auditors included the Dissertation Committee Chair and two subject matter experts to determine the credibility, dependability, and applicability of the interview guide's questions and the interview procedures. The three field test auditors — Dr. Daphne Halkias, the Dissertation Committee Chair; Dr. Paul Thurman, Professor and Executive Education Trainer at Columbia University (USA); and Dr. Nicholas Harkiolakis, an aeronautical engineer and engineering consultant, project manager, and Professor at Ecole des Ponts Business School (France) and have published peer-reviewed scholarly works as well as having practitioner experience in the domain of custom executive education development for corporate leadership and engineer leaders (e.g., Diaz et al., 2022; Diaz & Halkias, 2021a; 2021b; Harkiolakis, 2016; Thurman, 2020). This field testing supports the trustworthiness and credibility of the study's qualitative findings (Guba & Lincoln, 1994).

The reliability of an instrument in a qualitative study relies on the study's potential transferability of findings. External validity is related to transferability by the reader's ability to infer whether the study's findings can be applied in different contexts or situations (Merriam & Tisdell, 2015). In qualitative studies, transferability has been challenging because the findings are attached to specific contexts and individuals and may not align with other populations outside the group of participants (Stake, 2013).

Archival Data. Triangulation is the root of case study research and can be applied as an investigative approach in a field study with multiple data sources (Yin, 2017). Triangulation is a systematic approach in qualitative research that confirms or contradicts the interview data results strengthening the depth of the data collected (Guion et al., 2011). Several archival documents were used to triangulate the outcome of this multiple case study. Archival data from practitioner-based executive education programs and e examined a few databases relating to sustainability in customized executive engineering programs concerning the reskilling and upskilling of engineering leadership. These two archival data sources were utilized for triangulation to answer the research question and support the trustworthiness of the findings of the study.

Reflective Journal Notes. The third instrument this research used for data collection is reflective journal notes from the online observation during the interview process and the semistructured interviews. When reflexivity is used while writing qualitative research design field notes, the researcher can apply an unstructured observation by reflecting on the collected data (Alvesson & Sköldberg, 2017). Researcher reflexivity was managed during a Zoom interview conducted online**.** Online interviewing supports the replication and maximum variation process by enabling the researcher to reach participants in geographically dispersed locations and sustaining an unbiased atmosphere (Yin, 2017). Because Zoom allows me to interview participants in remote locations, this technology may mitigate the researcher's reflexivity by maintaining a primarily unbiased atmosphere (Gray et al., 2020).

Online interviews, self-observations, and interpersonal connections could be considered online data collection since most data online is automatically stored and documented (Kozinets, 2019; Merriam & Tisdell, 2015). Therefore, I began by reviewing and analyzing the field notes from the observation. Reflective journal notes maintain a natural setting for research that allows for a detailed collection of data observed that cannot be accomplished by asking questions and recording the explanatory answers. The reflective journal notes were logged during the online interviews by observing the participants' nonverbal cues, including their body language, emotions, and appearance (Kozinets, 2019).

I used netnographic field notes for triangulation in the data analysis process (Kozinets, 2017) to align with standard practices in multiple case study designs and research methods (Halkias & Neubert, 2020). In this research, the trustworthiness of instrumentation was determined by the transferability by providing findings and conclusions that could be extended to different sample groups within different settings (Merriam & Tisdell, 2015). The transferability advantage of the study's results could be an asset to other individuals outside of the study's participant sample and could act as an area of reference for future researchers to inquire further (Stake, 2013).

Procedures for Recruitment, Participation, and Data Collection

For this qualitative multiple case study, the sample size was 10 participants for the purpose of data saturation. A group of up to 10 executive education program experts was recruited for in-depth interviews, which allowed for substantial data saturation. (Fusch & Ness, 2015). To reach the data saturation point, the data collected failed to generate new themes or information (Glaser & Strauss, 1967; Mason, 2010; Yin, 2017).

The recruitment process began with a Google Scholar search to locate executive education program experts that meet the sample's inclusion criteria. I used the online professional network LinkedIn as the primary recruitment tool for potential participant identification. Candidates that meet the inclusion criteria were sent a recruitment letter inviting them to participate and requesting a response of interest from a personal phone or email address. Participants resumed the process by signing the Informed Consent form, and I scheduled their Zoom interviews. Zoom is an internet-based video method of communication (Lo Iacono et al., 2016) that enables the opportunity for expert interview interactions that remove context-based information to establish an unbiased environment (Bogner et al., 2018).

The qualitative expert interviews entailed participants' perspectives on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. Researchers and practitioners have used expert interviews across various disciplines for research, from international relations and politics to policy, sociology, and organizational research (Flick, 2018). Based on the exploratory nature of research studies, researchers find expert interviews to be a more useful form of data collection than observations (Wästerfors, 2018) or quantitative experimental research (Yin, 2017). Expert interviews, which are semistructured and open, allow for a deeper extraction of knowledge and experience from experts in research areas that have limited exploration (Littig & Pöchhacker, 2014). The data extracted from expert interviews may reveal more challenging and limited information in these fields of research (Bogner et al., 2018; Littig & Pöchhacker, 2014).

After Walden University's Institutional Review Board (IRB) approved the details for this study, recruitment letters were emailed to each participant that met the inclusion criteria and invited to participate in the study. The Informed Consent terms and conditions were attached to the email invitation and included: (a) an explanation of the study's details, (b) the option to withdraw, (c) the procedure, (d) any possible risk or discomfort associated with participation, (e) the time limit, (f) a statement of voluntary participation with zero consequences if refused (g) rights to confidentiality, and (h) the benefit of the study for IT managers and leaders interested in customized executive education programs for reskilling and upskilling engineers in leadership development. The participants who received a recruitment post on LinkedIn (Appendix A) and showed interest in participating in the study were asked to provide a personal email address, phone number, and Zoom link for future communication purposes.

This study's primary data collection method was the qualitative method of semistructured interviews to gain a deeper understanding of the executive education program experts’ knowledge and experiences. I engaged participants in conversations that asked them to share their experiences related to the study’s topic to produce rich and relevant data.

Without recruiting the substantial participants needed for the study, I would have applied a snowball sampling strategy to identify the remaining experts until a group of 10 quality candidates had been selected as the study’s potential participants (Merriam & Tisdell, 2015). The interview protocol included the generation of open-ended questions that aligned with the focused topic of the study and were designed to capture expert viewpoints regarding the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development (Yin, 2017).

Upon the critical approval of Walden University’s IRB application, expert interviews were conducted by the internet-based video communication platform Zoom or by telephone. Ten interviews were conducted during the data collection process lasting approximately 30 minutes, recorded with a digital audio recorder, and accompanied by handwritten notes in a reflexive journal to track self-reflection practices (Stake, 2013). A Windows 10 voice recorder was used to retain a recorded copy of the interview conversations, and a transcription application was employed to allow the participants’ responses to be transcribed. The data collected from the interviews were stored electronically in Microsoft Excel software and supported the recording, documenting, analyzing, and categorizing processes of the data collected. The data collection. Microsoft Excel is an effective tool for storing and documenting interview data, analyzing thematically, and categorizing information numerically (Tracy, 2019).

After the Zoom interviews, each participant was thanked for their participation and informed that further contact might occur if response clarification was needed. Participants were assured that their identity would remain anonymous and that the data collected would sustain confidentiality. I saved all collected data representative of the study on my laptop and stored it on a USB Flash Key and Dropbox, secured with password protection. All electronic files were stored on a secured server in a firewalled folder accessible only to me.

Data Analysis Plan

Researchers' primary responsibility was to know the extent and type of data needed and to develop a methodologically sound interview protocol to yield quality responses when conducting interviews to move to the data analysis process for a multiple case study (Halkias et al., 2022). The interview questions were used to produce relevant threads of ideas among the study participants to link with the study's overall purpose. In this study, the executive education expert was the unit of analysis. Each case in a multiple case study stands on its own and serves as a unit of analysis, allowing the exploration of social phenomena using replication logic and comparing and contrasting results between cases to extend the theory (Eisenhardt & Graebner, 2007; Yin, 2017). The executive education program expert was the unit of analysis in this multiple case study.

The data analysis process for the interview transcripts, journaling notes, and archival data developed a compilation of all data collected into categories and themes using the descriptive coding method (Saldaña, 2016). Saldaña (2016) recommended that the descriptive coding method is appropriate for novice qualitative researchers, assigning symbolic meanings to data segments and providing an inventory of words or phrases for indexing and categorizing data (Saldaña, 2016). In developing a case study database, identified themes, words of significance, viewpoints, and documented work was analyzed and organized using thematic analysis to support theme development from the collected data (Yin, 2017).

Yin (2017) recommended cross-case synthesis as the most appropriate data analysis technique in multiple case study research. Cross-case synthesis is more efficient than content analysis for a Ph.D. study that also involves comparing and contrasting cases rather than just analyzing individual cases (Halkias & Neubert, 2020). The cross-case synthesis technique involves treating each case separately while aggregating findings across a series of individual cases. Designs that use both within-case and cross-case synthesis have proven to provide a more consistent platform to generate theoretical propositions and constructs than designs that use only the within-case analysis (Barratt et al., 2011).

I followed Yin's (2017) recommendation for a "ground-up" strategy to analyze case study data. This strategy involved analyzing the data from the "ground up," thereby allowing key concepts to emerge by closely examining data. This strategy is the most appropriate when analyzing multiple case study data to align the emerging concepts with the central research question (Yin, 2017); this strategy is consistent with the descriptive coding method (Saldaña, 2016) used in the study.

A good research question, a robust design, and rigorously collected data help develop novel and credible insight in a multiple case study (Halkias et al., 2022). The data analysis is a two-stage process that starts by constructing an entire within-case analysis, proceeded by a case comparison using the iterative process until similar or different outcomes emerge (Eisenhardt & Graebner (2007). Data analysis in the present study followed Eisenhardt & Graebner's (2007) two-stage process. While the first stage consisted of a within-case analysis of each selected case, the second stage consisted of a cross-case analysis of data to seek similarities and differences across the conceptual categories and themes (Yin, 2017). Regarding individual within-case analysis, data collected from transcribed interviews and field notes were arranged in segments, indexed with line numbers, and arranged in line with the interview questions for easy identification of codes (Finfgeld-Connett, 2014). Codes sharing common meanings were classified into categories and themes (Saldaña, 2016).

Issues of Trustworthiness

Trustworthiness involves applying the criteria of credibility, transferability, dependability, and confirmability to ensure the methodological rigor of a qualitative study (Johnson et al., 2020). The systematic use of journals and audit trails of all essential issues or information about the theoretical approaches, methodological choices, and data analysis during the study promotes the study's trustworthiness (Lincoln & Guba, 1986).

Credibility

Credibility is considered the internal validity of the study and is based on how the research findings align with reality to measure the trustworthiness of the research (Merriam & Tisdell, 2015). Strategies include peer debriefing, member checking, knowledge of issues, rival explanations, referential adequacy, and triangulation (Lincoln & Guba, 1985; Yin, 2017). The interview protocol was developed based on the extended time spent reviewing the pertinent literature to ensure the appropriate data was gathered to reach data saturation. A definitive process was applied for a transcript review to establish the validity of the study's findings and involved the exchange and verification of transcripts with participants, known as member checking (Birt et al., 2016; Yin, 2017). Triangulation describes the various sources of evidence, such as interviews, observations, and case study documents used, and is considered an advantage to applying different data collection methods and cross-checking the facts and statements collected (Halkias et al., 2022; Yin, 2017). Field testing with other subject matter specialists was employed to verify that the interview questions were relevant and meaningful to the participants being asked and that the study's central research question was answered.

Transferability

Transferability is the external validity of a study that provides an opportunity to apply the findings from the original research study to other study contexts rather than the extent to which a study's results can be transferred to similar contexts and situations (Baskarada & Koronios, 2013; Yawar & Seurig, 2017). A study's transferability depends on the context-related knowledge linking the setting, the researcher's understanding of the situation, the researcher's analysis, and the population under investigation (Carminati, 2018; Yin, 2017). The researcher's role includes developing strategies throughout the analysis process that ensure participants' voices are sustained to allow readers to determine the transferability possibilities of the study's findings (Birt et al., 2016). At the same time, detailed documentation and descriptions of the sample, the boundaries, the setting, and the study's findings allowed other researchers to replicate and determine how it is transferred (Carminati, 2018; Marshall & Rossman, 2016).

For this study, I used a variety of data collection and sampling methods by using a purposive sampling strategy to recruit subject matter experts with varying perspectives through criterion sampling to improve the study's transferability (Halkias et al., 2022). I ensured the transferability of findings by selecting a small sample of experts that supported reasoned arguments to meet data saturation, maintained a consistent methodological approach, and provided a detailed description of the study's problem and research process (Anderson, 2017; Carminati, 2018; Morse, 2015).

Dependability

Dependability refers to the study's accuracy and consistency of data collection, data analysis, and thematic development that apply various strategies to increase the replication of findings (Halkias et al., 2022; Merriam & Tisdell, 2015). A study is dependable when the findings are consistent and replicable (Lincoln & Guba, 1986). Closely aligned with credibility, dependability includes audit trails, detailed methodological descriptions, and external audits, such as peer debriefing to review the documentation and triangulation of the research (Halkias et al., 2022; Morse, 2015).

I ensured dependability was met for this study by establishing alignment of the study's problem, purpose, research question gap, design, and methodology. I created a detailed procedure for the methodology and maintained an audit trail that documented each action and every decision that occurred throughout the data collection process. In addition to the audit trail, I kept a detailed chain of evidence to verify that alignment occurred at each stage of the research process and coincided with the findings that answered the study's central research question (Yin, 2017).

Confirmability

Confirmability is the degree to which the study's results can be determined objectively based on the detailed descriptions of the experts' responses and the researcher's role in managing subjectivity through the primary methods of reflexivity and audit trail (Berger, 2015; Halkias et al., 2022). Reflexivity involves the researcher's acknowledgment of their role in the research process that reflects upon prior experiences, beliefs, and assumptions that may influence the research process (Halkias et al., 2022). By employing an audit trail and developing reflexivity, the researcher becomes mindful of their social and emotional position and interpersonal connections (Berger, 2015; Morse, 2015).

Reflexivity ensures participants' voices are preserved through reflective journaling that expresses one's inner thoughts and feelings and includes composing unbiased questions to maintain rigor (Halkias et al., 2022; Morse, 2015). A multiple case study on change management conducted by Selsor (2020) employed effective qualitative processes that included triangulation, purposive sample selection, audit trails, and reflective journal notes. Selsor immersed himself in his environment through pictures, pamphlets, and videos of detailed reflective journaling. Halkias et al. observed how increased self-awareness before, during, and after data collection and analysis decreased personal bias.

For this study, I ensured transparency in reflexive practices by documenting my personal beliefs, assumptions, and emotional experiences in a reflective journal throughout the data collection process, including peer debriefing following data collection with research community members not associated with the study (Lincoln & Guba, 1986). Data coding and audit trails are proven tools that will be used to ensure reflexivity, member checking, and direct quotes in the findings to establish confirmability (Halkias et al., 2022; Tracy, 2019).

Ethical Procedures

The study's inauguration depends on the IRB's approval, which requires submitting pertinent information such as the potential risks and benefits, anonymity, and confidentiality. Additional documents describing the fundamental ethical concerns regarding the ethical treatment of human participants were included in the recruitment process plans and materials, data collection and intervention procedures addressed potential participant withdrawal, the appropriate treatment of data treatment, and other potential conflicts that may arise.

Once the study met the IRB's approval, I began the recruitment process that required careful selection of the potential participants from LinkedIn's professional network and sent email invitations requesting participant involvement. Potential candidates contacted me through LinkedIn if they were interested in participating in the study. Confidentiality was a priority; candidates verified that they met the study’s criteria and were required to agree to the terms and conditions of the informed consent.

Informed consent is a critical component in ensuring the study is ethically sound. I ensured all participants were notified that this study would be conducted following the landmark Belmont Report (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1978), and each participant received formal and detailed advisement of their rights before, during, and after the study. Participants were further notified regarding their participation as an optional decision due to their interest in the study's topic or the potential value the study may have in engineering leadership. I ensured to abide by Walden University and The Institutional Review Board (IRB) informed consent process, which included obtaining and maintaining a signed consent form from each participant that outlined the parameters of the study, their rights to review all interview data collected, and that they may change their responses or withdrawal from the study at any time without penalty.

Confidentiality is a significant concern for this study regarding protecting participants' information and the data collected from the organization used in the study's archival documents. A breach of confidentiality by the researcher will threaten the integrity and ethical standards of the researcher and the study (Klenke, 2016). I maintained confidentiality by securing all data and notes stored in a locked location in my home and password protected on my computer. This included five years of ancillary storage devices, such as external drives. After five years, the data will be deleted and destroyed. Owen and Bassey (2019) stressed the importance of employing standards for ensuring privacy, anonymity, confidentiality, and the use of data storage for its intended purpose will be secured folders with strong passwords.

Interviews via Zoom followed, and I collected personal emails to be used as communication throughout the process. Interviews were scheduled, and all details, including the date and time of the interview, were sent in an email, and each participant reviewed their voluntary role, individual privacy, and confidentiality. Internet research responsibilities regarding ethical principles were followed. At all times, participants were respected by ensuring harm of any kind was avoided, data storage and protection measures were in place, and privacy in multimodal environments (virtual platforms, complex cultures in online forums)was protected (Kantanen & Manninen, 2016).

To my knowledge, there were no ethical concerns with the data collection process. Participants were notified that their participation involved their knowledge as academics and authors of peer-reviewed papers published in reputable scientific journals within the talent management subject area and that no specifics were requested about their organization. If early participant withdrawal occurred, I reassured the participants that they would be respected and treated equally regardless of participation. If withdrawal occurred, I maintained a potential list of participants twice the number needed for the study.

All participant names were kept confidential and replaced with pseudonyms to protect their identity, and no identifying data was used in the archival data, data analysis, or findings. Each participant's folder was kept, and interview data was stored on my laptop on a USB Flash Key and Dropbox with password protection. Protecting the participants' identity and related data is essential to ensure full participation, disclosure, and belief sharing. I only shared the data with the Chair and Committee Member, and data encryption and passwords were used to transfer sensitive and confidential data. After five years, a particular file-shedding software will be employed to destroy data to address data remanence for addressing the issue of potential harm caused by the recovery or unintended disclosure (Owan & Bassey, 2019). Therefore, the interview-related files regarding the present study will be deleted from my laptop and personal USB Flash Key.

The ethical quality of the study is the responsibility of the researcher(s) to ensure ethical procedures of the study are followed, relationships with the participants are respected, and all circumstances of any situation, including the release of information with the practice of self-reflexivity, multivocality, and self-consciousness were preserved (Tracy, 2010). I conducted the research study outside my personal and professional context to avoid any conflicts of interest, data were collected anonymously, and all communication of the study's findings was represented as a contribution to positive social change.

Summary

This qualitative, multiple case study aimed to understand better executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. In this study, the instrument was semistructured interviews with open-ended questions to allow participants the opportunity to express their views fully. Archival data were collected from industry-related reports, media articles on executive education programs for reskilling and upskilling engineers in leadership development, and reflective journal notes were used to validate the findings and strengthen the study's trustworthiness.

Chapter 4 will include the detailed procedures for the interview protocol, data collection, and data analysis from the 10 semistructured interviews. Following the described procedures and after the cross-case synthesis is conducted, the data analysis results that answer the study’s central research question are presented in their final form. Detailed explanations were provided regarding any unexpected organizational, procedural, or situational conditions that may have occurred during the data collection process. In addition, provisional evidence of trustworthiness (credibility, transferability, dependability, and confirmability) was described in detail.

Chapter 4: Results

The purpose of this qualitative multiple case study was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. From the data collected to answer the research question, I gained a deeper understanding of theoretical insights and practitioner-based knowledge of the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development, which represented a gap in the literature. The research question that guided the development of this empirical study was the following: How do executive education program experts describe the critical success factors needed in customized executive education programs for reskilling and upskilling engineers in leadership development?

Customized executive education programs present a collaborative response by which firms and training providers develop specific solutions to unique problems within a given professional context (Diaz & Halkias, 2022; Retana & Rodriguez-Lluesma, 2022). Through a cocreation process, business school staff members and learning and development officers in the client firm diagnose a company's problems and codesign the program's contents to meet specific organizational needs; the contents are then planned and delivered, usually at the business school's facilities. Faculty members delivering customized executive education are highly specialized in their expertise area, and participants are often talented executives with great potential on a career development path within their companies (Kets De Vries & Korotov, 2007).

Customized executive education programs can prepare engineers for leadership roles required within their profession by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management (ASME, 2022; Retana & Rodriguez-Lluesma, 2022). Despite the relevance of customized executive education programs for leadership development between organizations and business schools, there remains a literature gap on the criteria that make these collaborations successful (Diaz et al., 2022; Roos, 2022). This study may be significant to professional practice to inform organizational leaders about the strengths of customized executive education programs to prepare engineers for leadership roles, support their midcareer transitions, and ensure livelihoods amidst disruptive global events (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022).

This study was framed by three key conceptual models that aligned with the purpose of the study, which was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: (a) Rottmann et al.'s (2015) concept of *engineering leadership*, (b) Fung's (2020) concept of *reskilling and upskilling the workforce*, and (c) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs.* This study is significant to theory in that it contributes original qualitative data to the foundational theories supporting my conceptual framework, including Farr et al.'s (1997) theory of engineering leadership, empowerment theory (Perkins & Zimmerman, 1995), and Argyris and Schön's (1996) theoretical works on organizational learning.

