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Investigation of the regional innovation system in rural region of New Jersey: a qualitative single case study

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INVESTIGATION OF THE REGIONAL INNOVATION SYSTEM IN RURAL REGION OF NEW JERSEY: A QUALITATIVE SINGLE CASE STUDY

by
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Abstract

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INVESTIGATION OF THE REGIONAL INNOVATION SYSTEM IN RURAL REGION OF NEW JERSEY: A QUALITATIVE SINGLE CASE STUDY
2023-2024
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The purpose of this qualitative single-case study was to investigate how a partnership between a rural community college in New Jersey and a manufacturer of emerging optics equipment reflected the regional networked innovation system, a type of regional innovation system. This single case study provided a comprehensive overview of the perceptions and roles of Sussex County Community College, Thorlabs, and the Sussex County government within the partnership framework of a triple/quadruple helix model in a rural region. This study discerned that the development of the optics technology program was an example of the second type of regional innovation system described by Asheim and Isaksen, the regional networked innovation system. The results of the study provided perspective for policymakers, educators, and industry leaders about effective collaboration to assist in regional economic development. Additionally, this research contributes valuable insights into how community colleges, particularly in rural regions, can leverage their role in regional innovation systems to address local challenges, bridge educational gaps, and stimulate economic development.

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Chapter 1

Introduction

This single-case study investigated how a partnership between a rural community college in New Jersey and a manufacturer of emerging optics equipment reflected the "regional networked innovation system," a type of regional innovation system (Asheim & Isaksen, 2002, p.83). The regional innovation system explains a region's development and competitiveness based on a set of actors within a region, developing specific forms of capital derived from social relations, norms, values, and interactions with the community (Doloreux & Parto, 2005). Asheim and Isaksen (2002) explain that regions can still be referred to as regional innovation systems even if they do not have all the characteristics, and they distinguish them between three broad groups: (1) "territorially embedded regional innovation networks" (p.83), (2) "regional networked innovation systems" (p.83), and (3) "regionalized national innovation systems" (p.84).

The second type of regional innovation system described by Asheim and Isaksen (2002), the regional networked innovation system, is further developed than the territorially embedded regional innovation networks. In this type, the authors believe the network has more R&D institutes and local vocational training organizations participating in the firms' innovative activities. Under this type, the network is surrounded by a regional cluster of supporting local institutional infrastructure, and where the authors (Asheim & Isaksen, 2002) have regarded this type as an ideal regional innovation system. For this study, as the purpose was to investigate the role of a rural community college in a regional innovation system involving a local emerging manufacturing firm within their region, the first and third types are not in consideration.

This study also identified the community college's role in the regional networked innovation system.

This study utilized a single-case study with a guiding methodological approach established by Yin (2014). I collected and analyzed data to determine if a regional network innovation system (Asheim & Isaksen, 2002) existed and the role played by a rural community college.

Background of the Study

Regional networked innovation systems in rural communities involve collaborations among communities, colleges, and other stakeholders to encourage innovation and economic growth (Asheim & Isaksen, 1997 & 2002; Charles, 2016; Doloreux & Parto, 2005). Community colleges play an essential role in economic development by providing educational opportunities and resources to rural communities (Charles, 2016; Lane et al., 2012). These colleges can provide access to technology, research, and training to help rural communities develop new products and services (Charles, 2016; Lane et al., 2012). Additionally, community colleges can help create a culture of innovation and entrepreneurship in rural areas, leading to increased economic development (Lane et al., 2012). A study on rural, regional networked innovation systems with the involvement of rural community colleges can help to understand the contribution of community colleges to the success of rural regions in terms of innovation and economic development (Asheim & Isaksen, 1997 & 2002; Charles, 2017; Doloreux & Parto, 2005).

The twentieth century has transitioned to a knowledge society and a knowledge-based economy (Drucker, 2001). This revolutionary shift to knowledge as a leading resource replaced capital, raw materials, and labor as the primary organizational currency

(de Jong et al., 2010). However, this transition to a knowledge economy in a rapidly evolving economy means organizations pursuing a competitive advantage must learn to create and share knowledge (de Jong et al., 2010). In a knowledge society, the competitive advantage of firms relates to their ability to adapt to a changing environment through collaborations with any higher education institution within their region, even if it is rural.

This qualitative single-case study was designed to investigate the development of a regional networked innovation system when a rural New Jersey community college, Sussex County Community College (SCCC), and a private sector technology company, Thorlabs, collaborated to develop an optics technology program. According to its website, Sussex County Community College's vision statement is to provide professional training and skills development to meet the needs of its community in a globally competitive environment (Sussex County Community College, n.d.). Thorlabs, a privately held optical equipment company headquartered in Newton—the same town Sussex County Community College is in—has a history of engaging and entering into partnerships that result in shared knowledge and resources (Thorlabs, n.d.).

The American Center for Optics Manufacturing (AmeriCOM), a nationwide organization, and the Department of Defense (DoD) launched a $34 million project to help provide skilled technicians needed in the optics industry, and some of those companies, like Thorlabs, are in Northern New Jersey (Edwards, 2021). AmeriCOM subcontracted SCCC to expand these educational opportunities and gave the college $2,000,000 to support the college's Optics Technology Program and strengthen an already-established partnership between Thorlabs and SCCC (Edwards, 2021; Morel, 2021).

Problem Statement

In recent years, New Jersey community colleges have been challenged with declining enrollment (NJ Office of the State Comptroller, 2023) and pressure from New Jersey county commissioners to justify receiving county aid. In addition, the twenty-first century brought in new informational technologies, the proliferation of mass media, and multinational free trade agreements, which have precipitated economic and social transformation in rural communities (Schafft & Jackson, 2010). Such changes have required innovation and the creation of new knowledge to drive the competitiveness of firms, industries, and regions (De Propris & Bailey, 2020). The viability of New Jersey rural community colleges is dependent on college leadership understanding their role in regional networked innovation systems and identifying how they, as higher education institutions, can be part of the regional support for innovative activities of a private firm. This study explored the type of innovation present when an emerging firm relies upon external network ties (Hite, 2005) to create new value by renewing or introducing a new product or service (Chesbrough, 2003; Doloreux & Parto, 2005).

Purpose of the Study

This study aimed to understand the role of community colleges in rural, regional networked innovation systems. This research provided insight into how to better support rural community colleges to facilitate innovation and economic development. Additionally, this study helped identify potential areas of improvement in rural and regional networked innovation systems and opportunities for improving the collaboration between colleges, firms, and policymakers.

The single-case study investigated how Sussex County Community College, using the geographical and relational proximity to Thorlabs, became part of the regional innovation system (Asheim & Isaksen, 2002).

Research Questions

The following research questions guided this qualitative case study:

RQ1: How do the geographical and relational proximity of a rural community college in New Jersey and a manufacturer of photonics equipment represent the regional cluster of "regional networked innovation systems"?

RQ2: What role did the community college play in the regional cluster of the regional innovation system?

RQ3: What role does the community college play in fostering a shared regional economic development vision between local academia-industry-government-community?

Theoretical Framework

The theoretical framework that guided this study is grounded in regional science theory and the concept of a regional networked innovation system, which explains innovation as a localized and locally embedded, not placeless, process (Asheim & Isaksen, 2002). This study's theoretical propositions and rival explanations focused on connecting the identified institutional actions with regional networked innovation systems through the lens of institutional leadership, a private sector representative, and a local government representative. The results of this study aim to contribute theory to the use of community college's role in the regional networked innovation system for a rural

region at a higher generalization level than the specific case studied in this research (Yin, 2018).

The concept of regional innovation systems is found in two central bodies of theory – systems of innovation and regional science (Doloreux & Parto, 2005). The innovation systems visualize innovation as an evolutionary and social process (Edquist, 2004). On the other hand, regional science theory explains innovation as localized and locally embedded, not a placeless process (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Storper, 1997). These two theories distinguish a regional innovation system by collective innovation activities between firms and knowledge-creating and diffusing institutions (Doloreux & Parto, 2005). This single-case study was grounded in regional science theory, as it deals with the advantages of proximity and localization. Furthermore, it allowed me to investigate the role of a community college in a rural region in innovation through collaboration with the private sector. The theories discussed in Chapter 1 are further elaborated on in Chapter 2.

Innovation Systems Theory

The primary function of innovation systems is to develop and diffuse innovations through activities that benefit from the relationship between private companies that perform activities, postsecondary institutions, and local policymakers to provide incentives influencing these activities (Edquist, 2004). Edquist (2004) offers examples of activities important in systems of innovation, which are: the provision of research and development (R&D), which creates new knowledge; competence building in the labor force that will be used in innovation and R&D activities; development of new product markets; articulation of quality requirements emanating from the demand side about new

products; creating organizations required for the development of new fields of innovation; incubation activities; financing of innovation processes and provision of consultancy services of relevance for innovation processes.

Therefore, the empirical knowledge from this study provided me with knowledge about the relations among primary functions, activities, organizations, and institutions in the innovation system.

Regional Science Theory

The literature on regional science theory deals with innovations emerging from the socio-institutional environment, benefitting from the proximity of firms and knowledge-creating and diffusing institutions, such as universities (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). In my single-case study, the knowledge provider and diffuser are Sussex County Community College and the private sector is Thorlabs.

Regional Clusters

A regional cluster is defined as a group of firms in the same industry or closely-related industries, governmental and educational institutions, and support services close to each other (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). These actors produce pervasive and systemic effects that encourage private firms within the region to develop political and financial capital that are derived from social relations, norms, values, and interaction within the community in order to reinforce regional innovative capability and competitiveness (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). Thus, the development from a cluster to an innovation system may require "(i) a formal inter-firm innovation collaboration between firms in the cluster, and (ii) a strengthening of the institutional infrastructure, i.e., that more knowledge providers (both regional and

national) are involved in innovation cooperation" (Asheim & Isaksen, 2002, p.83). In addition, the theoretical discourses on regional clusters highlight several key features, namely geographical and relational proximity (Anderson & Karlson, 2004; Doloreux & Parto, 2005). Under geographical proximity, educational and governmental institutions join regional supporters in a cluster becoming part of the private firm's regional cluster of supporting infrastructure, resulting in innovative activities (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). Under relational proximity within a region, knowledge in the context of innovation processes is tacit, which is semi and unconscious knowledge depending on the social and institutional context of the region (Anderson & Karlson, 2004). The literature adds that the main communication channels for implicit knowledge are employee mobility, informal personal relations, and necessitates face-to-face contact (Anderson & Karlson, 2004).

Significance of the Study

New Jersey community colleges face challenges like declining enrollment and the need to justify county aid amidst technological and economic changes; this study explored how one such college contributed to a regional innovation system, supporting an emerging firm in creating new value through external network ties. In understanding the role of a rural community college in regional innovation systems, this study highlighted implications for educational leaders, policymakers, and the private sector. The literature suggests that higher education institutions should actively invest in startups from collaborations between faculty members and students (Lutchen, 2018; Rhoades & Slaughter, 2004). Furthermore, the authors acknowledge that the rural areas in any country developing under market economy conditions have tremendous economic,

natural, demographic, and sociocultural potential. For those reasons, policymakers consider the development of rural regions as an essential step, not only for agricultural productivity but also for increasing GDP (Lutchen, 2018; Rhoades & Slaughter, 2004).

The literature on regional innovation has often focused on urban regions with universities (Vorley & Nelles, 2012; Etzkowitz & Leydesdorff, 1999). However, the literature on rural entrepreneurship (Deakins, 2006; Habersetzer et al., 2021) argues that rural regions have innovation characteristics and receive taxpayer-funded grants for startups and research. By developing an innovation system, rural communities can strengthen their capacity to solve local problems and build on existing resources to develop local businesses, technologies, and industries that create more jobs and broader economic opportunities (Asheim & Isaksen, 1997; Charles, 2016; Doloreux & Parto, 2005).

Colleges that are engaged and collaborate in industry-business partnerships receive more private-sector attention (Newfield, 2004). This attention can facilitate scholarship contributions, increasing access for economically disadvantaged students. Furthermore, colleges increase their faculty with more funding, reducing student/faculty ratios and class size and enhancing overall instructional quality (Newfield, 2004). In addition to increasing financial support, these partnerships can provide critical information to colleges to ensure they are informed on current workforce needs, facilitating the development of current and relevant curricula to meet those needs.

In their interest to economically develop their regions, New Jersey county commissioners will ask community college leaders to participate in economic development by helping the private sector beyond workforce training. With this in mind,

it is important to examine a rural region with only a community college as a higher education representative and explore what type of partnerships are formed and what characteristics of innovation systems are generated. Doing so can impact community colleges and the rural region positively. Furthermore, this examination of the partnership using the regional innovation system framework can ignite conversations with various stakeholders regarding community colleges' role in impacting a rural region's economic growth.

Announced on May 12, 2023, a Princeton University-led consortium of 12 universities and colleges (in New Jersey, Pennsylvania, and Delaware, including Sussex County Community College) and 11 companies (including Nokia Bell Labs, including Thorlabs) were awarded a development grant from National Science Foundation's Regional Innovation Engine, or NSF engines, program (Bergeron, 2023). The grant will establish the foundation for a collaborative effort called Advancing Photonics Technologies, spanning multiple states (Zandonella, 2023). The primary objective is to propel research forward, facilitate integrating new findings into the economy, and foster growth of the technological workforce in the region (Zandonella, 2023). This recent development at the inter-state level provides an example of a regional innovation system involving higher education, the private sector, and government. It provides a case in point to this single-case study in investigating the role of a community college in supporting the private sector in their innovation and how they involved local government.

The qualitative single-case study questioned whether a regional networked innovation system existed in a rural region when a rural New Jersey community college and the private sector collaborated to develop an emerging academic optics program.

Delimitations

I delimited the study to a single partnership involving an emerging firm, Thorlabs, and a rural community college in northwest New Jersey, Sussex County Community College, highlighted by a grant the college received for a nationwide project to strengthen the optics industry (Morel, 2021). This partnership between the college and Thorlabs is ongoing. The study included college leaders, faculty, a representative from Thorlabs, and a member of the county government all involved in the pre-development phase of the Optics Technology Academic program. The study included information and documentation spanning from December 2015 through January 2024, of which a timeline can be found in Appendix D.

Definition of Terms

The following definitions are used throughout the study to help the reader understand the terms' meanings and usage.

Academic Capitalism. Academic capitalism is the term coined to describe the transition where institutions and professors are becoming active players in bringing in external funds through startups and forging research deals between companies and institutions (Slaughter & Rhoades, 2004).

Community College. Cohen and Brawer (1996) summarize community colleges as comprehensive two-year, not-for-profit institutions, regionally-accredited to offer occupational, integrative, transfer, developmental, and community education, with the associate degree as its highest award.

Emerging Firms. Companies that seek disruptive formulas and methodology based on trial-and-error rely upon their external network ties to allow them to find innovative solutions (Hite, 2005).

Entrepreneurialism. An innovation that allows for the creation of a new enterprise or that benefits an existing enterprise and its importance to economic development in a capitalist economy (Cornwall & Perlman, 1990).

Extra-regional Systems. Regional innovation systems expand beyond their boundaries through economic integration and globalization (Asheim and Gertler, 2004).

Firms. A business organization, such as a corporation, with a desired structure produces and sells goods and services to generate revenue and make a profit (Hite, 2005, Nelson, 1991).

Heterophilous. People seek out or are attracted to those who are different from themselves. Within the regional innovation approach, diverse groups sharing common goals access social capital to acquire and maintain valued resources (Tripp et el., 2009).

Homophily. People seek out or are attracted to those who are similar to themselves. Within the regional innovation approach, actors with similar lifestyles or socioeconomic positions behave in rational, quasi-economic ways to maximize their access to social capital to acquire and maintain valued resources (Lin, 2001).

Institutions of Higher Learning. A college, university, or similar institution offers postsecondary level academic instruction leading to an associate degree or higher (https://www.law.cornell.edu/uscode/text/38/3452#f). For this study, I am using the word 'institution' to represent higher education institutions.

Learning Region. Regions becoming focal points for knowledge creation and learning in the new age of global, knowledge-intensive capitalism become Learning Regions (Florida, 1995).

New Venturing. Implementing innovations leads to new revenue and funding sources or revenue diversification (Sahlman et al., 1999).

Innovation. When a firm creates a new value by renewing or introducing a new product or service through applying new processes or using new technology on its own or in interactions with the community, including academia, or fostered by the relationship between academia, industry, and government (Chesbrough, 2003; Etzkowitz and Leydesdorff, 1995; Doloreux & Parto, 2005).

Open Innovation. When a firm creates a new value and defines innovation characteristics by renewing or introducing a new product or service through applying new processes or using new technology, it can and should use external ideas, internal ideas, and internal and external tracks to market (Chesbrough, 2003).

Open Innovation Network. Wincent et al. (2009) define open innovation as small firms harvesting R&D outside of narrowly defined organizational boundaries through a network of strategic participants who are open and prepared for joint innovation.

Optics and Photonics. Optics is the branch of physics that understands the behavior and properties of light, including its interactions with matter and the instruments used to detect and manipulate it (McGraw-Hill, 1993). Photonics, which is a branch of optics, is the study of the generation, detection, and manipulation of photons, the fundamental particles of light, and focuses on the practical application of optical technology in fields such as telecommunication, medicine, and manufacturing (Chai Yeh, 2012).

Region. Within the regional innovation approach, the 'region' is described as a geographically defined and administratively supported grouping of innovative networks and institutions that interact heavily and regularly with innovative output from regional firms. It extends to involving broader infrastructure geographically on which individual firms and production complexes can draw (Cooke 2001; Florida, 1995).

Regional Innovation Systems (RIS). It is a way of explaining a region's development and competitiveness based on a set of actors within a region, developing specific forms of capital derived from social relations, norms, values, and interactions with the community (Doloreux & Parto, 2005).

Regional Cluster. It is defined as a group of firms in close geographical proximity to each other and can include governmental and educational institutions (Doloreux & Parto, 2005)

Rural. The census describes rural areas as sparsely populated, having low density, and not within an urban area (Health Resources & Services Administration [HRSA], 2022).

Social Capital. Social capital is embedded in social networks accessed and used by actors from investments made from interpersonal relationships (Lin, 2001).

Triple/Quadruple Helix Model. Etzkowitz and Leydesdorff (1995) define the triple helix model as constant interactions between academia-industry-government to foster economic and social development. For rural region development, Kolehmainen et al. (2015) and Nordberg et al. (2020) are proponents of a broader quadruple helix model, which includes civil society as a community, where all types of educational and research institutes are included, in addition to different types of public organizations, not solely governments.

Summary

In summary, Chapter 1 identified the need to study regional networked innovation systems, a type of regional innovation system, in a rural community involving community colleges. This study has profound implications for educational leaders, policymakers, and the private sector. First, the research presented the theoretical framework of regional innovation systems, including the different types of regional innovation systems. Chapter 2 outlines the characteristics needed to understand the innovation process in regional economies, as conceptualized by Asbheim & Isaksen (2002). Next, the regional innovation system framework is further developed to include a contextual element about the foretelling effects of a rural Northwest NJ context to answer the research questions. Finally, the qualitative single case study shows a type of regional innovation system that can exist in a rural Northwest NJ region when a community college partnered with a private-sector firm to develop an emerging academic optics program.

