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Offshore Outsourcing of the United States Semiconductor Manufacturing: Management Approaches and Strategies

Oscar Mostofi
Walden University

Walden University

College of Management and Technology

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Oscar Mostofi

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Eric Riedel, Ph.D.

Walden University
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Abstract

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Oscar Mostofi

MBA, Florida Institute of Technology, 2011

BSEE, University of Arizona, 1982

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

The United States manufacturing employment decreased 33% from 1985 to 2014. During the same period, the United States semiconductor manufacturing, accounting for 1.7% of the total of the United States manufacturing workforce, lost 35% of its employees. The decline in semiconductor manufacturing jobs began in 1985 when semiconductor firms began offshoring product manufacturing overseas because of low cost of qualified labor force and facilities. This qualitative case study explored the analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations. The location theory provided the conceptual framework for this research study. Semistructured interviews were conducted using video conferencing with 5 midlevel managers who conducted offshoring or were currently offshoring semiconductor manufacturing. There were 10 themes identified and analyzed from transcription software. The themes were manufacturing cost, onshore manufacturing, offshoring site selection, competitive cost analysis, offshoring advantages, offshoring disadvantages, national manufacturing program, offshoring, reshoring, and social Impact. The findings showed that offshoring of the semiconductor product manufacturing will continue because of lower cost of operation. Social change could ensue if the leader of firms, together with the educational institutions and lawmakers, establish a national program for the industrial type of knowledge to build skills in the United States.

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Dedication

I dedicate this research study to my godfather, Mr. Jesse Kostin.

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I at this moment thank Dr. Anthony, Dr. Miller, Dr. Turner, and Dr. Walker for motivating me to stay in this program through completion. I do also thank Dr. Anthony for the outstanding feedback he provided reviewing my proposal.

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Section 1: Foundation of the Study

The need for manufacturing cycle efficiency, product cost control, and cost reduction has forced organizations to invest in product research and development, and outsource labor-intensive standardized manufacturing processes (Buckley, 2011). Economic factors have led to some of the United States companies, including semiconductor manufacturers, to relocating part or all manufacturing processes overseas to low-cost manufacturing locations (Levine, 2012). Unemployment, shrinkage of middle class, loss of technology, and weakening of the United States national security were the unintended consequences of the United States manufacturer outsourcing, which include commercial, military, and aerospace production relocation to offshore destinations (Brecher, Chen, & Yu, 2013; Davey, 2012; Moser, 2013; Ranjan, 2013).

Background of the Problem

From the early 2000s, offshoring has had an adverse impact on the United States labor market and has left some jobs vulnerable to displacement (Lazonick, 2011). In 2004, 15 - 20 million jobs were offshorable with 40% of these jobs in the manufacturing sector (Jensen & Kletzer, 2008). Manufacturing job losses accelerated during the December 2007 to June 2009 recession, causing more than two million employees, or 15% of the United States workforce, to be jobless during the 18-month period (Barker, 2011). However, foreign affiliate employment in low-income countries by the United States-based multinationals doubled from 1980 to 2002, which resulted in a 42% reduction in the United States based workforce (Baker, 2011).

The increase in the cost of offshore manufacturing, poor product quality, and product yield (Kouvelis & Li, 2013) coming from offshore facilities, and lack of effective

communication are the prime reasons for some organizations wanting to bring back, or reshore, manufacturing to the United States (Bigsten, Durevall, & Munshi, 2012). The impact the two million manufacturing jobs lost during the 2007-2009 recession in the United States is another important reason for a movement to bring jobs back (Bigsten, Durevall, & Munshi, 2012). The reshoring phenomenon has become a reality, and American economic policy is focusing on predicting when jobs will return to prerecession levels (Chudzicka, 2013; Gobble & Blau, 2012; Tate, 2014). Specifically, offshoring semiconductor manufacturing not only affects the United States economy but also has an adverse impact on the United States national security and defense (Under Secretary of Defense, 2005). In October 2013, representatives of the United States Defense Science Board on Technology and the Innovation Enablers for Superiority in 2030 reported that accelerated global sourcing of industrial technologies, combined with offshore manufacturing of components, places the supply chain for critical United States defense systems at risk (Under Secretary of Defense, 2013). The United States government agencies may have, however, failed to implement a strategy to address the effect of offshoring on the United States economy and national security in 2005 (McCormack, 2005, Perera, 2012). According to Levine (2012), economic factors have led to some companies in the United States, including semiconductor manufacturers, to outsource manufacturing abroad. Harada (2010) emphasized that restricting the flow of semiconductor technology in the name of national security is unwise. However, the United States government must revise the semiconductor export policy to protect semiconductor intellectual property to sustain its leadership. Therefore, there must be a collaboration between the United States government and semiconductor firms to protect

the manufacturing of sensitive semiconductor components that may place the United States national security at risk if offshored.

Problem Statement

The decline in the United States manufacturing and the associated job losses represent an alarming trend that has adversely affected the national economy (Baily & Bosworth, 2014). The United States manufacturing employment decreased 33% from 1985 to 2014 (The United States Bureau of Labor Statistics [BLS], 2014a). During the same period, the United States semiconductor manufacturing, accounting for 1.7% of the total of the United States manufacturing workforce, lost 35% of its employees (BLS, 2014b). The general business problem is that the semiconductor product profit margin is negatively affected by the United States firms' offshoring manufacturing of semiconductor components. The specific business problem is that some business leaders of semiconductor companies that offshore manufacturing lack the analytical approaches and strategies in making informed strategic outsourcing and offshoring decisions conducive to increasing sustainability and profitability of operations.