In Chapter 4, I present an analysis of this multiple case study's results based on thematic and cross-case analysis. As Yin (2017) recommended, the first approach, thematic analysis, was based on the study's three data sources. For this study, the three sources of data collected were (a) a semistructured interview protocol (Appendix B) with items that were grounded in the literature review and conceptual framework of this study and field-tested by a panel of three experts, (b) archival data in the form of industry-related reports and media articles on executive education programs for reskilling and upskilling engineers in leadership development (see Yin, 2017), and (c) reflective journal notes (see Merriam & Tisdell, 2015), which I kept throughout the data collection process.

I used theory-driven codes from the conceptual framework and inductive codes to review data as prior research-driven codes in a bottom-up strategy. While various approaches are helpful in qualitative data analysis, "thematic analysis is flexible, and what researchers do with the themes once they uncover them differs based on the research intentions and the process of analysis" (Boyatzis, 1998, p. 63). For the second step of the data analysis process, I implemented the cross-case synthesis method for data analysis to generate themes representing the convergence and divergence of participants' experiences within and between cases (see Yin, 2017). Although each case in the cross-case synthesis was evaluated as a separate case, synthesizing data from each case strengthened the rigor of the study's results (Eisenhardt & Graebner, 2007; Yin, 2017). Each case provided evidence to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development.

The multiple case study design's primary goal is to replicate the same findings across several cases by exploring the differences and similarities between and within cases (Eisenhardt & Graebner, 2007). This research was an extension study that provides replication evidence and expands previous studies' findings in other theoretical areas (Bonett, 2012). The minimum number of cases for a multiple case study is relative to the research question and its purpose. To gain an in-depth understanding of the phenomena under study, Eisenhardt (1989) suggested a limit for the number of cases (e.g., four to 10 cases). In such a study, the optimum qualitative design to retrieve data with the goal of theory extension is an exploratory, multiple-case study design (Eisenhardt & Graebner, 2007; Halkias & Neubert, 2020). The unit of analysis in this study was the executive education program expert.

Throughout this chapter, I describe the discovered patterns and recurrent themes resulting from the cross-case data analysis process. With this analysis, I maintain the voices and perspectives of the participants. As Yin (2017) recommended, the study's sample population, categories of codes, themes, and a cross-case synthesis of themes are also presented below.

Research Setting

I collected data from 10 executive education program experts for this multiple case study. The inclusion criteria required for expert participation in the study included (a) being an adult over the age of 18, (b) being an executive education program educator with a minimum of 5 years of experience delivering reskilling and upskilling programs for engineers in leadership development, (c) having published at least two articles in a peer-reviewed or practitioner-based journal on executive education ecosystems, (d) having a terminal degree from an accredited institution; and (e) possessing in-depth expert knowledge regarding the central topic of study (see Merriam & Tisdell, 2015). Participants were recruited from an initial search of executive education program experts from Google Scholar who met the inclusion criteria, followed by using the professional network LinkedIn for candidates to participate.

The recruitment process proceeded with an initial email contact sent to each participant. The email included an attached informed consent and questions regarding available days, times, and time zones. I requested that each participant respond to the email with “I consent” after reviewing the attached informed consent and include their answers to the availability questions posed at their convenience and within the outlined research study process timeline. The dates and times provided by the participant and the confirmed time we agreed upon ensured that the selected time and date were convenient and that there would be no interruptions or distractions that would distract from the interview or delay the data collection process. A Zoom invite was sent and included the day and time to confirm, as well as a link and password to enter the meeting that day.

The semistructured interview protocol (Appendix B) was established to guide the interview to ensure that the interviewee understood the background of the research, including context-based definitions critical to the topic of study, and to confirm that the participant was comfortable with the topic being discussed. The interview protocol was provided before the interview for participants to prepare for the topics discussed. As a result, the responses about the subject matter collected from each participant were in-depth and rich data.

Twelve experts were identified from LinkedIn's professional networking platform and agreed to participate. Ten responded with "I consent," and six confirmed available times and dates and were sent a Zoom invite to interview. The total sample size of 10 executive education program experts met the desired recruitment range. Four participants answered in writing due to scheduling conflicts/time zones, and six were interviewed via Zoom virtual meeting. Zoom interviews were recorded on the platform via the voice recorder app on iPhone and were professionally transcribed through the Transcribe Me! app.

Demographics

Eleven executive education program experts met the inclusion criteria in the study, and 10 answered the interview questions: nine men and one woman. Each of the 11 participants met the inclusion criteria by being an adult over the age of 18, being an executive education program educator with a minimum of 5 years of experience delivering reskilling and upskilling programs for engineers in leadership development, having published at least two articles in a peer-reviewed or practitioner-based journal on executive education ecosystems, having attained a terminal degree from an accredited institution, and possessing in-depth expert knowledge regarding the central topic of study.

The demographic characteristics collected were age, country of citizenship, educational degree, years of experience in leadership development, number of published peer-reviewed articles, and experience working with engineers. The demographic characteristics were data points relevant to the study's conceptual framework. Each participant was provided a participant number. The study's sample consisted of male (9/10) and female (1/10) participants ranging between the ages of 43 and 63 years old (average = 52.4).

The candidates' years of executive education experience in leadership development delivering reskilling and upskilling programs for engineers varied between 5 and 25+ years. Two participants were citizens of Canada, two were from the United States, one was from Jordan, one was from Spain, one was from Greece, one was from Italy, one was from Saudi Arabia, and one was from Switzerland. All candidates had a PhD or doctorate, and their number of peer-reviewed published articles ranged between three and 103, with three noted as having published books (average = 28.2). All candidates had developed leadership programs with engineers.

Data Collection

IRB approval was granted on August 30, 2022, and data collection began on September 1, 2022. A total of 11 candidates were identified as experts, 11 consented to the informed consent, and 10 either returned written responses or conducted a Zoom interview. Seven of the 11 participants joined the recorded video and audio Zoom interview, and four provided written responses to the interview questions. Interviews took place between September 6, 2022, and October 10, 2022, and lasted between 21 and 28 minutes (average = 24 minutes). The data collection concluded on October 10, 2022. The minimum number of interviews required for a qualitative multiple case study should be five participants, and I continued past this number until I reached data saturation, which occurred at 10 participants, with similar data noted from Participants 6, 7, 8, 9, and 10 (see Halkias & Neubert, 2020; Schram, 2006). Data saturation became evident during the data collection process when the emerging themes that contributed to answering the research question started repeating and no new themes surfaced.

After receiving Walden University's IRB approval, the following steps took place: (a) initial recruitment email to identified experts, (b) scheduling and conducting interviews via the Zoom platform, (c) creation of reflective field notes, (d) review of seminal publications, and (e) transcription of the interview recordings and member checking. Throughout each step of the data collection process, an audit trail was kept in a Microsoft Excel spreadsheet. The audit trail served as a detailed tracking document for each participant to ensure that each action item was recorded and completed. Each participant occupied an individualized sheet in the audit trail spreadsheet and included the initial contact, email, consent, Zoom meeting, transcription, and member check (sent out/received). The audit trail and the reflective field notes provided a consistent and thorough data collection process ensuring that the study's rigor was established.

The data collection process began on September 1, 2022, and was completed on October 10, 2022. Seven experts were interviewed and recorded on the Zoom platform in a virtual meeting, and four chose to provide written responses due to time zone differences. I scheduled interviews following participant consent, and an agreed-upon time and date were confirmed for Zoom participants based on their chosen time of convenience, which that ensured interviews were without interruptions.

I planned and scheduled the written and Zoom interviews once I received each participant's acknowledgment and agreement to the provided consent form. The interview date and time were mutually agreed upon to ensure that the participant had the time to answer the interview questions without interruptions while remaining within the research study process timeline. Each interview was attended only by the participant and me. The semistructured interview protocol safeguarded the participants' level of comfort throughout the process and served as a guideline for the interviewees to provide in-depth responses about the subject matter confidentiality and anonymity issues to worry about.

Immediately following approval from Walden University's IRB on August 30, 2022, I started reflective journaling and recorded my perspective, assumptions, beliefs, emotions, experiences, and comments, along with a chronology of all the steps during the research process, to ensure the transparency of this research study. Reflexive journaling continued throughout the study, and I attached the informal transcribed conversations with participants before and after the interview questions and included comments I made during the interview questions. I further noted comments during recruitment and any feedback I received through the member-checking process.

The subject matter discussed was relevant and of interest to all participants, including myself, enabling rapport to develop quickly. Trust between each participant and myself followed easily after the initial rapport was established and confirmed. This experience allowed me to develop a deeper understanding of the data collection process from the researcher's perspective, and I gained valuable knowledge from executive education program experts. The overall experience was rich, and I extend gratitude to the exceptional individuals who gave their time to be a part of my study.

Challenges included finding a time to speak directly with all experts, with time zones ranging between 8 to 10 hours. In some cases, I or the participant would be sleeping during the waking hours of the other. Other challenges included varying response times; some participants responded quickly, while others did not respond immediately, and I had to follow up with a few more than one or two times. In some cases, the participants' busy schedules and the dispersion across several time zones required multiple emails to find a mutually agreeable interview date, and one case caused the rescheduling of the interview due to an incorrect difference in time zones. Four participants preferred to provide written answers, given their time zone and schedule differences. There were no technical issues with the Zoom interviews, and all recordings (via Zoom and iPhone) were a success. The different time zones were respected; data confidentiality and the participant's anonymity were reassured. All interviews on Zoom were video and audio recorded and later used to transcribe the interview.

Each interview included the interview protocol to ensure consistency across the cases. I asked five total interview questions and began by asking executive education program experts their views on how the COVID-19 pandemic and the Fourth Industrial Revolution had altered the nature of executive engineering education in business schools. With the two questions that followed, I asked each participant to share what they perceived as strengths and weaknesses of the design and delivery of customized programs through academic–corporate partnerships, followed by describing what they perceived as

CSFs in effectively engaging partnerships. The last two questions explicitly focused on the CSFs needed in engineering programs. They closed by asking for participants' final insight on the top three or four criteria that make these academic–corporate collaborations successful in their specific area of expertise. The questions began from a broad perspective for overall design and delivery and narrowed in the final to their specific area of expertise and engineering. Experts shared a common language and terminology that focused on the interpersonal aspect of engineering leadership development and the interpersonal importance of successful collaborations between individuals in academia and leaders of corporations.

Initial Contact

The identified experts through the professional network sampling on LinkedIn and began contacting executive education program experts immediately following IRB approval on August 30, 2022. The inclusion criteria for participants in the study included being (a) an adult over the age of 18, (b) an executive education program educator with a minimum of five years of experience delivering reskilling and upskilling programs for engineers in leadership development, (c), had published at least two articles in peer-reviewed, or practitioner-based journal on executive education ecosystems, (d) had a terminal degree from an accredited institution; and (e) possessed in-depth expert knowledge regarding the central topic of study (see Merriam & Tisdell, 2015). Several experts were identified from a Google Scholar search and the primary references networked via LinkedIn.

Participants acknowledged and agreed to the consent form between September 1st, 2022, and September 15th, 2022. The final attempt to reach participants ended on October 10th, 2022. Executive education program experts were identified based on meeting the inclusion criteria through Google Scholar (described previously in Chapter 3 under recruitment procedures). Recruitment letters were sent following the identification of experts via email and included the informed consent and interview protocol following network confirmation via LinkedIn. Most participants responded immediately, and only a few required follow-up emails. Participants willing to interview via Zoom provided times and agreed promptly to the Zoom invite. All candidates that met the inclusion criteria responded positively to the study's topic of interest, five agreed to interview by providing dates and times, and four chose to provide written responses, given the associated challenges between time zones and schedules. Six of the seven experts that agreed to the informed consent followed through with either written responses or scheduled and completed Zoom interviews.

Interviews

The candidates responded within a few days of receiving the recruitment letter and shared their interest in participating in the study. One participant attached a digital signature and returned the informed consent attachment, and the remaining nine candidates replied to the invitation to participate with the attached informed consent with "I consent." Seven candidates provided availability for interview times and dates, and two requested a check-in at a later date. Candidates that received Zoom invite links with a time and date responded within a few days and confirmed their participation. The virtual

Zoom meeting platform was offered to all interviewees due to the candidates' geographical dispersion, the ongoing COVID-19 pandemic, and restrictions on in-person meetings.

Eleven participants were provided formal invites, and four chose to respond in writing. The Zoom invite included the date and time in my time zone that was calculated and expressed to each participant in their time zone. The invite included a direct link to click to attend the interview on the date and time provided and a password to protect the entry of only the participant invited. Links were left at the discretion of the participant's calendar (Gmail, Outlook, etc.), and all interviews were video and voice recording. I experienced no issues connecting with the experts via the Zoom platform or any of the employed recording tools. The iPhone audio recorder app was saved and sent via Transcribe Me! App to be professionally transcribed. The transcription was returned within a few days completed. Each candidate was provided with an initial transcript that was later cleaned up and corrected as needed. All interviews were successfully completed and yielded rich, in-depth data from the thinking of executive education program experts.

The seven interviewees agreed to the audio and video recording of the interview prior to the start of the interview. I ensured the Zoom platform was tested before each interview and provided the additional audio recording via the voice recorder app on iPhone for both interviews. Using a virtual meeting platform such as Zoom proved indispensable, considering that the candidates' locations spanned the time zones from Greece to Spain, Jordan, Italy, Switzerland, Canada, Saudi Arabia, and the United States. Each interview was conducted using the interview protocol (Appendix B) as a guideline.

Using Zoom as a virtual platform allowed me to recruit and interview executive education program experts regardless of their physical location and expanded the reach of this research study (see Yin, 2017).

Journaling/Reflective Field Notes

I received Walden University's IRB approval on August 30, 2022, and immediately started the reflexive journaling notes in a written journal. I created a Microsoft Excel spreadsheet and established an audit trail with the important dates and detailed explanations of the data collection process. I updated the audit trail daily as I emailed initial contacts, received confirmation from participants, informed consents, scheduled Zoom times, and provided pertinent details for each participant's data collection path. I provided weekly updates to my committee chair and maintained daily contact as I updated with confirmation, informed consent, and other communications. I coped with my committee chair on all email invites and scheduled Zoom interviews. I also included handwritten notes in my reflexive journal to complement the detailed audit trail and ensure appropriate documentation was met to strengthen the study's overall validity.

To minimize my researcher's bias and manage possible expectations, I continuously documented my thoughts in a journal throughout the data collection process, taking time to reflect on each stage of the process. I engaged continuously in active and mindful listening to ensure I remained objective during the interviews and yielded rich, in-depth participant data. I engaged in pauses and voice inflections, including accentuating essential words and phrases to allow time and processing for each participant. Pauses, tone of voice, speed, pronunciations, and the expression of vocal and word patterns enriched the interviewees' responses and accentuated specific points of interest during the conversation. The participants communicated their responses to the interview questions beyond simple words and added deeper meanings that naturally enriched the value of the data being collected. I remained culture conscious and treated each candidate's various backgrounds, feelings, and emotions respectfully and without judgment or preconceived assumptions. (see Stake, 2013).

I engaged in active listening and note-taking throughout the data collection process to ensure I captured the true nature of the data during the interviews. Following each interview, I stored the Zoom recordings in a password-protected folder and immediately sent the voice recorder recording from my iPhone for professional transcriptions. As I reviewed each transcription returned from Transcribe Me!, I watched the recorded video and paid close attention to the precise and correct verbiage in the transcription to ensure correctness.

I listened carefully to each participant's voice and video recording and focused on the interviewees' use of pauses, tone of voice, speed, pronunciations, and the expression of vocal and word patterns. The participants' inflections complemented their verbal responses and allowed me to identify common patterns and themes. I listened to each recording several times to ensure that I captured the truthful meaning of the conversation. Before starting each interview, I provided the definitions of customized executive education programs and their purpose that aligned with the importance of gathering rich, in-depth responses from each selected expert willing to participate in this study.

Transcript Review

Following the completion of each interview, participants were provided the recording and transcription via email and asked to review for completeness and correctness. Asking participants to verify their responses through a transcript review, known as member checking, ensures that the interviewee's voice is heard and is appropriately reflected to increase the data's credibility (Hagens et al., 2009). Each participant verified the accuracy of their own transcript without additions or changes. The transcript review process was an emailed communication and logged in the audit trail. Following the completion of the transcript review from each participant, concerns regarding data accuracy were reduced, and the data's creditability was strengthened (Merriam & Tisdell, 2015).

Before each interview, the interview protocol, including the questions, was provided to each participant. The protocol was used to prepare each participant to ensure the accuracy of responses throughout the interview. The questions were purposively arranged to yield a comprehensive review of the subject matter from the perspectives of the experts. Due to the semistructured nature of the interview, some questions allowed participants to respond in a way that touched on succeeding questions. Overall, the redundant information gathered in responses did not affect the interview data as the interview protocol ensured that all questions were answered consistently and in-depth, with some responses increasing the length of the interview.

The transcript review process allowed the participants to check, verify, and, if necessary, edit their responses to strengthen the data's validity and comply with ethical standards. All transcripts were sent via email to each candidate after the interview. The participants reviewed the transcripts to clarify responses, avoid misconceptions, or prevent misinterpretation of the collected data (Mero-Jaffe, 2011). The transcript review process was an additional tool to validate data accuracy and completeness. Most participants completed the process without corrections or additional comments within a few days. Before coding the data, the final transcripts were saved in password-protected files and folders per the ethical procedures outlined in Chapter 3.

Data Analysis

I used Saldaña's (2016) descriptive coding to analyze the collected data to identify emerging phrases and words for meaning assignment, categorization, and thematic analysis. In this study, raw data was collected from the transcript of the in-depth interviews of nine participants. Data saturation was reached in the interview data as similar and even redundant information came back in all interviews after Interview # 8, and the Dissertation Chair confirmed this observation from the transcripts.

Thematic analysis through categories and themes was used to analyze the transcripts from the interviews, the notes from journaling, and the gathered archival data (Merriam & Tisdell, 2015). The initially identified data segments came from the transcripts, and the recorded codes helped capture the patterns across data segments (Saldaña, 2016). The thematic analysis helped support a rich understanding of executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development.

A critical method to analyze qualitative data in an exploratory research study is the coding process, which requires a systematic and consistent methodology during the data collection and analysis processes Saldaña (2016). The coding method included coding manually, categorizing the data, and identifying surfacing patterns and themes across the cases. Thus, when the data collection process aligns with the data analysis, the researcher will notice synchronized concepts to commence receiving answers to the research question (Stake, 2013). The two data analysis stages of this multiple case study: are a within-case analysis for each case and a cross-case analysis looking at similarities and differences within the themes and categories (Yin, 2017). The benefit of using the same consistent coding method to analyze both the within and across data is to permit the replication of the cases, which will help compare and contrast the results (Yin, 2017).

I used the indexing method to determine the data segments from the in-depth interview transcripts Microsoft Excel spreadsheet to manually code the data and enter the interview notes after the participants' responses were verified from the transcripts and manually coded the data. (Saldaña, 2016; Vaismoradi et al., 2016). The data analysis process involved discovering patterns from the interview transcripts and integrating and examining the dissimilarities within the data sources for the triangulation purpose ((Merriam & Grenier, 2019). I identified and distinguished the patterns and discounted the nonrepetitive proof attributable to the particular cases from the themes during the data analysis process. During that process of case study data analysis, Yin (2017) suggested using the ground-up strategy to help recognize the codes from the data collected and find critical concepts from the data. The ground-up approach is similar to the descriptive method's analytical technique, where the researcher categorizes the themes that surfaced from the interview transcripts to discover shared associations across the participant's data (Yin, 2017).

For novice researchers during the data analysis process, Saldaña (2016) recommended hand coding to implement a descriptive manual coding method. The hand-coding method enabled the researcher to dive deep into the data to ensure a better understanding of the research problem and collected data (Halkias et al., 2022). An iterative data collection and analysis process was used to discover the answers to the research questions. Categories and themes were repeated during the iterative process of coding, indicating no further need to continue the coding process (Fusch & Ness, 2015).

During the data analysis, five coding categories were identified based on the problem and the three conceptual models that aligned with the purpose of the study, which is to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: 1) Rottmann et al.'s (2015) concept of *engineering leadership*, 2) Fung's (2020) concept of *reskilling and upskilling the workforce*, and 3) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs.*

The data collected gathered from the thematic analysis resulted in 20 themes from the five coding categories (a) customized executive education in the postpandemic era**,** (b) cocreation of academic-corporate partnership for customized executive education programs, (c) academic-corporate partnership goals for engineer leadership education, (d)

CSFs for a customized executive education program for engineers, and (e) CSFs for academic-corporate collaborations for reskilling and upskilling engineer leaders.

Below is a hierarchical coding frame used to present the codes and themes according to their relationships visually.

Coding Category: Customized executive education in the postpandemic era

Themes: 1) central focus on managing change and complex problem-solving skills, 2) skill-based executive education, 3) cross-cultural competency focus, 4) lifelong, industry-based learning versus traditional degree-based learning

Coding Category: Cocreation of academic-corporate partnership for customized executive education programs

Themes: 1) partners recognize engineering as a heterogeneous profession across workplace/disciplinary contexts, 2) business schools evolving to meet industry needs, 3) managing resource allocation and constraints, 4) continuous formal and informal communication between partners

Coding category: Academic-corporate partnership goals for engineer leadership education

Themes: 1) leadership training in interpersonal skills, 2) engineering leaders as employee coaches and team players, 3) multimodal leadership skills: face-to-face, hybrid, virtual, 4) entrepreneurial/commercial mindset

Coding Category: Critical success factors for customized executive education program for engineers

Themes: 1) agile EE program leadership team, 2) flexible programs with synchronous and asynchronous delivery options, 3) constantly updated STEM curriculum as markets and industries evolve, 4) deeply understanding the skill gaps/needs of the customer/learner

Coding Category: Critical success factors for academic-corporate collaborations for reskilling and upskilling engineer leaders

Themes: 1) focus on engineering leadership education that initiates/leads change; 2) focus on the deeper meaning behind program performance metrics, 3) emphasize leadership skills for AI-driven projects, 4) continuous program experimentation and upgrading

Boyatzis (1998) explained that case studies' findings could be displayed in various forms depending on the data type, the study's purpose, and the audience. This study used a table to display the themes and categories presented as a visual representation of executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development to prepare engineers for leadership roles in support of midcareer transitions amidst disruptive geopolitical shifts in the global labor market (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022). The Coding Category section of this chapter represents each theme and its corresponding category. The data analysis showed differences among themes by their frequency of incidences, recognizing certain cases as more notable than others. This chapter provides further details through a visual representation graph that depicts the frequency of occurrence for each theme across the cases in the cross-case synthesis and analysis section.