Chapter 2

Literature Review

The twenty-first century has brought in new informational technologies, the proliferation of mass media, and multinational free trade agreements, all of which have helped precipitate economic and social transformation in rural communities (Schafft & Jackson, 2010). Such changes have required innovation and the creation of new knowledge to drive the competitiveness of firms, industries, and regions (De Propries et al., 2020). The type of innovation important to this study is when an emerging firm relies upon external network ties (Hite, 2005) to create new value by renewing or introducing a new product or service (Chesbrough, 2003; Doloreus & Parto, 2005). Often, rural communities face fewer economic and educational opportunities and a lack of access to technological infrastructure (Brown et al., 2003). By developing an innovation system, rural communities can strengthen their capacity to solve local problems and build on existing resources to develop local businesses, technologies, and industries that create more jobs and broader economic opportunities (Asheim & Isaksen, 1997; Doloreux & Parto, 2005). A rural community college can play an essential role in the regional innovation system by providing technical training for emerging technology that is in demand locally (Charles, 2016). Such an endeavor is called academic capitalism (Slaughter & Rhoades, 2004). Historically, institutions have been involved in academic capitalism through activities ranging from niche-oriented degree programs created for an industry partner, educational alliances with the private sector designed to meet workforce needs, and/or educational and financial partnerships with local corporations to the lease and operation of conference center facilities (Hearn, 2003; Liu, 2007). Such links

between community colleges and the private sector are sometimes formed through informal social networks, resulting in positive cycles of development and progression in which learning interacts with social capital formation (Tripp et al., 2009). Slaughter and Rhoades (2004) remain critical of academic capitalism and its effect on higher education. In their view, the activities of academic capitalism and the commercialization of higher education undermine the traditional values of academia via institutions' increasing focus on market-oriented activities and the pursuit of profit.

Yet, the relationship between knowledge providers and the private sector has been a critical contributor to a region's innovation (Doloreux & Parto, 2005). Academic researchers and policymakers have used the regional innovation systems framework to better understand innovation processes in regional economies. Two central bodies of theory explain regional innovation systems: systems of innovation and regional science (Doloreux & Parto, 2005). The innovation systems theory explains the primary function of innovation systems developing and diffusing innovations through activities that benefit from the relationship between organizations and institutions (Edquist, 2004). The regional science theory focuses on a region with two key features: a formal inter-firm collaboration between firms in a cluster and knowledge providers who cooperate in developing innovation within a region (Asheim & Isaksen, 2002). Of the two theories, the single case study is grounded in regional science theory. The informal networking, not only between knowledge providers and the private sector but also influenced by policymakers, is part of the territorially embedded regional innovation systems (Wiig, 1996; Edquist, 2004). To conclude, Chapter 2 reviews the literature on community

colleges, academic capitalism, regional innovation systems, and Quadruple Helix, focusing on community colleges in rural regions.

Community College Education

History of U.S. Community Colleges in Economic Development

Community college began in the early 20th century as an extension of secondary schools (Diener, 1986). Building on Diener's research, Cohen and Brawer (1996) offer a comprehensive analysis of community colleges, including evaluating the number of high school graduates who attended college for two years, accounting for 40% of all college students. New technologies demanded additional schooling and gave high school teachers and superintendents opportunities for professional growth (Cohen & Brawer, 1996). In addition, community colleges also received support from local businesses by providing them with grant-funded customized training (Cohen & Brawer, 1996).

After World War II, vocational education increased in popularity (Kim & Rury, 2007). Students went to college to address the immediate economic need—to get jobs. Community colleges responded to this need for vocational education in their communities faster than any other Higher Education Institutes (HEIs) (Cohen & Brawer, 1996; Kim & Rury, 2007). The community college sector started to offer vocational associate degrees and certificates that prepared veterans for new careers (Cohen & Brawer, 1996; Kim & Rury, 2007). The Vocational Education Acts of 1963 brought federal dollars to states to maintain, improve, and develop vocational and technical education programs (Cohen & Brawer, 1996; Gorden, 2003; Kasper, 2002). Community colleges got their allocated share, which helped them create new programs that helped serve local businesses and communities. Rural communities with community colleges

benefitted the most, as they were the only option for postsecondary training for technical and vocational education (Cohen & Brawer, 1996; Gorden, 2003; Kasper, 2002).

The 1982 recession in the United States increased the urgency to link community colleges with the private sector. Many students who came to community colleges were displaced workers looking for new skills. The American Association of Community Colleges (AACC) responded by creating a new task force, Keeping America Working. Through their effort at the national level, the federal Job Training Partnership Act of 1982 depended on community colleges to train displaced workers (Day, 1985; Jacobs & Worth, 2019).

Many other examples of industry-driven workforce training and certificates have developed from firm partnerships with community colleges. Dougherty and Bakia (2000) studied various industries, such as motor vehicle manufacturing, apparel, construction, banking, and auto repair. The authors studied at least four community colleges with well-known partnership programs for each industry. In the 1990s, Delta College in University Center, Michigan, partnered with General Motors to develop a training program for mechanics and created an Automotive Service Education Program (ASEP) as part of its automotive programs (Dougherty & Bakia, 1999). Ford, Chrysler, and Toyota developed their own programs, resulting in separate automotive technical curricula at community colleges in Michigan, with funding provided via state and auto manufacturers grants. Community college students who took advantage of this opportunity got postsecondary education, hands-on training, and immediate job placement (Dougherty & Bakia, 1999; Jacobs & Worth, 2019). The research underscores the importance of the continuing education mission of the community colleges in partnering with local employers for

training and retraining their workforce (American Association of Community Colleges, 1988).

In addition, local economic development organizations (LEDOs) admit that the community college can be a crucial partner when courting new businesses or convincing a business not to leave the area (Nickoli, 2013). LEDOs work on behalf of a community or region to attract new businesses or keep current businesses in the area. Community colleges help identify recent program graduates in discipline areas sought by a new company and identify for-credit students who have taken short-term training from the college to update skills or acquire new certifications (Nickoli, 2013). They can provide services that include assessing the skills of job candidates; training those potential candidates to give them the skills they need before they start a new job; training incumbent workers to upskill them for new, more technical, and more complex jobs; and training for dislocated workers who formerly operated in lower-skilled positions that are no longer available (Nickoli, 2013).

Community colleges have expanded their mission statements by providing adult education, recreation, and vocational education by putting their facilities at the community's disposal (Pedersen, 1987; Pedersen, 1988). In addition, the legislation in each state offers curricular functions for community colleges, including academic transfer preparation, vocational-technical education, continuing education, remedial education, and community service (Cohen & Brawer, 1996; Pedersen, 1987; Pedersen, 1988). Lately, companies striving to excel in innovation have found that their workforce needs a combination of technical expertise, business acumen, and creative thinking. This necessitates a blend of knowledge and abilities acquired through both academic education

and vocational training (Soares, n.d.). The expansive reach and adaptability of community colleges make them an excellent option for spearheading the development of curriculum and instructional models that can equip a significant number of Americans with this desired skill set (Soares, n.d.). To achieve this, business and education leaders should forge collaborations that capitalize on their collective understanding of labor markets, skills, teaching methods, and student needs. (Soares, n.d.).

Academic Capitalism

Context

Since the worldwide recession in 1973, public support for universities has declined as a percentage of total institutional revenue (Rhoades & Slaughter, 1997). The decline in public support also includes decreased state appropriations; for many research universities, this funding represents 33 percent of their total revenue (Rhoades & Slaughter, 1997). These constraints urge public institutions to seek alternative funding instead of relying on tax-funded support (Berdahl & Gumport, 2011). To that end, universities are looking toward the private sector for funds by establishing development offices and campaigns to raise money. When institutions and professors bring in external funds from startups and research deals between companies and themselves, such an endeavor is an example of academic capitalism (Slaughter & Rhoades, 2004). This does create controversy regarding the encroachment and expansion of academic capitalism in the academy, as this has been viewed as undermining the traditional mission of institutions in providing quality education and facilitating the dissemination of knowledge (Slaughter & Rhoades, 2004). The commercialization of higher education and the pursuit of institutional profit can potentially have an impact on the broader social role

of higher education and how students perceive and engage their education (Slaughter & Rhoades; 2004). However, there are benefits, especially in the science and technology disciplines, where opportunities are generated for students and faculties through internships, private funding, and research partnerships. Such commercialization of academic teaching and research can potentially revitalize financially-strapped institutions (Newfield, 2004).

Community colleges have not been spared from inflation and funding pressure issues in their local counties and states (Cohen & Brawer, 2003). Community colleges have redefined their institutional missions and, like their 4-year counterparts, have engaged in profit-motivated entrepreneurial activities (Roueche & Jones, 2005). They engage in efforts ranging from niche-oriented degree programs created for an industry partner, educational alliances with the private sector designed to meet workforce needs, and educational and financial partnerships with local corporations to the lease and operation of conference center facilities (Hearn, 2003; Liu, 2007). Additionally, they have foundations that focus on raising funds to provide tuition scholarships. The community colleges also have relationships with local businesses through their role in occupational training. However, the ongoing funding and enrollment concerns have created a situation for community colleges to extend beyond cost recovery instead toward profit realization through relationships with the private sector.

Finance Capital, A Key Ingredient for Academic Capitalism

Cooke et al. (2003) examine the role of infrastructure in regional innovation systems and consider financial capacity as the key to the sustainability of any initiative. For any region to attract capital, a lender will want to know the valuable assets, such as

real estate, personal property, and regional investments, to help them evaluate the region's ability—referred to here as capacity—to repay debt. For regional innovation, financial competence is the number-one concern (Cooke et al., 2003; Cooke, 2013). In addition, public and private financing is taken into consideration. Cooke et al. (2003) and Cooke (2013) document the regions with governance that facilitate low risk for the industry partners by expediting loan guarantees, establishing regional credit-based systems, and successfully addressing the financial competence issue; they also ease open communication, capability, trust, and fidelity between regional partners by providing public financial capacity. This underscores the importance of public funding in deploying regional innovation potential.

Basic research in the U.S., which supports tomorrow's scientific discoveries and technologies, is funded predominantly (53%) by the federal government through public research universities (Wessner & Wolff, 2012). Federal funding also contributes to funding technology startups, representing 25% of early-stage technology funding (Wessner & Wolff, 2012). The growing global competition to influence the location of production of high-technology and value-added industries requires regions in the U.S. to have a well-trained workforce—a crucial component for exploiting emerging opportunities. This requires funding not just for research universities but also for community colleges. For such public taxpayer funding to be sustainable, it must result in job and economic growth.

Leadership Capital

Traditionally, colleges and universities in the U.S. are recognized for scientific inquiry (research) and human capital development (teaching) as part of their core mission

(Newfield, 2004; Powers et al., 1988). However, leaders and policymakers worldwide have had to push the universities' core mission of teaching instead of forming partnerships outside of their boundaries to retain competitiveness in the global economy (Breznitz & Feldman, 2010). In addition, leaders around the U.S. use local communities as test labs to test new ideas and find better ways to achieve social and economic goals (Breznitz & Feldman, 2010). Higher education institutes, either through their mission or motivation from policymakers, have responded to the business and industry needs through the academic capitalism process (Slaughter & Leslie, 1997). The literature from Salomaa (2019) and Breznitz and Feldman (2010) points to universities going beyond education and becoming active in neighborhood involvement, engaging in projects with local communities, and contributing to regional development as part of their third mission. Through local projects, local leaders of the colleges and universities assist local firms and provide policy advice to state and local policymakers via community outreach. The leaders in higher education have embraced this "third mission" as their commitment to regional economic development, including the triple helix model (Ezkowitz and Leydesdorff, 2000) of interactions between government, university, and industry.

The degree of success in connecting with the external world relies on a leader's capacity to cultivate personal connections rather than relying solely on formal networks (Salomaa, 2019). The growing diversity of external partnerships demands more from higher education leadership in balancing the needs between academic goals and regional needs (Salomaa, 2019). For continued partnership success, Foss and Gibson (2015) call for personal engagement and commitment from leaders in rural regions, as there is little space between the university, public, and private sectors. Such a need for a vital

leadership role in making a regional innovation system adds to the complexity of differences between regions.

Theoretical Framework

The Regional Innovation Systems

The conceptualization of regional innovation systems as a framework has existed since the 1990s (Doloreux & Parto, 2005). Academic researchers and policymakers have used the framework for understanding the innovation process in regional economies. Based on empirical investigation, the regional innovation systems approach is distinguished into two main lines of development (Doloreux & Parto, 2005). The first regional innovation systems approach explores aspects of regional innovation capabilities to produce a detailed analysis of elements that characterize regional innovation systems (Doloreux & Parto, 2005). It examines institutional actors, firms that comprise the system, and other actors. In addition, it explains regional differences in innovation activities and regional competitiveness, which are helpful to local and government authorities (Doloreux & Parto, 2005). The second approach evolves from the fact that one can find regional innovation systems everywhere (Doloreux & Parto, 2005). According to the authors, all regions have some degree of the regional innovation system, including regions with vital preconditions to innovation and old industrial regions, peripheral regions, rural regions, and regions in transition (Doloreux & Parto, 2005).

To understand regional innovation systems, looking at a set of interacting private and public interests functioning according to organizational and institutional arrangements is necessary. Such arrangements result in relationships between formal academic institutions and private sector organizations, generating and disseminating

knowledge that helps develop the academic curriculum needed for emerging programs (Doloreux & Parto, 2005; Enright, 2001). The knowledge sharing also leads to shared applications for grants and raising donations needed to support students' instruction, research, and training. The actors—HEIs and industries—in partnership develop intangible assets derived from community interactions, social relations, norms, and values within a region; subsequently, this developed social capital reinforces the capability to innovate and be competitive regionally (Doloreux & Parto, 2005; Enright, 2001).

From the literature (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Enright, 2001), I found that the research on regional innovation systems has focused on high-tech clusters in large metropolitan regions that are equipped with a wide range of strategic actors in the innovation process. This study examined one partnership in a rural area as a possible regional innovation system.

According to Doloreux & Parto (2005), continuous product and process innovations are prerequisites for nations and regions to sustain competitiveness. Regional innovation systems are termed when innovations result from ongoing and prolonged collaboration and interaction between firms and various actors (Edquist, 2004). These actors in regional innovation systems include customers, producers, subcontractors, consultants, governmental institutions, research institutes, and universities (Doloreux & Parto, 2005). The concept of regional innovation systems is found in two central bodies of theory—systems of innovation and regional science (Doloreux & Parto, 2005). This qualitative single-case study was grounded in regional science theory, explaining innovation as a localized, locally embedded, not placeless, process (Asheim & Isaksen,

2002). Both theories distinguish a regional innovation system through collective innovation activities between firms and knowledge-creating and diffusing organizations (Doloreux & Parto, 2005). However, the theories differ in focus and approach. While systems of innovation focus on the creation and diffusion of knowledge and technology, regional science looks at spatial and policy factors that influence economic outcomes in a particular region (Asheim & Isaksen, 2002; Doloreux & Parto, 2005).

Innovation Systems Theory

The primary function of innovation systems is to develop and diffuse innovations through activities that benefit from the relationship between firms and institutions (Edquist, 2004). The literature adds that the critical feature of innovation systems is that an economy's ability to generate innovations does not depend on how individual actors perform but on how they interact as parts of a system. In addition, Eduqist (2004) offers examples of activities important in systems of innovation, which are: the provision of research and development (R&D) in creating new knowledge, competence building in the labor force that will be used in innovation and R&D activities, formation of new product markets; articulation of quality requirements emanating from the demand side about new products; creating organizations required for the development of new fields of innovation; incubation activities; financing of innovation processes and provision of consultancy services of relevance for innovation processes.

The innovation system is a socio-economic process that evolves unplanned, and establishing centralized control over the innovation system is impossible (Eduist, 2004). It can only influence the spontaneous development of innovation systems to a limited extent (Edquist, 2004). The components of the innovation systems are the organizations

that perform the activities and the institutions that provide support influencing these activities. The foundation of innovation systems includes emphasizing formal and informal linkages between organizations, highlighting the flow of intellectual resources, and recognizing learning as a critical economic resource (Edquist, 2004). Therefore, the relationships between activities and components must be empirically analyzed to understand innovation and will serve to develop the conceptual and theoretical framework (Edquist 2004). In addition, the empirical knowledge gained using qualitative measures gives the researcher knowledge about the relations among the primary function, activities, organizations, and institutions in innovation systems (Edquist, 2004). This knowledge about relations can then provide a basis for further empirical generalizations to develop the framework, including theoretical elements.

Regional Science Theory

While the innovation systems theory was built on evolutionary economic and technological change theories, the regional science theory explains localized innovation involving local firms and knowledge providers. The concept of regional science theory within the body of regional innovation systems literature measures targeted policy efforts that improve local firms' capabilities and performance to ensure the regions' competitive advantage. Within the literature of regional science theory, regional clusters are explained as a category of firms, government and educational institutions, and support services close to each other (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Storper, 1997).

The primary justification for advancing selected policy initiatives within the regional innovation system framework focuses on improving competence and performance in local firms and business environments. Such a view promotes activity

between innovative actors with good reasons to interact, such as firms, knowledge providers, and policymakers. Such interactions typify localized interactive learning and can expand to include a more comprehensive business community and governance structure. In addition, localized innovation allows policymakers to orient strategies toward promoting accessibility in developing a regional innovation system and the development of local comparative advantages linked to specific local resources (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Storper, 1997).

Regional innovation systems under regional science theory are characterized by cooperative innovation activities between firms and knowledge-creating and disseminating organizations, such as postsecondary higher education institutes, training organizations, R&D institutes, technology transfer agencies, and the innovation-supportive culture that enables firms and systems to evolve (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). In most cases, innovation systems are referred to as national systems (Asheim & Isaksen, 2002); however, the literature (Wiig, 1996) stresses that a regional innovation system should be looked at as analogous to national innovation systems and recognize that regional systems may not only differ from national standard but may also be different from each other.

Regional Clusters

In the literature, a regional cluster is a category of firms in the same industry or closely related industries, governmental and educational institutions, and support services close to each other (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). These actors produce pervasive and systemic effects that encourage private firms within the region to develop specific forms of capital that are obtained from social connections, norms,

values, and relationships within the community in order to fortify regional innovative capability and competitiveness (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). Clusters have in common expert knowledge, proximity, and cooperation that lead to spillovers and synergies within the regional innovation system (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). The theoretical discourses on regional clusters highlight several key features. Innovation activities derived from a concentration of economic activities by similar and related firms in a cluster facilitate knowledge spillovers and stimulate various forms of adaptation, learning, and innovation (Doloreux & Parto, 2005). In addition, in a regional cluster environment, chances are greater that an individual private sector firm will contact actors that have developed educational curricula in vocational training or are early adopters of new technology (Doloreux & Parto, 2005).

Such knowledge in the context of innovation processes is tacit, which is semi and unconscious knowledge depending on the social and institutional context of the region (Anderson & Karlson, 2004). The main communication channels for tacit knowledge are employee mobility, informal personal relations, and face-to-face contact. Besides geographical proximity, relational proximity plays a role in transmitting knowledge, as it encompasses relations developed by integrating firms and socio-cultural homogeneity (Anderson & Karlson, 2004). Wiig (1996) stresses that mutual trust and collective tacit knowledge in a region tend to stimulate innovative activities, facilitate knowledge exchange, and diminish uncertainties that ease the exchange of technical know-how. Within this context, one can talk about localized learning processes in which the learning occurs locally with few external actors involved.