Purpose Statement

The purpose of the qualitative single case study was to explore the analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations. The targeted population comprised five midlevel managers from the semiconductor industry in Northern California and Arizona, who have experienced the impact of offshoring on product cost and the consequent lowered domestic employment. The implication for social change

from the findings of this study may include the possible contribution to existing knowledge and the potential increase in domestic manufacturing employment opportunities, leading to a more prosperous community.

Nature of the Study

According to Yin (2014), the qualitative method allows the researcher to study the facts and the reason a problem exists and can create new ideas, and develop hypothesis for future quantitative or mixed methods research. Quantitative studies address relationships among variables and hypotheses that cannot be developed during the qualitative study (Watson, 2015). A researcher should use a quantitative or mixed method when relationships between variables or factors are the focus of the study (Watson, 2015). For the doctoral study, I used a qualitative research method to explore the patterns and themes from the analysis of the interviews of participants in respect to management decisions to offshore semiconductor manufacturing operation. The findings from this qualitative study may suggest potential future research using quantitative or mixed method designs to expand upon the findings from my study, however, qualitative research would therefore likely bring forth rich data by using interviews of qualified and screened participants, who have the necessary subject matter expertise that aligns with the study (Yin, 2014).

To conduct qualitative research, the researcher will select one of the following four designs appropriate for the study: (a) case study design which will allow the researcher to explore a process or event involving one or more individuals in depth using different data collection technique; (b) ethnography, the study of a cultural group in a natural setting; (c) phenomenological, where the researcher explores the lived

experiences of the participants; or (d) narrative research, where the researcher studies the lives of individuals are appropriate for the proposed study (Yin 2014). I used qualitative method with a single case study design to explore analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing uses in making informed strategic location decisions conducive to sustainability and profitability of operations. Phenomenological, ethnography, and narrative designs did not apply to the study since I was interested in finding the process the management of semiconductor firms uses to make informed decisions with offshoring manufacturing.

Research Question

The overarching research question for the doctoral study was what analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations.

Interview Questions

The following were the interview questions to support the overarching research question:

1. How would you describe your experiences with offshoring semiconductor manufacturing?
2. What are the advantages and disadvantages of offshoring?
3. What analytical approach did managers use to select manufacturing sites outside of the United States?
4. Does your firm allow the onshore test facility to compete for the production business?

5. How do you measure the outcome of the offshoring product manufacturing from expectation?
6. What recommendations do you offer for selecting future manufacturing sites?
7. What is required for your firm to reshore semiconductor manufacturing to the United States?
8. What else would you like to discuss in relation to outsourcing of manufacturing that we have not covered in this interview?

Conceptual Framework

The location theory, developed in 1826 by von Thünen, emphasized traditional theories such as transaction costs or foreign direct investment (FDI) theory (Contractor, Kumar, Kundu, & Pedersen, 2010). Location theory underpins the study as the conceptual framework. Contractor et al. (2010) emphasized that traditional theories, such as transaction costs or FDI theory, could not explain strategic thinking regarding offshore outsourcing decisions in the 21st century. The location theory aligned with the problem statement and overarching research question since the objective was to study the analytical approaches and strategies that business leaders of the United States' semiconductor manufacturing firms uses to make informed strategic outsourcing and offshoring decisions. Given the focus of the research study, it was necessary to explore through different theoretical lenses to study this phenomenon. The FDI aspect of location theory was worth exploring because differential tax issues may model the location decision (Choudhari, Adil, & Ananthakumar, 2010; Ellram, 2013; Parida, Wincent, & Oghazi, 2015). Location theory is concerned with the geographic location of economic

activity; it has become an integral part of economic geography, regional science, and spatial economics (Ellram, 2013). The objective of my study was to determine the approaches and strategies business leaders of the United States' semiconductor manufacturing firms use to locate their manufacturing operations, which aligned with location theory.

Operational Definitions

The following terms unique to this study and explained using peer-reviewed sources, may offer clarity to the reader:

Fabless: A semiconductor company with no wafer fabrication capability (Ellram, 2013).

Factoryless: A factoryless firm is a company that outsources manufacturing activities (Bernard & Fort, 2013).

Final test - Class test: A final test is the process of testing the packaged chip under specified operating temperature range prior to delivery to the customer (Sze, 2008).

Integrated circuit (IC): A chip etched or imprinted with network or electronic components such as transistors, diodes, and resistors along with their interconnections is called an integrated circuit (IC) (Brindley, 1994).

Inshoring (Onshore Outsourcing): Inshoring is the process of moving activities back to home country (Liao. 2012).

Insourcing: Insourcing is the process of using an organization's own personnel or other resources to accomplish a task (Bovaird, 2015).

Nearshoring: Nearshoring is the process of outsourcing activities to a neighboring country (Sandhu, 2012).

Offshoring: Offshoring is the process of outsourcing activities to facilities outside of the businesses' home country (Ellram, 2013).

Reshoring: Reshoring is the process of bringing back offshored activities back to the businesses' home country (Nash-Hoff, 2011).