Table 3 presents this multiple case study that has finalized coding categories and themes, with representative participant quotations aligning with each of those categories and themes.

Table 3

Coding and Theme Examples

Participant	Interview excerpt	Coding category	Theme
Participant 3	"Both blue collar and white collar workers, and middle management and executives, have many more options when it comes to on-the-job education, both skill-based and leadership-focused, than just attending a bespoke executive education."	Customized executive education in the postpandemic era	1. Central focus on managing change and complex problem-solving skills 2. Skill-based executive education 3. Cross-cultural competency focus 4. Lifelong, industry-based learning versus traditional degree-based learning
Participant 1	"The main advantage is that these programs are designed collaboratively between both parties. Instead of the off-the-shelf training programs that don't go really beyond the basic level, a more in-depth tailored solutions are designed to solve the problems businesses face."	Cocreation of academic–corporate partnership for customized executive education programs	1. Partners recognize engineering as a heterogeneous profession across workplace/disciplinary contexts 2. Business schools evolving to meet industry needs 3. Managing resource allocation and constraints 4. Continuous formal and informal communication between partners
Participant 5	"The organization and the school need define exactly what they want and the communication and partnership should be ongoing."	Academic–corporate partnership goals for engineer leadership education	1. Leadership training in interpersonal skills 2. Engineering leaders as employee coaches and team players 3. Multimodal leadership skills: face-to-face, hybrid, virtual 4. Entrepreneurial/commercial mindset
Participant 9	"Our purpose as helping engineers lead change to build a better world—this may be partly about innovative technology, but is also always about building self-awareness paired with constant reflection about the social impact/consequences of our work."	Critical success factors for a customized executive education program for engineers	1. Agile EE program leadership team 2. Flexible programs with synchronous and asynchronous delivery options 3. Constantly updated STEM curriculum as markets and industries evolve 4. Deeply understanding the skill gaps/needs of the customer/learner
Participant 2	"We have a team of people that have all the practical experience they need. It would benefit them to be exposed to some theory to see how the variables and concepts of their practice relate to each other."	Critical success factors for academic–corporate collaborations for reskilling and upskilling engineer leaders	1. Focus on engineering leadership education that initiates/leads change 2. Focus on the deeper meaning behind program performance metrics 3. Emphasize leadership skills for AI-driven projects 4. Continuous program experimentation and upgrading

Evidence of Trustworthiness

Trustworthiness of a qualitative study applies the criteria of credibility, transferability, dependability, and confirmability to ensure methodological rigor is met (Merriam & Tisdell., 2015).

Credibility

This study's credibility or internal validity was based on the trustworthiness measured by the alignment with reality and the research findings (Merriam & Tisdell, 2015). Strategies included peer debriefing, member checking, knowledge of issues, rival explanations, referential adequacy, and triangulation (Lincoln & Guba, 1985; Yin, 2017). The interview protocol was developed based on the extended time spent reviewing the pertinent literature to ensure the appropriate data was gathered to reach data saturation. A definitive process was applied for a transcript review to establish the validity of the study’s findings and involved the exchange and verification of transcripts with participants, known as member checking (Birt et al., 2016; Yin, 2017).

Triangulation was described by the evidence that included the interviews, observations, and case study documents and their application to the different data collection methods, and the facts and statements collected were cross-checked (Halkias et al., 2022; Yin, 2017). Field testing with other subject matter specialists was employed to verify the relevancy and meaningfulness of interview questions to the participants being asked and to ensure the study’s central research question was answered.

Transferability

Transferability is the external validity of a study that enables an opportunity to apply the findings from the original research study to other study contexts rather than similar contexts and situations (Baskarada & Koronios, 2013; Yawar & Seurig, 2017). This study's transferability depended on the context-related knowledge that linked the setting with how I understood the situation, the analysis, and the population under investigation (Carminati, 2018; Yin, 2017). I developed strategies throughout the analysis process to ensure participants' voices were sustained and an opportunity for readers to determine the transferability possibilities for the study's findings was enabled (Birt et al., 2016). I applied detailed descriptions and documentation of the sample, the boundaries, the setting, and the study's findings to allow other researchers to replicate this study and determine how it is transferred (Carminati, 2018; Marshall & Rossman, 2016).

For this study, I used a variety of data collection and sampling methods that included a purposive sampling strategy to recruit subject matter experts with varying perspectives through criterion sampling to improve the study's transferability (Halkias et al., 2022). I ensured the transferability of findings by selecting a sample of experts' reasoned arguments until data saturation was met and maintained a consistent methodological approach through the detailed description of the study's problem and research process (Anderson, 2017; Carminati, 2018; Morse, 2015).

Dependability

Dependability refers to the study's accuracy and consistency of data collection, data analysis, and thematic development that apply various strategies to increase the replication of findings (Halkias et al., 2022; Merriam & Tisdell, 2015). A study is dependable when the findings are consistent and replicable (Lincoln & Guba, 1986). Dependability for this study included audit trails, detailed methodological descriptions, and external audits that included peer debriefing to review the documentation and triangulation of the research (Halkias et al., 2022; Morse, 2015).

I further ensured dependability was met for this study by establishing alignment of the study’s problem, purpose, research question gap, design, and methodology. I created a detailed procedure for the methodology and maintained an audit trail that documented each action and every decision that occurred throughout the data collection process. In addition to the audit trail, I kept a detailed chain of evidence to verify alignment at each stage of the research process and ensure it coincided with the findings that answered the study’s central research question (Yin, 2017).

Confirmability

Confirmability is the degree to which the study’s results can be determined objectively based on the detailed descriptions of the experts’ responses and the researcher’s role in managing subjectivity through the primary methods of reflexivity and audit trail (Berger, 2015; Halkias et al., 2022). Reflexivity involves the researcher’s acknowledgment of their role in the research process that reflects upon prior experiences, beliefs, and assumptions that may influence the research process (Halkias et al., 2022). I employed an audit trail and developed reflexivity by becoming mindful of my social and emotional positions and interpersonal connections (Berger, 2015; Morse, 2015).

Reflexivity ensured that participants' voices were preserved through reflective journaling, where I expressed my inner thoughts and feelings and included noting any unbiased questions throughout the process to maintain rigor (Halkias et al., 2022; Morse, 2015). My increased self-awareness before, during, and after data collection and analysis decreased my personal bias (Halkias et al.) I ensured transparency in reflexive practices by documenting my personal beliefs, assumptions, and emotional experiences in a reflective journal throughout the data collection process and peer debriefing with research community members not associated with the study following the data collection. For this study, I employed data coding and audit trails to ensure reflexivity and implemented member checking and direct quotes in the findings to establish confirmability (Halkias et al., 2022; Tracy, 2019).

Study Results

This qualitative multiple case study is framed by three key conceptual models that aligned with the purpose of the study, which is to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: 1) Rottmann et al.'s (2015) concept of *engineering leadership*, 2) Fung's (2020) concept of *reskilling and upskilling the workforce*, and 3) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs.* The study's conceptual framework aligns with developing a qualitative empirical study using expert interviews as the primary data collected. A sample size of ten subject matter experts participated in the interview process and shared their views on the strategies needed on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. This study's overarching research question was: *How do executive education program experts describe the critical success factors needed in customized executive education programs for reskilling and upskilling engineers in leadership development?*

As recommended, a multiple-case study design enables the investigator to inductively identify data segments to build a list of phrases and words to categorize and index (Saldaña, 2016). The manual coding method was used to formulate the themes that emerged from the thematic data analysis and the cross-case synthesis analysis, indicating the convergent and divergent data across the ten cases. The executive education program expert was the unit of analysis in this multiple case study. Identifying similarities and differences in the evolving themes across the cases were iterative throughout the data analysis step (see Halkias et al., 2022). The data collected throughout the interview process were relevant and rich, eliminating the issue of non-relevant information.

Themes on how executive education program experts describe the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development emerged through the study's data analysis procedures. The cross-case analysis conducted during the data analysis helped establish the similarities among the cases through a convergence and divergence analysis of the data collected (Halkias et al., 2022). The three sources of data collected for this study included (a) a semistructured interview protocol (Appendix B) with items that are grounded in the literature review and conceptual framework of this study and field-tested by a panel of three experts, (b) archival data in the form of industry-related reports, media articles on executive education programs for reskilling and upskilling engineers in leadership development (see Yin, 2017) and (c) reflective journal notes (see Merriam & Tisdell, 2015), which I kept throughout the data collection process.

In this study, the final results section incorporated the evidence from multiple sources to drive the data triangulation process (see Guion et al., 2011). Triangulation is essential in multiple case studies to ensure the results' credibility and improve the results' quality (Halkias & Neubert, 2020). Further, I conducted a triangulation of data sources to support the overall trustworthiness of the study's data analysis (Merriam & Grenier, 2019).

Yin (2017) recommended consistency when collecting, analyzing, and synthesizing data within a multiple case study design for thematic analysis and cross-case comparisons. The data synthesis method combined answers across various individual cases and reinforced the study's results while treating each case separately (see Halkias & Neubert, 2020). The cross-case analysis was conducted by categorizing the emerging themes in a tabular format during the data analysis process, allowing a cross-reference of the results to represent the participants' direct quotes visually. The two phases of this study's data analysis were completed as described in detail below: the first phase: was a within-case analysis of each selected case, and the second phase was a cross-case analysis of the data to find similarities and differences across the categories and themes (Yin, 2017).

First Phase: Thematic Analysis of the Textual Data

Because synchronized data collection and data analysis could impact the strength of study results, Nowell et al. (2017) recommended conducting the data analysis in a sequence of steps for the trustworthiness process. A step-by-step process allows for a logical and objective obtention of study results, reflecting the data collection and analysis processes and delivering credibility and dependability. This study's thematic analysis approach included presenting

The following paragraphs present the themes from the interview data collected and analyzed, along with representative verbatim quotes for an in-depth understanding of participant explanations, allowing them to maintain their voice in the study results presentation.

Central Focus on Managing Change and Complex Problem-Solving Skills. This theme refers to the central focus on managing change and complex problem-solving skills. Scholars continue to recognize the complex interactions between management and leadership in engineering and technology (Rottmann & Kendall, 2022). Interdisciplinarity enables integrative learning, creative problem-solving, and critical thinking experiences needed to develop creative solutions to the future's changing technological problems (Retana, & Rodriguez-Lluesma, 2022; Roy & Roy, 2021). In today's highly innovative market, participants agreed that engineering leadership is essential for preparing entry-level engineers to solve complex problems collaboratively (Ensley, 2017; Florez, 2019).

Participant 1: "Prior to this era, change was slow and staff had ample time to get onboard. Now, change seems almost sudden. It is very much a shock-change. It doesn't give employees time to comprehend or adjust. The new era requires 24/7 agility and alertness."

Participant 7: "The 4.0 digital transformation has accelerated the innovation, innovation meaning more tools, more simplification, more devices that help do all kinds of things from simple stuff, online video conferencing, to more complex stuff like using big data algorithms, applications, machine learning, AI, blockchain, whatever, platforms. And platform business model, that means also the softwares, the service applications, the service, all kinds of things. So we go from very simple stuff, basic things - so we all use like Microsoft 365 - to specialized software for investors, for technicians, for mechanical engineer, for planning and designing."

Participant 11: "I would imagine that integrating more complex system will be important. It's important that we also are exposing companies to the idea of complex organizations and markets that are following dynamic evolutions. And not necessarily too much of a linear model of execution of strategy, more integration of foresights as a degree of actionability that needs to be integrated because today a lot of strategy is migrating into more of an option for the future."

Skill-Based Executive Education. This theme refers to the focus on skill-based executive education. Fung (2020) studied how educators must consider a range of megatrends affecting today's business environment, foremost that of demographics, innovation, sustainable development, and technology, and how these trends will consistently alter the state of the global workforce. The Reskilling Revolution program launched by the World Economic Forum in January 2020 estimated that one billion people need to be provided with a renewed education process to gain new skills and upgrade existing ones by 2030 (Diaz & Halkias, 2021a; World Economic Forum, 2022). Participants agreed with other organizational leaders that limited information remains on the preferred alternatives for executive education programs for reskilling and upskilling engineers in customized leadership development and training relevant to the engineering profession (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022).

Participant 6: "Figure out goals and expectations. What is the specific activity you want to deliver to improve leadership skills? And what leadership skills in particular you're trying to develop, broad or narrow type of leadership improvement? And once you identify that, I would say you should always start with self-assessment test in the beginning to understand the characteristics of participants in terms of leadership,."

Participant 7: "The need to develop these skills that will help you to track, retain, accelerate, develop your talent becomes even more critical because you're going to lose it, and you are losing talent, so it's becoming an imperative to build these leadership skills."

Participant 8: "We have a lot of change in business environment, and during the last two years a lot of change that executive education is moving more to online as delivery form, and companies are very comfortable with that because that keeps employees at the desk. They don't have to travel to the university, and they don't have to bring in outside lecturers, they have lower travel expenses. I believe is also very strong, that is more driven by the Industrial Revolution, that the contents are becoming more and more modularized and shorter. They are focused on specific skills, competencies, and knowledge. And they are delivered when they are needed. Thus you're not teaching a lot of general stuff anymore, but the participants expect clear information how they need to solve a specific problem in a specific situation."

Cross-Cultural Competency Focus. This theme refers to cross-cultural competency. Edmonson (2020) proposed that high-quality discussion processes, agility, and adaptability will be required to improve strategic decision-making, sensemaking, social intelligence, 21st-century adaptive thinking: cross-cultural competency, computational thinking, new-media literacy, transdisciplinary, design mindset, cognitive load management, and virtual collaboration. In engineering leadership, clear and precise communication is critical for interacting with managers and peers, providing effective presentations, improving business-related writing skills, and communicating cross-culturally (Ismail & Fathi, 2018; Rottmann et al., 2016). Participants agreed that cross-cultural awareness and experience, alongside good communication skills, will continue to be required for successful global business activities (Hirudayaraj et al., 2021).

Participant 6: "I really think it's cultural sensitivity; you need to adjust your cultural sensitivity. I teach courses with people in all continents. For me, it's also very exciting, an impressive learning experience to touch base and talk with people in Dubai and then the next moment in Nigeria or in China or in US or in UK or in Germany. Although you are one click away from them, you need to remember their cultural background. You need to find a framework for connecting all the different cultural traits. The fact that I grew up in a multicultural, diversity, multi-ethnic city helped me feel comfortable everywhere with everybody."

Participant 1: ”Culture is a major issue as well. What works in a culture may not work in another culture. For example, training program in the Arabian Gulf have to accommodate for differences between males and females. For example many joint activities that are carried out in a business as usual manner in Western countries require male only or female only teams as mixed teams are nt the norm.

Participant 9: “Understand that you can never fully step into somebody else’s shoes. When you do that, you still do so from your own perspective. Make sure to listen to what others are saying.”

Lifelong, Industry-Based Learning Versus Traditional Degree-Based Learning. This theme refers to lifelong, industry-based learning versus traditional degree-based learning. Lifelong learning remains essential for the engineering workforce to develop versatile, agile, creative, and positive learning mindsets to solve complex problems that lie ahead (Diaz & Halkias, 2021b; Fung, 2020). Remote workplaces have enabled increased online learning platforms globally that support the upskilling and reskilling of the engineering workforce (ASME, 2022; Huber et al., 2020). Traditional tasks will be left for digital automation to ensure timely, precise, and intelligent analysis (Jerman et al., 2020). Participants agreed with Fung (2020) that employability would depend more heavily on lifelong learning and skills development than the initial qualifications.

Participant 1: “The Fourth Industrial Revolution was already a major change driver in executive education. Firms were finding that many of their executives are somewhat too traditional and are not embracing the ways of work brought by the increasing interconnectivity at the workplace."

Participant 3: "I think more and more firms are developing their own "universities" (Boeing, SABIC, Google, etc.), and the proliferation of online education has never been stronger (YouTube, Coursera, Khan Academy). Thus, both blue collar and white collar workers (and middle management and executives) have many more options when it comes to on-the-job education—both skill-based and leadership-focused—than just attending a bespoke executive education (EE) program in-person for a large amount of money."

Participant 5: "From time to time, organizations tend to restrategize, tend to say, "Okay. This is our focus for this year, this quarter, this couple of years." They should, based on that, turn around and say, "Okay. What kind of skills do we need to suit where we are headed? What kind of engineering skills do we need? We have them in-house or are we hiring new? Okay, we have them in-house, but they don't have the right skills. We have some engineers here, but they don't have the right skills to take us to where we are headed. We need to train them to be able to do X, Y, Z that will suit our near future or far future plan," So yeah, for engineers or people in STEM, that is certain, because you can see how dynamic the world of technology is. You can't just stay without learning. You have to learn new skills. You have to learn-- if you're a software engineer, you have to learn new programming languages."

Partners Recognize Engineering as a heterogeneous Profession Across Workplace /Disciplinary Contexts. This theme refers to partners that recognize engineering as a heterogeneous profession across workplace /disciplinary contexts. Customized executive education programs present a collaborative response by which firms and training providers develop specific solutions to unique problems within a given professional context (Diaz & Halkias, 2022; Retana & Rodriguez-Lluesma, 2022). Participants agreed that customized executive education programs could prepare engineers for leadership roles required within their profession by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management (ASME, 2022; Retana & Rodriguez-Lluesma, 2022).

Participant 9: "Recognize that engineering is a heterogeneous profession and make sure to connect with industry partners across workplace/disciplinary contexts before developing your program unless you are gearing your program to a particular discipline or industry."

Participant 10: "Taking time to understand the need of the engineer individually and the need of the industry they are targeting. You can't target everything, even the engineers. They work in different sectors, and giving everything to everyone would not be successful. From both perspectives, the demographic and also the behavior traits."

Participant 5: "For engineers or people in STEM, that is certain, because you can see how dynamic the world of technology is. You can't just stay without learning. You have to learn new skills. If you're a software engineer, you have to learn new programming languages and you can't stay where you are. The organization has to keep investing in teaching these people new skills, how to program, how to adapt, how to customize. It has to be a continuous thing."

Business Schools Evolving to Meet Industry Needs. This theme refers to business schools evolving to meet industry needs. The global pandemic has tested businesses' resiliency, leadership, and organizational management capabilities worldwide (Iñiguez & Lorange, 2022). Remote workplaces have enabled an increase in online learning platforms globally and have supported the upskilling and reskilling of the engineering workforce (ASME, 2022; Huber et al., 2020). Companies and business schools have different syntactic, semantic, and pragmatic approaches, but they can cocreate a project with common objectives through joint collaboration (Diaz and Halkias, 2021a). Participants agreed that the company aims to solve a training problem through a capacity-building program, and the business school has the experience to carry out tailor-made training programs (Diaz and Halkias, 2021a).

Participant 3: “Business schools need to be more flexible in terms of what they deliver, they really must make sure it matches client needs, and spend more time on developing detailed content that is client-focused. We should be working harder upfront to learn about the client, participant needs, and what success means to the client, not the university’s executive education group.”

Participant 7: “The main strength of partnership is the relevance. A partnership ensures that there is relevance in the program design but also in the delivery of the program. The reality, the context, the reality check from the recipients, in the sense, becoming partners ensures relevancy.”

Participant 8: “I believe that you can see in the programs which are currently offered at business schools, even the top ones like London Business School, Harvard

Business Schools, they are quite slowl to respond to these needs because they know that it's really very difficult to develop a program for these new upcoming topics, it's changing all the time. You can't generalize, every single one is customized specifically for that specific situation."

Participant 11: "It is the ability to represent with more accuracy the problems that the corporate partners are facing and tapping into the knowledge or the knowledge creation or content creation of the business school to try to address this effectively through a variety of frameworks that are within the competence of the business school.

Managing Resource Allocation and Constraints. This theme refers to managing resource allocation and constraints. The global pandemic heightened the need for organizational leaders to face interdisciplinarity challenges and train engineers in leadership development to combat these demands (Rovida & Zafferri, 2022; Roy & Roy, 2021). Digital disruptions and the emergence of innovative technologies and business models are essential to sustain a competitive advantage, continue to grow, and create value at macro and micro levels (Meske & Junglas, 2020; Zaki, 2019). Therefore, participants agreed that educators must consider the wide range of megatrends affecting today's business environment, including demographics, innovation, sustainable development, and technology that continue to alter the state of the global workforce (Fung, 2020).

Participant 8: "There is a funding trend that has existed for several years when we talk about the cooperation with universities; it is a cost-sharing between the participants and the firms where the participants pay an increasingly higher share of the total training program. This is especially true when it's a non-customized program; when it's a customized program, the company pays, generally, everything, but for non-customized program, you see that the share is increasing. Value is also something important. I see a lot of business schools that executive education cross subsidizes other departments in the institution. That often the value for money is not given. For example, a company or you have a course where you have, say, 10 participants and they have a one-day seminar. Every participant pays $1,000 and then the lecturer receives $1,000. That's like $10,000 paid value is delivered on $1,000. Executive education is used to fund other departments, and that's really a challenge if you want to be competitive."