Different Types of Regional Innovation Systems

Asheim and Isaksen (2002) explain that regions can still be referred to as regional innovation systems even if they do not have all the characteristics, and they distinguish them between three broad groups: (1) "territorially embedded regional innovation networks" (p.83), (2) "regional networked innovation systems" (p.83), and (3) "regionalized national innovation systems" (p.84). By distinguishing the regional innovation system into three types, the authors want to capture this phenomenon's "conceptual variety and empirical richness" (p.83). Asheim and Isaksen (2002) explain in the first type that firms center their innovation through the localized learning process stimulated by geographical and relational proximity; however, they may get tied up with lock-in partnerships with other firms within their industrial district. Alternatively, the authors say firms have very modest interactions with knowledge providers under the first type. Firms in territorially embedded regional innovation networks rely upon locally developed knowledge. They suggest that learning-by-doing and learning-by-using are the fundamental knowledge-generating mechanisms, and innovations achieved are mainly incremental (Asheim & Isaksen, 2002).

The second type of regional innovation system described by Asheim and Isaksen (2002) is the regional networked innovation system. These networks may be further developed than the territorially embedded regional innovation networks. In this type, the authors believe the network has more R&D institutes and local vocational training organizations participating in the firms' innovative activities. Under this type, the network is surrounded by a regional cluster of supporting institutional infrastructure, and where the authors (Asheim & Isaksen, 2002) have regarded this type as an ideal regional

innovation system. As a result, the firms have access to local capability, lowering the likelihood of lock-in situations, as prevalent in the first type, and increasing the probability of radical innovations. Therefore, Asheim and Isaksen (2002) argue that the regional networked innovation systems are ideal-typical regional innovation systems because the regional cluster of firms is surrounded by local supporting institutional infrastructure.

The third type, regionalized national innovation systems, differs from the other two in that the outside actors are involved in the firms' innovative activities and the regional industry (Asheim & Isaksen, 2002). The authors argue that cooperation between firms and knowledge organizations is often related to specific projects to develop radical innovations and that the process is linear. Furthermore, the cooperation between the actors is stimulated due to participants having a similar education to the local community. Therefore, the interaction seems hinged on contractual research work rather than integration and continuous involvement (Asheim & Isaksen, 2002). For this study, the first and third types were not in consideration, as the purpose was to investigate the role of a rural community college in a regional innovation system involving a local emerging manufacturing firm, both within the same regional cluster. The first involves partnerships between private firms, mainly within an industrial park, and the third involves actors outside a regional cluster.

The points made by Asheim and Isaksen (2002) on the different types of regional innovation systems available are based on how the actors within a region interact, how clustering enables such interaction, and how it results in knowledge creation and

diffusion, which guided my study of identifying the regional innovation system in a rural part of New Jersey.

Regional Policymakers

Higher education institutes and policymakers must recognize what kind of education and knowledge the regional firms demand. To that end, Edquist (2004) states that knowledge providers are not enough for a successful innovation process and should interact and collaborate with the business sector. To that end, regional policymakers can play a role in influencing well-functioning higher education institute-industry-government relations. To accomplish a relationship between the private and public sectors, the literature calls on policymakers to create an environment of the Triple Helix Model where there is an incentive for higher education institutes, the private sector, and local government to interact, collaborate, and take advantage of the proximity between them (Edquist, 2004; Wiig, 1996). In addition, meeting places within a community should be established that facilitate face-to-face contact, allowing knowledge spillover in the context of tacit knowledge. Such arrangements can overcome network bottlenecks (Wiig, 1996). Furthermore, the policymakers have to ensure that higher education institutions have the resources to continue developing and meeting the needs of the skilled labor force that the private sector needs.

According to Koschatzky (2001), higher education fulfills two main functions within a region. The first is to manage and share the knowledge of a region through education, information sharing, and solution transfer (p.3). The second is to provide expertise to different regional actors through various means, such as training and consulting to focus on meeting individual needs (p.3). Fundamentally, higher education is

a hub of regional knowledge and expertise, promoting innovation, development, and growth. In addition, Koschatzky (2001) maintains that higher education institutes do not only act as knowledge providers; they are also incubators for new firms since they qualify and support potential entrepreneurs. Furthermore, higher education institutes help transform new scientific knowledge into commercialized products and create new businesses.

The importance of academia, firms, and government collaborating in promoting the economic and technological progress of a region is exemplified through the announcement of a development grant from the National Science Foundation's Regional Innovation Engines, or NSF Engines, to a Princeton University-led collaboration to drive economic and technological advancements in photonics (Zandonella, 2023). This collaboration included 12 universities and colleges across New Jersey, Pennsylvania, and Delaware, 11 companies, including Nokia Bell Labs, and four economic development agencies (Zandonella, 2023). This triple helix relationship demonstrates the degree to which collaboration among academia, industry, and government can foster cutting-edge research, convert research outcomes into economic growth, and cultivate a skilled technological workforce within a region (Bergeron, 2023; Zandonella, 2023).

Triple or Quadruple Helix

Etzkowitz and Leydesdorff (1995) define the triple helix model as constant interactions between academia-industry-government to foster economic and social development. Höglund and Linton (2018), as well as Ranga and Etzkowitz (2013), trace the emergence of the triple helix thesis to the mid-1990s when, for the benefit of society, the policymakers urged the universities and industry to work together. During that time,

regionalization occurred at technological, economic, and political levels, with evidence of success stories in California's Silicon Valley and Boston's Route 128 (Saxenian, 1994). Both regions showcased their technological vitality, entrepreneurship, and extraordinary economic growth. In addition, each region benefited from infrastructures encouraging the new firm formation, with excellent research universities, ample supply of venture capital, and large pools of talented technical workforce (Kenney & von Burg, 1999; Saxenian, 1994, Viale & Pozzali, 2010). According to Kenney and von Burg (1999), Saxenian (1994), and Viale and Pozzali (2010), the two regions, in addition to having established universities and cultural differences, benefit from the continuous creation of new firms, can emerge as spin-offs from university labs, out of established firms looking to commercialize a project that was blocked inside an established firm, or from venture capitalists willing to invest in partial ownership.

It is important to note that capital ventures and entrepreneurs have a win-win situation that makes Silicon Valley a unique example. Venture capitalists absorb losses because the profits from winners have proven enormous (Karlgaard, 1997; Kenny & von Burg, 1999). Moreover, the managers and engineers leave their secure positions in established firms for high capital gains and low personal risk, as many are sought after for their startup experience (Kenny & von Burg, 1999). In addition, literature from Asheim and Isaksen (2002) and Camagni and Capello (2013) have examined why regions like Silicon Valley continue to have a competitive and sustainable advantage over other locations. They argue that a region's competitive advantage is local knowledge, relationships, and motivations, which non-local rivals cannot match.

Policymakers worldwide have been looking to replicate the success of Silicon Valley by linking government, universities, and industry (Cai & Lattu, 2021; Etzkowitz & Leydesdorff, 2000; McAdam & Debackere, 2018). Etzkowitz and Leydesdorff (1995) propose the triple helix model when explaining how innovation driven by entrepreneurship and economic growth in a knowledge-based economy are fostered by the relationship between academia, industry, and government. Eztowitz and Leydesdorff (1995) offer evidence from a collaboration between policymakers, technology clusters, and research institutes, like the Massachusetts Institute of Technology in Boston and Stanford University in California. Since the introduction of the triple helix model, researchers have studied the rationale for the model, drawn insights, and summarized its aspects (Cai & Etzkowitz, 2020; Cai & Lattu, 2021; McAdam & Debackere, 2018). They have determined that triple helix development is a collaborative evolutionary process among regional actors, requiring top-down and bottom-up coordination. In addition, these researchers posited that, over time, the interaction among the regional actors could result in swapping their traditional roles and often becoming consumers and users of one another.

However, the triple helix model has opponents who criticize it for being too restrictive and excluding civil society in fostering social innovation (Cai & Etzkowitz, 2020; Kolehmainen et al., 2015; Mok & Jiang, 2020; Nordberg et al., 2020). According to them, the knowledge transfer in the triple helix model, which promoted technology transfer through commercialization or research, is inadequate. In addition, they argue that besides technology transfer, it should include knowledge transfer through collaborations

across multiple sectors, including the government, the university, industry, and the wider society.

Quadruple Helix in Rural Regions

Dargan and Schucksmith (2008) and Nordberg et al. (2020) argue that the triple helix model is narrow in definition and emphasizes scientific and technological expert knowledge, as it represents innovations emerging in cooperation between universities, industry, and government. Especially regarding knowledge-based development in remote, rural, and less-favored regions, the regional strategies and policies aim to develop innovation in centrally located urban areas, assuming it is universally applicable (Kolehmainen et al., 2015). Moreover, there may not even be a university in many rural areas. For rural region development, Kolehmainen et al. (2015) and Nordberg et al. (2020) are proponents of a broader quadruple helix model, which includes civil society as a community, where all types of educational and research institutes are included, in addition to different types of public organizations, not just governments.

Furthermore, Lowe et al. (2019) state that the community-based quadruple helix model for rural regions calls for a non-endogenous development theory based on local resources and participation of local and extra-local connections with the outside world. Their main argument calls for understanding formal and informal ways the community networks within the quadruple helix model enable development in rural areas. According to Nordberg et al. (2020), local communities cooperate with different actors—industry, government, and academia—in different ways while simultaneously accessing participation from several networks beyond the local community. Community-based actors link societal needs and innovation to the other key actors of the quadruple helix

model, advocate integration and interaction between the helices, and facilitate the knowledge-sharing required for innovation processes (Nordberg et al., 2020). However, each actor of the traditional triple helix model—academia, industry, and the government—has visions concerning their future in the region, requiring a need for a fourth helix community that includes various actors with a shared interest and that helps in developing a shared vision (Kolehmainen et al., 2015; Nordberg et al., 2020). Future research is needed to determine if community colleges can sustainably participate in regional innovation.

Summary

Existing literature illustrates the need for regions to have an open innovation concept between businesses and academia. There is a strong motivation for regional leaders from government, businesses, academia, and the community's citizens to come together for economic development and be competitive in the global environment. The literature on academic capitalism, community colleges, regional information systems, and the triple/quadruple helix presents a compelling argument for higher education institutions' involvement in partnerships. It explains that each regional innovation system can differ, and the researcher must determine what type exists or is needed in a given region.

Rural regions can have the landscape for entrepreneurship and motivation to be relevant in the global environment and warrant exploring whether regional innovation systems have characteristics and what role a community college plays in that development.

Chapter 3

Methodology

This chapter describes the research design and methodology for the qualitative single-case study that investigated a collaboration between a rural New Jersey community college and a private sector firm in developing an optics technology program that resembles a regional networked innovation system. This single-case study (Yin, 2014) used a thematic analysis of the community college leaders' perspectives and understandings of a single partnership with a local firm (Rossman & Rallis, 2012). The sample consisted of a group of executive administrators and faculty from a rural New Jersey community college who were primary data sources needed to answer the research questions. This chapter includes a case study protocol illustrating how each research question and source was used as an essential data collection tool (Yin, 2018). Data collected was triaged by their centrality to my inquiry and included a matrix to show the alignment of research questions, theoretical propositions, rival explanations, corresponding theories, interview questions, and supplemental documents. The remaining sections discussed the role of the researcher, limitations, and ethical considerations.

Case

The case was to understand how a rural community college's collaboration with a private sector within close proximity resembled a regional networked innovation system. The aim was to investigate through a single-case study the development of an academic optics program by Sussex County Community College in collaboration with Thorlabs. The study utilized interview methods and descriptive analysis of the perspectives and

understanding of community college representatives, the private sector, and local government.

Statement of the Problem

Rural community colleges are challenged to develop impactful ways to show their relevance to their local government, the business community, and the residents of their community, as the local funds allocated to them are questioned at every budget cycle. The vocational education and training of the local workforce has traditionally been the responsibility of community colleges (Cohen & Brawer, 1996; Pedersen, 1987; Pedersen, 1988). In the modern age, companies aiming to maintain a competitive edge through innovation necessitate a workforce with technical expertise, business acumen, and creative thinking (Soares, n.d.). This skill set demands knowledge and proficiencies obtained through academic education and vocational training (Soares, n.d.). With their vast scope and adaptability, community colleges emerge as a compelling choice for driving curriculum development and instructional models that can impart this skill set to many Americans (Soares, n.d.). To achieve this, a collaboration between business and education leaders becomes crucial, enabling them to leverage their collective understanding of labor markets, skills, teaching methods, and student needs (Soares, n.d.).

How can a rural community college successfully adapt to these demands? While research exists on research universities, little research has investigated how rural community colleges have collaborated with the private sector and local government in developing programs that deliver skills needed for working in firms with emerging technology.

Context

My research site was a rural community college in Sussex County, New Jersey, which according to the county website, Sussex.nj.us, is the northernmost county in New Jersey. Because of its topography, the county has remained a rural and forested area (www.sussex.nj.us). The largest employer in Sussex County is Thorlabs, a privately held optical equipment company headquartered in Newton, Sussex County, New Jersey (www.sussex.nj.us). The company utilizes a Strategic Partnership Program, which helps start-up manufacturers through shared knowledge and resources in barter for an equity stake in the company (https://optics.org/article/19695). The program helps Thorlabs stay on top of market trends as emerging technologies account for roughly 25% of its annual revenue (https://optics.org/article/19695). Over the past decade, Sussex County Community College has offered customized grant-funded training to Thorlabs and recently entered into a formal relationship to help Thorlabs meet their needs to amass a skilled workforce in optics technology (Edwards, 2021; Sussex.edu).

The college, in August 2021, received $2,000,000 by joining a partnership between New-York based American Center for Optics Manufacturing, known as AmeriCOM, and the U.S. Department of Defense, as a portion of a nationwide project designed to strengthen the optics industry (Morel, 2021).

Research Questions, Theoretical Propositions, and Rival Explanations

The following research questions, theoretical propositions, and rival explanations guide this qualitative study:

RQ1: How do the geographical and relational proximity of a rural community college in New Jersey and a manufacturer of photonics equipment represent the regional cluster of "regional networked innovation systems"?

Proposition 1: The rural community college uses geographical and relational proximity to become part of the regional support for innovative activities of a private firm, resulting in the regional innovation type of "regional networked innovation systems" (Asheim & Isaksen, 2002, p.83).

Rival Explanation 1: The community college does not directly engage in a regional support network and instead assists the private firm to go beyond the local territory and regional network to access the needed knowledge.

RQ2: What role did the community college play in the regional cluster of the regional innovation system?

Proposition 2: Community colleges can be a local source of technical know-how, grant financial support, regional leadership and locally trained labor (Asheim & Isaksen, 2002; Anderson & Karlson, 2004).

Rival Explanation 2: Community colleges will serve as a channel for accessing the required resources from universities outside the cluster.

RQ3: What role does the community college play in fostering a shared regional economic development vision between local academia-industry-government-community?

Proposition 3: To attain the results of a shared regional economic development vision partnership from a triple helix collaboration (Kolehmainen et al., 2015; Nordberg et al., 2020), the community college plays a vital role in the Sussex County Economic Development Partnership (SCEDP) and through them, facilitates cooperation through its role as a community leader by initiating workshops, conducting interviews and surveys with regional actors, provides access to historical records on regional development, and coordinates regular meetings with different regional actors (Roman & Fellnhofer, 2022).

Rival Explanation 3: Community college leaders are aware of the difficulty in developing a sustainable shared vision for a region and will bypass the SCEDP and engage independently with industry, government, and community leaders at different times and stages to achieve an economic plan for the region.

The Rationale for Qualitative Research

Qualitative research initiates as a formal, structured approach to the investigation (Creswell, 2013; Roller & Lavrakas, 2015). Denzin and Lincoln (2011) explain qualitative research as a conceptual approach where researchers attempt to make sense of or interpret occurrences regarding the meanings people bring to a naturalistic approach to the world. Researchers connect to participants by talking to them and watching how they engage with others over time and in their natural settings (Creswell, 2013). When researchers situate themselves within the participants' world, collecting relevant, meaningful, and rich data will lead them to celebrate the moment and reveal in-depth insights (Roller & Lavrakas, 2015). Qualitative research embraces the essence of real-life experiences and values the intricate aspects of people's expressions, behaviors, and

thoughts. By gathering and interpreting data from individuals, qualitative research seeks to identify patterns, establish connections, and derive meaningful insights (Roller & Lavrakas, 2015). This qualitative research aimed to learn from the participants' perspectives about community colleges' role in regional innovation.

Case study research is crucial because it provides in-depth analysis and understanding through an empirical investigation that uses multiple data sources to examine contemporary phenomena (Yin, 2018). The critical single case study approach was selected to explore the circumstances of the regional networked innovation systems that existed in the development of the optics technology academic program resulting from the community college and private sector partnership (Yin, 2014). The study followed a rigorous case study protocol to inform the research questions, achieve its purpose, and promote replication of the study in fields of understanding innovation in rural communities and by other researchers.

Strategy of Inquiry

The strategy of inquiry I used for this research was a single-case study with a guiding methodological approach established by Yin (2014). The inquiry strategy was conducted as a case study using descriptive analysis of the community college and private sector perspectives and understanding as they emerge (Rossman and Rallis, 2012).

Yin (2014) shares various rationales when researchers determine whether to use a single-case or multi-case study. When a study involves investigating one or more phenomena to decipher and focus on a single occurrence instead of generalizing the situation, it is a critical case study (Yin, 2014). The *critical case* rationale was used to

select a single-case line of inquiry, as I investigated a single occurrence of the development of the optics academic program by a rural community college (Yin, 2014, p.51). The *critical case* rationale is relevant to this research because this study intended to learn that the regional networked innovation system existed when the optics technology academic program was developed from the partnership between the community college and the private sector. Ultimately, this single case's potential was to investigate or confirm that a regional networked innovation system involving a rural community college can exist.

Case Selection

The case investigated whether a rural community college within a regional cluster provided resources to support the private sector when innovating through developing new local skills and cultivating a collaborative network, forming regional networked innovation systems (Asheim & Isaksen, 2002). The single case line of inquiry (Yin, 2014) was selected to investigate whether regional networked innovation systems (Asheim & Isaksen, 2002) existed when a rural community college close to a private firm offered support by developing a new academic program that provided skills sets that were new to the region, resulting in innovative activities.

To gather rich information about the phenomenon, several criteria were used to determine the critical case selection. First, the institution selected is in a rural region with a history of participating in regional economic development. Second, the institution has a history of leadership that engages with the community, county, state, and federal organizations to bring resources to the local region. Finally, the region where the institution was selected also has the private sector involved in emerging technology.

These criteria together created a strong argument for investigating the existence of a regional networked innovation system in a rural region.

Participants

The qualitative single-case study was designed to investigate the development of a regional networked innovation system possible when a rural New Jersey community college, Sussex County Community College (SCCC), and the private sector, Thorlabs, collaborated to develop an optics technology program. Study participants were selected based on their experience at the community college and exposure to the development of the partnership, as well as other projects involving external partners. To capture a complete perspective, participants ranged from executive level to middle management leaders from both administrative and academic units. Specifically, I included the president, chief academic officer, dean of technical programs, optics technology faculty member, and other college executive team members.