Semiconductor: A semiconductor is a material used to make electronic components. Semiconductor only conducts electricity only if a small electrical energy is applied to it (Ferry, 2015).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions in a research study are facts thought to be true and are not in control of the researcher, but nevertheless, may contribute to the relevancy of the study (Simon, 2011). The first assumption was that I could locate five participants with semiconductor components manufacturing offshoring process for the interviews. The second assumption was that reaching data saturation with the selected sample size would be possible. Saturation is the phase in a research study the researcher can no longer attain new themes by continued sampling (Fusch & Ness, 2015). The third assumption was the participants chosen for the study had the credential and working experience in outsourcing semiconductor final test process. Furthermore, another assumption that members provided honest answers to interview questions may be reasonable since there is no way of testing truthfulness. The constraints expressed in the assumption made insofar as undertaking a quality study was minimal and inconsequential with the invocation of purposeful sampling (Suri, 2011).

Limitations

Limitations are potential weaknesses in a study out of the control of a researcher (Simon, 2011). The one noteworthy possible weakness to this study was the potential the participant's corporate culture may influence answers to the interview questions even though personal experience may be other than stated. Another limitation was time. The study conducted during this research study was indicative of conditions occurring in the past and at present time.

Delimitations

The delimitations are those characteristics that limit the scope and define the boundaries of study (Simon, 2011). I interviewed five midlevel managers from semiconductor industry who have experienced the impact of offshoring on product cost and the consequent lowered domestic employment. However, the outcome of the study may or may not apply to all businesses that outsource the manufacturing process to facilities located onshore and offshore. The second delimitation was the study would cover only the area of the product test. However, the assembly of the product and assembly location can have an impact on site and product final test.

Significance of the Study

According to Gobble (2012), the lack of information and dearth of knowledge on outsourcing and reshoring concerning semiconductor manufacturing industry potentially confers significance to the findings of this study. The data published by the representatives of the Hackett, BCG, and Alix Partners consulting groups confirmed the knowledge deficit on management approaches and strategies on outsourcing the United

States semiconductor manufacturing (Gobble, 2012). The purpose of the research was to close this gap in current knowledge by interviewing more midlevel managers.

Contribution to Business Practice

Since the 2008 recession in the United States, policy makers and corporate managers began evaluation of the cost of manufacturing products in offshore facilities to maximize the firms' profit margins (Tassey, 2010). The findings from my study provided relevant data including process improvement in manufacturing and information for business leaders of the United States semiconductor companies to make informed strategic outsourcing and offshoring decisions on manufacturing locations (Ellram, 2013; Pearce, 2014). The findings from my study may contribute to the knowledge deficit, and may assist in an ongoing quest in seeking a viable solution or strategy for future manufacturing location of the next generation of semiconductor products.

Implications for Social Change

The onshore resourcing of the United States semiconductor manufacturing may strengthen the United States manufacturing sector and contribute to a viable and healthy national economy. The knowledge from this study may contribute to job creation, an increase in employment of qualified United States citizens, improve product quality, and increase firm's profitability. The United States can retain a leadership position in the area of the economy, national security, and technical superiority by reshoring of the semiconductor manufacturing (Ezell, 2012; Ezell & Atkinson, 2011; Hutzel & Lippert, 2014; Navarro, 2013).

A Review of the Professional and Academic Literature

The literature review section comprises of review, critique, and analysis of information that I obtained from 82 peer-reviewed journal articles, with 86.6% of the articles published within the last 5 years. I began my research using Walden University library to perform multidatabase search on the topic of the research study. In addition, I retrieved articles using Google Scholar and crossref.org. Finally, I used crossref.org and Ulrich to verify articles used were peer reviewed. The review of literature encompassed an exploration of the effect of the outsourcing and offshoring on the United States economy and a discourse on employment, global economy, wages, and national security, as these issues relate to the study objectives.

The need for manufacturing cycle efficiency, product cost control, and cost reduction have led to some of the United States companies, including semiconductor manufacturers, to relocate part or all manufacturing processes overseas to low-cost manufacturing locations (Buckley, 2011; Levine, 2012). Clearly, the research reveals that as time progressed, more businesses were outsourcing manufacturing to foreign locations. Unemployment, loss of technology, and weakening of the United States national security are the unintended consequences of the United States manufacturer outsourcing, including commercial, military, and aerospace production to offshore locations (Agrawal, 2014; Moser, 2013; Ranjan, 2013). De Treville (2014), in another study, discovered that some companies have massive inventories in their offshore facilities but could not meet all demands despite those inventories because of increased transportation costs and delivery time. These studies together confirmed that outsourcing manufacturing to

foreign locations had an adverse effect on product cost, the United States employments, and national security.

The purpose of this qualitative single case study was to explore the analytical approaches and strategies business leaders in the semiconductor industry that offshore manufacturing internationally need in making informed strategic outsourcing and offshoring location decisions conducive to sustainability and profitability of operations. Many of the factoryless semiconductor firm's leaders could benefit from the outcome of this study; however, the result may also benefit the entire semiconductor manufacturing industry. In this literature review, I did provide necessary information about semiconductor devices and the processes required to manufacture integrated circuit (IC's). Then, I discussed and analyzed key points from peer-reviewed articles, to make the case the need for the research study exists. The discussion included past and present strategies regarding outsourcing to offshore facilities, and evaluated the outcome of such an approach. A critical review entailed analysis of the offshoring effect on the United States economy, product cost, the job market, and the United States national security.