Participant 3: "They need to lower their prices to be more competitive. Only the largest, most profitable companies can afford a Harvard executive education program. That leaves a lot of untapped market potential if only executive education programs can make the economics work. Universities, though, are hard to do business with given all the additional costs baked into anything sold to the outside. Thus, online and professional/consulting firm executive education programs tend to get more traction and prominence. "

Participant 7: "The main strength of partnership is the relevance. A partnership ensures that there is relevance in the program design but also in the delivery of the program. The reality, the context, the reality check from the recipients, in the sense, becoming partners ensures relevancy."

Continuous Formal and Informal Communication Between Partners. This theme refers to continuous formal and informal communication between partners.

Participants agreed that executive education customized by business schools for engineers plays a pivotal role in leadership development by reskilling and upskilling abilities such as collaboration, conflict management, and personal and organizational transformation (ASME, 2022; Siegelman et al., 2021).

Participant 9: “Make sure to include more than one academic and more than one industry partner. There is a wide range of academic contexts/ frameworks/ paradigms, and an equally wide range of workplace contexts. Try to diversify each side of the partnership so that you can reach the full range of potential students.”

Participant 6: “It is a mutual process in which the company gives a lot of ideas to the school, and the school receives a flow of ideas from multiple companies and their research teams, they can really add everything together and deliver a lot of value.”

Participant 2: “Academia can provide insights from research that are not available through other forms of corporate training. It is also the place where theoretical perspectives are valued. Practitioners often get absorbed in their field and the day to day issues they face ignoring the possibility of alternative and fresh perspective that academic research can provide. Customized programs can address the need to expose executives to alternative ways of thinking and decision making. In this way it widens their perspective.”

Leadership Training in Interpersonal Skills. This theme refers to leadership training in interpersonal skills. Customized executive education programs offer a collaborative solution to prepare engineers for leadership roles required within their profession by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management (ASME, 2022; Retana & Rodriguez-Lluesma, 2022). Recent research has compiled a list of soft critical skills for engineer leaders and includes social and emotional learning competencies such as critical thinking/problem solving, creativity, communication skills, and collaboration (de Campos et al., 2020; Montandon et al., 2021; Pócsová et al., 2020). Although strong technical skills always have distinguished engineers from their peers, participants agreed with the research that engineers need to develop more than technical skills based on the assumption that engineers will most likely progress into leadership positions (Capretz & Ahmed, 2018).

Participant 7: "Leadership skills are needed for engineers, potentially, I see a huge need for upskilling, reskilling, especially because now they need to lead. It's been always a lack in engineering background, the leadership skills, but now, it's even beyond. There are other things that are here to stay such as the future of work dimension, so you are going to be leading, communicating, negotiating, working in teams that are hybrid, most of the time online with different challenges."

Participant 4: "I became involved with with a couple of engineers, and they were teasing, but they were saying that these little old ladies will come out of their door and start yelling at you from the porch saying, "What are you doing over there?" And they would have to explain why they were out there. It was surprising to me the level of interaction that they actually have with the public. So it's almost as if they're becoming more customer service oriented. And that's just one aspect where we talk about something that deals heavily with engineering."

Participant 10: “You need to define whom or which kind of companies you want to target. So targeting and I said, I'm trying to understand the need to be patient when knocking on the doors and talking to them. Listen more than talk. The issue with lots of universities is that they design the program and don't care who you are.”

Engineering Leaders as Employee Coaches and Team Players. This theme refers to engineering leaders as employee coaches and team players. Ongoing debates in the literature argue about the importance of specific skills over others and whether they are necessary for leadership roles (Tiberius et al., 2021). Researchers have found that engineers who transitioned into leadership roles lacked the necessary leadership skills to succeed (Capretz & Ahmed, 2018; Kappelman et al., 2017; Perry et al., 2017; Racine, 2015). Effective leadership drives projects and organizational success. Participants agreed that engineers need rapid reskilling and upskilling of skills to continuously enhance their abilities to learn and use new knowledge for their employability and to maintain a sustainable world (Pistoia et al., 2021).

Participant 9: “While it is important to listen to industry representatives and support their work as an equal partner, do not lose your own voice. That is, try not to cater to/serve industry. The idea of engineering leadership education (as I understand it) is to drive/lead change, not prepare our students to fit into the world as it is. While it would be irresponsible for us to exclusively focus on students driving change (their future employers may penalize them for thinking of themselves as leaders who don’t need to first learn about the org context), we should nevertheless help our graduates navigate organizations without assimilating into them.”

Participant 10: “The leadership capability will have a gap without understanding. If every one of them feels like you understand their wants, their needs very well. You listen to their case individually, not a mass communication leader, I believe you will be able to extract more effort, more support, and more better performance.”

Multimodal Leadership Skills: Face-to-Face, Hybrid, Virtual. This theme refers to multimodal leadership skills: face-to-face, hybrid, and virtual. Due to the increasing and constant evolution of technology, identifying the skills needed to drive change can be challenging in organizations with technical leadership roles (Kappelman et al., 2017).

It is important to understand how leaders utilize technical, human, and conceptual skills to understand how the engineering leadership literature connects leadership development, leadership skills, and effective leadership (Hirudayaraj et al., 2021). Participants agreed that in many universities, engineering leadership skills are being improved through project management training that includes developing personal and organizational skills that will add value to teamwork-related skills and confidence (Jamieson & Donald, 2020; Rottmann et al., 2016).

Participant 3: “Consulting firms are getting into executive education very heavily these days. They work for the client, know the leadership, and can customize programs very easily. They don’t necessarily have the best faculty, but they are winning more and more executive education clients these days. Offer flexible programs over time and utilize in-person, virtual, and asynchronous channels of instruction easily”

Participant 6: “The demand and the dynamics of the market, and specifically for the executive education, in the sense that has been like a catalyst of acceleration for digitization, more digital delivery, more digital products. The context has changed the way we work. There are more remote activities, a lot more remote courses. Zoom has just been booming in the last couple of years. It was there before, but now much more delivery on remote or sort of hybrid blended mode type of a delivery. So we do a lot of training.”

Participant 8: “The quality of the delivery and the content is becoming more and more challenging and more important. Especially when there are no cross-delivery modes, they're just listening to the material, or reading it, you need to update it permanently; because otherwise, they say, oh, that's old, that has no value for me."

Entrepreneurial/Commercial Mindset. This theme refers to an entrepreneurial/commercial mindset. Scholars have suggested that the opportunity to customize digital technologies will strengthen entrepreneurial intention and deepen relations within the entrepreneurial ecosystem (Ben Youssef et al., 2021; Snihur et al., 2021; Treanor et al., 2021). Research has shown that interactions via e-learning platforms should increase enrollment of student entrepreneurs in university courses to fill any training gaps, and participants agreed that universities teach e-skills as part of their entrepreneurship training (Lamine et al., 2021).

Participant 7: “One of the things that I think has been, let's say, modified, is the idea that the corporate education, moving from educating the C-level executives and the very senior-level executives into something that this is not anymore valid. Nowadays, it's needed to educate a much bigger portion of your community. So it's kind of leadership at scale, as my detail, so I even have a book on that, the leadership at a scale. So the change is so dramatic and so needed that that's what I think the Fourth Industrial Revolution together with COVID has generated a new need that we need to educate many more people."

Participant 2: "Here you have people that have all the practical experience they need. It would benefit them to be exposed to some theory to see how the variables and concepts of their practice relate to each other."

Participant 3: Universities are very slow improve/adapt/innovat and even YouTube videos are beating them out these days. The firms (and individuals) that have the best (tested) content, references, and adaptability to offer EE online, in-person, blended, etc., will win in the end."

Agile Executive Education Program Leadership Team. This theme refers to interactions with an agile executive education program leadership team. Executive education program directors play an important role in defining the CSFs of the program delivered (Diaz et al., 2022). Without practitioner-based empirical research on CSFs of executive education programs, organizational leaders cannot identify effective leadership development programs customized for engineers (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022). Executive education approaches to develop leadership in engineers have shown mixed results in the slow transition of these learning outcomes toward accepting leadership identities and holding professional leadership positions (Roos, 2022; Schell et al., 2021). Participants agreed that organizational leaders throughout all specialization sectors employing engineers must adjust quickly to changing market conditions, and there is a need for professional training customized for engineer leaders (Fung, 2020; Retana & Rodriguez-Lluesma, 2022).

Participant 7: “First, is there a team called the develop team? This program is really connected to the strategy of the organization; to talk about the strategy while defining the design. A team in charge of the project that is created as a core developmental team, where we have representatives of the different members of the partnership.”

Participant 5: “It takes a lot of work, not just coming up with curriculum, but understanding the organization, understanding their needs, working like a consultant, as well, to help the organization in defining their needs. Second, by saying the organization should define its needs, what is required. But the educator should also be involved in that, helping them understand their needs. So the partnership should be a two-way thing. In the setting of an executive education, in terms of partnering with an organization, it's customized to their needs, which is great. And it helps to build teamwork and collaboration among the participants coming from that organization. So they are learning together and then it's building teamwork.”

Participant 1: “These programs are designed collaboratively between both parties. Instead of the off-the-shelf training programs that don’t go really beyond the basic level, a more in-depth tailored solutions are designed to solve the problems businesses face.”

Participant 11: “In executive education, we are dealing with much more customization that is inferred greatly from the corporate partner. It seems to be more of a way of channeling the interest of the corporate partner through the validation of an educational player, rather than having nonetheless, this necessary tension between the theoretical onset and what should be delivered. It's about timing. Many of the corporate partners, they tend to have faster cycles of response than what academia has. Some of the schools that have been able to be very agile and responsive have created a higher chance of success in this partnership."

Flexible Programs With Synchronous and Asynchronous Delivery Options. This theme refers to flexible programs with synchronous and asynchronous delivery options. Several gaps exist in engineering and management literature surrounding effective leadership and its development, resulting in limited resources relevant to the engineering profession (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022; Skibniewski & Kim, 2022). This involves redesigning the roles of business education providers to become Executive Education providers that work to develop relevant, digitally driven, and sustainable executive education ecosystems (Caratozzolo et al., 2020; Horn, 2020). Participants agreed that partnerships with corporate clients aim to network universities and synthesize solutions (Rotatori et al., 2021; Caratozzolo et al., 2020).

Participant 6: "After the COVID, people learned that was making most cost-effective or more efficient if you have to deliver a course to people in many different geographical areas. For example, I teach courses to executives regularly, and when I do my class online, I have students simultaneously from many continents - Africa, North

America, Asia, Europe - all at the same time, not only asynchronous, even synchronous course."

Participant 7: "There is a lot of added value and innovation coming from the blend of digital and physical, the two things, digital and physical, and the ability to work with everybody simultaneously in different parts of the world, and even to engage in team activities or company-client relationship on real-time mobile devices and digital devices."

Constantly Updated STEM Curriculum as Markets and Industries Evolve. This theme refers to constantly updated STEM curricula as markets and industries evolve. A professional engineer is expected to transition into leadership roles throughout one's career by integrating communication, interpersonal, and leadership skills into their technical knowledge base (Pistoia et al., 2021; Rottmann et al., 2018). Participants agreed that engineering education has yet to master the multidisciplinary and collaborative programs needed to develop the engineer to communicate, negotiate and lead in a complex technology-driven society (Caratozzolo et al., 2020; O'Heir, 2021).

Participant 1: "We have some generational issue that is not given the attention it deserves. Some leaders are tech savvy and some are not as much. Any executive education program must take these subtle individual differences into consideration."

Participant 9: "Engineering is not just one thing, it is an acknowledgement of the wide range of workplace contexts, disciplines and industries in which engineers work. We characterize our purpose as helping engineers lead change to build a better world, this may be partly about innovative technology, but is also always about building self-awareness paired with constant reflection about the social impact/consequences of our work."

Participant 5: "STEM, as people in STEM, should therefore within organization should be taught or should learn based on defined organizational strategies, organizational objectives, rather, and approach where they are going. We should not just be done haphazardly. "

Participant 4: Understanding where technology is going to go, and the practical relationship or interpersonal relationship with all its users. When you can combine the STEM component with something that people grasp, those who are not STEM-oriented. We need to know how it can be introduced in a practical way, where it is useful to people, and where they see the need for it. To be able to deliver these complex ideas in a way that is understandable in lay terms."

Participant 11: "Given the nature of their professions, I think what defined the engineer' s success has been a clear expansion from vertical integration of knowledge and mainly specializations into more transversal distribution of knowledge. I would make my own priority to basically enhance this kind of education that is going to support engineers and STEM professionals."

Deeply Understanding the Skill Gaps/Needs of the Customer/Learner. This theme refers to profoundly understanding the skill gaps/needs of the customer/learner. Reskilling and upskilling programs must follow a three-step process that first identifies the skills needed to address business reality, a clear understanding that distinguishes the role of the needed skill in the new model, and a collection of providers capable of supporting the needs of lifelong learning (Agrawal et al. 2020). Participants agreed that the emphasis on engineering leaders having technical and non-technical skills to meet organizational goals shows the importance of considering the reskilling and upskilling of engineering leaders to adjust to the Fourth Revolution market demands in their profession (O'Heir, 2021).

Participant 1: "A major disadvantage is related to the show-off effect. Many firms will contract big names in excutive education and then assume that they have done enough. Well, this is a training program not an Adidas or Nike shoes. While brand names in education give some assurances, if no detailed analysis of the situation of the business is carried out and the problem is clarified then there is the chance that the training will be no more than a certificate and a useless item to add on the CV. Before the design of the program beings, the problem from the viewpoint of all of the stockholders must be understood."

Participant 3: "Firms also often hire their own internal "university" team or create their own partnerships with educational providers (online and in-person) to maximize the creativity and customizability of their programs. Consulting firms are getting into executive education very heavily these days. They work for the client, know the leadership, and can customize programs very easily. They don't necessarily have the best faculty, but they are winning more and more executive education clients these days. Offer flexible programs over time and utilize in-person, virtual, and asynchronous channels of instruction easily."

Participant 10: “The needs of the engineers in Japan is completely maybe different to the needs of the engineers in China.”

Focus on Engineering Leadership Education to Initiate/Lead Change. This theme focuses on engineering leadership education to initiate/lead change. In many universities, engineering leadership skills are being improved through project management training that includes developing personal management and organizational skills that will add value to teamwork-related skills, confidence, empowering early development of leadership styles such as transformational leadership (Jamieson & Donald, 2020; Rottmann et al., 2016). Participants agreed that industries and institutions must collaborate and successfully assimilate new technologies interdisciplinarity into the engineering curriculum (Diaz & Halkias, 2021b; Roy & Roy, 2021).

Participant 9: “The idea of engineering leadership education (as I understand it) is to drive/lead change, not prepare our students to fit into the world as it is. While it would be irresponsible for us to exclusively focus on students driving change (their future employers may penalize them for thinking of themselves as leaders who don’t need to first learn about the organizational context), we should nevertheless help our graduates navigate organizations without assimilating into them.

Participant 7: “For engineers, leadership skills is where I see huge need on upskilling, reskilling especially because now you need to lead. I see a huge need of upskilling, reskilling for the engineers that are potentially in managerial positions. There are other things that are here to stay such as, the future of work dimension, so you are going to be leading, communicating, negotiating, working in teams that are hybrid, most of the time online with different challenges."

Participant 10: "Social emotional awareness is number one, first, getting the time to understand the need of the engineers individually and the need of the industry they are targeting. And maybe this puts me back on knowing which industry they should target. You can't target everything, even the engineers. They work in different sectors, and giving everything to everyone would not be successful. You have to define your offering and also define your target audience very well."

Focus on the Deeper Meaning Behind Program Performance Metrics. This theme refers to focus on the deeper meaning behind program performance metrics. Academic and industry leaders and researchers are working to redefine executive education toward enabling the opportunity for business schools to work as partners to redefine innovative business school ecosystems committed to innovation and experimentation (Halkias et al., 2020; Horn & Dunagan, 2018). Partnerships with corporate clients aim to network universities with other key drivers such as educational platforms, certification programs, corporate universities, and other professional bodies and synthesize solutions (Rotatori et al., 2021; Caratozzolo et al., 2020). Despite the relevance of customized executive education programs for leadership development between organizations and business schools, participants agreed that a gap in the criteria that makes these successful collaborations remains (Diaz et al., 2022; Roos, 2022).

Participant 8: "Understanding flexibility and speed to respond to market needs. That is also very important that you have access to or understand the problems of practice and can respond to that. And that is limited due to accreditation, but it's something where you need to find a strategy, for example, we have learning objectives, which are more general, and then you have the possibility to respond to different needs more flexibly."

Participant 9: My recommendation is to look beyond skills and traits, include leadership identity and mindset as a starting point, encouraging students to reflect on the impact of the pandemic on their leadership opportunities over the last 3 years. Consider pairing it with industry-specific practical skill training since that will likely attract more students."

Emphasize Leadership Skills for AI-Driven Projects. This theme refers to emphasize leadership skills for AI-driven projects. Industry 4.0 emerged from the evolution of digitalization and robotics by interconnecting physical and cybernetic environments through digital technology (Liu & Xu, 2017). These digital technologies include artificial intelligence (AI), cyber-physical systems, big data, and the Cloud causing disruptive changes in the workforce labeled a socio-technical revolution (Sony et al., 2020). Participants agreed that adopting disruptive technologies linked with the Fourth Industrial Revolution, also named Industry 4.0, has changed how people interact, learn, recruit, manage, and lead (Matt et al., 2020).

Participant 8: "What you have a lot of now is data science, artificial intelligence and during the pandemic, there's rescaling concerning logistics, resilience of companies, and cost savings, which can be achieved through, data science, and AI."

Participant 1: "The new era requires 24/7 agility and alertness. Adding to that is the catastrophic consequences of COVID-19. Suddenly and out of the blue sky leaders found themselves having to lead a remote workforce, with little controls in their possessions. Both employees and leaders were forced to embrace the change brought by the advances on technology and accelerated by COVID-19. Many were not ready."

Continuous Program Experimentation and Upgrading. This theme refers to continuous program experimentation and upgrading. Academic and industry leaders and researchers are working to redefine executive education toward enabling the opportunity for business schools to work as partners to redefine innovative business school ecosystems committed to innovation and experimentation (Halkias et al., 2020; Horn & Dunagan, 2018). Retana and Rodriguez-Lluesma's (2022) followed established techniques and procedures to construct a grounded theory (Glaser & Strauss, 1967) of how customized executive education programs function. Participants agreed that as the demand for engineering leaders grows in our global economy, future research in engineering education aims to examine the educational pipeline to understand how the concept of engineering identity might change over time (Rodriguez et al., 2018; Schell et al., 2021).

Participant 5: "Instead of the organization going to everybody, an organization going to just learn for learning's sake or learning in an open-ended environment. But in the setting of an executive education, in terms of partnering with an organization, it's customized to their needs, which is great. And it helps to build teamwork and collaboration among the participants coming from that organization. So they are learning together and then it's building teamwork."

Participant 6: “Every time you deal with multiple organizations, there's a lot of learning on both sides, so you can really bring to the table a lot of constant innovation and stimulus. So that's really very important, that continuous collaboration, and also, of course, the professional structure and organization that the school can deliver. I think it’s a mutual process in which the company gives a lot of ideas to the school, and the school receives a flow of ideas from multiple companies and their research teams, they can really add everything together and deliver a lot of value.”

Participant 8: “Universities and higher education institutions have a very good reputation, prestige, or generally have a strong brand, and that gives them a competitive edge. Then what I also see is that it's a good argument when you can tell the participants that they can earn credits which they can use for accredited degrees if they want to continue their studies.

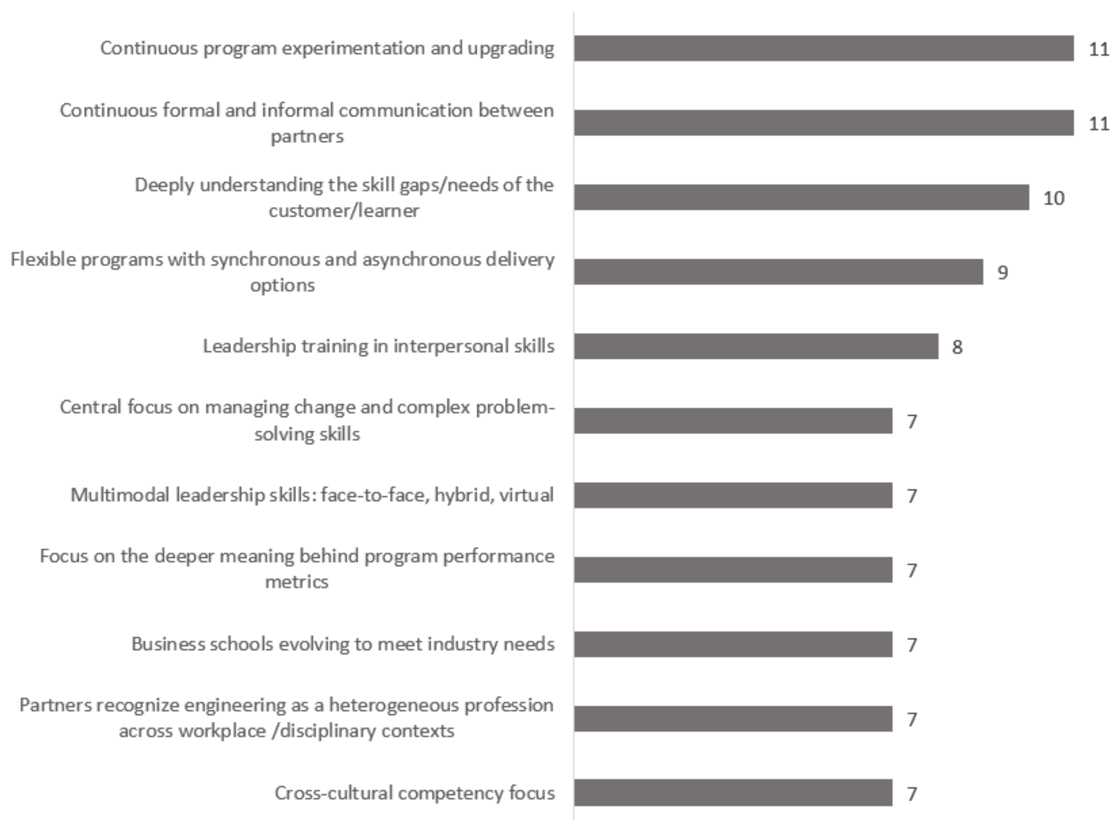
Second Phase: Cross-Case Synthesis and Analysis

Cross-case synthesis is recommended by Yin (2017) for data analysis in a multiple case study to strengthen the trustworthiness of data and provide rigorous multiple case study results. The analytic process includes both within-case and cross-case analyses for multiple case study designs to identify patterns within the data. In the later stages of the analysis, I reviewed related literature once more to confirm theoretical assumptions (Halkias & Neubert, 2020). A cross-case synthesis technique helps achieve an organized analysis of the reasoning connecting the collected data with the study’s conceptual framework (Eisenhardt & Graebner, 2007; Yin, 2017).