Table 1

Participants by Organization

Organization	Position	Role in Partnership
SCCC	Executive Director, Foundation	Funding options and relationships
SCCC	Senior Vice President of Student and Academic Affairs	Academic leader, program oversight
SCCC	Associate Vice President of Academic Affairs	Program detail oversight
SCCC	President	Leader, influencer, and overall oversight
SCCC	Optics Technology Supervisor	Program building and implementation
SCCC	Vice President of Institutional Effectiveness	Data and accreditation

Organization	Position	Role in Partnership
SCCC	Dean of Technical Operations	Program building and implementation
Sussex County Government	County Commissioner	County policy, support, and facilitator
Thorlabs	ESG & Communication Manager	Company liaison and relationship manager
Thorlabs	Mechanics Unit Business Leader	Leader, facilitator, equipment knowledge
Thorlabs	Coproduction Manager	Detailed knowledge of workforce skills needed

Sampling Strategy

I used purposeful intensity sampling (Patton, 2002) and selected participants in this study who were involved in developing the partnership between the community college and Thorlabs. The purposeful intensity sampling selected for this study provided excellent, information-rich examples without being extreme or highly unusual (Patton, 2002). In addition, the participants selected had played a role as administrative leaders, faculty, or representatives of the private sector in developing the partnership that resulted in the development of the optics technology academic program.

Data Collection

Before data collection, I obtained IRB approval. Data collection primarily included semi-structured interviews and qualitative documents that supplemented the evidence collected from the interviews. Documents such as open-ended surveys, social media, and website materials were considered data (Creswell & Poth, 2016). Multiple

sources of data assisted me in identifying the "convergence" of findings (Yin, 2014) and in identifying the "divergence" of findings (Stage, 1995).

Case Study Protocol

In following a Yin (2018) case study methodology, one of the most critically important aspects is the development of a case study protocol. A case study protocol helps the researcher ensure they have sources, including interviews, documents, or observations, that address the problem and answer the study's research questions (Yin, 2018). Developing a crosswalk illustrating how each research question and source will be used is an important data collection tool in keeping the researcher on track (Yin, 2018). A well-designed protocol can also be an effective way to deal with increasing the reliability of case studies (Yin, 2018).

Interviews

This study's most important source of case study information was semi-structured one-on-one interviews, which were guided conversations rather than structured queries (Yin, 2018). In other words, the actual stream of questions followed my line of inquiry, as the interview protocol reflects. The questions were conversational and unbiased to reveal participants' unique perspectives and understandings (Rubin & Rubin, 2012, Yin, 2018). The case study adopted a focused interview type (Yin, 2018). Interviews were open-ended and conversational, which led to how and why questions and probed participants to extend their ideas during the semi-structured interview process, which allowed for flexibility and spontaneity (Rubin & Rubin, 2012; Yin, 2018). One-on-one interviews fostered a trusting environment that resulted in extended conversations on a specific topic, which allowed me to bring out meaningful responses through follow-up

and probing questions (Roller & Lavrakis, 2015). Conversational interviewing allowed me to gather participants' unique perspectives and understanding (Hatch, 2002; Roller & Lavrakas, 2015; Rubin & Rubin, 2012). The semi-structured method allowed me to focus on issues essential to this study (Brinkmann, 2013). In addition, open-ended questions and probing participants to extend their ideas during the semi-structured interview allowed flexibility and spontaneity (Rubin & Rubin, 2012).

All participants signed a consent form before the interview (See Appendix A). The consent form specified that their names would never be used in any portion of this study, ensuring participants that their responses to questions would remain confidential. As in-person interviews were not as feasible, online Zoom interviews were a viable option. Zoom allows efficient access to participants and will be less intimidating, more convenient, secure, and time-efficient (Gray et al., 2020). All interviews were recorded using Zoom, and transcripts were gathered from Zoom for analysis through Dedoose.

In addition, an interview guide was established to provide structure to the line of questioning and for the interviewer to refer to a guide and ensure relevant issues were covered (Roller & Lavrakas, 2015; See Appendix B). These guides assisted me in conducting interviews elicited responses to open-ended questions related to the study area. The guides intended to act as conversation facilitators and allowed for opportunities to expand the data collected by probing participants to respond with greater depth and breadth. The questions guided the participants and the researcher through extensive conversation regarding regional networked innovation systems and the college's role in their development. The interview guide was established to ensure that each participant who was interviewed would be engaged in the same primary line of inquiry while

allowing for spontaneity (Patton, 2015). The questions developed were done to gather data that explored community colleges' involvement in building characteristics of regional networked innovation systems through partnerships with industries, policymakers, and community leaders. An interview guide and documentation protocol were established as instruments for data collection (See Appendix B).

Documents

Documents are essential to data collection as they help supplement evidence from other sources, such as interviews and observations (Yin, 2018). Therefore, it is essential to thoroughly understand how the institution forms a relationship with the private sector when participating in regional innovation, including the role county, state, and federal policymakers play in regional development that indirectly or directly influences the formation of such partnerships. Finally, documents provide evidence of resources generated from the partnership that resulted in a regional innovation system.

To that end, I followed the document collection protocol Yin (2018) provided, depending on the document type and the collection purpose. The guidelines Yin (2018) provided are: during my interviews, I obtained relevant documents to corroborate with their responses, such as partnership agreements, press releases, and board minutes. Also, the guidelines from Yin (2018) provided for establishing a document control system; secure the documents; verify completeness; review and analyze; record and report; retain and dispose of documents. Documents utilized during the study are displayed in Table 2:

Table 2

Documents

Source	Document Title
SCCC's continuing education & workforce development archives	MOU between Thorlabs and SCCC
SCCC's IR department	Proposal A.A.S. Technical Studies Optics
SCCC's IR department	Proposal Optics Technology CNC Certificate
SCCC's IR department	Proposal Optics Technology Metrology Certificate
SCCC's IR department	Proposal Optics Technology Conventional Certificate
SCCC's IR department	Optics Marketing Materials
SCCC's IR department	Scope & Sequence Part of Application for Securing our Children's Future Bond Act
SCCC's IR department	Budget Summary Part of Application for Securing our Children's Future Bond Act
SCCC's IR department	NJ Pathways Project Optics Technology Implementation Plan
SCCC's Chief of Staff	Board Resolution Implementation of Securing our Children Bond Act

Table 4, found in Appendix C, shows the alignment of research questions, theoretical propositions, interview protocol questions, and document collection. The complete interview protocols for the College's President (Interview Protocol A), the rest of the participants from the College (Interview Protocol B), a representative from Thorlabs (Interview Protocol C), and for County Commissioner (Interview Protocol D) can be found in Appendix B.

Yin (2018) recommends the use of a case study database as a way to organize and document notes. This provides a transparent system of collecting and analyzing the data from the proposed study in a retrievable form (Yin, 2018). Creating a case study database also increases the reliability of the proposed study since categorizing the notes can be

subject to secondary analysis by other researchers who can systematically review and replicate findings (Yin, 2018). For this study, I utilized Dedoose, a web-based qualitative data analysis application, to organize notes and categorize emerging trends within the data.

Pilot Study

Before entering the field, Yin (2018) encourages pilot studies to test protocols for both content and procedures. The pilot can help ensure that interview questions are clear and relevant; engaging in a pilot may also further clarify the research design (Yin, 2018). Commonly cited as the main criteria for a pilot case selection, I used convenience and access (Yin, 2018) as my determining factors to test my interview protocol. I selected an institution that is local to me and that engages in regional economic development by partnering with the local private sector. From the pilot study, I learned how to generate more effective interview questions after discerning areas of weakness in my interview protocol. I revised my interview questions to avoid being too open-ended and to receive information more conducive to answering the study's research questions.

Data Analysis

My general analysis strategy relied on theoretical propositions and examination of plausible rival explanations (Yin, 2018). Theoretical propositions and rival explanations were developed as part of the original case study design. Each stems from a literature review and points to relevant contextual conditions derived from the study's theoretical framework (Yin, 2018).

Qualitative research encourages data analysis to begin with the first interview to ensure the project makes sense and that the data collected answers the intended research

questions (Rubin & Rubin, 2005). Yin (2018) suggests *playing* with early collected data to search for promising patterns, insights, or concepts. Data analysis is one of the critical steps in qualitative research because of its versatility and applicability to much of what researchers seek to accomplish (Leech & Onwuegbuzie, 2007; Roller & Lavrakas, 2015). The literature from Hatch (2002) tells us that data analysis is a *systematic search for meaning* and a way to process data so that findings can be fluently communicated to others (p. 148). Furthermore, the analysis of data is a way for researchers to organize and examine data in a manner that will allow them to "see patterns, identify themes, discover relationships, develop examinations, make interpretations, critique, and generate potential theories" (Hatch, 2002, p. 148).

Transcription

The first step in analyzing data is to prepare a transcript that encapsulates "a full and accurate word-for-word written rendition of the questions asked and responses given" (Rubin & Rubin, 2012, p. 190). Qualitative research typically uses words and interpretations of words as its primary data source (Rossman & Rallis, 2012). This language is essential to the process of participants conveying their beliefs, perspectives, and understandings (Rossman & Rallis, 2012). Therefore, the analysis and interpretation of focus group and interview data came from examining transcribed recordings. Zoom's transcription was used to capture verbatim responses from participants.

First Cycle Coding

Saldaña (2016) separates coding into two stages: first-cycle and second-cycle. The first coding cycle will allow the researcher to chunk the data by code into manageable pieces; the second coding cycle will then be used to reorganize and

categorize emerging concepts (Saldaña, 2016). A consuming question for any researcher is: where do my codes come from? To answer, Creswell (2015) notes that using priori or preset codes will test theory against empirical data. During the first coding cycle, I utilized *prefigured coding schemes* (Creswell, 2015). I developed codes ahead of time based on the theoretical framework, interview questions, propositions, rivals, and pre-existing knowledge. At the same time, I was open to additional codes that might have emerged during the analysis (Creswell, 2015).

Second Cycle Coding

Drawing upon the first cycle of coding data, I utilized pattern coding to organize and analyze the data into more meaningful grouped themes (Saldaña, 2016). Pattern coding is similar to a table of contents that outlines and assists in consolidating the findings of a research study (Saldaña, 2016). During this second cycle, I assigned codes to various segments as I assessed and enhanced my data. Pattern coding identified emerging patterns through the lens of my propositions (Yin, 2018). Pattern coding can be used to identify patterns or themes in qualitative data that support or refute specific propositions and identify rival explanations (Saldaña, 2016; Yin, 2018). Pattern coding can assist in resolving perplexing or contradictory findings in the data by reorganizing codes and themes into distinct categories and subcategories to produce a complete overarching narrative of a study's findings (Delve & Limpaecher, 2022). The underlying advantage of pattern coding is reinforcing the study's narrative by analyzing additional themes or categories discovered during the study's findings (Delve & Limpaecher, 2022). Alternatively, it can be used to identify new patterns or themes in the data that suggest the need to revise or refine existing propositions (Saldaña, 2018). In both cases, pattern

coding can be a valuable tool for expanding our understanding of the relationships between concepts that underlie propositions and rival explanations (Saldaña, 2016; Yin, 2018).

Qualitative Codebook

Developing an analytic codebook is essential to keep emergent codes organized (Saldaña, 2016). Therefore, I created a codebook using a table format with headings that identify the chosen code, then define the code, the inclusion/exclusion criteria, and a quote from the interview transcripts that illustrates an example of the code in action. These parameters helped me delineate between codes and ensured I consistently used them throughout the analysis of my interview transcripts and document analysis.

Research Design Quality

In carrying out a case study research design, it is necessary to ensure that the research represents a logical set of statements since the quality of any empirical research design is evaluated according to specific logical tests (Yin, 2018). Logical tests, including construct validity, internal validity, external validity, and reliability, are standard across all social science research methods and apply to case study research (Yin, 2018). Therefore, throughout my research, I used various techniques recommended to increase my research design's data quality and validity.

Construct Validity

To reflect the concepts being studied, construct validity is about how well the case study's measures are designed to evaluate (Yin, 2018). For my study, I used multiple sources of evidence to triangulate my findings. By doing so, I developed intersecting lines of inquiry where each source corroborated across the different sources to generate

findings for the study (Yin, 2018). This triangulation helped assess the strength and credibility of the case study findings (Yin, 2018). Furthermore, by connecting each data source back to the research questions, theoretical propositions, and rival explanations, I developed a chain of evidence that showed close links between my data collection and findings (Yin, 2018).

Internal Validity

A case study captures a range of perspectives to answer *how* and *why* questions about a phenomenon being studied (Yin, 2018). Internal validity focuses on the answers to the *how* and *why* questions and makes conclusions of causal inferences from the findings. In this study, I used analytic techniques Yin (2018) described, such as pattern matching and addressing rival hypotheses, to address internal validity. In addition, the study was strengthened by rejecting the rival hypotheses (Yin, 2018).

External Validity

External validity is the extent to which the study can be analytically generalized to other situations not part of the original study (Yin, 2018). In this single case study, I used theoretical propositions from my research design to increase external validity through analytic generalization. This was achieved by corroborating, modifying, rejecting, or otherwise advancing the theoretical propositions initially developed in my research design and by addressing new concepts that arose from completing the study (Yin, 2018).

The theoretical propositions of my study have been developed using the literature and theoretical framework that guided my conceptual framework. The theoretical framework is grounded in regional science theory and the concept of a regional

networked innovation system, which explains innovation as a localized and locally embedded, not placeless, process (Asheim and Isaksen, 2002). This study's theoretical propositions and rival explanations focused on connecting the identified institutional actions with regional networked innovation systems through the lens of institutional leadership. The results of this study aim to contribute theory to the use of community college's role in the regional networked innovation system for a rural region at a higher generalization level than the specific case studied in this research (Yin, 2018).

Reliability

Reliability focuses on the consistency and repeatability of producing the case study findings (Yin, 2018). Yin (2018) recommends using a case study protocol and a case study database as design procedures to increase reliability so other researchers could conduct a similar study. For this study, I utilized both of these validity procedures to increase the reliability of the study. A case study protocol is essentially a blueprint outlining the significant sections of the case study with clear procedures for the overview of the study, data collection procedures, protocol questions, and a tentative case study report. The protocol was of great use to the researcher in designing a case study research design as it focuses on the designed plan and anticipates potential problems ahead of time (Yin, 2018). The case study database is another design tool used to increase reliability. The database was used to track and analyze analytic memos from the researcher. By including a systematic approach to collecting and analyzing my research notes, other researchers could better understand the impressions I encountered (Yin, 2018).

Avoiding Bias

Creswell (2014) explains that, in qualitative research, the researcher engages with participants in an in-depth and comfortable experience. Because I worked at the community college that is part of the study, Glesne and Pershkin (1992) describe it as backyard research. This backyard research involves the researcher conducting a study in a familiar work setting. I worked at the community college from 2017 to March 2022.

I have a thorough background in evaluating resource investment and allocation of the financial budget of educational institutions. Strategically, I believe institutions, in pursuing their overall mission and strategic goals, must work collaboratively with private industry clients, local policymakers, and community leaders to bring in tax-payer-funded grants to participate in regional economic development. Based on the consistent focus on building partnerships with private industry clients, I assumed that the community college participants would have a foundational knowledge of traditional auxiliary revenue and how the college's work can be extended to building characteristics of the regional networked innovation system. In addition, I knew the participants had not been engaged in professional discussions related to regional networked innovation systems. These assumptions had the potential for exploration throughout this study (Creswell, 2014).

Because I selected a single-case study involving an institution where I have worked, I was open to contrary findings and avoided substantiating a preconceived position (Yin, 2018). To test my own tolerance for contrary findings, I reported my preliminary findings to two or three critical colleagues (Yin, 2018). The colleagues offered alternative explanations and suggestions for data collection so that contrary

findings could produce a documentable rebuttal, and thus, the likelihood of bias was reduced (Yin, 2018).

Limitations

Regional Innovation Systems involving research universities in urban markets are not new; however, the study of rural regions with community colleges involved in regional innovation systems is nonexistent (Charles, 2016). This case study investigated the role of a community college in the regional networked innovation system by examining a critical case that involved a single occurrence of developing an optics technology program at a rural community college. At the same time, the study looked to validate the existence of only one type of regional innovation system, the regional networked innovation system, based on the investigation of the selected critical case study. The study also investigated community colleges' role in the quadruple helix, a collaboration between academia, firm, community, and government, to develop a new academic program, once again only looking at a single occurrence; despite this, it is worth noting that this single-case study is deeply grounded in research literature and, through the findings supporting or challenging the existing theory, this single case can provide basis for analytic generalization (Yin, 2010).

Ethical Considerations

Ethical considerations play an essential role, and the researcher may face considerations and decisions that directly impact the study design and dissemination (Roller & Lavrakas, 2015). Qualitative researchers can get close to the action and to their participants (Hatch, 2002) and, in turn, should anticipate ethical issues that may arise throughout their study and put assurances in place to prevent them (Punch, 2005). For

this study, numerous ethical assurances were enacted to conduct ethically grounded research.

Understanding ethics' role in the research procedures is essential in qualitative research. Therefore, I applied for Institutional Review Board (IRB) approval from Rowan University and the community college before conducting the research. In addition, each participant in the study was offered to sign a consent form (Appendix A) and could have voluntarily asked to be removed from the study at any time with no risk. Once the data collection began, I used pseudonyms to protect the identity of each participant. All data were labeled by a pseudonym and will be stored on a Rowan University electronic share drive for five years. Once the dissertation manuscript is complete, the study, including pseudonym-referenced analysis, will be published on ProQuest through Rowan University.

Summary

This chapter began by addressing the research problem and exploring the literature that indicated gaps for qualitative research around regional innovation systems and community colleges' role in a rural region. Then, I explored the need for more substantial evidence around community colleges' role in influencing other actors as part of the quadruple helix model from theory to implementation. This was needed because the researchers have not explored the regional innovation system in a rural region. This study adds value to the field by helping rural community college leaders understand how their contribution generates a type of regional innovation system.

This chapter described the methodological approach I used to capture the evidence from multiple sources needed to answer the research questions in this case

study. Following the rigorous procedures Yin (2018) described, this case study design allowed me to study my propositions and reject or explore my rival explanations. This chapter addressed how I approached data analysis, including my analytic strategy and coding techniques. Systematic protocols and the use of various logic tests ensure rigor in this study (Yin, 2018). I also explored my role as the researcher, the study's limitations, and ethical considerations.

Chapter 4

Findings

The purpose of this single case study was to evaluate the extent to which a partnership between a rural community college and a local manufacturer of optics technology represents a "regional networked innovation system" (Asheim & Isaksen, 2002, p.83). More precisely, this study was to understand the role assumed by the College in facilitating this partnership as part of a shared economic vision between the local industry, academic institution, and county government. The following research questions guided the study:

RQ1: How do the geographical and relational proximity of a rural community college in New Jersey and a manufacturer of photonics equipment represent the regional cluster of "regional networked innovation systems"?

RQ2: What role did the community college play in the regional cluster of the regional innovation system?

RQ3: What role does the community college play in fostering a shared regional economic development vision between local academia-industry-government-community?

This chapter summarizes each interviewee's role in the partnership between Thorlabs and Sussex County Community College. After analyzing the data from the community college, the local photonics equipment manufacturer, and a county government member, the chapter also presents an overview of the findings.