Conceptual Framework

The location theory developed in 1826 by von Thünen emphasized traditional theories such as transaction costs or FDI theory (Contractor, Kumar, Kundu, & Pedersen, 2010). Location theory underpins the study as the conceptual framework. The objective of my study was to determine the approaches and strategies business leaders of the United States' semiconductor manufacturing firms use to locate their manufacturing operation which aligns with location theory. Contractor et al. (2010) emphasized that traditional theories such as transaction costs or FDI theory could not explain strategic

thinking regarding offshore outsourcing decisions in the 21st century. Location theory aligns with the problem statement and overarching research question since the objective is to study the analytical approaches and strategies that business leaders of the United States' semiconductor manufacturing firms uses to make informed strategic outsourcing and offshoring decisions. Given the focus of the research study, it is necessary to explore through different theoretical lenses to study this phenomenon. The FDI aspect of location theory is worth exploring because differential tax issues may model the location decision (Choudhari, Adil, & Ananthakumar, 2010; Ellram, 2013; Parida, Wincent, & Oghazi, 2015). Location theory is concerned with the geographic location of economic activity; it has become an integral part of economic geography, regional science, and spatial economics (Ellram, 2013).

Manufacturing

Manufacturing is the art of mass production of goods and products for a profit (Levinson, 2013). A healthy economy necessitates manufacturing, because manufacturing is the source of creating jobs for all levels of workforce, educated and noneducated (Levinson, 2013). Even though an inventor designs new products, manufacturing is the key driver of innovation and without manufacturing research, design will not succeed. (Ancarani, Mauro, Fratocchi, Orzes, & Sartor, 2015).

Currently, most new graduates from engineering institutions receive training in the field of manufacturing, and new products and processes are developed by these graduates based on the training they received (Ancarani et al., 2015). In addition, manufacturing has an effect on other economic sectors by creating indirect employment in those sectors, and the national trade deficit of any nations depends on it (Levinson, 2013).

Semiconductor Manufacturing: An Overview

The 1959 invention of the silicon planar transistor led to the development of the IC, which had a remarkable impact on modern life (Mack, 2011). Semiconductor innovations form the foundation for America's $1.1 trillion-dollar technology industry, affecting the United States workforce of nearly six million (Mack, 2011). Research indicates that issues with semiconductor production should receive high priority by businesses and government agencies.

Semiconductors are a solid substance and their conductivity is between conductors (metals) and insulators (such as ceramics) (Brindley, 1994). Firms make semiconductor devices using pure elements such as silicon or gas compounds such as gallium arsenide (O'Mara, Herring, & Hunt, 2007). In a process called doping, technicians add a small amount of impurities, such as phosphorous and boron, to pure silicon wafer causing substantial changes in the conductivity of the material (Brindley, 1994). Semiconductors are an essential part of modern life because of their role in the fabrication of electronic devices (Brindley, 1994).

O'Mara, Herring, and Hunt (2007) provided an overview of IC manufacturing. An IC is a network of submicron transistors and wires fabricated on a silicon surface used for processing data in binary code 0 (off) and 1 (on) (O'Mara et al., 2007). The development and manufacturing of IC consist of design, fabrication, front-end test, assembly, and final test (O'Mara et al., 2007). During the design stage, the desired electronic circuits are engineered using AutoCAD software and create photomasks, a process called tapeout used in the fabrication process (Glaser & Subak-Sharpe, 1977). During the fabrication process, technicians use fabrication equipment to build the desired circuits on the surface

of a silicon wafer using successive photomask (O'Mara et al. 2007). After fabrication, technicians will test the chip (test chip) to record the electrical characteristics of the device used for engineering evaluation and debug of a faulty device (O'Mara et al. 2007). Next, the fabricated wafers will go through an electrical test (wafer sort) for classification of each chip for functionality per specification (O'Mara et al. 2007). After wafer sort, the wafers are cut into individual chips (or die) and packaged in a protective covering, a process called the assembly, either using plastic or ceramic which includes leads or other forms of connectors for connections to other components (Glaser & Subak-Sharpe, 1977).

The economic characteristics of each step of the IC manufacturing processes differ significantly (Ferry, 2015). The design stage is skill-intensive and requires expensive AutoCAD software (Ferry, 2015). Fabrication requires fixed funding (currently on the order of two billion dollars) for the facility and equipment but it is a less skill-intensive process than the design process (Ferry, 2015). Assembly (Veen, 1998) also requires expensive equipment but it is less expensive than fabrication and is less skill-intensive than the fabrication stage (Ferry, 2015). Equipment costs for fabrication and assembly are higher than the labor cost, and this has contributed to small and medium size semiconductor firms to become fabless, and offshore the fabrication and assembly processes abroad, mainly to Taiwan and China (Ellram, 2013). Over time, the labor-intensive semiconductor manufacturing processes have automated, and firms outsourced less skill-intensive operations abroad to reduce product cost (Ellram, 2013).