A cross-case synthesis method aims to identify the divergence and convergence between cases through the data analysis process in a multiple case study design (Halkias et al., 2022). I used the cross-case analysis method in an iterative process to analyze the data across the study's ten cases, allowing me to identify the themes and patterns across expert participants' views. In Figure 1, each theme's cumulative frequency of occurrence shows the cross-case analysis of the convergent and divergent data across the seven cases.

Figure 1

Cross-Case Synthesis Results (Theme Frequency of Occurrence by Participants)



My expert participants' role disseminates *contextual and interpretative knowledge* in synchrony *technical* and *process knowledge of* a specific topic (Littig & Pöchhacker, 2014). Exploratory interviews with experts are designed openly to best collect a deep understanding and breadth of knowledge and interpretations. Witzel and Reiter (2012) recommended that an expert interview continuously revise the study's topic while expanding the specific body of knowledge. There is scarce knowledge of what CSFs are needed in customized executive education programs for reskilling and upskilling engineers in leadership development, and further research is needed in scholarly and practitioner-based knowledge. There are numerous ways to conduct expert interviews and various procedures that may be used to analyze such interviews (Flick, 2018). Qualitative social research methods are used to analyze the primary data extracted from expert interviews and often include qualitative thematic analysis, such as code-based techniques (Bogner et al., 2018). The following paragraph presents the twenty themes that emerged from the expert interviews with eleven participants.

In formulating implications for the study and focused recommendations for further research in Chapter 5, my interpretation of the study findings will be based on the frequency with which expert-generated themes occurred together in at least seven of the eleven cases (Rosenthal, 2018). A total of 11 cross-case themes emerged across the data collected from the 11 expert participants: (a) continuous program experimentation and upgrading, (b) continuous formal and informal communication between partners, (c) deeply understanding the skill gaps/needs of the customer/learner, (d) flexible programs with synchronous and asynchronous delivery options, (e) leadership training in interpersonal skills, (f) central focus on managing change and complex problem-solving skills, (g) multimodal leadership skills: face-to-face, hybrid, virtual, (h) focus on the deeper meaning behind program performance metrics, (i) business schools evolving to meet industry needs, (j) partners recognize engineering as a heterogeneous profession across workplace /disciplinary contexts, (k) cross-cultural competency focus.

The two strongest cross-case themes were agreed on all by all participants: (a) continuous program experimentation and upgrading, and (b) continuous formal and informal communication between partners, with the theme (c) deeply understanding the skill gaps/needs of the customer/learner following and mentioned by 10 out of the 11 participants. The implications of the managerial practice and research of these prominent themes are presented in Chapter 5.

Triangulation

I used multiple chosen data sources that may support insights resulting from the first phase of the data analysis process, and I tracked evidence through an audit trail throughout the entire study process (see Stake, 2013). Themes on how executive education program experts describe the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development emerged through the study’s data analysis procedures. The three sources of data collected for this study included (a) a semistructured interview protocol (Appendix B) with items that are grounded in the literature review and conceptual framework of this study and field-tested by a panel of three experts, (b) archival data in the form of industry-related reports, media articles on executive education programs for reskilling and upskilling engineers in leadership development (see Yin, 2017) and (c) reflective journal notes (see Merriam & Tisdell, 2015).

Data triangulation was used to corroborate facts found within the multiple data sources (Farquhar et al., 2020). Accurate interview transcription supported my positionality and reflexivity. I employed a transcript review process following each interview that entailed sending separate emails to each participant, including transcribing their responses and allowing a reasonable time for the individual to review and validate their responses (Mero-Jaffe, 2011). Participants were encouraged to correct or clarify any information that may be unclear or misunderstood if necessary (Davidson, 2009; Mann, 2016). The transcript review process allowed me to avoid any significant errors in the data collected and reassured the overall quality of the research study.

I triangulated the semi-structured interview results with archival data findings to strengthen further the trustworthiness of the study's data analysis (Guion et al., 2011). I I read approximately 226 scientific peer-reviewed scholarly articles and journals to increase my knowledge of the research topic and continue the method triangulation process to answer the research question. Out of those approximately 128 publications, I found around 60 closely relevant to my research, including engineering leadership, reskilling and upskilling engineers in leadership development, and customized executive education programs from peer-reviewed, government, media, and business reports. Although not all these articles were substantial enough to be considered in the literature review, they expanded my understanding of the research topic and were used as a source to complement the semistructured expert interviews.

With my archival data collection, I could identify and articulate recurring concepts and themes emerging from the data analysis grounded in the conceptual framework. Triangulation, as such, enhances the richness of data (Farquhar et al., 2020). Study results and findings were analyzed and interpreted within the context of the conceptual framework and how these findings may confirm or extend theory. My findings in the second phase of the data analysis using the cross-case synthesis method may confirm or extend the knowledge in the discipline, as each case presented can be grounded in the reviewed literature (Halkias et al., 2022).

Summary

In this chapter, I presented a case-by-case analysis of 11 participants, followed by a cross-case analysis and synthesis to answer this study’s research question: How do executive education program experts describe the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development?

Engineering leadership has evolved, yet there remain limited perspectives on how engineers can develop their career's technical, interpersonal, and conceptual skills (Farler & Haan, 2021; Hickman & Akdere, 2018). Understanding the dynamic skills of innovation leaders has not received sufficient evidence to define engineering leadership (Rottmann & Kendall, 2022). Additionally, organizational leaders report having little on what makes executive education programs for engineers in leadership development effective and successful (Richardson & McCain, 2022; Rottmann & Kendall, 2022). Without practitioner-based empirical research on CSFs of executive education programs, organizational leaders cannot identify effective leadership development programs customized for engineers (Retana & Rodriguez-Lluesma, 2022; Skibniewski & Kim, 2022).

The data analysis techniques to yield the study's results were produced in this section in a two-step procedure: (a) thematic analysis of the textual data and (b) cross-case synthesis analysis (see Yin, 2017). A total of five coding categories emerged from this multicase study's findings, which included 20 themes. These provided rich data on the experiences of subject matter expert participants. The data collected gathered from the thematic analysis resulted in 20 themes from the five coding categories (a) customized executive education in the postpandemic era**,** (b) cocreation of academic-corporate partnership for customized executive education programs, (c) academic-corporate partnership goals for engineer leadership education, (d) critical success factors for a customized executive education program for engineers, and (e) critical success factors for academic-corporate collaborations for reskilling and upskilling engineer leaders.

I applied a cross-case analysis and synthesis as a data analysis technique in the study to combine findings from each case study as soon as themes across multiple cases were arranged. The 20 themes that emerged from the data analysis process include (a) focus on managing change and complex problem-solving skills, (b) skill-based executive education, (c) cross-cultural competency focus, (d) lifelong, industry-based learning versus traditional degree-based learning, (e) partners recognize engineering as a heterogeneous profession across workplace /disciplinary contexts, (f) business schools evolving to meet industry needs, (g) managing resource allocation and constraints, (h) continuous formal and informal communication between partners, (i) leadership training in interpersonal skills, (j) engineering leaders as employee coaches and team players, (k) multimodal leadership skills: face-to-face, hybrid, virtual, (l) entrepreneurial/commercial mindset, (m) agile EE program leadership team, (n) flexible programs with synchronous and asynchronous delivery options, (o) constantly updated STEM curriculum as markets and industries evolve, (p) deeply understanding the skill gaps/needs of the customer/learner, (q) focus on engineering leadership education to initiate/lead change, (r) focus on the deeper meaning behind program performance metrics, (s) emphasize leadership skills for AI-driven projects, (t) continuous program experimentation and upgrading.

I enhanced the study's data trustworthiness by employing methodological triangulation of three data sources, which included (a) a semistructured interview protocol (Appendix B) with items that are grounded in the literature review and conceptual framework of this study and field-tested by a panel of three experts, (b) archival data in the form of industry-related reports, media articles on executive education programs for reskilling and upskilling engineers in leadership development (see Yin, 2017) and (c) reflective journal notes (see Merriam & Tisdell, 2015).

The multicase study results were further analyzed and interpreted within the context of the conceptual framework: three key conceptual models that aligned with the purpose of the study, which is to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: 1) Rottmann et al.'s (2015) concept of *engineering leadership*, 2) Fung's (2020) concept of *reskilling and upskilling the workforce*, and 3) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs.* This study is significant to theory by contributing original qualitative data to the foundational theories supporting my conceptual framework, including Farr et al.'s (1997) theory of engineering leadership, empowerment theory (Perkins & Zimmerman, 1995), and Argyris and Schön's (1996) theoretical works on organizational learning.

I will present an interpretation of this study's findings in Chapter 5, compared to the literature review in Chapter 2. The implication of the findings to social change, theory, practice, and policy will also be detailed in Chapter 5. I will also explain how empirical results describing executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development may extend theory to other related areas within the management, leadership, executive education, and the reskilling/upskilling literature. Finally, Chapter 5 will present how the research community, practitioners, and policymakers can extend the findings of this study.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this qualitative, multiple case study was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. CSFs are not equivalent to a standard set of measures (e.g., key indicators); CSFs can be identified from the perspective of strategy-as-practice scholars (Aminy et al., 2019). With the support of an open-ended interview model, I collected data from experts' breadth of knowledge and experience in a research field that remains underdeveloped (see Littig & Pöchhacker, 2014). To meet the purpose of this subject matter expert study and be consistent with the qualitative paradigm, a multiple case study design (Yin, 2017) was used to collect data from a purposeful sample of executive education program experts who successfully delivered programs for reskilling and upskilling engineers in leadership development. The interviews allowed participants to elaborate on their personal experiences and the emergence of unexpected data (Jacob & Furgerson, 2012).

The research design and approach of this study were grounded in the study's conceptual framework, which was built on three key conceptual models that aligned with the purpose of the study, which was to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development: (a) Rottmann et al.'s (2015) concept of *engineering leadership*, (b) Fung's (2020) concept of *reskilling and upskilling the workforce*, and (c) Retana and Rodriguez-Lluesma's (2022) concept of *customized executive programs.* Using a multiple case study approach was particularly useful in this study because it gave me the flexibility I needed to extend a theoretical model (Halkias & Neubert, 2020; Stake, 2006). With the use of a multiple case study design, new knowledge emerges through identifying patterns in the collected data and the logical arguments supporting them (Eisenhardt & Graebner, 2007). This study may be significant to theory by contributing original qualitative data to the foundational theories supporting my conceptual framework (Fung, 2020; Retana & Rodriguez-Lluesma, 2022; Rottmann et al., 2015).

Thematic analysis and cross-case synthesis and analysis of data from face-to-face interviews with 11 participants revealed the following 20 themes: (a) focus on managing change and complex problem-solving skills; (b) skill-based executive education; (c) cross-cultural competency focus; (d) lifelong, industry-based learning versus traditional degree-based learning; (e) partners recognize engineering as a heterogeneous profession across workplace /disciplinary contexts; (f) business schools evolving to meet industry needs; (g) managing resource allocation and constraints; (h) continuous formal and informal communication between partners; (i) leadership training in interpersonal skills; (j) engineering leaders as employee coaches and team players; (k) multimodal leadership skills: face-to-face, hybrid, virtual; (l) entrepreneurial/commercial mindset; (m) agile EE program leadership team; (n) flexible programs with synchronous and asynchronous delivery options; (o) constantly updated STEM curriculum as markets and industries evolve; (p) deeply understanding the skill gaps/needs of the customer/learner; (q) focus on engineering leadership education to initiate/lead change; (r) focus on the deeper meaning behind program performance metrics; (s) emphasize leadership skills for AI-driven projects; and (t) continuous program experimentation and upgrading.

Interpretation of Findings

This multiple case study's findings confirm or extend current knowledge in the discipline, with each case presenting examples from the literature discussed and critically analyzed in Chapter 2. In this section, I present the study's findings in the context of the five coding categories that emerged from the data analysis. I compare these five categories with relevant concepts from the conceptual framework and the research from extant updated literature on reskilling/upskilling engineer leaders and leadership development of the 4IR era.

I provide evidence from the 11 semistructured interviews with subject matter experts to support how the study's findings confirm or disconfirm existing knowledge or extend it. Extension studies, such as this multiple case study, provide replication evidence and support extending prior research results by offering new and critical theoretical directions (Bonett, 2012). The term "extension" refers to using multiple case studies to provide further evidence in developing a given theory (Eisenhardt, 1991). Theory extension from case studies represents a vital research strategy that may contribute new and novel insights into theorized phenomena that remain unexplored in the extant literature (Halkias & Neubert, 2020; Eisenhardt, 1991).

Customized Executive Education in the Postpandemic Era

Customized executive education can prepare engineers for leadership roles by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management, yet organizational leaders have little information on what makes these programs between business schools and employers successful (Diaz et al., 2022; Roos, 2022). Scholars found limited and inconsistent scholarly or practitioner-based literature that guided business schools to develop an executive education model that reskills/upskills leaders to manage the future-changing workforce successfully (Diaz & Halkias, 2021b; Fung, 2020). My study results confirmed that although customized executive education programs offer a codesigned solution, they lack a theoretical framework that ensures success.

Study participants confirmed that a model for success must be established, and business schools and firms must set goals toward achieving their anticipated outcomes. This study aligns with Retana and Rodriguez-Lluesma's (2022) conclusions that a theoretical framework describes the behaviors needed to foster a successful codesigned executive education program. The study results extend knowledge based on the works of Retana and Rodriguez-Lluesma to support the emerging theory that describes four conceptually distinct but interrelated behaviors that foster successful customized executive education programs and the qualitative (a) brokerage by program directors, (b) boundary-crossing, (c) case script enactment through role switching in veiling and unveiling of the organization, and (d) diagnostic and codesign and delivery.

Cocreation of Academic–Corporate Partnerships for Customized Executive Education Programs

Despite the relevance of customized executive education programs for leadership development between organizations and business schools, differentiated practitioner-based empirical research on the CSFs of executive education that make these collaborations successful remains scarce (Diaz et al., 2022; Retana & Rodriguez-Lluesma, 2022; Roos, 2022; Skibniewski & Kim, 2022). This study confirmed that although several partnerships have successfully met context-specific problems through a codesign, several important factors that enable effective partnerships among business schools and executive education providers have not yet been identified.

Study participants confirmed that communication is critical and that both business schools and executive education providers must take the time to learn about the specific business they are working with through their research and listen to the goals they share in developing it. This study aligned with Halkias et al.'s (2020) and Horn and Dunagan's (2018) conclusions that academic and industry leaders and researchers are working to redefine executive education toward enabling the opportunity for business schools to work as partners to redefine innovative business school ecosystems committed to innovation and experimentation. The study results extend knowledge from the works of Caratozzolo et al. (2020), Diaz and Halkias (2021b), and Horn (2020), and this research study's results that partnerships with corporate clients aim to work to develop relevant, digitally driven, and sustainable executive education ecosystems that network universities with educational platforms, certification programs, corporate universities, and other professional bodies to synthesize solutions.

Academic–Corporate Partnership Goals for Engineer Leadership Education

Higher education institutions and online learning play a significant role in reskilling and upskilling the workforce and are essential in developing a robust pipeline of skilled engineers (Paullet et al., 2020; Skibniewski & Kim, 2022). As the demand for engineering leaders grows in the global economy, a lack of scholarly knowledge on what makes an effective engineering leader or how they develop leadership remains (Skibniewski & Kim, 2022). My study results confirmed that although engineers continue to work in the field as independent contributors, the need for more customer-service skills continues to rise.

Study participants confirmed that engineers must be prepared with the sector-specific digital and soft skills needed to present, negotiate, and lead the future. This study aligns with Jamieson and Donald's (2020) and Rottmann et al.'s (2016) conclusions that engineering leadership skills continue to be improved through project management education that includes developing personal management and organizational skills that will add value to teamwork-related skills and confidence, empowering early development of leadership styles such as transformational leadership. The study's results extend knowledge based on the works of Rodriguez et al. (2018), Rottmann et al. (2018), and the research collected from this study that engineers must learn to embrace their roles as leaders and the aim of engineering education must continue to examine the educational pipeline to understand how the concept of engineering identity might change over time.

Critical Success Factors for a Customized Executive Education Program for Engineers

Valuable skills are being taught in engineering education training programs, but they lack the skill-based approaches needed to drive real-world application (Harrison et al., 2017; Nix & Bigham, 2015). My study results confirmed that although universities are working to prepare engineers for the future, the need for digital skills and interpersonal skills is ever-changing. Study participants confirmed that engineers must continue to learn the essential technical skills needed to meet the requirements of their specific sector and changing technologies, but interpersonal skills continue to be a challenge for early engineers entering the field.

This study aligns with Ismail and Fathi's (2018) and Rottmann et al.'s (2016) conclusions that the engineer is expected to engage in lifelong learning to ensure the engineering mindset continues to develop alongside strengthening skills in communication, presentation, business writing, and cross-competence. This study extends knowledge from the works of Flores et al. (2020), Romero et al. (2020), Sakurada et al. (2020), and the research from this study that engineering leaders need strong skills that include intrinsic human skills to ensure practical application and optimal usability of digital technologies and that demonstrate strategic and innovative approaches that add value to an organization

Critical Success Factors for Academic–Corporate Collaborations for Reskilling and Upskilling Engineer Leaders

Business school industry partnerships enable opportunities to develop a partnership of technology, knowledge, and organizational transfer to support digital skill development critical for success (Diaz & Halkias, 2021b). Organizational leaders need engineering leaders across all specialization sectors to reskill and upskill to adjust to rapidly changing market conditions (Fung, 2020; Retana & Rodriguez-Lluesma, 2022). My study results confirmed that although there is a lack of preferred alternatives and success factors for engineers across the profession, it is essential to understand each engineer individually from their context-specific sector.

Study participants confirmed that engineering is a dynamic and broad industry, and each program is designed specifically to meet the needs of that organizational issue. This study aligns with Diaz and Halkias's (2021a) conclusions that partnerships between education providers and industry leaders can codesign ecosystem models that offer the preparedness and agility needed to reskill and upskill 4IR leaders' changing workforce. This study extends knowledge from the works of Agrawal et al. (2020), Fung (2020), Halkias's et al. (2020), and the research from this study that the postpandemic world requires 4IR leaders to deliver access to new models and ever-evolving reskill and upskill training and education programs to keep up with the ever-evolving digital technologies that interconnect the physical and cybernetic environments.

Limitations of the Study

Research limitations are study circumstances that the researcher cannot control and may influence the interpretation of the findings in case study research (Yin, 2017). One limitation of this and any qualitative study involves the participants' truthfulness and the trustworthiness of the study results. I facilitated the creation of an open, friendly, and supportive environment for all the Zoom interviews. To further increase credibility, I inspected the transcripts for evidence of assumption and bias, and I followed up and verified contacts with each participant (Merriam & Grenier, 2019). A detailed audit trail was kept in the narrative of the study's design. I collected the data from interviews and archival data and used the reflective field notes to collect accurate data supporting the study's results (Guion et al., 2011). I included a comprehensive literature review in this document to show that my research strategy was reliable and supported by scientific literature.

A second limitation of this study was that I selected participants who only met specific inclusion criteria, which may have limited the representation of the overall targeted population. To mitigate this issue, I followed Schram's (2006) recommendation and recruited between five to 10 participants for a qualitative study because a larger sample size could have weakened the research results and compromised the production of detailed, thick descriptions of the phenomena under study. To mitigate the above-stated limitations, I demonstrated robust methodological rigor by applying a documented audit trail, and I triangulated the data between the semistructured interviews, archival data, and reflective field notes. The comprehensive literature review further supported the study's findings and interpretations.

The third and final limitation regarding the interview process was that the interviewees may not have engaged truthfully with me, and their responses may have been influenced by bias, nervousness, or concerns (Merriam & Tisdell, 2015). I attempted to establish a bond of trust with the participants to manage this limitation. Any qualitative researcher is limited by the difficulty of extending the findings to a broader population with the same degree of certainty as with quantitative approaches. This study used a multiple case study approach to allow a more exhaustive exploration of the research question and ensured trustworthiness to mitigate the qualitative research limitation and extend the theory (Eisenhardt & Graebner, 2007; Halkias & Neubert, 2020).