Case Description

The aim of this single-case study was to examine if rural areas, specifically regional clusters, possess resources for private enterprises during the innovation process through the support of local infrastructure and collaborative networks, thereby establishing regional innovation systems (Asheim & Isaksen, 2002). The research focused on a singular line of inquiry (Yin, 2014) to ascertain whether a "regional networked innovation system" (Asheim & Isaksen, 2002) was present when a community college joined the regional cluster of supporting infrastructure for a private firm, leading to innovative activities. This research helped identify potential areas for enhancement within rural and regional networked innovation systems, as well as opportunities to enhance collaboration among colleges, businesses, and policymakers.

Home to around 145,000 residents, Sussex County is a rural, forested county in the northernmost part of New Jersey. Politically, Sussex County is a majority Republican area with economically pro-business policies and minor dependence on state and federal involvement. Due to the county officials' pro-economic perspective, they are highly concerned with developing and filling skilled jobs to retain residents in the County (Sussex County Chamber of Commerce, 2019). Through the County's Chamber of Commerce, Sussex County developed the Sussex County Economic Development Partnership (SCEDP), a nonprofit organization that promotes the proactive recruitment, retention, and growth of businesses in Sussex County. Broadly, the SCEDP serves to facilitate the economic development of the region (Sussex County Chamber of Commerce, 2019).

Sussex County Community College is a rural community college located in Sussex County, New Jersey, with an enrollment of approximately 2,250 students. The College offers a vast array of academic programs, technical certificates, modality options, and workforce development opportunities (Sussex County Community College, n.d.). During the development of the partnership with Thorlabs, the College established an advisory board with the purpose of gathering key stakeholders together to forge advantageous connections and share information about the program. Over the program's history, over 42 students have completed their program in Optics Technology, and as of Spring 2024, the program has a current cohort of 17 students—the highest number to date (IR Department, 2024).

Thorlabs is a privately held optical equipment company headquartered in Newton, New Jersey, with over 2,500 employees across manufacturing and sales offices, both domestically and internationally. The corporation runs a Strategic Partnership Program to assist new manufacturers by providing them with access to expertise and resources in return for a share of the company (Thorlabs, n.d.). This initiative enables Thorlabs to remain competitive by staying updated on market developments, with emerging technologies contributing approximately 25% to its annual revenue (Thorlabs, n.d.). Presently, Thorlabs is the largest employer in Sussex County and a key economic resource for the community.

In this single-case study, it is crucial to evaluate the role that the geographic characteristics of Sussex County played in the development of the optics technology program. Sussex County has limited access to certain economic and educational resources as a forested, rural area. Sussex County Community College is the only higher

education institution in the county, making it a central resource for the region. Through its partnership with Thorlabs, the College assumed a significant role in implementing a new technical education training program to further aid in the economic development in the region. According to interview data, the College being in a rural area seemed to increase the impact of the partnership, particularly in the ability of the College to contribute significant economic opportunity to an economically underdeveloped area. As Participant 1 noted:

> Sussex County was traditionally a very rural county. It was primarily farms and family farms, not a lot of industry. The other thing historically is Sussex County was massive on mining. You look at Franklin and Hardyston, and there were iron mines and things like that. So historically, very agrarian…family farms…mining, but now the mines are gone. All of the mines closed up in the fifties and sixties, and with many family farms, the next generation is not necessarily involved with farming.

This shift away from an agrarian economy has created a gap in employment for many of those living in Sussex County, and along with a need for employment comes a need for training and education. With the community college as the only higher education institution in Sussex, Participant 2 noted that the "college is a living, breathing thing that is integral to the health of everybody in the county." With this in consideration, the partnership between Thorlabs and Sussex County Community College in their development of an optics technology program sought to facilitate regional economic development and to help provide the county, and more precisely, Thorlabs, with a skilled labor force.

Participants

Eleven leaders participated in the interviews, all of whom had a certain level of involvement in establishing the partnership between Sussex County Community College (SCCC) and Thorlabs. Table 3 illustrates the relevant characteristics of the interview participants.

Table 3

Interviewee Characteristics

Organization	Pseudonym	Role in Partnership
SCCC	Participant 1	Funding options and relationships
SCCC	Participant 2	Academic leader, program oversight
SCCC	Participant 3	Program detail oversight
SCCC	Participant 4	Leader, influencer, and overall oversight
SCCC	Participant 5	Program building and implementation
Sussex County Government	Participant 6	County policy, support, and facilitator
Thorlabs	Participant 7	Company liaison and relationship manager
SCCC	Participant 8	Data and accreditation
SCCC	Participant 9	Program building and implementation
Thorlabs	Participant 10	Leader, facilitator, equipment knowledge
Thorlabs	Participant 11	Detailed knowledge of workforce skills needed

Participant 1

Participant 1 had served in his role for over three years and provided significant insight into the College's mission toward regional economic development. During the

partnership with Thorlabs, he helped facilitate funding partnerships to finance the program. According to Participant 1, he helped develop New Jersey Pathways. This initiative involves community colleges, four-year schools, private industry, and economic partners to help residents have accessible education and training opportunities to assist in finding jobs. Participant 1 noted that Pathways provided a $125,000 grant to the College to work with local schools to provide pathways into careers in optics technology.

Additionally, he worked closely with Participant 9 and Participant 5 to build partnerships with optics technology companies throughout the region. He worked with optics partners as well as business partners during his time on the advisory board to help provide financial, philanthropic support for the optics technology program. Participant 1 also assisted in the College securing 1.15 million dollars from the Children's Future Bond Act, which will be utilized in building necessary program expansions.

Participant 2

Participant 2 provided academic leadership and program oversight during the partnership. She had been at the College for 25 years with crucial insight into the institution's inner workings and the history of the College's technical studies degrees. According to her, the institution had attempted numerous career technical programs that had been relatively unsuccessful until 2015, when the current President stepped in. At the same time, she discovered that the College had an additional technical studies degree approved at the state-level but not pursued further. As Participant 2 stated, this unutilized degree, combined with the President's leadership, catalyzed the successful development of various technical degree programs. Through this, she provided insight into the College's history of developing technical studies degrees to enrich the local workforce.

Participant 3

Participant 3 was not directly involved in the partnership with Thorlabs, but she was able to provide observations relating to the growth of the program. She noted that Thorlabs had been a vital partner to the College for many years and that the synergy between both entities was mutually beneficial. According to Participant 3, she had peripheral involvement in the budgeting process of the partnership through the Perkins Grant, where she participated in the financial planning process, budget allocation, and budget review for the partnership between the community college and Thorlabs.

Participant 4

Participant 4 served a critical role in providing leadership, influence, and broad oversight for the development of the partnership between the College and Thorlabs. He provided comprehensive insight and thoughtful reflection regarding the initial conception of the Thorlabs partnership, the challenges faced during its evolution, and precisely how the partnership was motivated by the College's mission toward regional economic development.

According to Participant 4, he met the CEO of Thorlabs during the first two months of his presidency to discuss the various needs of both the College and Thorlabs. However, this conversation did not evolve into building the program until much later, primarily because the College did not have the proper resources or space to house an optics technology program. With this, Participant 4 noted the immense amount of leadership and initiative required of the College to begin program development, particularly with obtaining initial funding, gaining political leverage, and engaging various stakeholders. In his leadership role, Participant 4 was responsible for gaining the county commissioners' approval by securing both public and private funding. After that,

he noted that the main challenge was acquiring further funding for the program. According to Participant 4, much of the funding came from Thorlabs stakeholders and the Foundation at the College. In his discussion of the elements necessary to implement the optics technology program, Participant 4 summarized that "without Thorlabs, political muscle, financial resources and social capital with their business partners and so forth, we would not have been able to get this partnership going and create this optics technology program." Although he attributes much of the program's success to Thorlabs, he discussed the resilience of the College in overcoming significant obstacles during the initial development phase of the program. Namely, Participant 4 took time to discuss the political climate of the County in challenging the program's development.

According to Participant 4, one of the significant challenges associated with the partnership's development was navigating the County and state's complex political landscape. He explored a dimension of political obstacles within the town as a source of adversity during the development of the optics technology degree program. According to him, these political challenges were experienced at different points by all collaborators in the partnership, including the CEO of Thorlabs and the county administrator. Consequently, Participant 4 admitted the significant level of perseverance required to secure funding and support from the County. He emphasized the necessity of engaging various stakeholders and securing both private and public funding as political leverage. Broadly, he stressed the relevance of these political challenges to better understand the network of support, challenges, and leadership requirements when establishing a novel program like the collaboration between the community college and Thorlabs.

However, Participant 4 affirmed the shared mission between the College, Thorlabs, and the county government in desiring the economic well-being and development of Sussex County. He noted these shared objectives of economic prosperity and increased job opportunities for the community and how the College partnered with Thorlabs to accomplish that. He broadly discussed the relationship between the College and the surrounding community. According to him, "If Sussex County Community College does not consider the economic prosperity of the County in which it is nested as a mission priority, it simply does not have its priorities straight. It cannot exist for itself." Participant 4 also took note of the symbiotic relationship of a college and the community surrounding it. Because Sussex County is a rural area and the College is the only higher education institution, it serves as the community's critical education and career development hub. However, the community college cannot sustain itself without a vibrant, prospering community. In this way, Participant 4 highlighted the importance of higher education institutions engaging with local industry to facilitate economic development.

Participant 5

Participant 5 served as the liaison between the community college and Thorlabs throughout the development of the program. He had been working for three years, though his role at the College was his first experience working in a community college environment. In his position, he communicated with Thorlabs to ascertain what a technician coming out of the program needed to know to work in the industry and ensure classes were staffed by instructors with expertise in the field. According to Participant 5, most of the conversations he engaged with Thorlabs involved developing and formalizing the program curriculum and course sequences.

Participant 6

Participant 6 was responsible for evaluating the county budget and promoting the County's economic development, which resulted from his position as the liaison to the Sussex County Economic Development Corporation (SCEDP)—a nonprofit entity tasked with promoting economic development in the County. Participant 6 described that the group was made up of individuals from both local government and private business and was also tangentially related to the Sussex County Chamber of Commerce. He would regularly participate in their meetings and serve on various subcommittees. Through his experience, Participant 6 provided a comprehensive overview of Sussex County's mission for regional economic development and the critical role performed by the planning division in that process.

According to Participant 6, the county government was not involved in promoting the partnership between Thorlabs and the community college, but did support both entities. He noted that the monies supplied to the community college originate from both the State of New Jersey and the County, mainly provided for capital project investment. On this, he did mention that part of the County's responsibility is to maintain and support the work of Sussex County Community College. He described the annual budget process and the community college's presentation to the budget subcommittee, which was how he initially became aware of the College pursuing a collaboration with Thorlabs. In this process, Participant 6 provided recommendations to the Sussex County Board of Commissioners and represented the goals of the College's proposed partnership with Thorlabs. He noted the critical role that the County played in supporting the development of the optics technology program through buy-in from county officials regarding what the community college envisioned for its investments.

In reflecting on the partnership between the College and Thorlabs, Participant 6 also commented more broadly on the role of Sussex County Community College in the County and its overall economic impact. He emphasized the critical value of the College in its mission and capacity to train a local workforce. He also noted the College's history of seeking out opportunities to connect with the community, establishing technical career programs, and training the local workforce to meet the needs of private entities, all prior to the development of the optics technology program. Because of that historical precedence of engagement with the local economy, Participant 6 indicated the College's active participation in the region's economic development.

It is worth noting that Participant 6 replaced the County Commissioner, who was originally involved in approving the partnership between Thorlabs and the community college. During the interview, the County Commissioner was unavailable for comment, as she had retired. Participant 6 sees the partnership from the same lens as the County Commissioner. However, Participant 6's position is not politically elected, so the lens of seeing it from political motivation was lost. However, Participant 6 is charged with economic development, so he is motivated from the perspective of workforce development in comparison to the County Commissioner's political perspective.

Participant 7

Participant 7 served in a project management role while developing the optics technology program with the community college. She said much of her involvement included ensuring the group met necessary deadlines, proofreading essential materials, and ensuring clear communication across the multiple entities engaged in the partnership. Participant 7 was able to provide critical insight into preexisting relationships between the College and Thorlabs prior to the development of the optics technology program. She

noted central figures at Thorlabs responsible for catalyzing the initial program development. Participant 7 also discussed the support provided by the College to Thorlabs, namely through supplying academic expertise, securing funding, engaging with external stakeholders, and developing tours and information days to advertise the program to prospective students. She provided perspective on the College's role in funding the Thorlabs adjuncts and bypassing specific teaching requirements; according to Participant 7, many of the adjuncts lacked two or four-year degrees, but they possessed significant industry experience to supplant that which the College recognized and allowed as they hired optics adjuncts.

Participant 8

Participant 8 worked at the College for over nine years and had been involved in building the program between the College and Thorlabs for over five years. According to Participant 8, his role in the partnership with Thorlabs was to strategize how to establish the connection between the community college and Thorlabs in adapting the industry to an educational model. He also served a crucial role in leading a strategic planning initiative with the Sussex County Economic Development Partnership (SCEDP) to help develop themes, goals, and objectives for economic development expansion in Sussex County. His role provided oversight for the program to collect data from key stakeholders, secure funding, and ensure the partnership between the College and Thorlabs reflected the strategic plan of the community college in supporting the development of the local economy.

Participant 9

Participant 9 was crucial in building and implementing the optics technology program. Before the program's development, Participant 9 coordinated with a fellow

dean, the executive committee, and the board of trustees to initiate an investigation inspired by the College's existing academic programs to evaluate if the College could partner with local industry. Through this experience, he provided vital insight into the College's vision to partner with local industry and further engage the local community. He participated in early discussions and assisted in building a committee to understand what a collaborative partnership with industry might look like, especially as it pertained to the development of curriculum and career opportunities for potential program students. The committee was comprised of members of Thorlabs at various levels of leadership, members of the community college executive team, and department heads within relevant fields such as physics and engineering.

Before developing the optics technology program, Participant 9 had worked in collaboration with Thorlabs on an unrelated career technical program targeting underemployed or displaced workers to provide training in advanced manufacturing. However, the existence of this prior partnership worked to generate familiarity that was helpful for the initial conceptualization of the optics technology program.

According to Participant 9, his initial investigative role transitioned into that of an interim supervisor, where he coordinated directly with adjunct faculty in administering the curriculum. He managed significant financial aspects of the program in securing essential equipment and resources. He was also involved in recruitment and retention community outreach and worked with other industry partners to help build, fund and source the program.

Participant 10

Participant 10 was responsible for facilitating the initial partnership connection between Thorlabs and the community college due to his close positionality to the CEO of

Thorlabs. As a result of his extensive career in the industry, Participant 10 provided a comprehensive perspective on the optics technology industry, its history, and the increased demand for domestic labor following a movement to bring optics manufacturing back into the United States. During the development of the program, he was responsible for communicating the educational needs of Thorlabs and assisted the College in understanding the curriculum necessary for a sufficient optics technology program. Participant 10 was well-versed on the needs of both Thorlabs and Sussex during the partnership and the ability for either entity to fulfill the needs of the other. He noted the strengths of both entities, with the community college's ability to develop academic programs, engage in outreach, and secure funding. He highlighted Thorlabs' ability to provide necessary context and information for curriculum development, obtain funding via key stakeholders, and provide physical space, adjuncts, and equipment for the program during its preliminary phases. Participant 10 also provided insight into Thorlabs' motivation for the partnership, namely in working to create a more skilled workforce to not only fulfill the needs of the company, but to further enrich and economically develop the surrounding community.

Participant 11

Participant 11 was responsible for understanding the needs of Thorlabs, discerning the education required to produce a skilled workforce, and promoting the program to the upcoming workforce in the local community. His role involved visiting local high schools, discussing the industry, how optics technology works, and the opportunities for employment in the field. Participant 11 participated in various webinars, seminars, and trade panels to advertise the program. He noted that before the optics technology program was developed, there was a lack of a clear pathway for those

in the community to get involved in the industry. According to Participant 11, Thorlabs took note of this demand and saw an opportunity for high earning potential. He noted the proximity of the community college as a significant driving factor in the partnership, as well as the College's inclination toward innovative solutions and developing a novel program. Participant 11 provided further details about the College's role in providing funding support and preparing program graduates to become adjuncts. He cited the critical cycle of community engagement with the program at the College, their subsequent involvement at Thorlabs, and their return to the College to instruct the next class of optics technology graduates.

Findings

The data suggest multiple findings, namely that: 1. Regional proximity to Thorlabs was a significant factor in the development of the partnership; 2. Access to funding and the leadership required to secure that funding is advantageous for building a regional networked innovation system; 3. Aligning support from local policymakers, businesses, and the College facilitates regional economic development.

Regional Proximity

One of the most prevalent patterns to emerge throughout all of the qualitative interviews involved participants' framing of the College's proximity to Thorlabs as an essential component of the partnership. With Thorlabs located just 1.6 miles from the College, interviewees cited the proximity as facilitating better communication, increased resource-sharing, and better exposure for the program to the local community. This proximity is also key in understanding the partnership between the College and Thorlabs as a regional networked innovation system, as the network is surrounded by a regional

cluster of supporting institutional infrastructure. According to Participant 5, "having [Thorlabs] right next door was huge for [the College] because it meant that if anything needed to happen between the two spaces, it could happen more or less instantaneously…It is like a satellite campus right down the road." On the matter of communication, he noted, "[the proximity] was essential nonetheless because it allowed that constant line of communication." Although either institution could simply call or email the other, multiple interviewees highlighted that the close proximity between the two allowed for members of either entity to visit the other within a matter of minutes. For instance, Participant 7 noted the flow of employees from either institution visiting the other. She made note of a typical example:

> Two days ago, the college received a new piece of equipment at our recommendation, and it was like, 'Hey guys, this is installed. You've got to come over and see it.' We can just run over and see it. Or if there's a problem with something, if they need help setting something up, we can send one of our techs over and it takes them five minutes to get there. So, I think that's really unique to the situation that we have and it's definitely a benefit.

This ease of accessibility provides opportunities for increased communication in problem-solving that would not be as available if both entities were further from one another. As highlighted by Participant 7, there was somewhat of a casual nature to the communication between the college and Thorlabs that was able to develop as a result of the close proximity.

The positive benefits of the regional proximity between the college and Thorlabs was one that numerous others highlighted. For instance, Participant 9 indicated, "[the

proximity] made [the partnership] a lot easier because it gave more instant access to the institution and labs at all times." As evidenced by what Participant 7 had noted earlier, ease of access between the college and Thorlabs served a critical function in allowing for quick problem-solving and relationship-building. Echoing this, Participant 8 observed that "if they were in Sparta, for instance, or another town within the County, [the partnership] would be slightly more disjointed if we were not in the same town… so I think that proximity is really crucial." Through Participant 8's assertion of what could have been a "disjointed" partnership, he summarizes a key point evidenced throughout the data the partnership between Thorlabs and Sussex County Community College would not have been as cohesive had there been a lack of regional proximity between both institutions.

Participant 10 even highlighted a past partnership that Thorlabs had attempted with a different higher education institution, stating that,

> Early on, even before I reached out to Sussex, way before that, I reached out to [another school] and I went and visited [them] a couple of times. We hired some people that went to school there, and we developed a nice relationship…So we went there and visited them a couple of times, and it started out well for a while. And I think after a while it fell off.

In discussing the key factor that presented issues in developing a successful partnership then, Participant 10 simply noted that, "the location was a problem." Through this, Participant 10 provides another perspective on why proximity can serve as a critical factor for a successful (or unsuccessful) partnership between a higher education institution and industry.