Reasons for Offshoring

Global outsourcing is a phenomenon that manufacturing firms have used since 1950 (Jain, Hausknecht, & Mukherjee, 2013; Warner & Hefetz, 2012). Outsourcing provides an opportunity for firms to purchase materials at a lower cost than is possible domestically (De Felice, Petrillo, & Silvestri, 2015; Jain & Swarup, 2011). The first wave of manufacturing outsourcing occurred post-World War II (Gobble, 2013). Contractor et al. (2010) stated that firms held onto core functions, notably aspects of the organizational activity that gave the company its identity, and they outsourced labor-intensive operations to offshore facilities. The development of Internet technology (Lanier, 2014) eliminated the physical distance barrier for firms to outsource new products development and manufacturing to a series of suppliers across the globe (Vrhovec, Trkman, Kumar, Krisper, & Vavpotic, 2015). Firm leaders chose to outsource innovation globally, to reduce costs, and gain access to talents and ideas from their foreign business partners (Roy & Sivakumar, 2012). This phenomenon caused firms to relocate the high-value company functions such as research and development, design, and engineering to foreign locations as well (Fontana & Prencipe, 2013). Thus, many firms in many industries began to outsource production to offshore facilities without acknowledging the unintended consequences of such a phenomenon (Harrison & McMillan, 2011; Mykhaylenko, Motika, Waehrens, & Slepniov, 2015).

Offshoring and its' Beneficiaries in the New Global Political Economy

The recession of 2007 and the global financial crisis associated with it brought the media focus onto the offshoring phenomenon and its' impact on a wide range of jobs in industrialized economies of the western world (Levy, 2005). In this process, consumers

and politicians reacted against the outsourcing of service and goods outside of the home country, both in the United States and Europe (Levy, 2005). In the 1970s and 1980s, low-skilled workers were displaced as the result of offshoring; however, advancement in telecommunications technology caused offshoring of some jobs (Levy, 2005). Levy (2005) argued that offshoring signaled a change in global political economy related to advancement in communication as well as organizational and managerial capabilities to coordinate tasks and activities globally. Offshoring processes and services to developing countries increased the wealth of the host country, which then increased the demand for Western products consumed by the host countries (Levy, 2005). Offshoring in the 21st century is different than perceived by researchers, as Levy pointed out. In the 21st century, all jobs, low-skilled or high-skilled, are susceptible to offshoring because firms, particularly multinational companies, can coordinate a network of contractors globally to perform a certain set of activities (Levy, 2005). As the capacity of organizations to manage dispersed networks increases, the need for domestically located workers diminishes, and the United States may comprise an electronic design center in Silicon Valley with software and hardware engineers located overseas (Levy). Summary and synthesis are needed to connect back to your study's focus.

Globalization and the State of the United States' Manufacturing

The beginning of the globalization took place in the 15th century when European monarchs funded explorers to find new trade routes (Osland, 2003). As the focus and perspective in manufacturing evolved over time (Rolstadas, Henriksen, & O'Sullivan, 2012), outsourcing of manufacturing was described as a new paradigm. According to Bonvillian (2012), the share of gross domestic product (GDP) for manufacturing in the

United States fell 15% over the past 50 years. For the period of 1965 to 2000, manufacturing employed 17 million (BLS, 2014a). However, from 2006 to 2016, manufacturing employed 12 million, a 31.4% drop from the previous decade (Bonvilian, 2012). Outsourcing of production abroad (offshoring) affected the United States' manufacturing sector beginning in the mid-1980's (Bonvilian, 2012). The United States' manufacturing industry lost 5.9 million jobs from 1985 to 2014 (BLS, 2014a) (Appendix A). In the same period, the semiconductor industry lost 78,000 jobs in the manufacturing sector (BLS, 2014b) (Appendix B).

During the recession of 2008, the impact on employment was immediate and severe (Goodman & Mance, 2011). At its lowest point, February 2010, the United States' employment had declined by 8.8 million from its prerecession peak of 2008 (Goodman & Mance, 2011). However, post-2008 recession, the United States economy has been recovering from one of the longest and deepest recessions since the end of World War II (Goodman & Mance, 2011).

Offshoring the United States Manufacturing

Outsourcing manufacturing activities started in late 1950's when manufacturing firms began to specialize in the various field and electronic firms that pioneered outsourcing activities first in the home country and then later offshoring those activities abroad (Buckley, 2011). However, the concept became apparent in the mainstream academic literature 20 years later (Buckley, 2011). Initially, firms outsourced production activities to domestic facilities because of the level of difficulty associated with managing offshore facilities (Baily & Bosworth, 2014; Buckley, 2011). However, globalization and the emergence of internet technology reduced those difficulties and firms began

offshoring a significant portion of manufacturing activities to selected locations such as Singapore, Taiwan, and Mexico (Baily & Bosworth, 2014; Buckley, 2011). The transferred activities were unskilled, labor intensive, and standardized manufacturing processes that had a minimal tariff on reimports (Buckley, 2011). According to Rilla and Squicciarini (2011), since mid-1980's, manufacturing has witnessed the first wave of offshoring followed by offshoring of value chain activities, and finally, management began to outsource labor-intensive operations such as information technology (IT) and customer services to foreign facilities (Egger, Kreickemeier, & Wrona, 2015). At present, firms are outsourcing knowledge-intensive activities and research and development (R&D), which are large parts of firms' value chains abroad (Egger et al., 2015).