Recommendations

Increasing demand for high-level leadership skills in engineering, coupled with the global digitalization trend and 24/7 connectivity, may be heralding a new period of disruption for executive education programs servicing various industry sectors (Diaz et al., 2022). Literature shows that completing a higher education degree will not be sufficient to ensure employability, placing upskilling and reskilling for engineers' ongoing career advancement at the forefront of corporate training policies and applied research initiatives (Ismail & Fathi, 2018; Jamieson & Donald, 2020; Rottmann et al., 2016). Practice-based knowledge and future research suggestions on where business schools' executive education programs find themselves today and how to develop academic-industry partnerships for successful customized executive education remain rare in the extant scholarly literature (Rottmann & Kendall, 2022; Tiberius et al., 2021). In this section, I offer practice, policy, and research recommendations on strengthening the business school–industry partnership bond in reskilling/upskilling engineers in leadership development.

Recommendations for Policy and Professional Practice

The rise of digital technologies is quickly creating new demands and challenges throughout the engineering field. It is estimated that at least half of today's engineers will need to learn new skills to keep up with job market demands. Today’s corporations must trailblaze pathways to support continuing education in leadership training for engineers while retaining the best engineering talent. Scholars and practitioners write that the most important qualities needed for reskilling and upskilling engineers in leadership skills are leading a cross-functional team member, project management leadership skills, communication and writing, and hybrid and digital leadership. Engineers who feel that their current employers support their future career development tend to be more productive and focused in their roles within the company. Successful customized executive education programs for engineers increase the quality of their work output and make employers more attractive to attract top STEM talent in a competitive global market.

A skills-dominated market will give power to individuals, allowing them to articulate their capabilities better and support employers in their talent identification. More research will be required to understand better how employers can assess and recognize skills to operate in a skill-based context (Fung, 2020). The disappearing boundary work and skills have been accelerated by online learning, launching a new ecosystem of educational alternatives, including degrees, credit, skill-building program certificates, boot camps, in-house training, and external partnerships (EdSurge, 2021).

Collaboration between business schools, providers, and engineering corporations and via partnerships with external providers, such as technology partners, will be pivotal in meeting the range of new needs and the scale of change required to reskill and upskill engineers for the 4IR. For a meaningful shift towards lifelong learning in business schools entering the reskill/upskill market, leadership teams of such programs must be agile and collaborative, with a clear line of communication running between customized executive education partners. Effective communication systems must be in place and communicated to all partners at the partnership's launch.

As indicated in my research, the future of customized executive education for engineers must be perceived as moving away from supply-led content of the past and even the present and towards demand-led, flexible solutions to support tomorrow's engineering leaders. Business schools must interact with and listen closely to their market peers and understand their clients' and end users' changing requirements.

Participants in my study agreed that a one-size-fits-all lifelong learning strategy for reskilling and upskilling leaders for the 4IR does not exist. An academic-industry partnership strategy for executive education for engineer leaders must be customized to a provider's market segmentation, geographic location and regional culture, operational capabilities, and content/domain knowledge expertise.

My study participants agreed that the cocreation of reskilling/upskilling programs requires crossing organizational knowledge boundaries. Academics and partners must be ready to share domain-specific knowledge and be flexible in what and how the material is delivered to the end-user. Participants stated that business schools tend to minimize the scale of change and investment required to develop customized executive education programs that hinder the agility needed to challenge the status quo. Study participants also discussed this issue as a critical challenge around connecting the personal goals of business school leaders with strategic organizational goals for employers. Many business schools may still not be ready to let go of traditional degree learning and to invest heavier into lifelong learning solutions such as micro-credentials which appear to "muscle into the territory" now occupied by traditional degree programs. Academics in business schools interested in reskilling and upskilling engineers must be willing to break their silos and share knowledge and research with industry partners to offer cross-discipline and career-long learning solutions and give up-to-the-minute expertise on STEM issues.

Recommendations for Future Research

More research will be required to understand better how employers can assess and recognize skills to operate in a skill-based context and how business schools can seek partnerships within the industry if they hope to continue a relevant role within the executive education sector (Diaz et al., 2022). The future of work will generate new jobs and destroy many existing ones. Corporate leaders can support practitioners-based research first to define the skills that are relevant for any given job, look at their existing workforce to see if someone has the capabilities to assume this job, and finally make an intentional move towards incorporating a more diverse labor force supported by this new emphasis on skills rather than credentials (Longmore et al., 2018).

The COVID-19 pandemic has accelerated digital and sustainable transformation strategy for STEM-oriented companies. Business Schools can launch more practice-based research on proactively incorporating external stakeholders—such as internal company teams, e-learning academies, coaches, or specialized professional training centers —to serve the reskilling and upskilling learning experience. Postpandemic executive education programs will force institutions to research best practice strategies, prepare their faculty for technology-based hybrid programs, identify and train them to engage in online academic experiences, and adapt the renewed economic model for future workplace training needs. A higher upfront investment will be required and serve a market in which the attraction of digital-first future executive education students will reinvent how business schools connect with their customer candidates.

The benefit of upskilling is an investment in building relevant and competitive organizations that reduce turnover and increases employee satisfaction and engagement. Industries and institutions must support future research on successfully assimilating new technologies and interdisciplinarity into the engineering curriculum (Diaz & Halkias, 2021b; Roy & Roy, 2021). Interdisciplinarity enables integrative learning, creative problem-solving, and critical thinking experiences to develop creative solutions to the future's changing technological problems (Retana & Retana Rodriguez-Lluesma, 2022; Roy & Roy, 2021).

Implications

Social change is a fundamental approach to providing opportunities for communities to receive support in their development, such as in engineering education (Rottmann et al., 2016). By recruiting engineers with leadership qualities within a professional project, a project's stakeholders are more likely to feel the positive impact of a successful project. Projects can also progress more smoothly and efficiently, achieving positive results in less time with competent engineers educated in leadership (Bakht, 2018). Effective leadership drives projects and organizational success through rapid reskilling and upskilling of engineers' skills as needed to enhance their abilities to learn and use new knowledge for their employability continuously and in building a sustainable world (Pistoia et al., 2021).

Engineering leadership education has become increasingly popular over the past decade in response to national calls for another type of social change: educational change (Rottmann et al., 2016; Kendall & Rottmann, 2022). As the pandemic has brought new homeostasis to world labor markets, industry and professional bodies have re-asserted the importance of “non-technical” skills, which has created openings for a leadership resurgence in engineering (Klassen et al., 2020). Workers across industries must figure out how to adapt to rapidly changing conditions, and leaders must learn how to match those workers to new roles and activities (Fung, 2020).

Hickman and Akdere (2018) described how leadership development in engineering remains understudied, and the increasing importance of IT across all organizations emphasizes how leadership is highly context-bound. Reskilling and upskilling engineers in leadership development are more than leading corporate initiatives for innovative technology and artificial intelligence. Today’s professional leaders must access ever-evolving reskill and upskill training and education programs to support their workforce and deliver new business models in the postpandemic era (Halkias et al., 2020). This study may be significant to practice in that it may inform organizational leaders on the CSFs of customized executive education programs to prepare engineers for leadership roles required within their profession to support their midcareer transitions and ensure livelihoods amidst disruptive global events (Retana & Rodriguez-Lluesma, 2022; Rottmann & Kendall, 2022).

This study adds empirical research from scholar-practitioners perspectives that may be significant to practice by offering solutions that support midcareer transitions of individual engineers and their families' livelihoods amidst disruptive global events (Rottmann & Kendall, 2022). Lifelong learning is essential for the engineering workforce and impacts their ability to develop versatile, agile, creative, and positive learning mindsets needed to solve complex problems (Diaz & Halkias, 2021b; Fung, 2020). Effective leadership drives projects, and organizational success through rapid reskilling and upskilling of engineers' skills as needed to enhance their abilities to continuously learn and use new knowledge for their employability and a sustainable world (Pistoia et al., 2021), and customized executive programs foster leadership development capabilities such as collaboration, conflict management, and personal and organizational transformation (e.g., Crossan et al., 2013; Kets De Vries & Korotov, 2007; Retana & Rodriguez-Lluesma, 2022).

This study provides insight for organizations needing to reskill and upskill leaders in the Hybrid Era that may provide insight into the various synchronous and non-synchronous programs that have revolutionized frameworks to connect the sensemaking, experimentation, and self-discovery components of leadership development (Birkinshaw et al., 2022). The experts from this study may offer scholars and industry leaders a deeper understanding of the strengths and weaknesses of customized executive education programs from their experiences. The CSFs identified by the EE program experts may enable new insights to support apprehensions about integrating customized programs into their firm’s professional development.

The findings from this study may have potential implications that support the expansion of several engineering leadership theories (Kalliamvakou et al., 2017;

Rottmann et al., 2016) and add insight into the application of Katz's (1955) model of effective leadership to various levels of leadership. Engineering leaders in the IT field may apply the data from this study to support the development of effective engineering leadership for mid and senior-level leaders and managers. Strategy-as-practice scholars call for further empirical research to fill a literature gap on the CSFs needed for effective reskilling and upskilling of engineers in leadership development and highlight the need for further empirical research from practitioner-scholars (Rottmann & Kendall, 2022).

This study may be significant to theory by contributing original qualitative data to the foundational theories supporting my conceptual framework (Fung, 2020; Retana and Rodriguez-Lluesma, 2022; Rottmann et al., 2015). Such empirical results describing executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development may extend theory to other related areas within the management, leadership, and executive education, and reskilling/upskilling literature.

Conclusions

Professionals searching for upskilling and reskilling together with academic and non-academic players can create a skill-up economy at the intersection of education and career paths through customized executive education programs (Richardson & McCain, 2022; Retana & Rodriguez-Lluesma, 2022). As people pursue high-tech jobs, knowledge and skill-building must occur intentionally and continuously. Universities and companies have tried to bridge the gap, and recently many new skill-up providers, including boot camps, have sprung up to smooth the transitions between learning and career opportunities (Diaz et al., 2022; Lamine et al., 2021). Customized executive education programs present a collaborative response by which firms and training providers develop specific solutions to unique problems of reskilling and upskilling within a given professional context to ensure livelihoods in the turbulent future of labor markets (Diaz & Halkias, 2022; Retana & Rodriguez-Lluesma, 2022).

The purpose of this qualitative, multiple case study is to describe executive education program experts' views on the CSFs needed in customized executive education programs for reskilling and upskilling engineers in leadership development. The Reskilling Revolution program launched by the World Economic Forum in January 2020 estimated that one billion people need to be provided with better education, new skills, and better work by 2030 (Diaz & Halkias, 2021a; World Economic Forum, 2022), with engineers needing to engage in regular reskilling throughout their careers (O'Heir, 2021). Semistructured interviews (Yin, 2017), archival data, and reflective field notes (Merriam & Tisdell, 2015) drove the trustworthiness of the multiple case study's findings through data triangulation (Guion et al., 2011; Halkias et al., 2022). Data analysis was conducted using Yin's (2017) cross-case synthesis method.

Despite the relevance of customized executive education programs for leadership development between organizations and business schools, there remains a literature gap on the criteria that make these collaborations successful (Diaz et al., 2022; Roos, 2022). This study's results align with Ismail & Fathi's (2018), Rottmann et al.'s (2016), and Rottmann & Kendall's (2022) conclusions that customized executive education for the engineers is expected to engage in lifelong learning to ensure the engineering mindset continues to develop alongside strengthening skills in communication, presentation, business writing, and cross-competence. This study extends knowledge from the works of Flores et al. (2020), Romero et al. (2020), Sakurada et al. (2020), and the research from this study that engineering leaders need strong skills that include intrinsic human skills to ensure practical application and optimal usability of digital technologies and that demonstrate strategic and innovative approaches that add value to an organization

More research is needed in this new educational ecosystem with different players, interests, and potentially different outcomes for students and companies across industry sectors, including engineering (Diaz et al., 2022; Rottmann & Kendall, 2022). Customized executive education can prepare engineers for leadership roles by reskilling and upskilling abilities such as soft skills, communication skills, leading through change, and conflict management (Roos, 2022; Rottmann & Kendall, 2022). Further empirical research that includes scholar-practitioners views is needed to drive social change by identifying the CSFs of executive education programs for reskilling and upskilling engineers in leadership development required during the Fourth Industrial revolution (Rottmann & Kendall, 2022).

References

Agarwal, V., Mathiyazhagan, K., Malhotra, S., & Saikouk, T. (2022). Analysis of challenges in sustainable human resource management due to disruptions by Industry 4.0: An emerging economy perspective. *International Journal of Manpower, 43*(2), 513-541. https://doi.org/10.1108/IJM-03-2021-0192

Agrawal, S., De Smet, A., Lacroix, S., & Reich, A. (2020, May 7). *To emerge stronger from the COVID-19 crisis, companies should start reskilling their workforces now*. McKinsey & Company. https://www.mckinsey.com/~/media/mckinsey/business%20functions/organization/our%20insights/to%20emerge%20stronger%20from%20the%20covid%2019%20crisis%20companies%20should%20start%20reskilling%20their%20workforces%20now/to-emerge-stronger-from-the-covid-19-crisis.pdf

Akkermans, J., Richardson, J., & Kraimer, M. L. (2020). The Covid-19 crisis as a career shock: Implications for careers and vocational behavior. *Journal of Vocational Behavior, 119*, Article 103434. https://doi.org/10.1016/j.jvb.2020.103434

Alvesson, M., & Jonsson, A. (2016). The bumpy road to exercising leadership: Fragmentations in meaning and practice. *Leadership, 14*(1), 40-57. https://doi.org/10.1177/1742715016644671

Alvesson, M., & Sköldberg, K. (2017). *Reflexive methodology: New vistas for qualitative research*. SAGE.

Amdam, R. P. (2016). Executive education and the managerial revolution: The birth of executive education at Harvard Business School. *Business History Review, 90*(4), 671–690. https://doi.org/10.1017/S0007680517000010

American Society of Mechanical Engineers. (2022, February 11). *How companies can support continuing education while retaining engineering talent*. https://www.asme.org/topics-resources/content/how-companies-can-support-continuing-education-while-retaining-engineering-talent

Aminy, B., Jokel, H., & Klasson, M. (2019). *Self-service business intelligence towards a CSF model for SSBI success* (Publication No. 8984517) [Master's thesis, Lund University]. LUD University Libraries.

Anderson, V. (2017). Criteria for evaluating qualitative research. *Human Resource Development Quarterly*, *28*(2), 125–133. https://doi.org/10.1002/hrdq.21282

Argyris, C., & Schön, D. A. (1996). *Organizational learning II: Theory, method, and practice*. Addison-Wesley.

Bakht, A. B. (2018). *Engineering leadership competencies for entry-level civil engineers: A multiple case study* [Doctoral dissertation, Walden University]. Walden University ScholarWorks.

Barratt, M., Choi, T., & Li, M. (2011). Qualitative case studies in operations management: Trends, research outcomes, and future research implications. *Journal of Operations Management, 29*(4), 329–342. https://doi.org/10.1016/j.jom.2010.06.002

Baskarada, S., & Koronios, A. (2013). Data, information, knowledge, wisdom (DIKW): A semiotic theoretical and empirical exploration of the hierarchy and its quality dimension. *Australasian Journal of Information Systems*, *18*(1), 5-24. https://doi.org/10.3127/ajis.v18i1.748

Beckhusen, J. (2016). *Occupations in information technology*. U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau. https://www.census.gov/content/dam/Census/library/publications/2016/acs/acs-35.pdf

Bele, D. (2019). Benefits and issues in implementing business intelligence in enterprises. In D. Bele, L. Weis, & N. Maher (Eds.), *Sustainable development under the conditions of European integration. Part I* (pp. 173–196). Ljubljana School of Business. https://nbn-resolving.org/urn:nbn:de:0168-ssoar-62812-8

Ben Youssef, A., Boubaker, S., Dedaj, B., & Carabregu-Vokshi, M. (2021). Digitalization of the economy and entrepreneurship intention. *Technological Forecasting and Social Change*, *164*, Article 120043. https://doi.org/10.1016/j.techfore.2020.120043

Berger, R. (2015). Now I see it, now I don't: Researcher's position and reflexivity in qualitative research. *Qualitative Research*, *15*(2), 219–234. https://doi.org/10.1177/1468794112468475

Bergeron, H. E. (2001). A perspective on the need to give an introduction to engineering management to all engineering students. *Leadership and Management in Engineering*, *1*(1), 26–29. http://doi.org/10.1061/(asce)1532-6748(2001)1:1(26)

Birkinshaw, J., Gudka, M., & Marshall, S. (2022, June 1). What leadership development should look like in the hybrid era. Harvard Business Review. https://hbr.org/2022/06/what-leadership-development-should-look-like-in-the-hybrid-era

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*, *26*(13), 1802–1811. https://doi.org/10.1177/1049732316654870

Bogner, A., Littig, B., & Menz, W. (2018). Generating qualitative data with experts and elites. In U. Flick (Ed.), *The SAGE handbook of qualitative data collection* (pp. 652–665). Sage Publications Ltd. https://doi.org/10.4135/9781526416070

Boyatzis, R., Rochford, K., & Cavanagh, K. V. (2017). Emotional intelligence competencies in engineer's effectiveness and engagement. *Career Development International*, *22*(1), 70–86. https://doi.org/10.1108/cdi-08-2016-0136

Bracio, K., & Szarucki, M. (2020). Mixed methods utilisation in innovation management research: A systematic literature review and meta-summary. *Journal of Risk and Financial Management, 13*(11), Article 252. https://doi.org/10.3390/jrfm13110252

Browne, N., & Keeley, S. (2014). *Asking the right questions* (11th ed.). Pearson Education Limited.

Büchel, B., & Antunes, D. (2007). Reflections on executive education: The user and provider's perspectives. *Academy of Management Learning & Education*, *6*(3), 401-411. https://doi.org/10.5465/amle.2007.26361629

Cagliano, R., Canterino, F., Longoni, A., & Bartezzaghi, E. (2019). The interplay between smart manufacturing technologies and work organization: The role of technological complexity. *International Journal of Operations & Production Management*, *39*(6/7/8), 913–934. https://doi.org/10.1108/IJOPM-01-2019-0093

Capretz, L. F., & Ahmed, F. (2018). A call to promote soft skills in software engineering. *Psychology and Cognitive Sciences - Open Journal*, *4*(1), e1–e3. https://doi.org/10.17140/pcsoj-4-e011

Caratozzolo, P., Sirkis, G., Piloto, C., & Correa, M. (2020). Skills obsolescence and education global risks in the fourth industrial revolution. In *2020 IFEES World Engineering Education Forum - Global Engineering Deans Council (WEEF-GEDC)* (pp. 100–104). IEEE. https://doi.org/10.1109/weefgedc49885.2020.9293687

Carminati, L. (2018). Generalizability in qualitative research: A tale of two traditions. *Qualitative Health Research*, *28*(13), 2094–2101. https://doi.org/10.1177/1049732318788379

Chen, Y., Xu, Y., & Zhai, Q. (2019). The knowledge management functions of corporate university and their evolution: Case studies of two Chinese corporate universities. *Journal of Knowledge Management*, *23*(10), 2086–2112. https://doi.org/10.1108/JKM-04-2018-0228

Christ, K. L., & Burritt, R. L. (2019). Implementation of sustainable development goals: The role for business academics. *Australian Journal of Management*, *44*(4), 571–593. https://doi.org/10.1177/0312896219870575

Christensen, C. M., & Carlile, P. R. (2009). Course research: Using the case method to build and teach management theory. *Academy of Management Learning & Education, 8*(2), 240-251. https://doi.org/10.5465/amle.2009.41788846

Colcleugh, D., & Reeve, D. W. (2013, June). Translating a corporate leadership philosophy and practice to the engineering classroom. In *Proceedings of the Canadian Engineering Education Association Conference- École Polytechnique de Montréal June 2013*. Canadian Engineering Education Association (CEEA). https://doi.org/10.24908/pceea.v0i0.4849

Cooper, K., & White, R. E. (2012). *Qualitative research in the post-modern era: Contexts of qualitative research*. Springer.