During the partnership's initial stages, Thorlabs and the College shared several resources to help galvanize the program. Because Sussex County Community College lacked adjunct faculty with expertise in the field and a space on campus to house an optics technology program, the two entities could share resources with Thorlabs, holding courses at Thorlabs with their expert technicians as adjunct faculty. The College provided general education, funding for adjuncts, and a pathway to a degree. In this way, the proximity to Thorlabs was critical for allowing students flexibility in attending classes in either location. As Participant 2 noted:

> I think [the proximity] is more accessible for students who, if they are in a program of study, and it is not simply that they are taking optics courses, but they also need to take a history class and English class. I mean, yes, they could have looked online. Not every student wants online. So there is a proximity to the campus.

For students in the optics technology program who need to complete general education requirements as well as their technical training, the proximity of both entities helps ensure that students are able build a schedule that allows for minimal travel between either entity while still maintaining adequate completion of the courses required of the program. Had there been a significant distance between Thorlabs and the College, the lack of proximity may have prevented students from entering the program. Participant 2 noted this in her statement, "[Distance] is not going to attract students to the program." As indicated by Participant 2, a lack of proximity and the travel required of students to commute between the college and Thorlabs might have made it difficult for the college to market the optics technology program to prospective students. Without sufficient

enrollment, the program would not be able to succeed in its mission of helping to produce a skilled labor force for the local economy.

Because both entities lacked the necessary components for developing an optics technology program on their own, resource-sharing between institutions was crucial to implementing the initiative. The college did not have the on-campus space or faculty expertise for the optics program, so Thorlabs was instrumental in the program's launch by providing access to their internal space and staff. In order to teach at the college, faculty are required to have a four-year degree, which many of the Thorlabs employees lacked. Despite this, the College bypassed those requirements in favor of valuing the employees' industry expertise; this bypass emphasizes the College's knowledge and initiative within the partnership as it pertained to the administrative development of the program. Without this administrative bypass, the college would not have been able to utilize the available resources of knowledgeable Thorlabs employees who could facilitate instruction for students in the program.

This level of resource sharing would not have been possible without the close regional proximity of both institutions, mentioned by interviewees from both the College and Thorlabs. Participant 7 noted that "having the county college here allows us to have employees that come in and work nearly a full workday and then go to courses [some as students in the program and some as adjunct faculty]…I think it makes a huge difference that a matter of a couple of miles separates us." For Participant 10, he revealed that "the location was a problem [during a former partnership]." And, very plainly, Participant 11 admitted that "we decided to partner with SCCC because they were close by." These references to the regional proximity of the College to Thorlabs highlight the extent to

which the minimal distance between both entities allowed an increase in resource sharing and ultimately assisted in the implementation of the program.

The regional proximity of Thorlabs and Sussex County Community College is also beneficial in that there exists a combined exposure both entities have with the local community. Thorlabs is the largest employer in Sussex County, so the company is the employer of many local workers; additionally, Sussex County Community College is the only higher education institution in the county, so the two entities are recognizable names for the local community. Many in the community have a relationship to either entity via personal experience or exposure to either entity via friends or family members. Highlighting this point, Participant 5 noted:

> If a student comes in from, say, Newton High School, right…there is a pretty good chance that they are going to be talking with employees from Thorlabs, whether or not they are learning from someone from Thorlabs, whether or not they have ever stepped foot in the building.

This level of community exposure, critical to the establishment of a regional networked innovation system, illustrates that the regional proximity between Thorlabs and the community college was helpful in informing the local community about the emerging optics technology program, as the partnership involved two well-known entities within the county.

Access to Funding & Access to Leadership Necessary to Secure Resources

An additional pattern that emerged within the data suggests access to funding and access to strong leadership in securing funding is beneficial for building a regional networked innovation system. Multiple interviewees highlighted the necessity of strong

leadership for forming critical connections with stakeholders and securing essential funding for the program to afford key equipment and space renovations. It was through the leadership role assumed by Sussex County Community College and the outreach that they were able to perform with community organizations and donors that they were able to contribute significant funding support for the program.

SCCC assumed a significant leadership role in acquiring grants and funding to help finance the development of the optics technology program, with participants citing the Securing Our Children's Future Bond Act as a key source of funding to ensure space was created for the program. For the College, obtaining this grant was essential to the continued growth and development of the optics program. One of the challenges initially identified by Participant 4 during his very first conversation with the CEO of Thorlabs in December 2015 was that Sussex County Community College had no space to house equipment for a proper optics technology program. By acquiring funds from the Securing Our Children's Future Bond Act in Fall 2022 to ensure space was created for the program, the College took significant initiative to further the program's development. Participants 8, 5, 1, 4, and 9 all noted that the College was acquiring a share of the Securing Our Children's Future Bond Act (Sussex County Community College, 2022). Participant 9 indicated that "[the Bond Act] will allow us to expand another 2,500 square feet onto our existing building and outfit ourselves very shortly to have a 100% in-house, on-campus Optics Technology Center." Beyond the Securing Our Children's Future Bond Act, many participants noted the College's leveraging of the Perkins Grant and other state grants to fund equipment for the partnership. This acquisition of government funding was

highly important for addressing the college's material needs pertaining to space and equipment as they developed the optics technology program.

As it pertains to funding, the college also spearheaded securing funding from private donors. Participant 1 highlighted multiple anonymous donors and how fundamental their support was that they provided to the program, particularly during its initial stages. Upon reflecting on a $96,000 anonymous donation for optics technology equipment, he stated, "The Foundation is working to build that financial support, that budget-relieving support for a lot of the equipment and faculty and staff support." Per Participant 1, that donor was an individual who worked in the field and had been brought forward by a member of the advisory board Sussex had established with the purpose of gathering key stakeholders together.

Participant 1's interview shed light on how Sussex played a significant role in securing funding support toward the development of the optics technology program.

However, one interviewee did voice that the acquisition of funding was not solely for securing equipment and developing an on-campus space for the program. In many ways, the college securing funding helped secure another key resource: political support. According to Participant 4, Sussex obtaining private donations helped further the program politically. Leveraging the college's access to funding was key to securing political support; as highlighted during the Participant 4's interview, navigating the political landscape of the county was a challenge for Sussex during the implementation of the optics technology program. According to him:

> [The private funding] allowed us to have some political leverage with the commissioner saying, look, we have a private donation from the McGuire

> Brothers of $250,000. We've got four labs contributing private dollars. We have private dollars coming from…Eastern Maine Medical Center from Newton Medical Center in the amount of $25,000 a year because of Joe DePalo.

Participant 4 directly highlighted the role of authority held by the County Commissioner, with the college needing to secure county approval from him in order to move forward with the program. Considering Participant 4's emphasis on the political landscape's role in establishing the optics program, it is worth noting the function that funding serves as political capital. Participant 4's mention of previously-acquired funding as a persuasive tool to win political support highlights the dual nature of funding; not only does funding serve to help in the implementation of a program, but it can help in navigating the political landscape surrounding a program.

Aligning Support for Regional Economic Development

Multiple interviewees emphasized the importance of aligning a shared economic development mission and garnering support among local policymakers, businesses, and the College as an avenue for regional economic development. Participant 8 commented on the importance of that dynamic several times, especially in his discussion of working with the SCEDP, the Chamber of Commerce, and county officials. He warned that if the College could not garner support from local policymakers, the program would have been challenging to establish, noting, "if you don't have the buy-in of the municipality or the town you're building in, they might not be as friendly to a model like this." To facilitate clear communication and a shared, established goal, Participant 4's strategic planning session at the SCEDP in April 2016 helped facilitate a more universal understanding of the region's economic development goals. According to him, "there were 10 or 11

[partnership members] from all industry sectors at the time… We connected ideas, developed themes, developed goals, developed objectives that each creates a synergy essentially between all townships in the county." The exercise performed in that meeting indicates the importance of establishing common objectives between local government and industry members to mobilize. Without shared goals, Participant 4 suggests that developing programs might lack the necessary support from key stakeholders.

Participant 6 commented on the critical importance of officials staying informed on the economic development plans of businesses across the County. According to him, officials need to be made aware of development programs, mainly because of the impact that they can have on land usage and county infrastructure. He noted that emerging capital projects could also have an immense impact on the workforce of a particular area. As a result, the planning division was interested in understanding the existing needs of the county workforce. More broadly, by understanding the needs of private businesses and the workforce, Participant 6 noted that this "would then in turn help develop and cultivate a local workforce that would be complementary to the private investment being made by businesses throughout the county." This was particularly relevant during the initial stages of the optics technology program when the County reviewed the proposed optics program. Participant 6 made multiple mentions of the county government and Sussex County Community College participating in the Sussex County Economic Development Partnership (SCEDP) to facilitate economic development in the region. He noted the importance of this, as well as the shared mission between both the County and the College:

> And so then the projects that would be advanced by the College would come before that group. And then in turn, because of our mutual participation, the mutual participation being that of the College as well as the County, we would then have access to the larger business community in the County to share what projects were being considered, pursued, implemented, and ultimately funded in part through the County's responsibility of maintaining and supporting the work of Sussex County Community College.

Participant 6's reference to the support provided to Sussex by the County alludes to the dynamic of co-leadership of both entities in furthering the region's economic development. He reiterated this idea once more when again describing the dynamic between both entities:

> What I found in my role as county administrator was that being able to partner with the College and having opportunities, both at budget time as well as other planning meetings with the College throughout the year, would allow the college board of trustees and the county board of commissioners to better understand what each entity's goals were and how to bring those goals into harmony. And once those goals achieved some amount of harmony or at least understanding, then when budgets would be considered that the resources that would be given to the community college would be in support of and coordinated with the larger county operations.

In his interview, Participant 6 emphasized the benefit of having a shared economic vision to ensure that projects in their initial stages aligned with the desired trajectory that the County had for the development of the region. This idea was similarly emphasized by

Participant 4 in noting that "it was key that we moved forward [with the optics program] while also collecting feedback from other stakeholders." In this, he discussed how connections to other stakeholders, particularly from the county, was critical to align the economic development plan of the college with the surrounding economic infrastructure of the county.

In discussing the SCEDP, Participant 6 made note of the economic development benefits that come from partnerships between different entities within a given region, especially a rural region with its unique economic challenges. Talking broadly of this idea, he noted:

> There are tangible benefits to not only partnerships but cooperation with other entities, whether those are public entities such as the relationship between the County and the community college, the County and private business, the County working with an entity such as the Sussex County Economic Development Corporation, and that there are real benefits to be had in having both the opportunity as well as the forum to be able to share ideas, to harmonize goals, and to be able to have a real impact on economic development within a rural part of New Jersey.

In this statement, he provides an economic perspective that values collaboration and communication via the SCEDP and provides an underlying basis of support for the cooperative partnership between higher education and industry. He goes on to note the compelling representation of the College on the SCEDP in their promotion of the education-industry partnership with Thorlabs:

> I can recall at least one, if not more meetings where that program was discussed that was advanced by the College's representative on the Development Corporation board. And my recollection is that the presentation of that was very well received by those members on the board who represented a cross section of businesses throughout the County, and I believe that it was well understood by that group the value of such strategic partnership would have in the development, the economic development of the County more broadly.

From Participant 6's economically motivated position in the County, his perception of the partnership, especially as it was pitched to the SCEDP, was one accepted for its high potential for economic development in the rural region. That perspective is more economically centered, whereas the County Commissioner, who was unavailable for interview, might have provided a more politically motivated perspective on the partnership and the County's reception of it.

However, Participant 6's emphasis on economics helps to affirm the existing supposition that the College played a significant role in facilitating the shared economic mission of not only the College and Thorlabs, but of the County too.

Participant 4 reaffirmed the idea presented by Participant 6 about the high potential for economic development as a result of the partnership. On discussing the mission of the partnership, he notes:

> Our point [of the optics technology program] is to try to create a circumstance in which economic prosperity exists and economic opportunity exists in the county so that the students that we teach and the students that we graduate will have

> some interest in staying and contributing to the ongoing economic prosperity of the county.

According to him, in a rural region with unique economic challenges, the development of the optics technology program would offer a new avenue for technical training and employment, with the opportunity to contribute more greatly to the economic development of the region as a whole. In this way, Participant 4 further reinforced the college's mission to serve in the development of the local economy and the county's prosperity.

Part of aligning the economic development mission of the College with that of other businesses involved direct networking with other optics companies who could then become stakeholders in the program. According to Participant 9, Participant 1 served a crucial role in engaging outside partners:

> [Participant 1 and his team] were tasked with making [connections], they had the initial connections there, but really sort of being the boots on the ground to go to actually go out to these CEOs of [other optics technology companies], discuss their needs and then talk about what financial support or other support that they were willing to provide in the early stages of the overall development of this program.

By engaging various stakeholders, Participant 1 established a developing network of support from local and outside business leaders in the optics industry, many of whom were interested in the possibility of establishing a similar program for themselves, thereby increasing the overall buy-in for the program. As Participant 4 noted, buy-in from local industry leaders and the financial aid they can provide toward a shared economic

mission can serve as leverage for support from policymakers within a challenging political landscape.

In addition to his work securing support from other industry partners, Participant 1 took significant initiative with the development of New Jersey Pathways, a program that facilitates collaborations between community colleges, private industries, and economic partners to guarantee accessible educational and training options for New Jersey residents, aiding them in securing employment opportunities. Participant 1 noted that "one of [Pathways'] goals is so that any consortium, any area of study…that a community college could possibly have, whether it be machine tool or manufacturing or anything else…it's important that you have the partnerships." Because the program seeks to "create an aligned education and workforce development ecosystem" in New Jersey, Sussex County Community College's involvement in the program helped to inform other companies interested in developing optics technology programs, thereby further increasing the network of buy-in, both in overall support and in funding.

Because Sussex County Community College is aware of the importance of communicating and developing a shared goal about regional economic development, they took multiple steps to ensure that the optics technology program was aligned with the goals of business leaders, policymakers, the institution's economic mission to support the local economy, as well as other community college's education and economic goals. By facilitating strategic communication and planning with key community members during the SCEDP meetings regarding the development of Sussex County's regional economic development, the College played an integral role in fostering a shared economic vision for the future of the County.

Conclusion

This chapter provided the geographical, situational, and institutional context for each entity involved in the partnership, as well as the findings of the qualitative interviews. Each entity was analyzed using a thematic analysis to approach propositions and rival explanations as a means of understanding the phenomenon of a regional networked innovation system in a real-world context.

Chapter 5

Discussion and Implications

Regional innovation systems in rural areas involve collaborative efforts among communities, colleges, and stakeholders to foster an environment that promotes innovation and economic growth (Asheim & Isaksen, 1997 & 2002; Charles, 2016; Doloreux & Parto, 2005). Community colleges play a vital role in these regions by offering educational opportunities and resources to rural communities and granting access to technology, research, and training for developing new products and services (Charles, 2016; Lane et al., 2012). Moreover, these community colleges contribute to cultivating a culture of innovation and entrepreneurship in rural regions, leading to enhanced economic development (Lane et al., 2012).

Lately, New Jersey community colleges, and others nationally, have been challenged by an overall decline in enrollment (NJ Office of the State Comptroller, 2023); consequently, in certain cases, county commissioners may experience significant pressure to justify an increase in aid from local government. In rural communities, the development of new information technologies, the prevalence of mass media, and the influence of multinational free trade agreements have triggered significant economic and social shifts within those communities (Schafft & Jackson, 2010). This emerging socio-economic landscape demands innovation from local infrastructure in meeting the developing needs of the rural community. Identifying how higher education institutions can contribute to a region's development and competitiveness is crucial for the region's success (Doloreux & Parto, 2005); therefore, the sustainability of New Jersey's rural

community colleges inheres on an understanding of their role within regional innovation systems.

During the partnership between Sussex County Community College and Thorlabs in their development of an optics technology program, both entities engaged in knowledge-sharing, collaborative resource pooling, and leveraging support from external stakeholders to develop the program and, ultimately, contribute to the region's economic development. This study evaluated the convergence of three components necessary to discern the partnership as a reflection of a "regional networked innovation system" (Asheim & Isaksen, 2002, p.83). Namely, the study evaluated the extent to which geographic and regional proximity played a role in the development of the partnership, the extent to which the community college contributed support and the role of the community college in fostering a shared regional economic development mission between the local academia-industry-government-community.

The findings in this study provide a qualitative perspective to understanding how community colleges can leverage collaborations with other entities in regional innovation systems to develop new academic programs, increase enrollment, influence support from county policymakers, and better support employers in a region to develop a skilled workforce. Current research involving regional innovation systems is rooted within two distinct frameworks—innovation systems and regional science (Doloreux & Parto, 2005). While innovation systems view innovation as an evolving social process (Edquist, 2004), regional science theory emphasizes localized and embedded innovation, contrasting that, instead, it occurs as a place-specific phenomenon (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Storper, 1997). Both theories identify a regional innovation system through

collaborative innovation activities among businesses and knowledge-creating institutions (Doloreux & Parto, 2005). Edquist (2004) notes that a critical component of innovation systems is that the capacity of an economy to produce innovations depends on the performance and interaction of individual actors within a system.

This single-case study involved qualitative analysis of data from interviews with higher education, local industry, and county government leaders and Thorlabs, as well as key documents The data collected provided insight of the role played by the community college in acquiring funding and developing the academic program, and the participants were able to provide various perspectives on the resources, knowledge-sharing, and regional proximity required for the development of such a program. The data collected about implementing the optics technology program can help other leaders at community colleges, particularly those within rural regions, understand the benefits of engaging in their regional innovation system.

This single-case study was selected with consideration of Yin's (2014) critical case rationale, as this study aimed to understand the nature of the regional innovation system that occurred when a community college and the private sector collaborated to develop an optics technology academic program. Asheim & Isaksen's (2002) theoretical framework of the "regional networked innovation system" (p.83) provided a lens to analyze the regional proximity of the College and Thorlabs as representing a regional cluster of the innovation system. This study's theoretical propositions and rival explanations focused on connecting the institutional actions of the community college during the partnership with that of the regional innovation system.

This chapter addresses the research gaps found in the literature on rural regions in regional innovation systems and answers the guiding research questions. The chapter begins by addressing each research question, proposition, and rival explanation in light of the insights discussed during Chapter 4 as well as the current theoretical framework. The institutional actions cited by interviewees aligns with regional science theory's assertion of innovation as a localized and locally embedded process, not a placeless one (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Storper, 1997). As part of the shared geographic proximity, facilitating knowledge-sharing, providing academic leadership, and acquiring financial support were identified as crucial innovation activities demonstrated by the College (Doloreux & Parto, 2005). Further in the chapter, I discuss implications for regional policy, practice, and community college-industry collaborations and provide perspectives and recommendations on strengthening regional innovation systems. Finally, I discuss the study's limitations, suggestions for future research, and my conclusion.

RQ1: Geographical and Regional Proximity Reflects the Networked Innovation System

My first research question asked how the geographical and relational proximity of this single-case study reflects the characteristics of a regional cluster as cited in Asheim & Isaksen's (2002) "regional networked innovation system" (p.83). While innovation systems focus on creating and diffusing knowledge and technology, regional science looks at spatial and policy factors that influence economic outcomes in a particular region (Asheim & Isaksen, 2002; Doloreux & Parto, 2005).