The successes and failures of firms in the global market are the result of accelerated offshoring (Jensen & Pedersen, 2012). Consequently, firms can now offshore not only the activities but also the labor force with short notice (Bovaird, 2015). Jensen and Pedersen (2012) argued that firms offshore advanced tasks to gain access to knowledge and skills present in the offshore facilities and countries as well as to gain savings in operation's costs. Research reveals that firm's owners began to search for talent besides reducing product cost by outsourcing activities abroad.

Theory of Capitalism and Offshoring

Laibman (2010) suggested that the crisis of the late 2000s is one of the unregulated, neoliberal forms of capitalism inaugurated during the 1980s, not of the capitalist system itself. Laibman discovered that secure jobs, home ownership, health care, and retirement income posed at least as much of a threat to capitalism as did their absence. Economists have confused job offshoring with free trade; offshoring of

employment is not trading at all but is labor arbitrage (Roberts, 2011). Firms using labor arbitrage are in pursuit of absolute power (Roberts, 2011). Roberts (2011) further argued that offshoring separated consumers from the incomes and careers associated with the production of the goods and services consumed. The welfare of the foreign country where the activities are offshored economically benefited from the process of offshoring (Roberts, 2011). The belief by economists that market capitalism delivers economic well-being to society is not valid any longer (Roberts, 2011). The research reveals the neoliberal form of capitalism has some business owners outsource both labors and activities abroad.

The 2008 crisis led to advanced capitalism for policy reform to reduce economic insecurity by expanding the protections for social and labor (Bruff & Horn, 2012; Milberg & Winkler, 2013). Even economic failures because of globalization did not stop some countries to discontinue market globalization, but instead, they focused on controlling the economic insecurity (Milberg & Winkler, 2013). In 1942, the researchers determined that the cause of the double movement of capitalist economies and the corrective action was to continue the trend toward free markets (Milberg & Winkler, 2013). However, the free market forces increased the inequities and insecurities, and countries began to enforce greater state intervention to address the growing inequities and dangers free markets induce (Milberg & Winkler, 2013). Starting late 1990's, advances in communication technology and the dynamics of globalization began transforming the free market and the distribution of economic activity (Craig & Gunn, 2010; Kotz, 2015). The offshoring process is essential to the restructuring of the distribution of the economic activities (Craig & Gunn, 2010; Kotz, 2015). From findings of studies conducted by

Milberg and Winkler (2013), one can draw the conclusion that increased inequities and insecurities caused by market forces do require greater state intervention to address dangers associated with free markets, which is inevitable.

Unintended Consequences of Offshoring the United States Manufacturing

As reported by Gasparac (2015), the advantages of offshoring, which included cost savings and innovation, were initially apparent to companies that implemented the offshoring process, but the hidden cost of offshoring problems surfaced after implementation (Borchert, 2013; MoosaviRad, Kara, & Hauschild, 2014). Cost savings using offshoring places the firm in a competitive position; however, offshoring affects the structure of organization's internal activity and domestic employees, and it can create tension within the internal structure of the organization (Leibl, Nischler, Morefield, & Pfeiffer, 2009; Oldenski, 2014). Offshoring has an adverse effect on employee performance (Wright, 2014). However, lured by the appearance of substantial savings in direct labor costs from offshoring, some firms have rushed into moving manufacturing and product development offshore with inadequate analysis of, and preparation for the difficulties involved (Wright, 2014). Moe, Šmite, Hanssen and Barney (2013) estimated that no more than 20% of companies benefit from offshoring of manufacturing and product development, and retrenchment has occurred as management has realized that the additional costs of offshoring may have exceeded the benefits (Leibl et al., 2009; Moe, Smite, Hanssen & Barney, 2013). Therefore, the data reveals that for production in high-cost countries to be viable, labor costs must be a slight percentage of total direct costs. Consequently, to achieve this objective, firms should design and develop products for automated production.

Other studies indicated that some companies (Boeing and Microsoft) are rethinking the concept of outsourcing (Jain & Swarup, 2011; Schwarz, 2014). Boeing (BA), because of repeated delay in the delivery of its 787 began to rethink offshore outsourcing (Jain & Swarup, 2011; Mansfield & Mutz, 2013). Jain and Swarup further argued that offshoring high-value activities have both higher risks and benefits for the organizations. The cultural and traditional difference, communication issues between a group of individuals, and their business practices are examples of the problems that arises during and after the offshoring process. (Clampit, Kedia, Fabian, & Gaffney, 2015; Jain & Swarup, 2011; Smite, Wohlin, Aurum, Jabangwe, & Numminen, 2013). Other problems are associated with offshoring of high value-creating activities while trying to protect critical events as the foundation of the organizational configuration (Jain & Swarup, 2011; Jarmin, Krizan, & Tang, 2011). Clearly, the research demonstrates that firm's management should coordinate company's critical and outsourcing activities to minimize problems associated with offshoring.

Offshoring has an adverse effect on the wages of workers. Oldenski (2014) found outsourcing has a negative impact on the wages of low-skilled workers. On the contrary, high-skilled workers benefit from outsourcing and receive a higher salary (Horgos & Tajoli, 2015; Oldenski, 2014). Oldenski discovered that one percentage point increase in offshoring reduced the wage of the lowest-skilled workers by up to 1.5%. However, the high-skilled workers received a wage increase of up to 2.6% (Oldenski, 2014). Milberg and Winkler (2010) revealed that from 1979 to 1999, 64.8% of manufacturing workers lost their jobs, and the earnings of 25% of those reemployed declined 30% or more. However, 69% of displaced nonmanufacturing workers found employment with 21% of

them receiving a 30% or more reduction in their wages (Milberg & Winkler, 2010; Ottaviano, Peri, & Wright, 2013). Thus, continued outsourcing of manufacturing abroad had benefited domestic high-skilled worker and displaced the low-skilled workers.