Crisp, A. (2019). See the future. *Global Focus: The EFMD Business Magazine, 13*(1), 4–5. https://www.globalfocusmagazine.com/see-the-future/

Crossan, M., Mazutis, D., Seijts, G., & Gandzs, J. (2013). Developing leadership character in business programs. *The Academy of Management Learning and Education, 12*(2), 285–305. https://doi.org/10.5465/amle.2011.0024A

Davidson, C. (2009). Transcription: Imperatives for qualitative research. *International Journal of Qualitative Methods, 8*(2), 35–52. https://doi.org/10.1177/160940690900800206

de Campos, D., de Resende, L., & Fagundes, A. (2020). The importance of soft skills for the engineering. *Creative Education, 11*(8), 1504–1520. https://doi.org/10.4236/ce.2020.118109 de Vries, H., Meyer, J., Van Wassenhove, L., & von Bernuth, N. (2020). Strategic challenges as a learning vehicle in executive education. *The International Journal of Management Education, 18*(3), Article 100416. https://doi.org/10.1016/j.ijme.2020.100416

Diaz, J., & Halkias, D. (2021a). Pivoting towards an innovative executive education ecosystem in business schools. *EFMD Global Focus.* https://www.globalfocusmagazine.com/pivoting-towards-an-innovative-executive-education-ecosystem-in-business-schools/

Diaz, J., & Halkias, D. (2021b). Reskilling and upskilling 4IR leaders in business schools through an innovative executive education ecosystem: An integrative literature review. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3897059

Diaz, J., & Halkias, D. (2022, April 14). The business school role in reskilling and upskilling leaders for the future of work. *Ambition Magazine*, 52, 12-17. https://edition.pagesuiteprofessional.co.uk/html5/reader/production/default.aspx?pubname=&edid=e066af88-9e64-466c-b1fb-adf5bdf481d8

Diaz, J., Halkias, D., & Thurman, P. W. (2022). *The innovative management education ecosystem: Reskilling and upskilling the future workforce*. Routledge

Döringer, S. (2020). 'The problem-centred expert interview'. Combining qualitative interviewing approaches for investigating implicit expert knowledge. *International Journal of Social Research Methodology, 24*(3), 265-278. https://doi.org/10.1080/13645579.2020.1766777

Dowd, A. C., & Johnson, R. M. (2020). Why publish a systematic review: An editor's and reader's perspective. In O. Zawacki-Richter, M. Kerres, S. Bedenlier, M. Bond, & K. Buntins (Eds.), *Systematic reviews in educational research* (pp. 69–87). Springer VS. https://doi.org/10.1007/978-3-658-27602-7_5

Ebert, C., & Duarte, C. H. C. (2018). Digital transformation. *IEEE Software, 35*(4), 16–21. https://doi.org/10.1109/MS.2018.2801537

Edmonson, C. (2020, May 26). *Respond quickly and keep adapting amid COVID-19: Amy C. Edmondson*. People Matters, Leadership. https://www.peoplematters.in/article/leadership/respondquickly-and-keep-adapting-amid-covid-19-amy-c-edmondson-25795

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, *50*(1), 25–32. https://doi.org/10.5465/AMJ.2007.24160888

Ensley, K. (2017). Preparing students for the satellite industry. Resources in technology and engineering. *Technology and Engineering Teacher*, *77*(2), 16–21. https://www.iteea.org/File.aspx?id=166967&v=d359ce5f

Farler, D. W., & Haan, P. (2021). Effective leadership in the engineering, technology, and construction industry. *Journal of Construction Materials, 2*(4), 4-8. https://doi.org/10.36756/jcm.v2.4.8

Farquhar, J., Michels, N., & Robson, J. (2020). Triangulation in industrial qualitative case study research: Widening the scope. *Industrial Marketing Management*, *87*, 160–170. https://doi.org/10.1016/j.indmarman.2020.02.001

Farr, J. V., & Brazil, D. M. (2009). Leadership skills development for engineers. *IEEE Engineering Management Review, 38*(4), 110–118. https://doi.org/10.1109/emr.2010.5645763

Farr, J. V., Walesh, S. G., & Forsythe, G. B. (1997). Leadership development for engineering managers. *Journal of Management in Engineering, 13*(4), 38–41. https://doi.org/10.1061/(asce)0742-597x(1997)13:4(38)

Fazli, F., & Bittner, E. A. C. (2017). Cultural influences on collaborative work in software engineering teams. In T. Bui & R. Sprague, Jr. (Eds.), *Proceedings of the 50th Hawaii International Conference on System Sciences* (pp. 454–463). University of Hawaii. https://doi.org/10.24251/hicss.2017.056

Financial Times. (2022, May 22). *Executive education custom 2022.* (https://rankings.ft.com/rankings/2871/executive-education-custom-2022)

Finfgeld-Connett, D. (2014). Use of content analysis to conduct knowledge-building and theory-generating qualitative systematic reviews. *Qualitative Research, 14*(3), 341–352. https://doi.org/10.1177/1468794113481790

Flick, U. (2018). *Designing qualitative research* (2nd ed). SAGE Publications Ltd.

Flores, E., Xu, X., & Lu, Y. (2020). Human capital 4.0: A workforce competence typology for Industry 4.0. *Journal of Manufacturing Technology Management, 31*(4), 687–703. https://doi.org/10.1108/JMTM-08-2019-0309

Florez, W.A. (2019). Embodying engineering leadership. *Kybernetes, 48*(7), 1547-1562. https://doi.org/10.1108/K-05-2018-0242

Fung, M. (2020). Developing a robust system for upskilling and reskilling the workforce: Lessons from the skillsfuture movement in Singapore. In B. Panth & R. Maclean (Eds.), *Anticipating and preparing for emerging skills and jobs* (pp. 321–327). Springer Singapore. https://doi.org/10.1007/978-981-15-7018-6_39

Fusch, P., & Ness, L. R. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report, 20*(9), 1408–1416. https://doi.org/10.46743/2160-3715/2015.2281

Gagnidze, I. (2020). *The role of the education system for responding the challenges of industry 4.0* [Paper presentation]. 2020 Strategic Imperatives of Modern Management (SIMM) Conference at KNEU, Kiev, Ukraine. https://ir.kneu.edu.ua/handle/2010/32952?locale-attribute=en

Gehman, J., Glaser, V. L., Eisenhardt, K. M., Gioia, D., Langley, A., & Corley, K. G. (2018). Finding theory-method fit: A comparison of three qualitative approaches to theory building. *Journal of Management Inquiry, 27*(3), 284–300. https://doi.org/10.1177/1056492617706029

Gelinas, L., Pierce, R., Winkler, S., Cohen, I. G., Fernandez Lynch, H., & Bierer, B. E. (2017). Using social media as a research recruitment tool: Ethical issues and recommendations. *The American Journal of Bioethics, 17*(3), 3-12. https://doi.org/10.1080/15265161.2016.1276644

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Sociology Press.

Goodale, M. J. (2005). The right stuff: Traits and skills of effective leaders. *Leadership* *and Management in Engineering*, *5*(1), 7–8. https://doi.org/10.1061/(ASCE)1532-6748(2005)5:1(3)

Graham, R., Crawley, E., & Mendelsohn, B. R. (2009). *Engineering leadership education: A snapshot review of international good practice* [White Paper]. Bernard M. Gordon MIT Engineering Leadership Program. https://www.rhgraham.org/resources/ELE-White-Paper-102109.pdf

Gratton, L. (2019, July 8). New frontiers in re-skilling and upskilling. *MIT Sloan Management Review, 61*(1). https://sloanreview.mit.edu/article/new-frontiers-in-re-skilling-and-upskilling/

Gray, L. M., Wong-Wylie, G., Rempel, G. R., & Cook, K. (2020). Expanding qualitative research interviewing strategies: Zoom video communications. *The Qualitative Report*, *25*(5), 1292-1301. https://nsuworks.nova.edu/tqr/vol25/iss5/9

Gren, L., & Ralph, P. (2022 May 21-29). *What makes effective leadership in agile software development teams?* [Paper presentation]. 44th International Conference on Software Engineering, Pittsburgh, PA, USA. https://doi.org/10.48550/arXiv.2201.08058

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105–117). Sage Publications, Inc.

Guion, L. A., Diehl, D. C., & McDonald, D. (2011). Triangulation: Establishing the validity of qualitative studies: FCS6014/FY394, rev. 8/2011. *EDIS, 2011*(8), Article 3. https://doi.org/10.32473/edis-fy394-2011

Hagens, V., Dobrow, M. J., & Chafe, R. (2009). Interviewee transcript review: assessing the impact on qualitative research. BMC Medical Research Methodology, 9(1). https://doi.org/10.1186/1471-2288-9-47

Halkias, D., & Neubert, M. (2020). Extension of theory in leadership and management studies using the multiple-case study design. *International Leadership Journal*, *12*(2), 48–73. https://doi.org/10.2139/ssrn.3586256

Halkias, D., Neubert, M., Thurman, P. W., Adendorff, C., & Abadir, S. (2020). *The innovative business school: Mentoring today's leaders for tomorrow's global challenges*. Routledge.

Halkias, D., Neubert, M., Thurman, P. W., & Harkiolakis, N. (2022). *The multiple case study design: Methodology and application for management education*. Routledge. https://doi.org/10.4324/9781003244936

Harkiolakis, N. (2016). *Leadership explained: Leading teams in the 21st century*. Routledge.

Harkiolakis, N. (2017). *Quantitative research methods: From theory to publication*. CreateSpace Independent Publishing Platform.

Harrison, H., Birks, M., Franklin, R., & Mills, J. (2017). Case study research: Foundations and methodological orientations. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *18*(1), Article 19. https://doi.org/10.17169/fqs-18.1.2655

Hartmann, B. L., Stephens, C. M., & Jahren, C. T. (2017). Validating the importance of leadership themes for entry-level engineering positions. *Journal of Professional*

Issues in Engineering Education and Practice, *143*(1), Article 04016016. https://doi.org/10.1061/(asce)ei.1943-5541.0000301

Hickman, L., & Akdere, M. (2018). Effective leadership development in information technology: Building transformational and emergent leaders. *Industrial and Commercial Training*, *50*(1), 1–9. https://doi.org/10.1108/ict-06-2017-0039

Hirudayaraj, M., Baker, R., Baker, F., & Eastman, M. (2021). Soft skills for entry-level engineers: What employers want. *Education Sciences*, *11*(10), Article 641. https://doi.org/10.3390/educsci11100641

Hoffmann, M., Mendez, D., Fagerholm, F., & Luckhardt, A. (2022). The human side of software engineering teams: An investigation of contemporary challenges. *IEEE Transactions on Software Engineering*. Advance online publication. https://doi.org/10.1109/tse.2022.3148539

Hong, P. C., Singh, N. P., Elangovan, N. and Yeon, G. (2022). Responding to pandemic challenges: Leadership lessons from multinational enterprises (MNEs) in India. *Journal of Management Development*, *41*(4), 205-222. https://doi.org/10.1108/JMD-11-2021-0309

Hopkins, P., & Unger, M. (2017). What is a “subject-matter expert”? *Journal of Pipeline Engineering*, *16*(4), 227–230.

Horn, M. B. (2020). Education, disrupted. *MIT Sloan Management Review*, *61*(2), 1-5. https://sloanreview.mit.edu/article/education-disrupted/

Horn, M. B., & Dunagan, A. (2018). *Innovation and quality assurance in higher education*. Christensen Institute. https://www.christenseninstitute.org/publications/quality-assurance/

Hsiao, A. (2013, June). Developing an entrepreneurial mindset in engineering students. In *Proceedings of the Canadian Engineering Education Association Conference- École Polytechnique de Montréal June 2013*. Canadian Engineering Education Association (CEEA). https://doi.org/10.24908/pceea.v0i0.4832

Huber, L., Lane, J. N. & Lakhani, K. R. (2020). *Learning with people like me: The role of age similar peers on online business course engagement* (Working Paper No. 21-072). Harvard Business School. https://hbswk.hbs.edu/item/learning-with-people-like-me

Iñiguez, S., & Lorange, P. (Eds.). (2022). *Executive education after the pandemic: A vision for the future*. Palgrave Macmillan Cham. https://doi.org/10.1007/978-3-030-82343-6

Ismail, M., & Fathi, M. S. (2018). Leadership in construction: Leadership styles practiced in construction project–a review. *Journal of Advanced Research in Business and Management Studies, 13*(1), 24-30. https://doi.org/10.1109/ieeestd.2017.8016712

Jamieson, M., & Donald, J. (2020). Building the engineering mindset: Developing leadership and management competencies in the engineering curriculum. In *2020: Proceedings of the Canadian Engineering Education Association (CEEA)*

Conference (Article 14129). Canadian Engineering Education Association (CEEA-ACEG). https://doi.org/10.24908/pceea.vi0.14129

Jerman, A. J., Pejić Bach, M., & Aleksić, A. (2020). Transformation towards smart factory system: Examining new job profiles and competencies. *Systems Research and Behavioral Science*, *37*(2), 388–402. https://doi.org/10.1002/sres.2657

Johnson, J. L., Adkins, D., & Chauvin, S. (2020). A review of the quality indicators of rigor in qualitative research. *American Journal of Pharmaceutical Education, 84*(1), Article 7120. https://doi.org/10.5688/ajpe7120

Kalliamvakou, E., Bird, C., Zimmermann, T., Begel, A., DeLine, R., & German, D. (2017). What makes a great manager of software engineers? *IEEE Transactions on Software Engineering, 45*(1), 87-106. https://doi.org/10.1109/TSE.2017.2768368

Kantanen, H., & Manninen, J. (2016). Hazy boundaries: Virtual communities and research ethics. *Media and Communication, 4*(4), 86–96. https://doi.org/10.17645/mac.v4i4.576

Kappelman, L., Jones, M. C., Johnson, V., McLean, E. R., & Boonme, K. (2017). Skills for success at different stages of an IT professional's career. *Communications of the ACM*, *59*(8), 64-70. https://doi.org/10.1145/2888391

Katz, R. L. (1955). *Skills of an effective administrator.* Harvard Business Review Press,

Katz, R. L. (2009). *Skills of an effective administrator.* Harvard Business Review Press.

Katz, S. M. (1993). The entry-level engineer: Problems in transition from student to professional. *Journal of Engineering Education*, *82*(3), 171-174. https://doi.org/10.1002/j.2168-9830.1993.tb00097.x

Kee, K. F., & Schrock, A. R. (2020). Telephone interviewing as a qualitative methodology for researching cyberinfrastructure and virtual organizations. In J. Hunsinger, M. M. Allen, & L. Klastrup (Eds.), *Second international handbook of internet research* (pp. 351–365). Springer Netherlands. https://doi.org/10.1007/978-94-024-1555-1_52

Kendall, M. R., & Rottmann, C. (2022). Student leadership development in engineering. *New Directions for Student Leadership*, *2022*(173), 7-12. https://doi.org/10.1002/yd.20474

Kets De Vries, M. F. R., & Korotov, K. (2007). Creating transformational executive education programs. *The Academy of Management Learning and Education*, *6*(3), 375–387. https://doi.org/10.5465/amle.2007.26361627

Kirschenman, M. (2011). Leadership of multidisciplinary programs and systems. *Leadership and Management in Engineering*, *11*(2), 137–140. https://doi.org/10.1061/(asce)lm.1943-5630.0000113

Klassen, M., Kovalchuk, S., Reeve, D., & Sacks, R. (2017) Leading from the bottom up: Leadership conceptions and practices among early career engineers. In *2017 ASEE Annual Conference & Exposition Proceedings*. American Society for Engineering Education. https://doi.org/10.18260/1-2--28608

Klassen, M., Reeve, D., Evans, G. J., Klassen, M., Reeve, D., Evans, G. J., Rottmann, C., Sheridan, P. K., & Simpson, A. (2020). Engineering: Moving leadership from the periphery to the core of an intensely technical curriculum. *New Directions for Student Leadership, 2020*(165), 113–124. https://doi.org/10.1002/yd.20373

Klenke, K. (2016). *Qualitative research in the study of leadership* (2nd ed.). Emerald Group Publishing Limited. https://doi.org/10.1108/978-1-78560-651-920152007

Knight, D. B. & Novoselich, B. J. (2017). Curricular and co-curricular influences on undergraduate engineering student leadership. *Journal of Engineering Education 106*(1), 44-70. https://doi.org/10.1002/jee.20153

Knowles, M. (1973). *The adult learner: A neglected species*. Gulf Publishing Company.

Knowles, M. S., Holton III, E. F., & Swanson, R. A. (2020). *The adult learner: The definitive classic in adult education and human resource development* (9th ed.). Routledge.

Knowles, S. (2021). *Positive psychology coaching*. Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-030-88995-1

Kocaoglu, D. F. (1986). Editorial: Engineering management: New perspectives. *IEEE Transactions on Engineering Management, EM-33*(1), 1-3. https://doi.org/10.1109/TEM.1986.6447714

Kozinets, R. (2017). Netnography: Radical participative understanding for a networked communications society. In C. Willig & W. S. Rogers (Eds.), *The SAGE handbook of qualitative research in psychology* (pp. 376–380). SAGE Publications Ltd.

Kozinets, R. (2019). *Netnography: The Essential Guide to Qualitative Social Media Research*. SAGE.

Kross, J., & Giust, A. (2019). Elements of research questions in relation to qualitative inquiry. *The Qualitative Report, 24*(1), 24-30. https://doi.org/10.46743/2160-3715/2019.3426

Lamine, W., Mian, S., Fayolle, A., & Linton, J. D. (2021). Educating scientists and engineers for technology entrepreneurship in the emerging digital era. *Technological Forecasting and Social Change, 164,* Article 120552. https://doi.org/10.1016/j.techfore.2020.120552

Langley, A., & Abdallah, C. (2015). Templates and turns in qualitative studies of strategy and management. In G. B. Dagnino & M. C. Cinici (Eds.), *Research methods for strategic management* (pp. 155-184). Routledge.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. SAGE Publications Ltd.

Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation*, *1986*(30), 73-84. https://doi.org/10.1002/ev.1427

Littig, B., & Pöchhacker, F. (2014). Socio-translational collaboration in qualitative inquiry: The case of expert interviews. *Qualitative Inquiry, 20*(9), 1085–1095. https://doi.org/10.1177/1077800414543696

Liu, Y., & Xu, X. (2017). Industry 4.0 and cloud manufacturing: A comparative analysis. *Journal of Manufacturing Science and Engineering*, *139*(3), Article 034701. https://doi.org/10.1115/1.4034667

Lo Iacono, V., Symonds, P., & Brown, D. H. K. (2016). Skype as a tool for qualitative research interviews. *Sociological Research Online, 21*(2), 103–117. https://doi.org/10.5153/sro.3952

Low, S. P., Gao, S., & Ng, E. W. L. (2019). Future-ready project and facility management graduates in Singapore for Industry 4.0: Transforming mindsets and competencies. *Engineering, Construction and Architectural Management, 28*(1), 270–290. https://doi.org/10.1108/ECAM-08-2018-0322

Mallette, L. A. (2005). Theory Pi - engineering leadership not your theory X, Y or Z leaders. In *2005 IEEE Aerospace Conference Proceedings*. Institute of Electrical and Electronics Engineers (IEEE). https://doi.org/10.1109/aero.2005.1559744

Mann, S. (2016). *The research interview. Reflective practice and reflexivity in research processes*. Palgrave Macmillan UK. https://doi.org/10.1057/9781137353368

Marshall, C., & Rossman, G. B. (2016). *Designing qualitative research* (6th ed.). Sage Publications.

Mason, M. (2010). Sample size and saturation in PhD studies using qualitative interviews. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 11*(3), Article 8. https://doi.org/10.17169/FQS-11.3.1428

Matt, D. T., Orzes, G., Rauch, E., & Dallasega, P. (2020). Urban production – A socially sustainable factory concept to overcome shortcomings of qualified workers in smart SMEs. *Computers & Industrial Engineering, 139*, Article 105384, https://doi.org/10.1016/j.cie.2018.08.035

Matteson, M. L., Anderson, L., & Boyden, C. (2016). “Soft skills”: A phrase in search of meaning. *portal: Libraries and the Academy, 16*(1), 71–88. https://doi.org/10.1353/pla.2016.0009

McMartin, D. W. (2013, June). Service learning and teamwork: Elements of leadership. In *Proceedings of the Canadian Engineering Education Association Conference- École Polytechnique de Montréal June 2013*. Canadian Engineering Education Association (CEEA). https://doi.org/10.24908/pceea.v0i0.4830

Medcof, J. W. (2017). Leadership development: Towards a more systematic approach in technology management. *The Journal of High Technology Management Research, 28*(2), 167-178. https://doi.org/10.1016/j.hitech.2017.10.006

Menezes, A. & Prikladnicki, R. (May 2018) Diversity in software engineering. In *CHASE '18: Proceedings of the 11th International Workshop on Cooperative and Human Aspects of Software Engineering* (pp. 45–48). Association for Computing Machinery (ACM). https://doi.org/10.1145/3195836.3195857

Mero-Jaffe, I. (2011). ‘Is that what I said?’ Interview transcript approval by participants: An aspect of ethics in qualitative research. *International Journal of Qualitative Methods, 10*(3), 231–247. https://doi.org/10.1177/160940691101000304

Merriam, S. B., & Grenier, R. S. (2019). *Qualitative research in practice: Examples for discussion and analysis*. John Wiley & Sons.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

Meske, C., & Junglas, I. (2020): Investigating the elicitation of employees' support towards digital workplace transformation. *Behaviour & Information Technology, 40*(11), 1120–1136. https://doi.org/10.1080/0144929X.2020.1742382

Microsoft (2021, March 22). *The next great disruption is hybrid work—Are we ready?* https://www.microsoft.com/en-us/worklab/work-trend-index/hybrid-work

Minh, N. V., Badir, Y. F., Quang, N. N., & Afsar, B. (2017). The impact of leaders' technical competence on employees' innovation and learning. *Journal of Engineering and Technology Management*, 44, 44–57. https://doi.org/10.1016/j.jengtecman.2017.03.003

Moldoveanu, M., & Narayandas, D. (2019). The future of leadership development. *Harvard Business Review*. https://hbr.org/2019/03/the-future-of-leadership-development

Montandon, J. E., Politowski, C., Silva, L. L., Valente, M. T., Petrillo, F., & Guéhéneuc, Y.-G. (2021). What skills do IT companies look for in new developers? A study with Stack Overflow jobs. *Information and Software Technology*, *129*, Article 106429. https://doi.org/10.1016/j.infsof.2020.106429

Montgomery, L. (2016). *Choosing your executive-education programme: Custom vs. open-enrolment*. Economist Education. https://execed.economist.com/career-advice/choosing-your-programme/choosing-your-executive-education-programme-custom-vs-open

Morse, J. M. (2015). Critical analysis of strategies for determining rigor in qualitative inquiry. *Qualitative Health Research, 25*(9), 1212–1222. https://doi.org/10.1177/1049732315588501

Mosca, N., Halkias, D., & Heitner, K. (2021). Competency characteristics of the innovative talent leader: A multiple case study. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3777258

Mumford, M. D., Scott, G. M., Gaddis, B., & Strange, J. M. (2002). Leading creative people: Orchestrating expertise and relationships. *The Leadership Quarterly, 13*(6), 705-750. https://doi.org/10.1016/S1048-9843(02)00158-3

Mumford, M. D., Zaccaro, S. J., Harding, F. D., Jacobs, T. O., & Fleishman, E. A. (2000). Leadership skills for a changing world. *The Leadership Quarterly, 11*(1), 11–35. https://doi.org/10.1016/s1048-9843(99)00041-7

NASA. (2019). *2019 Report on NASA'S top management and performance challenges.* https://oig.nasa.gov/docs/MC-2019.pdf

National Academy of Engineering. (2013). *The engineer of 2020: Visions of engineering in the new century.* The National Academies Press.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (1978). *The Belmont Report: Ethical principles and guidelines for the protection of human subjects of research.* https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report

Newman, T. J. (2020). Life skill development and transfer: "They're not just meant for playing sports". *Research on Social Work Practice, 30*(6), 643–657. https://doi.org/10.1177%2F1049731520903427

Nix, S., & Bigham, G. (2015). Five critical skills necessary for the interim superintendent in Texas. *School Leadership Review*, *10*(2), Article 7. https://doi.org/10.5929/2011.1.1.6

Northouse, P. G. (2018). *Leadership: Theory and practice*: Sage publications. https://doi.org/10.1016/s1048-9843(99)00041-7

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods6*(1). https://doi.org/10.1177/1609406917733847

O'Heir, J. (2021). *Reskilling Engineers*. Mechanical Engineer. http://asmedigitalcollection.asme.org/memagazineselect/articlepdf/143/5/38/6763596/me-2021-sept2.pdf 26 May 2022

Owan, V. J., & Bassey, B. A. (2019). Data management practices in educational research. In P. N. Ololube & G. U. Nwiyi (Eds.), *Encyclopedia of institutional leadership, policy, and management: A handbook of research in honour of Professor Ozo-Mekuri Ndimele* (pp. 1251–1265). Pearl Publishers International Ltd. https://rgdoi.net/10.13140/RG.2.2.16819.04647

Paullet, K., Behling, D., & Behling, R. (2020). The role of higher education institutions in reskilling the workforce. *Issues in Information Systems*, *21*(1), 49–54. https://doi.org/10.48009/1_iis_2020_49-54

Pedersen, M. L. (2020). *Engineering leaders' descriptions of leadership competencies in the information technology field* (Publication No. 28090370) [Doctoral dissertation, Grand Canyon University]. ProQuest Dissertations Publishing.