The geographical closeness between Sussex County Community College and Thorlabs was a significant factor in the development of the partnership, in part because the proximity facilitated more vital communication and increased resource-sharing. The proximity enabled instant access to the physical campus of either entity, making the partnership more cohesive and fostering stronger ties between the community college and Thorlabs. This proximity not only eased some of the logistical challenges involving a lack of on-campus space and faculty expertise but also helped attract students and engage the community, which was crucial for the program's success. Members of Thorlabs cited previous challenges the company had encountered in attempting to form partnerships with other entities. They noted that they had struggled to maintain certain partnerships due to the difficulty of increased geographical distance, highlighting the significance of regional proximity in establishing a successful innovation system. These findings supported my proposition, grounded in regional science theory, that the community college used geographical and relational proximity to become part of the regional support for innovative activities of Thorlabs, a private firm.

In rural areas, limited economic and educational prospects and inadequate access to technological infrastructure are common challenges (Brown et al., 2003). Establishing a "regional networked innovation system" (Asheim & Isaksen, 2002, p.83) can empower these communities to address local issues, capitalize on existing resources, and foster the growth of local businesses, technologies, and industries. This, in turn, creates job opportunities and expands economic prospects (Asheim & Isaksen, 1997; Doloreux & Parto, 2005). A rural community college plays a crucial role in this regional innovation system by offering essential technical training tailored to emerging technologies of the

local community that are in demand (Charles, 2016). As the sole higher education institute in a heavily forested, rural county, the college played a pivotal role in bridging an existing gap in technical education, thereby enhancing the regional economic prospects for community members. In this way, the relational proximity of the community college to the rural community surrounding it was critical to establishing the partnership within the regional cluster and the subsequent economic benefits generated for local industry and the community.

The close regional proximity between Thorlabs and the College facilitated the reciprocity of knowledge-sharing and resource allocation. These findings agree with existing literature in that the resource and knowledge-sharing that occurred between the college and Thorlabs aligns with the common features characteristic to regional clusters. Broadly, regional clusters are explained as a category of firms, government and educational institutions, and support services close to each other (Asheim & Isaksen, 2002; Doloreux & Parto, 2005; Storper, 1997). The College's proximity to Thorlabs situates both entities within the same regional cluster. More precisely though, the actors within a regional cluster generate widespread and systemic impacts, fostering the development of unique forms of capital by local private firms. This capital can be derived from social connections, community norms, values, and relationships, contributing to the enhancement of regional innovative capability and competitiveness (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). These regional clusters share common features such as expert knowledge, proximity, and collaboration, resulting in spillovers and synergies within the regional innovation system (Asheim & Isaksen, 2002; Doloreux & Parto, 2005). The sharing of resources and knowledge between the college

and Thorlabs as two entities with regional proximity aligns with the existing literature on regional clusters.

This research question had one rival explanation that can be divided into subparts for the sake of a more thorough analysis. The first was that the community college would not engage with other entities in the regional cluster and would attempt to remain independent. I found no evidence to support this subpart of the rival explanation. On the contrary, the leadership of all three entities cited the College's readiness to engage with other actors in the regional cluster, with a key example being the College's involvement in the Sussex County Economic Development Partnership (SCEDP).

The second subpart of the rival explanation involved the College's role as an educational institution in the regional innovation system, namely that the College would not engage in developing a technical program and would instead solely focus on general education. As evidenced by the partnership with Thorlabs and the College's history with professional degree programs, Sussex County Community College has extended its offerings beyond general education requirements. Prior to the development of the optics technology program, Sussex had developed numerous career and technical degree paths, some of which include automotive service technology, agricultural business, cosmetology, and welding ("Career & Technical Programs," n.d). These technical degree paths serve the community by producing a skilled workforce that can help enrich the county's economic landscape.

The third subpart of this rival explanation assumed that the development of the optics technology program would not have been an institutional action representative of the College's mission. However, the institutional actions of the College illustrate a clear

mission to support the local economy, again illustrated through their prior involvement in the SCEDP and development of other technical degree programs. The College's economic mission was validated numerous times by leaders from all three entities surveyed; participants from the college community, Thorlabs, and the county government all affirmed that the College remains committed to fostering economic development and supporting local industry in the surrounding county.

The final subpart of the rival explanation for this research question involved the alternative connections the college could have made to develop a technical degree program. This subpart proposed that the College would connect with another higher education institution in their development of a technical degree program rather than directly engage with local industry. Although the College might have been able to mimic the structure of another higher education technical degree program, there was no evidence that this was ever a consideration of the College, as the initial building of the optics technology program originated from a conversation between leadership from Thorlabs and the College. In this way, the initial relationship-building and subsequent program development between the College and Thorlabs demonstrates the utility of program building within a given regional cluster. Consequently, this rival explanation was rejected.

RQ2: Role of the Community College in Regional Cluster

My second research question asked about the role that the community college played in the regional cluster of the regional innovation system. Regional innovation systems are characterized by innovations emerging from continuous and extended collaboration and interaction among firms and various stakeholders (Edquist, 2004).

Sussex County Community College played an active, continuous leadership role in developing the optics technology program. Their dynamic leadership was fundamental in establishing connections with industry leaders, community organizations, and with the acquisition of both public and private funding. College leaders actively engaged with various stakeholders, forming an advisory board and collaborating with outside organizations to increase community exposure to the program. Access to grants, particularly the Securing Our Children's Future Bond Act and private donations, provided essential financial support.

Edquist (2004) notes a number of important activities in systems of innovation, some of which include: the supply of research and development (R&D) to generate new knowledge; enhancing the skills of the workforce for use in innovation and R&D endeavors; establishing new markets for products; articulating quality standards based on demand for new products; establishing organizations necessary for the advancement of innovative fields; incubation initiatives; funding innovation processes; and offering relevant consultancy services for innovation processes. During the partnership, the College played a pivotal role in carrying out multiple of the important activities outlined by Edquist (2004).

The advisory committee established by the college during the initial stages of the partnership was valuable in constructing a system of representation and clear communication between Thorlabs and the College. The establishment of the advisory board aligns with allowing the demand side of the partnership to articulate quality requirements about new products (Edquist, 2004). By providing Thorlabs a forum to communicate their needs about the educational requirements required of an optics

technology degree, Sussex facilitated a critical conversation about how the emerging workforce could best be educated in a way that would mutually benefit both parties; Thorlabs could ensure proper training for prospective employees, and the College could secure expert knowledge that would be used in formulating the program structure.

As it pertained to academic and administrative matters, college leadership was instrumental in developing the optics technology program. Because the College lacked experts to provide instruction to incoming students, Thorlabs was able to supply a series of expert employees to deliver program instruction. However, interview data from Thorlabs revealed the critical role that the College played in bypassing the hiring degree requirements for the adjuncts Thorlabs provided the program. In this way, the academic and administrative expertise of the College in its maneuver around the hiring requirements acted as an incubator activity (Edquist, 2004) to facilitate growth for the optics technology program. The ability and initiative of the College to navigate around that requirement was instrumental in the development of the program.

Sussex adopted another considerable leadership role as it pertained to the acquisition of funding, another critical activity within a system of innovation (Edquist, 2004). Leaders from both the College and Thorlabs discussed the College's initiative in securing public and private grant funding, as well as private donations through the College's Foundation. By securing funding, the College assumed responsibility for obtaining critical resources necessary for the implementation of the optics technology degree.

Serving a pivotal role in the regional innovation system, the College acted as a critical source of skilled labor, addressing gaps in technical education and facilitating

workforce training. Through partnerships like the one with Thorlabs, the College bridged these gaps, enhanced the region's workforce capabilities, and contributed significantly to the innovation system. In this way, the College performed another important activity of a system of innovation: enhancing the skills of the workforce for use in innovation (Edquist, 2004). By strengthening the workforce capabilities of those involved in the technical degree program, the College helped promote general economic development of the rural region by creating skilled labor pipelines to support the county's industries.

Research question two had one rival explanation. Instead of building in-house and securing their own resources, the College could have connected with higher education institutions outside of the region to secure key assets necessary for the development of the program. Interviews with leaders from all three entities point to the College's continued activities within the regional cluster as the central manner by which the College acquired the means to establish an optics program. Rather than find resources beyond the regional cluster, the College assumed a leadership role in the execution of numerous important activities within the system of innovation (Edquist, 2004). Consequently, this rival explanation was rejected.

RQ3: Fostering a Shared Regional Economic Development Vision

The third research question involved the role assumed by the community college in fostering a shared economic vision between the academia-industry-government-community actors in the regional cluster. The College's participation in the SCEDP and collaborative projects with Thorlabs demonstrated their active involvement in aligning academic curriculum development, industry workforce needs, and governmental goals. By facilitating cooperation and understanding between academia, industry, government,

and the community via strategic planning initiatives, the community college facilitated communication so that the economic development goals of all stakeholders were coordinated for more effective action to be taken toward a shared vision for the region.

Aligning support between the College, local policymakers, and businesses was conducive to generating a shared regional economic vision which helped guide the important activities (Edquist, 2004) taken by each actor during the partnership. College leadership leading strategic planning sessions with organizations like the Sussex County Economic Development Partnership (SCEDP) helped establish common goals among academia-industry-government, fostering a shared economic vision. College leaders engaging optics industry partners as a way to secure funding increased buy-in and financial support for the program and expanded the economic vision to a wider community. Furthermore, the College's involvement in initiatives like New Jersey Pathways generated critical financial support and emphasized the importance of forming partnerships to create a cohesive education and workforce vision. The partnership between Sussex County Community College and Thorlabs not only met an educational gap that existed in the community, but also contributed significantly to the local economy, emphasizing the vital role of community colleges in fostering regional economic development.

Ultimately, this question considers the influence of the community college as part of the quadruple helix model (Kolehmainen et al., 2015; Nordberg et al., 2020) in cultivating similar visions concerning the future of each actor within the region. In this way, the community college assumed a crucial role in bridging societal needs and innovation with the other key components of the quadruple helix model. Their focus was

on advocating for the integration and interaction among these helices, fostering the knowledge-sharing essential for innovation processes (Nordberg et al., 2020). Much of the knowledge-sharing that occurred during the partnership ensued as a result of the leadership assumed by the College in connecting with other actors in the region. Through the leadership of the College in connecting with Thorlabs, the College was able to leverage the support Thorlabs had access to as a way of increasing the network of buy-in from the community. Thorlabs actively engaged with the local community and optics industry partners to create awareness about the program. Outreach efforts included high school visits, webinars, seminars, and panels about the program. This early exposure built a strong network of community and industry support. Leveraging this support, Thorlabs was able to assist the community college in securing grants, business funding, and general exposure for the program. In evaluating qualitative data from Thorlabs, the findings underscore the importance of geographical proximity, leadership from actors, resource sharing, and community engagement within the quadruple helix model in a rural region (Kolehmainen et al., 2015; Nordberg et al., 2020) as a way of fostering successful collaborations between industry and community colleges.

This research question had one rival explanation, which, for the sake of providing a more comprehensive analytic lens when evaluating the data, was broken into four subparts, all of which asserted that the community college would not engage with various actors in the region. This rival explanation asserted that the community college would fail to engage with the SCEDP, the Chamber of Commerce, the county government, or with industry leaders while attempting to foster a shared economic vision. As illustrated by the data, there was no evidence to suggest that the community college was not willing

or able to engage with actors in the region. Rather, the community college was proactive in engaging with each of the entities mentioned (SCEDP, Chamber of Commerce, county government, and industry leaders) both prior to and during the development of the partnership with Thorlabs. The College's previous strategic planning initiative at SCEDP demonstrates the proactive approach taken by the College to facilitate a shared economic vision for the region. With ample evidence confirming the active role taken by the community college in engaging with other actors in the region, these rival explanations were rejected.

In conclusion, the analysis of the partnership between Sussex County Community College and Thorlabs illuminates a regional networked innovation system, affirming the theoretical framework proposed by Asheim and Isaksen (2002). The findings reveal that the geographical and relational proximity played a pivotal role in fostering collaboration, facilitating knowledge-sharing, and promoting resource pooling among actors in the regional cluster. The community college emerged as a key player in the regional cluster, actively engaging in critical activities within the innovation system, such as articulating quality standards and securing funding. Additionally, the college's leadership in strategic planning sessions fostered a shared regional economic vision, aligning academia, industry, government, and the community towards common goals. The findings underscore the importance of geographical proximity, leadership, resource-sharing, and community engagement within the quadruple helix model, providing a blueprint for successful collaborations between community colleges and industry partners in fostering innovation and regional development.

Implications for Regional Policy and Practice

While the regional innovation literature has predominantly concentrated on urban areas with access to universities (Vorley & Nelles, 2012; Etzkowitz & Leydesdorff, 1999), discussions on rural entrepreneurship (Deakins, 2006; Habersetzer et al., 2021) emphasize that rural regions possess unique innovation characteristics. By establishing an innovation system, rural communities can enhance their ability to address local challenges and leverage existing resources for the development of local businesses, technologies, and industries. This, in turn, fosters job creation and broadens economic opportunities (Asheim & Isaksen, 1997; Charles, 2016; Doloreux & Parto, 2005). The findings in this study can help inform regional economic policies and assist leaders in a regional cluster to identify practical strategies for enhancing education-industry collaborations.

In particular, the partnership between the community college and Thorlabs emerging from a rural region emphasized the benefits of proximity and localization in the regional innovation system. The findings also provided practical examples of the potential for economic development within rural regions. As noted in the timeline (Appendix D), the initial conversation between the CEO of Thorlabs and Participant 4 was vital to the development of the optics technology program. According to Kalaschevska (2018) and Zhu et al. (2015), rural regions in countries developing under market economy conditions possess significant economic, natural, demographic, and sociocultural potential; therefore, it is critical that policymakers, higher education executives, and private industry leaders engage in ongoing, collaborative conversations to aid in facilitating partnerships among regional actors.

It is also critical to consider the role of the community college within the rural region to provide perspective for stakeholders about community colleges' ability to impact the economic development of a given region. The findings assert that the community college played a significant role in facilitating critical conversation and planning among key stakeholders regarding economic development. Local stakeholders should be informed about the ways in which community colleges can positively influence the economic development of a region in order to better understand how to support them in those activities. This can be achieved via communication with the local Chamber of Commerce, as well as establishing a committee geared toward economic development, similar to the SCEDP and the role it served in generating a shared economic mission among various entities in the county. Ultimately, it is key to make economic development a collaborative effort with open communication, especially in rural counties where areas might be faced with unique economic challenges.

Yet, even with the potential for these industry-academia partnerships to catalyze economic development in a region, it is important to consider the critique of academic capitalism in its potential to undermine the core mission of higher education institutions. According to Slaughter and Rhoades (2004), the potential erosion of academic integrity and the prioritization of market-driven interests over educational values are concerns that institutional leaders should take into account; effectively, the pursuit of profits may jeopardize the fundamental mission of universities—to advance knowledge and deliver high-quality education. This single-case study inserted a community college into the conversation of regional innovation, and more broadly, into that of academic capitalism, though not without recognition of Slaughter and Rhoades' (2004) critique. With

increasing difficulties of enrollment and funding, institutional leaders must find a proper balance between the institution's participation in innovative activities with that of honoring the fundamental principles of higher education.

The single-case study helped add to the existing body of evidence that collaborations between higher education and industry facilitate better engagement with the local government and the surrounding community. Newfield (2004) notes that colleges that are engaged and collaborate in industry-business partnerships receive more private-sector attention. That recognition can then lead to an increase in scholarship contributions and growth in funding for faculty and staff positions. This attention can also provide colleges with insight to keep them informed about current workforce needs, facilitating the development of pertinent curricula to address those requirements. Leaders in higher education should consider similar partnerships as a way to secure the benefits of regional collaboration. Not only does this benefit the educational institution themselves, but it creates a feedback loop of fostering economic development within a given region, thereby generating a more robust socio-economic landscape. That economic development can create mutual benefit for the community, local government, and higher education institutions; in turn, these partnerships can forge a stronger connection between each actor in the region, particularly if a given entity is interested in collaboration as a means of enriching the wider community.

Implications for Theory

While the literature on regional innovation typically focuses on urban regions with universities (Vorley & Nelles, 2012; Etzkowitz & Leydesdorff, 1999), the literature on rural entrepreneurship (Deakins, 2006; Habersetzer et al., 2021) argues that rural

regions possess unique innovation characteristics and receive taxpayer-funded grants for startups and research. By establishing an innovation system, rural communities can enhance their capacity to address local issues, leveraging existing resources to develop local businesses, technologies, and industries, thereby creating more jobs and broader economic opportunities (Asheim & Isaksen, 1997; Charles, 2016; Doloreux & Parto, 2005). This single-case study provided a practical application of existing theory on regional innovation systems to highlight the ability of academia-industry partnerships in the rural region to share resources between a rural community college and an innovative industry partner; this study also provided insights into the role of the rural community college in partnership with local industry to drive local economic development. In addition, it provided potential areas for improvement for rural community colleges to stay informed on current workforce needs and to have a better understanding of the collaboration involved in creating a compelling economic development mission with local stakeholders. Such actions and partnerships can lead to increased scholarship contributions and expanded access for economically disadvantaged students.

Limitations of the Study

This study focused on qualitative data from three helices of a triple/quadruple helix model within a regional innovation system. Namely, the study included interview data from a higher education institution, industry leader, and government office. Yet, a limitation of the study was that there was an unequal distribution of interview data from each of the three helices evaluated. It is key to note the variance in the number of participants per entity, which affects the understandings learned from the data. Of the eleven interviewees, seven were from the community college, three were from Thorlabs,

and one was from the county government. This lack of equal representation means that the study leans most heavily on the accounts of members of the college, then those of Thorlabs, and then the member from the county. Despite this, there was significant consistency among the data between all three entities.

Similarly, it is also worth noting that there are gaps in the data as it pertains to the Participant 6's knowledge of the fundraising efforts of the College, and Thorlabs' awareness of the leadership the College provided with county officials and the SCEDP. This can be explained by the lack of involvement of either entity in those areas. Thorlabs would have an increased awareness of the College's funding abilities, as evidenced by the data, and less knowledge of their involvement with the County, and vice versa for Participant 6. This possibly demonstrates the degree to which the College served as a connecting entity between the County and Thorlabs during the development of the optics program.

It is important to highlight that the individual initially engaged in approving the collaboration between Thorlabs and the community college, the County Commissioner, had been replaced by another county official at the time of data collection for the study. The County Commissioner, now retired, was declined to participate in the study. The alternative interviewee, Participant 6, shared a similar perspective on the partnership as the former Commissioner, although Participant 6's role was not subject to political election, resulting in a shift away from a more politically-motivated viewpoint. More importantly, Participant 6 was less involved in the development of the optics technology program than the now-retired Commissioner was, meaning that the findings likely varied in some of the specific data that was able to be provided by Participant 6. Despite a lack

of initial involvement in the partnership, Participant 6 was able to provide a broad perspective regarding economic and workforce development for the county as a whole.

Suggestions for Future Research

There would be value in further exploring various spheres of influence when evaluating innovation systems and their effect on the economic development of rural communities. In obtaining qualitative data, this study focused explicitly on the influence of leaders within the academia-industry-government model. While those leaders are key to understanding the evolution of the partnership between Thorlabs and the College at each stage of development, research on the influence of the surrounding community regarding such a collaboration would be beneficial; such investigation could increase understanding of if there is a gap between the success of an education-industry collaboration as perceived by the leaders themselves, in comparison to the perception of that venture from the surrounding community that is one of the intended beneficiaries of that partnership. While economic development can be quantitatively tracked and studied, whether or not a surrounding community recognizes or feels the effects of that economic development is a separate matter. It would be beneficial to study the success of rural regional innovation systems from a quantitative perspective while also investigating the efficacy of that innovation system based on quantitative data from the community. Such research would benefit local leaders and policymakers in better understanding measures of success and effectiveness as they develop collaborative partnerships in the region.