Offshoring of the United States Semiconductor Manufacturing

From the early 1960s, the United States semiconductor industry has formed a fully integrated global supply chain with high-levels of outsourcing and offshoring activities, and the semiconductor firms began moving individual supply chain operations to foreign countries to take advantage of the inexpensive labor overseas (Jiang, Quan, & Zhou, 2010; Mandal, Rao Korasiga, 2016). The success of the initial movement, the availability of highly skilled labor together with the receiving countries' government support, motivated the industry to move a greater number of its supply chain activities overseas (Jiang et al., 2010). Jiang, Quan, and Zhou also reported that three sequential manufacturing operations are necessary for the development and production of semiconductors: design, fabrication, and assembly, and testing. Assembly and testing activities, the most labor-intensive and least skilled functions offshored first, followed by the outsourcing of the capital-intensive fabrication activities to foundries (Spence & Hlatshwayo, 2012). The most skill-intensive semiconductor design activities were the last that moved overseas by semiconductor firms (Spence & Hlathshwayo, 2012). In 2010, some of the United States semiconductor assembly and production activities had outsourced offshore, with less than 5% remaining in the United States for prototyping and military purposes (Jiang et al.). The reports published by scholars together confirmed that majority of the United States semiconductor firms outsourcing the least skilled-intensive operations to international facilities.

Impact of Continued Offshoring Semiconductor Manufacturing on the United States National Security

The inclusion of the 2005 report published by McCormack (2005) below may show its significance and may indicate the United States Department of Defense possibly ignored the urgency of implementing the recommendation made by Defense Science Board on semiconductor manufacturing location for eight years. The failure mentioned above may have contributed to manufacturing and technology be outsourced to countries who are the United States adversaries (McCormack, 2005; Perera, 2012). In 2005, McCormack reported the rapid transfer of semiconductor manufacturing facilities abroad was an alarming trend that required actions by the United States lawmakers in a forthright immediately. Howard, Chairman of the Pentagon's Defense Science Board (DSB) task force, argued the United States department of defense must act swiftly to implement the recommendations of the study performed by DSB task force on high-performance microchip supply (Under Secretary of Defense, 2005). Howard further emphasized the United States national security as well sustainability and growth of the United States economy demands such a rapid action by the United States Department of Defense to address offshoring of semiconductor technology.

Furthermore, the United States undersecretary of defense accepted the fact the emerging competitive dynamics of globalization was shifting the balance of markets and production away from the United States that includes offshoring of the United States semiconductor industry (Under Secretary of Defense, 2005). The United States undersecretary of defense stressed the United States government has the function of addressing this rapid trend to minimize the impact of this phenomenon on the future of

the United States economy and national security (Harada, 2010; McCormack, 2005). Howard considered the Department of Defense to take the leadership role and create a task force that should include those government agencies responsible addressing the critical problems associated with offshoring of technology, to lead and bring about a viable national solution to this critical problem, McCormack noted.

In the latest report published by the DSB task force committee members on technology and innovation enablers for superiority in 2030 (Under Secretary of Defense, 2013), it was stated that the movement of critical manufacturing capabilities abroad, combined with the global sourcing of commercial technologies, places the supply chain for the major U.S. defense systems at risk. The report published by McCormack and Howard confirmed that the department of defense and the other responsible government agencies in the United States should proactively to minimize the impact of offshoring semiconductor manufacturing and other sensitive technology on the United States defense system, national security, and economy.

Current Trend in Manufacturing: Reshoring Phenomenon

Offshoring production in 1960's was a process available to firms in the United States and other nations to reduce product cost while gaining access to ideas and innovation for the available talents in the host countries (Gasparac, 2015). Some firms attracted by substantial savings in direct labor costs from offshoring moved the manufacturing and product development overseas without adequate analysis and preparation (Wright, 2014). Cost savings using offshoring placed the firm in a competitive position. However, the problems associated with offshoring became apparent after implementation, as management had realized the additional costs of offshoring had

exceeded the benefits (Borchert, 2013). Offshoring also affected the structure of organization's internal activity and domestic employees by creating tension within the inner structure of the organization (Borchert, 2013; Leibl, Nischler, Morefield, & Pfeiffer, 2009; MoosaviRad, Kara, & Hauschild, 2014; Oldenski, 2014). Researchers estimated that only 20% of firms benefited from offshoring (Moe, Šmite, Hanssen and Barney, 2013).

During the recession of 2007, narrowing differentials in labor costs combined with communication difficulties, increased shipping cost, and outdated business practices made offshoring unattractive to those United States firms who offshored processes and manufacturing (Imberman, 2013; Stentoft, Mikkelsen, & Johnsen, 2015). Gobble and Blau (2012) revealed that a rising trend among manufacturers is to reshore manufacturing operations to the United States. Gray, Skowronski, Esenduran, and Rungtusanatham (2013) defined reshoring as location decision. Location decision theory is concerned with where firms manufacture their products (Gray, Skowronski, Esenduran, & Rungtusanatham, 2013). Reshoring is not a United States-based phenomenon (Gray et al., 2013; Moe et al., 2013). Firms in countries besides the United States can engage in reshoring activities (Gray et al., 2013; Stentoft, Mikkelsen, & Johnsen 2015). As the total cost gap of manufacturing in offshore facilities shrinks, Reshoring becomes more viable, and firms begin to bring back productions back to their home country (Navarro, 2013).