Peña-Cabrera, M., Lomas V., & Lefranc, G. (2019). Fourth industrial revolution and its impact on society. In *2019 IEEE CHILEAN Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON)* (pp. 1-6). IEEE. https://www.doi.org/10.1109/CHILECON47746.2019.8988083

Perkins, D. D., & Zimmerman, M. A. (1995). Empowerment theory, research, and application. *American Journal of Community Psychology, 23*(5), 569-579. https://doi.org/10.1007/BF02506982

Perri, S. T., Farrington, T., Johnson, S., & O'Connor, G. C. (2019). Today's innovation leaders. *Research-Technology Management*, *62*(1), 20–29. https://doi.org/10.1080/08956308.2019.1541726

Perry, S. J., Hunter, E. M., Currall, S. C., & Frauenheim, E. (2017). Developing engineering leaders: An organized innovation approach to engineering education. *Engineering Management Journal*, *29*(2), 99–107. https://doi.org/10.1080/10429247.2017.1298189

Pistoia, M., Ahmad, S. F., Ajagekar, A., Buts, A., Chakrabarti, S., Herman, D., Hu, S., Jena, A., Minssen, P., Niroula, P., Rattew, A., Sun, Y., & Yalovetzky, R. (2021, November). Quantum machine learning for finance ICCAD special session paper. In *2021 IEEE/ACM International Conference on Computer Aided Design*

(ICCAD) (pp. 1-9). Institute of Electrical and Electronics Engineers (IEEE). https://doi.org/10.1109/ICCAD51958.2021.9643469

Pócsová, J., Bednárová, D., Bogdanovská, G., & Mojžišová, A. (2020). Implementation of agile methodologies in an engineering course. *Education Sciences, 10*(11), Article 333. https://doi.org/10.3390/educsci10110333

Racine, W. P. (2015). Social identity development and the situation of scientists and engineers as new leaders. *Journal of Leadership Studies, 9*(3), 23–41. https://doi.org/10.1002/jls.21398

Reeve, D. W., Rottmann, C., & Sacks, R. (2015, June). The ebb and flow of engineering leadership orientations. In *122nd American Society of Engineering Education Annual Conference and Exposition 2015 Proceedings* (pp. 612-627). American Society for Engineering Education (ASEE). https://doi.org/10.18260/p.24857

Retana, R. C., & Rodriguez-Lluesma, C. (2022). Overcoming boundaries between companies and business schools: The case of customized executive programs. *The International Journal of Management Education, 20*(1), Article 100608. https://doi.org/10.1016/j.ijme.2022.100608

Richardson, J. M., & McCain, K. S. (2022). Contextualizing engineering leadership development in science, technology, engineering and mathematics. *New Directions for Student Leadership, 2022*(173), 139–147. https://doi.org/10.1002/yd.20485

Ridder, G. (2017). The theory contribution of case study research designs. *Business Research, 10*(2), 281–305. https://doi.org/10.1007/s40685-017-0045-z

Robledo, I. C., Peterson, D. R., & Mumford, M. D. (2012). Leadership of scientists and engineers: A three-vector model. *Journal of Organizational Behavior, 33*(1), 140–147. https://doi.org/10.1002/job.739

Rodriguez, S. & Charles. L. & Morgan, B. (2018). Engineering identity development: A review of the higher education literature. *International Journal of Education in Mathematics, Science and Technology, 6*(3), 254-265. https://www.ijemst.net/index.php/ijemst/article/view/293

Romero, D., Stahre, J., & Taisch, M. (2020). The Operator 4.0: Towards socially sustainable factories of the future. *Computers & Industrial Engineering, Elsevier 139*, Article 106128. https://doi.org/10.1016/j.cie.2019.106128

Roos, J. (2022). Executive education 2.0 coming right up. In S. Iñiguez & P. Lorange (Eds.), *Executive education after the pandemic* (pp. 47-55). Palgrave Macmillan. https://doi.org/10.1007/978-3-030-82343-6_5

Rosenthal, G. (2018). *Interpretive Social Research: An Introduction*. Universitätsverlag Göttingen. https://doi.org/10.17875/gup2018-1103

Rotatori, D., Lee, E. J., & Sleeva, S. (2021). The evolution of the workforce during the fourth industrial revolution. *Human Resource Development International, 24*(1), 92–103. https://doi.org/10.1080/13678868.2020.1767453

Rottmann, C., & Kendall, M. R. (2022). Looking to the future: Four key purposes of engineering leadership education. *New Directions for Student Leadership*, *2022*(173), 149-155. https://doi.org/10.1002/yd.20486

Rottmann, C., Reeve, D., Klassen, M., Kovalchuk, S., Liu, Q., Olechowski, A., & Santia, M. (2018). *Examining the engineering leadership literature: Community of practice style* [Paper presentation]. 2018 American Society for Studies in Engineering Education (ASEE) Annual Conference, Salt Lake City, Utah. https://doi.org/10.18260/1-2--30470

Rottmann, C., Reeve, D. W., Sacks, R., & Klassen, M. (2016). An intersubjective analysis of engineering leadership across organizational locations: Implications for higher education. *Canadian Journal of Higher Education*, *46*(4), 146–173. https://doi.org/10.47678/cjhe.v46i4.186198

Rottmann, C., Sacks, R., & Reeve, D. (2015). Engineering leadership: Grounding leadership theory in engineers' professional identities. *Leadership*, *11*(3), 351-373. https://doi.org/10.1177/1742715014543581

Rovida, E., & Zafferri, G. (2022). *The importance of soft skills in engineering and engineering education.* Springer Cham. https://doi.org/10.1007/978-3-030-77249-9

Roy, M., & Roy, A. (2021). The rise of interdisciplinarity in engineering education in the era of industry 4.0: Implications for management practice. *IEEE Engineering Management Review*, *49*(3), 56–70. https://doi.org/10.1109/emr.2021.3095426

Runfola, A., Perna, A., Baraldi, E., & Gregori, G. L. (2017). The use of qualitative case studies in top business and management journals: A quantitative analysis of recent patterns. *European Management Journal*, *35*(1), 116-127. https://doi.org/10.1016/j.emj.2016.04.001

Sakurada, L., Geraldes, C. A. S., Fernandes, F. P., Pontes, J. & Leitão, P. (2020). Analysis of new job profiles for the factory of the future. In T. Borangiu, D. Trentesaux, P. Leitão, O. Cardin, & S. Lamouri (Eds), *Service oriented, holonic and multi-agent manufacturing systems for industry of the future. SOHOMA 2020. Studies in computational intelligence* (Vol. 952) (pp. 262–273). Springer. https://doi.org/10.1007/978-3-030-69373-2_18

Saldaña, J. (2016). *The coding manual for qualitative researchers* (3th ed.). Sage.

Satellite Industry Association. (2019). 2*2nd State of the Satellite Industry Report.* https://sia.org/news-resources/state-of-the-satellite-industry-report/

Schell, W. J., Hughes, B. E., Tallman, B., Kwapisz, M., & Sybesma, T. (2021, July 26-29). *Examining the components of an engineering leadership identity* [Poster presentation]. 2021 American Society for Studies in Engineering Education (ASEE) Annual Conference & Exposition, virtual. https://monolith.asee.org/public/conferences/223/papers/32456/view

Schram, T. H. (2006). *Conceptualizing and proposing qualitative research* (2nd ed). Pearson.

Selsor, W. K. (2020). *Managerial competencies driving successful change initiatives: A multiple case study of healthcare administrators* (Publication No. 9255) [Doctoral dissertation, Walden University]. Walden University ScholarWorks. https://scholarworks.waldenu.edu/dissertations/9255/

Siegelman, M., Brittle, S., Hodge, N., O'Kane, L. & Taska, B. (2021). *After the storm: The jobs and skills that will drive the post-pandemic recovery*. Burning Glass Technologies. https://www.economicmodeling.com/wp-content/uploads/2022/05/after_the_storm_recovery_jobs_final.pdf

Skibniewski, M. J., & Kim, Y. J. (2022). Engineers as business leaders: A need to investigate formative collegiate experiences of highly successful executive-level engineers. *Frontiers of Engineering Management, 9*(1), 159-162. https://doi.org/10.1007/s42524-021-0183-z

Snihur, Y., Lamine, W., & Wright, M. (2021). Educating engineers to develop new business models: Exploiting entrepreneurial opportunities in technology-based firms. *Technological Forecasting and Social Change, 164,* Article 119518. https://doi.org/10.1016/j.techfore.2018.11.011

Sony, M., Antony, J., & Douglas, J. A. (2020). Essential ingredients for the implementation of Quality 4.0: A narrative review of literature and future directions for research. *The TQM Journal, 32*(4),779–793. https://doi.org/10.1108/TQM-12-2019-0275

Stake, R. E. (2005). Qualitative case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (3rd ed., pp. 443–466). Sage Publications Ltd.

Stake, R. E. (2006). *Multiple case study analysis*. Guilford Publications.

Stake, R. E. (2013). *Multiple case study analysis*. Guilford Press.

Stewart, G. B., III. (2005). The importance of economics. In National Academy of Engineering (Ed.), *Educating the engineer of 2020: Adapting engineering education to the new century* (pp. 156–159). National Academies Press.

Sukovataia, I. E., Cherkasova, Y. I., Dvinskikh, E. V., & Vitkovskaya, L. K. (2020). New approaches to the development of additional professional competences for the purposes of new economy. *Journal of Siberian Federal University. Humanities and Social Sciences, 13*(11), 1781–1792. https://doi.org/10.17516/1997-1370-0684

Sydorenko, V. (2020). Soft skills as an educational trend and a necessary development component for a vocational lifelong education teacher. *Fundamental and Applied Researches in Practice of Leading Scientific Schools, 38*(2), 127–134. https://farplss.org/index.php/journal/article/view/699

Taylor, F. W. (1911). *The principles of scientific management*. Harper Brothers.

Theofanidis, D., & Fountouki, A. (2018). Limitations and delimitations in the research process. *Perioperative Nursing*, *7*(3), 155–163. https://doi.org/10.5281/zenodo.2552022

Thurman, P. W. (2020). Not just for business: Sustainability curricula at Columbia University. In D. Halkias, M. Neubert, P. W. Thurman, C. Adendorff, & S. Abadir (Eds.), *The innovative business school* (pp. 103-105). Routledge.

Tiberius, V., Hoffmeister, L., & Weyland, M. (2021). Prospective shifts in executive education: An international Delphi study. *The International Journal of*

Management Education, *19*(3), Article 100514. https://doi.org/10.1016/j.ijme.2021.100514

Torpey, E. (2018). *Engineers: Employment, pay, and outlook*. Career Outlook. U.S. Bureau of Labor Statistics. https://www.bls.gov/careeroutlook/2018/article/engineers.htm

Touloumakos, A. K. (2020). Expanded yet restricted: A mini review of the soft skills literature. *Frontiers in Psychology*, *11*. https://doi.org/10.3389/fpsyg.2020.02207

Towers-Clark, C. (2020, December 10). Human skills will be most important in the digital future of work. *Forbes Magazine*. https://www.forbes.com/sites/charlestowersclark/2020/12/10/human-skills-will-be-most-important-in-the-digital-future-of-work/?sh=544113da7721

Tracy, S. J. (2010). Qualitative quality: Eight “big-tent" criteria for excellent qualitative research. *Qualitative Inquiry*, *16*(10), 837–851. https://doi.org/10.1177/1077800410383121

Tracy, S. J. (2019). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. John Wiley & Sons.

Treanor, L., Noke, H., Marlow, S., & Mosey, S. (2021). Developing entrepreneurial competences in biotechnology early career researchers to support long-term entrepreneurial career outcomes. *Technological Forecasting and Social Change*, *164*, Article 120031. https://doi.org/10.1016/j.techfore.2020.120031

Tsang, E. W. K. (2013). Case study methodology: Causal explanation, contextualization, and theorizing. *Journal of International Management, 19*(2), 195–202. https://doi.org/10.1016/j.intman.2012.08.004

Uhr, C. (2017). Leadership ideals as barriers for efficient collaboration during emergencies and disasters. *Journal of Contingencies and Crisis Management, 25*(4), 301–312. https://doi.org/10.1111/1468-5973.12157

Ulrich's Periodicals Directory. (n.d.). Retrieved December 15, 2018, from http://ulrichsweb.serialssolutions.com.ezp.waldenulibrary.org/

Van den Beemt, A., MacLeod, M., Van der Veen, J., Van de Ven, A., Baalen, S., Klaassen, R., & Boon, M. (2020). Interdisciplinary engineering education: A review of vision, teaching, and support. Journal of Engineering Education, 109(3), 508–555. https://doi.org/10.1002/jee.20347

Vaismoradi, M., Jones, J., Turunen, H., & Snelgrove, S. (2016). Theme development in qualitative content analysis and thematic analysis. *Journal of Nursing Education and Practice*, 6(5), 100–110. https://doi.org/10.5430/jnep.v6n5p100

Vinayan, G., Harikirishanan, D., & Ling, S. M. (2020). Upskilling and reskilling the workforce via industry-driven technical and vocational education and training: Strategies to initiate industry/institution partnership in Malaysia. *Journal of Economic Info, 7*(2), 94-103. https://doi.org/10.31580/jei.v7i2.1438

Wagner, S., & Ruhe, M. (2018). A systematic review of productivity factors in software development. In *Proceedings of the 2nd International Workshop on Software*

Productivity Analysis and Cost Estimation (SPACE 2008). Chinese Academy of Sciences. https://doi.org/10.48550/arXiv.1801.06475

Wästerfors, D. (2018). Observations. In U. Flick (Ed.), *The Sage handbook of qualitative data collection* (pp. 314–326). SAGE Publications Ltd. https://doi.org/10.4135/9781526416070

Welch, C., Piekkari, R., Plakoyiannaki, E., & Paavilainen-Mäntymäki, E. (2020). Theorising from case studies: Towards a pluralist future for international business research. In L. Eden, B. B. Nielsen, & A. Verbeke (Eds.), *Research methods in international business* (pp. 171-220). Palgrave Macmillan Cham. https://link.springer.com/chapter/10.1007/978-3-030-22113-3_9

Wiles, J. (2020, May, 22). *Build the workforce you need post-COVID-19*. Gartner. https://www.gartner.com/smarterwithgartner/build-the-workforce-you-need-post-covid-19

Williams, E. P. (2022). Case study# 5: University of California San Diego–Gordon Engineering Leadership Center. *New Directions for Student Leadership*, *2022*(173), 109-111. https://doi.org/10.1002/yd.20491

World Economic Forum. (2022). *Schools of the future: Defining new models of education for the fourth industrial revolution*. https://www.weforum.org/reports/schools-of-the-future-defining-new-models-of-education-for-the-fourth-industrial-revolution

World Economic Forum. (2020). *The future of jobs report.* 2020. https://www.weforum.org/reports/the-future-of-jobs-report-2020/

Yates, J., & Murphy, C. (2022). Introduction: Standards and the global economy. *Business History Review, 96*(1), 3-15. https://doi.org/10.1017/S0007680522000058

Yawar, S. A., & Seurig, S. (2017). Management of social issues in supply chains.: A literature review exploring social issues, actions and performance outcomes. *Journal of Business Ethics, 141*(3), 621-643. https://doi.org/10.1007/s10551-051-2719-9

Yeoh, W., & Koronios, A. (2010). Critical success factors for business intelligence systems. *Journal of Computer Information Systems*, *50*(3), 23–32. https://doi.org/10.1080/08874417.2010.11645404

Yin, R. K. (2017). *Case study research: Design and methods* (5th ed.). Sage Publications

Yuan, X., He, P., Zhu, Q., & Li, X. (2019). Adversarial examples: Attacks and defenses for deep learning. *IEEE Transactions on Neural Networks and Learning Systems, 30*(9), 2805-2824. https://doi.org/ 10.1109/TNNLS.2018.2886017

Zaki, M. (2019). Digital transformation: Harnessing digital technologies for the next generation of services. *Journal of Services Marketing*, *33*(4), 429–435. https://doi.org/10.1108/JSM-01-2019-0034

Appendix A: Recruitment Letter

Hello,

I am a doctoral student at Walden University, and I invite you to participate in my research study.

This study explores the critical success factors needed for executive education programs for reskilling and upskilling engineers in leadership development to prepare engineers for leadership roles required within their profession to support their midcareer transitions and ensure livelihoods amidst disruptive global events.

The purpose of this qualitative, multiple case study is to describe executive education program experts' views on the critical success factors needed in executive education programs for reskilling and upskilling engineers in leadership development. I believe that your experience would be a great contribution to the study.

The study is important as the findings may inform organizational leaders on the critical success factors of customized executive education programs to prepare engineers for leadership roles required within their profession to support their midcareer transitions and ensure livelihoods amidst disruptive global events. Finally, the social change impact of this study may potentially result from providing executives with a better understanding of how customized executive education programs can present a collaborative response for firms and training providers to develop specific solutions to unique problems of reskilling and upskilling within a given professional context to ensure livelihoods in the turbulent future of labor markets.

If you would be interested in participating in this study, please review and return the signed consent form, which is attached to this letter. If you want additional information, you may reply to this email. Thank you in advance for your consideration.

Respectfully,
Sarah Haverland (Researcher)
Ph.D. Candidate – Walden University

Appendix B: The Interview Protocol

Researcher to Participants Prologue:

Thank you so much for agreeing to participate in this study. I will begin the interview by asking the demographic question to ensure you qualify to participate in the study. In the interview, I will ask you about your experience with the critical success factors needed for designing and delivering customized executive education programs through an academic-corporate partnership.

Periodically I may ask clarifying questions or encourage you to describe in more detail. You are invited to elaborate on where you feel comfortable and decline to do so when you do not have additional information.

If you need clarification from me, please ask. I am interested in knowing your experiences as an expert in executive education programming and want you to feel comfortable during this process.

Demographics will only be used for statistical purposes in aggregate form

Number identifier: ________
Age: _______
Highest level of education________
Years' experience in Executive Education in Leadership Development ________
Published articles on Executive Education and Leadership: ________
Have your Executive Education programs included Engineers ?__________

From Research to Participants: *As a prologue to my questions and so that you may gain greater clarity on the nature of my study, I would like to define some commonly used terms you'll hear in the interview questions.*

Customized executive education programs present a collaborative response by firms and training providers developing specific solutions to unique problems within a given professional context. In customized executive education, partners from companies and business schools assume different roles in designing and delivering the program. Through a co-creation process, business schools and corporate development officers in the client firm diagnose a company's problems and co-design the program's contents. Despite the relevance of customized executive education programs for leadership development between organizations/corporations and business schools, there remains a lack of research on the criteria that make these collaborations successful.

Are we ready to begin?

1. How do you believe the onset of the Fourth Industrial Revolution and the COVID-19 pandemic have altered the nature of executive education in business schools?
2. What do you perceive as the strengths and weaknesses of customized executive education programs designed and delivered through an academic-corporate partnership?
3. How would you describe the critical success factors needed for business schools and their corporate clients to effectively engage as partners in designing and delivering customized executive education programs?
4. My study explores the need for reskilling and upskilling for leadership training for engineers and STEM professionals, particularly after the pandemic. How would you describe the critical success factors needed in a customized executive education program for engineers in leadership development, given the nature of their profession?
5. Given your years of professional experience in heading executive education programs, cooperating with corporate clients, and seeing the future of work for engineers and STEM professionals after the COVID-19 pandemic, do you have any further personal insights on the top three or four criteria that make academic-corporate collaborations successful in your area of expertise?

For researcher only:

Probes to facilitate conversations around the facts:

"*Can you give me an example of that?"*
"Please tell me more about that."

Researcher to Participant Epilogue:

I cannot thank you enough for your time and attention during this interview. I will be conducting interviews with other executive education experts. You will receive a copy of your interview transcript to check for the accuracy of your narratives.

The answers of all participant interviews will be combined for analysis and report. Nothing you said will be ever identified with you personally.

Thank you for your participation.