This study focused on a rural community college that was the only higher education institution within its county. These circumstances necessitate further case studies to evaluate the capacity for a similar innovation system to be replicated in a rural

region where a community college exists among other four-year institutions in the same region. Studying how regional innovation systems develop in rural regions with both singular and multiple higher education entities would add value to the body of literature on rural innovation systems and provide perspective for community college leaders in various circumstances to be informed on the best practices for their particular regional cluster.

Conclusion

This single case study provided a comprehensive overview of the perceptions and roles of Sussex County Community College, Thorlabs, and the Sussex County government within the partnership framework of a triple/quadruple helix model in a rural region (Kolehmainen et al., 2015; Nordberg et al., 2020). This study discerned that the development of the optics technology program was an example of the second type of regional innovation system described by Asheim and Isaksen (2002), the regional networked innovation system. The results of the study provided perspective for policymakers, educators, and industry leaders about effective collaboration to assist in regional economic development. Additionally, this research contributes valuable insights into how community colleges, particularly in rural regions, can leverage their role in regional innovation systems to address local challenges, bridge educational gaps, and stimulate economic development. Through the tangible example of the development of the optics technology program between Sussex County Community College and Thorlabs, leaders were educated on how to support a collaboration between actors within a given region. More precisely, this study asserted the importance of higher education institutions in regional innovation systems, particularly those within rural areas, in their

knowledge-diffusing capabilities and potential for contributing to the innovation of a local region.

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Appendix A

Consent Form

Dear _____,

I am a doctoral student at Rowan University and am currently in the dissertation process. I am conducting a study to gather community college leaders, faculty, private sector, and county commissioner's perspectives, understandings, and teaching practices regarding regional innovation systems. I will be collecting data through the use of interviews, focus groups, and graphic elicitations. Focus group discussion will take place for approximately 60-90 minutes. The interviews will take place and last approximately less than an hour. All interviews and focus group discussions will be recorded using Zoom technology. Participants should understand that they may be quoted directly, but their names will not be used in any part of the report. I will protect participants' identities through pseudonyms in this and any future publications or presentations. Please understand that you may withdraw from the study without prejudice. I would greatly appreciate your willingness to give your time to this study and assist me in my growth as a professional and leader in my field.

Thank you,

Ketan Gandhi

Doctoral Candidate

I have read the above and discussed it with the researcher. Therefore, I understand the study, and I agree with the following:

I agree to participate in a study entitled "Investigation of the regional innovation system in rural region of New Jersey," conducted by Ketan Gandhi, a Doctoral student at Rowan University.

I understand that my responses will be confidential. I agree that any information obtained from this study may be used in any way thought best for publication or education, provided that I am in no way identified and my name is not used.

I understand that no physical or psychological risks are involved in this study and that I am free to withdraw my participation at any time without penalty.

I understand that my participation does not imply employment with the state of New Jersey, Rowan University, the principal investigator, or any other project facilitator.

If you have any questions or problems concerning my participation in this study, I may contact Ketan Gandhi at (908) 770-3120 or gandhi59@students.rowan.edu.

Participant Name (Please print)

I agree to be audio recorded:

_____

_____

(Signature of Participant) (Date)

By signing this form, the participant understands and acknowledges all of the terms listed above, and the participant has had the chance to ask questions about the study.

_____

_____

(Signature of Investigator/or person explaining the form)

(Date)

Appendix B

Interview Protocol

Interview Protocol A: President

Hello,

My name is Ketan Gandhi; I am a doctoral candidate in the Community College Leadership Initiative program at Rowan University. I am currently working on my dissertation research. The title of my study is *Investigation of the regional innovation system in Rural New Jersey: a qualitative single case study.* I would like to thank you for your participation today.

Today's interview will take approximately 45-60 minutes and will include 11 questions focused on your experience working with external partners to participate in the region's economic development.

Specifically, I will investigate how and what external relationships were needed to obtain resources for developing the optics technology program. Since the optics technology program is still a new initiative, I am here to learn from your experience.

All the information you provide here today will remain confidential and for the use of this dissertation research. Your participation in this interview is strictly voluntary. If at any time you need to pause or stop the interview, let me know, and we will stop immediately.

Do you have any questions or concerns before we begin?
Introduction Questions

1. Can you tell me about your educational and professional background? How long have you served in your current role? How long have you worked in a community college?

2. Can you explain the College's mission toward regional economic development?

3. What is your role in the working relationship with Thorlabs?

    Probe: How long have you been involved with building a relationship with Thorlabs? Please provide examples of ways you have built the connection.

    Probe: How, if at all, are you involved with the optics program and other technical academic programs with Thorlabs?

Main Questions

4. What role did you play in the College's involvement in optics technology with Thorlabs? And Why?
   Probe: In the context of regional economic development

5. What role does the proximity between the college and Thorlab play in business relationship development?

6. What resources of support did the College commit to Thorlabs?
   Probe: how did the commitment to developing the academics optics program come about?
   Follow-up: Is there any documentation to corroborate the support?
7. What initiatives did the College take in procuring resources to support the development of the academic optics program?
   Follow-up: How did the College fund the capital cost needed for delivering the academic optics program?
   Probe: Be specific on capital cost for facility space and equipment
   Follow-up: What structures did the College create to expose students to Thorlabs?
   Follow-up: What internship and job placement assistance did the College provide to the students involved in the academic optics program?
   Follow-up: Who were the personnel dedicated to the development and regular delivery of instruction of the academic optics program?
   Probe: Provide detail by position
   Follow-up: How were the direct personnel cost funded?
   Follow-up: Is there any documentation to corroborate the support?

8. How did the College participate in the Sussex County Economic Development Partnership (SCEDP)?
   Follow-up: What role did you play in the SCEDP? And in what capacity?
   Follow-up: Who among the County stakeholders participates in the SCEDP? Did it include the private sector, county government officials, and other community leaders?
   Follow-up: How did you influence the vision and agenda of the SCEDP toward supporting Thorlabs in the emerging field of optics?
   Probe: Discuss challenges faced in obtaining consensus
   Follow-up: How did the College measure its success in participating in SCEDP? Follow-up: Is there any documentation to corroborate the support?

9. Who and how did the College engage stakeholders outside of SCEDP to bring support to Thorlabs?

Probe: County Commissioner's Involvement
Follow-up: Is there any documentation to corroborate the support?

10. What can you tell me about the recent Princeton & Rowan University-led regional consortium to advance research in the emerging field of photonics, which includes the Sussex County Community College and Thorlabs (Bergeron, 2023)?
    Follow-up: Is there any documentation to corroborate the support?

Thank you for your participation in this interview.

Interview Protocol B: The Rest of the Interviewees at the College

Hello,

My name is Ketan Gandhi; I am a doctoral candidate in the Community College Leadership Initiative program at Rowan University. I am currently working on my dissertation research. The title of my study is *Investigation of the regional innovation system in Rural New Jersey: a qualitative single case study.* I want to thank you for your participation today.

Today's interview will take approximately 45-60 minutes and will include 11 questions focused on your experience working with external partners to participate in the region's economic development.

Specifically, I will investigate how and what external relationships were needed to obtain resources for developing the optics technology program. Since the optics technology program is still a new initiative, I am here to learn from your experience.

All the information you provide here today will remain confidential and for the use of this dissertation research. Your participation in this interview is strictly voluntary. If at any time you need to pause or stop the interview, let me know, and we will stop immediately.

Do you have any questions or concerns before we begin?

Introduction Questions

1. Can you tell me about your educational and professional background? How long have you served in your current role? How long have you worked in a community college?

2. Can you explain the College's mission toward regional economic development?

3. What is your role in the working relationship with Thorlabs?
   Probe: How long have you been involved with building a relationship with Thorlabs? Please provide examples of ways you've built the connection.

   Probe: How, if at all, are you involved with the optics program and other technical academic programs with Thorlabs?

Main Questions

4. How did the College get involved in optics technology with Thorlabs?
   Probe: Who initiated the involvement? Was there a prior relationship with executives at Thorlab?
   Follow-up: What was the purpose of the prior relationship with Thorlabs?

Follow-up: Is there any documentation to corroborate the support?

5. Does the proximity to Thorlab matter for the College and why?

6. What resources of support did the College provide to Thorlabs?

7. What initiatives did the College take in procuring resources to support the development of the academic optics program?
   Follow-up: How did the college fund the capital needed to deliver the academic optics program?
   Probe: Be specific on capital cost for facility space and equipment
   Follow-up: What structures did the College create to expose students to Thorlabs?
   Follow-up: What internship and job placement assistance did the College provide to the students involved in the academic optics program?
   Follow-up: Who were the personnel dedicated to the development and regular delivery of instruction of the academic optics program?
   Probe: Provide detail by position
   Follow-up: How were the direct personnel costs funded?
   Follow-up: Is there any documentation to corroborate the support?

8. How was the College providing Thorlabs with a trained workforce in optics?

9. How did the College participate in the Sussex County Economic Development Partnership (SCEDP)?
   Follow-up: Who from the College represented in the SCEDP? And in what capacity?
   Follow-up: Who among the County stakeholders participates in the SCEDP? Did it include the private sector, county government officials, and other community leaders?
   Follow-up: How did the College influence the vision and agenda of the SCEDP toward supporting Thorlabs in the emerging field of optics?
   Probe: Discuss challenges faced in obtaining consensus
   Follow-up: How did the College measure its success in participating in SCEDP? Follow-up: Is there any documentation to corroborate the support?

10. Who and why did the College engage stakeholders outside of SCEDP to bring support to Thorlabs?

Thank you for your participation in this interview.

Interview Protocol C: Representative from Thorlabs

Hello,

My name is Ketan Gandhi; I am a doctoral candidate in the Community College Leadership Initiative program at Rowan University. I am currently working on my dissertation research. The title of my study is *Investigation of the regional innovation system in Rural New Jersey: a qualitative single case study.* I want to thank you for your participation today.

Today's interview will take approximately 45-60 minutes and will include 11 questions focused on your experience working with external partners to participate in the region's economic development.

Specifically, I will investigate how and what external relationships were needed to obtain resources for developing the optics technology program. Since the optics technology program is still a new initiative, I am here to learn from your experience.

All the information you provide here today will remain confidential and for the use of this dissertation research. Your participation in this interview is strictly voluntary. If at any time you need to pause or stop the interview, let me know, and we will stop immediately.

Do you have any questions or concerns before we begin?

Introduction Questions

1. Can you tell me about your professional background? How long have you served in your current role? How long have you worked at Thorlabs?

2. Can you briefly explain Thorlabs optics products?

3. What is your role in the working relationship with the College?
   Probe: How long have you been involved with building a relationship with the College? Please provide examples of ways you've built the connection.
   Probe: How, if at all, are you involved with the optics program and other technical academic programs with the College?

Main Questions

4. How did Thorlabs get involved in optics technology with the College?
   Probe: Who initiated the involvement? Was there a prior relationship with executives at the College?
   Follow-up: What was the nature of the prior relationship with the College?

5. How does proximity to the College allow for the implicit agreement to share knowledge of innovation occurring at Thorlabs?

6. Why is it important to Thorlabs, that the local community college has the capacity to train the workforce in optics technology?

7. What resources of support did the College provide to Thorlabs?

8. What initiatives did the College take in procuring resources to support the development of the academic optics program?
   Follow-up: How did the college fund the capital needed to deliver the academic optics program?
   Probe: Be specific on capital cost for facility space and equipment
   Follow-up: What structures did the College create to expose students to Thorlabs?
   Follow-up: What internship and job placement assistance did the College provide to the students involved in the academic optics program?
   Follow-up: Who were the personnel dedicated to the development and regular delivery of instruction of the academic optics program?
   Probe: Provide detail by position
   Follow-up: How were the direct personnel costs funded?
   Follow-up: Is there any documentation to corroborate the support?

9. What was to be gained for the College to bring support from Sussex County Economic Development Partnership (SCEDP) and the County Commissioners for the optics program?
   Probe: Why? And did Thorlabs engage with the College in bringing support from SCEDP and County Commissioners?

Thank you for your participation in this interview.

Interview Protocol D: County Commissioner

Hello,

My name is Ketan Gandhi; I am a doctoral candidate in the Community College Leadership Initiative program at Rowan University. I am currently working on my dissertation research. The title of my study is *Investigation of the regional innovation system in Rural New Jersey: a qualitative single case study.* I want to thank you for your participation today.

Today's interview will take approximately 45-60 minutes and will include 11 questions focused on your experience working with external partners to participate in the region's economic development.

Specifically, I will investigate how and what external relationships were needed to obtain resources for developing the optics technology program. Since the optics technology program is still a new initiative, I am here to learn from your experience.

All the information you provide here today will remain confidential and for the use of this dissertation research. Your participation in this interview is strictly voluntary. If at any time you need to pause or stop the interview, let me know, and we will stop immediately.

Do you have any questions or concerns before we begin?

Introduction Questions

1. Can you tell me about your professional background? How long have you served in your current role? How long have you worked as County Commissioner?

2. Can you explain the County Commissioner's mission toward regional economic development?

3. What is your role in the working relationship with the College and Thorlabs?

Main Questions

4. Why do you think it's essential for the county community college to be well-informed of the emerging workforce needs of local employers?
   Probe: specifically the optics program of Thorlabs

5. Why is it essential for the county community college to have the capacity to train the workforce in emerging technology needed by local employers?
   Probe: specifically for the optics program

6. How do the County Commissioners support the community college with resources needed for new academic programs?
   Probe: specifically for the optics program

7. What role did the county community college play in engaging you and/or county commissioners in collaboration with SCEDP and Thorlabs as part of the county's economic development?
   Probe: specifically for the optics program

Thank you for your participation in this interview.

Appendix C

Analysis Matrix

Table C1
Research Questions, Theory, Data Collection, Analysis Matrix

Research questions	Theory	Interview Questions	Document Review
Background **RQ1:** How do the geographical and relational proximity of a rural community college in New Jersey and a manufacturer of photonics equipment represent the regional cluster of "regional networked innovation systems"? **Proposition 1**: The rural community college uses geographical and relational proximity to become part of the regional support for innovative activities of a private firm, resulting in the regional innovation type of "regional networked innovation systems" (Asheim & Isaksen, 2002, p.83). **Rival Explanation 1**: The community college does not directly engage in a regional support network and instead assists the private firm to go beyond the local territory and regional network to access the needed knowledge. **RQ2:** What role did the community college play in the regional cluster of the regional innovation system? **Proposition 2**: Community colleges can be a local source of technical know-how, grant	Regional clustering (Asheim & Isaksen 2002; Friedel, 2010) Academic Capitalism – finance, social, and leadership (Asheim & Isaksen, 2002;	Interview Protocols A, B, C, and D Q: 1, 2, 3 Interview Protocol A Q: 4, 5 Interview Protocol B Q: 4, 5 Interview Protocol C Q: 4, 5 Interview Protocol D Q: 4	College's Mission Statement (Institution Web pages) Board of Trustee Minutes, resolutions, media and Institution Webpages Board of Trustee presentations and resolutions,

financial support, regional leadership and locally trained labor (Asheim & Isaksen, 2002; Anderson & Karlson, 2004). **Rival Explanation 2**: Community colleges will serve as a channel for accessing the required resources from universities outside the cluster. **RQ3:** What role does the community college play in fostering a shared regional economic development vision between local academia-industry-government-community? **Proposition 3:** To attain the results of a shared regional economic development vision partnership from a quadruple helix collaboration (Kolehmainen et al., 2015; Nordberg et al., 2020), the community college plays a vital role in the Sussex County Economic Development Partnership (SCEDP) and through them, facilitates cooperation through its role as a community leader by initiating workshops, conducting interviews and surveys with regional actors, provides access to historical records on regional development, and coordinates regular meetings with different regional actors (Roman & Fellnhofer, 2022). **Rival Explanation 3:** Community college leaders are aware of the difficulty in developing a sustainable	Anderson & Karlson, 2004) Integration and interaction, knowledge sharing, and shared vision (Kolehmainen et al., 2015; Nordberg et al., 2020)	Interview Protocol A Q: 6, 7 Interview Protocol B Q: 6, 7 Interview Protocol C Q: 6, 7 Interview Protocol D Q: 5 & 6 Interview Protocol A Q: 7, 8, 9 and 10 Interview Protocol B Q: 7, 8, 9 and 10 Interview Protocol C Q: 7, 8, and 9 Interview Protocol D Q: 7	media, and institution Webpages Grant applications Board of Trustee presentations, and Resolutions, Webpages

shared vision for a region and will bypass the SCEDP and engage independently with industry, government, and community leaders at different times and stages to achieve an economic plan for the region.			

Appendix D

Timeline of Events

Table 5

Timeline of Events

December 2015	Alex Cable (Founder of Thorlabs) and Participant 4 Introduction Dinner. Topic downtown Newton economic development and Alex's vision of Optics Technology and need for trained workforce. (From Interview with Participant 4)
April 2016	Alex Cable brings a group of community leaders to a meeting for helping the college create a trade education center in downtown Newton (From Interview with Participant 4)
2016-2017	As a result of the April 2016 meeting, private donations were raised ($400K) with a commitment to donate another ($250K) for building trade programs at SCCC. (From Interview with Participant 4)
2017-2018	College leases the vacant McGuire Automotive building in downtown Newton (From Interview with Participant 4)
Fall 2018	SCCC Academic team met with Thorlabs to develop Optics curriculum (From Interview with Participant 8)
December 2019	College buys the McGuire Automotive Building (NJH article, 12/12/2019)
Spring 2019	Academic Affairs Curriculum Committee Approved the Optic courses and original degree (From Interview with Participant 8)
Fall 2019	Academic Affairs Curriculum Committee approves three tracks – Metrology, CNC and Conventional (all for Optics Program). These tracks would upskill the current Thorlabs workforce. (From Interview with Participant 8)
October 2019	Tyler Morgus, Executive from Thorlabs meets with Bill Curcio, Board Chair of SCCC and Participant 4 to discuss the AmeriCOM-DOD grant. (From Interview with Participant 4)
Spring 2020	SCCC marketing (Interview with Participant 8)
July 2020	New supervisor hired for Optics Technology Program, to supervise the Optics Program and teach some of the courses. The first year salary cost was funded from the private donations raised in 2016-17. (From Interview with Participant 4 and 5)
Fall 2020	SCCC, Thorlabs and AmeriCOM collaborated in applying for the $34M DOD grant, Monroe Community College, Front Range Community College (From Interview with Participant 8)
August 2021	SCCC receives $2M for equipment needed , part of the AmeriCOM-DOD, $34M project (From Interview with Thorlabs, Participant 4 and 8; article published in NJH 8/27/2021)

Fall 2021	SCCC applies for Securing our Children Bond Act – for building a dedicated space for Optics Program. $1.15M (From Interview with Participant 8)
Fall 2022	SCCC receives approval of the bond and the board passes the resolution to proceed with building the dedicated space (From Interview with Participant 8)
January 2024	SCCC breaks ground for building the dedicated space (SCCC Website announcement)