In 2011, some of the United States manufacturing firms which included General Electric, NCR, and Caterpillar began to reshore production abroad (Gray et al., 2013). These companies started reshoring some of their production processes from China back to the United States (Gray et al., 2013). At the same time, many companies in the United

States are using domestic suppliers for purchasing components previously purchased from overseas suppliers (Gray et al., 2013). Gray et al. reported the reshoring movement contributed to a gain of 109,000 manufacturing jobs in the United States in 2010. The information provided in the reports published by Gray et al., and Navarro, suggests that as the gap in the cost of manufacturing shrinks reduced between offshore and onshore facilities and suppliers, reshoring and insourcing becomes the future of production and supply chain management.

To add to the outcome of reshoring in recent years, Hemphill and Perry (2012) reported that United States manufacturing sector added 233,000 manufacturing jobs in 2011, and manufacturing gained another 83,000 jobs in the first two months of 2012. The total number of jobs added to the manufacturing sector was a notable 425,000 since the beginning of 2010, the first significant increase since 1997 (Hemphill & Perry, 2012). The United States manufacturing sector continued to experience an increase in employment in 2011, and this was the first-time manufacturing sector added jobs in two consecutive years (Hemphill & Perry, 2012).

In a survey conducted by Hemphill and Perry in 2010, one-quarter of firms reported reshoring some or all manufacturing processes to the North America. In 2011 survey, 22% of companies were planning to inshore production activities to the United States (Hemphill & Perry, 2012). In the following survey conducted in 2012, Hemphill and Perry confirmed that production of goods and products has reshored to the United States. In 2010, the United States economy began to experience the benefit of inshoring manufacturing processes back to the United States, and the manufacturing sector began to rebound (Hemphill & Perry, 2012).

The reshoring phenomenon will continue as American workers and citizens begin to focus on the welfare of the home country under the official American flag of "Made in America" (Grappi, Romani, & Bagozzi, 2015; Hoffmann, 2013; Koku, 2015; Navarro, 2013). As the result of this movement and reshoring phenomenon two to three million more jobs could be created by the United States firms by the end of 2017 (Sirkin, Zinser, & Hohner, 2011). In a Boston consulting group (BCG) administered survey, 37% of representatives of the manufacturing firms reported that they either planned to reshore some of their manufacturing jobs or were strongly considering it (Hemphill & Perry, 2012). However, 48% of technology firms with over $10 billion in revenue are considering reshoring (Hemphill & Perry, 2012). In the second study, representatives of the Hackett Group agreed with many of BGG's conclusions (Hemphill & Perry, 2012). In a follow-up analysis by the representatives of the Hackett Group, the continued offshoring activity, the reshoring trend may not be as strongly evident as the data seem to suggest (Hemphill & Perry, 2012). However, Hemphill and Perry, and Lee concluded the number of jobs returning to the United States is growing, and the United States manufacturing sector and manufacturing job market would experience a renaissance within the next 5 years when the labor costs between the China and the United States converge.

A third study, administered by the representatives of the Alix Partners, discovered that manufacturing is drifting away from China (Hemphill & Perry, 2012). The representatives of the Alix Partners firms argued that 34% of respondents identified rising costs in China as the reason (up from 21% in 2011) (Hemphill and Perry, 2012). Thirty-five percent of respondents reported the United States was the favored destination

(Hemphill & Perry, 2012). Fifty percent of respondents placed Mexico at the top of their list, making it the locale of choice for reshoring and nearshoring manufacturing for two consecutive years (Hemphil & Perry, 2012). However, if the cost differential between the developing countries including India, Thailand, Vietnam, and Brazil with growing share of global manufacturing, and the United States remains as high as 20%, these economies are more likely to receive those jobs than the United States (Hemphill & Perry, 2012; Navarro, 2013). However, more research is required to determine if business leaders are reshoring or nearshoring production.

Thus, these developments together confirm that the United States manufacturing has been recovering since 2010 and businesses are considering reshoring part or all manufacturing operations back to the United States; however, business owners may still consider outsourcing to developing countries if the cost differential can be justified. The proposed research study can add knowledge to offshoring and reshoring phenomenon and close the gap that exists in the current knowledge base.

Manufacturing in 21st Century

During 20th century, firms used the power of computing for becoming smarter to increase productivity and in the 21st century, the challenges are for businesses to develop sustainable manufacturing using computer aided manufacturing (Davim, 2013). According to the NACFAM (National Council for Advanced Manufacturing USA), Sustainable Manufacturing addresses all manufacturing issues related to society and the environment (Davim, 2013). Sustainable manufacturing creates safe products for the environment, employees, consumers, and the communities (Davim, 2013). The objective of building product using sustainable manufacturing is conserving energy, pollution

control, and conservation of natural resources (Davim, 2013). Sustainable manufacturing consists of techniques for environmentally friendly design and processes, sustainable manufacturing systems, renewable energies manufacturing, recycling, clean, and energy-efficient manufacturing technology, and education and training of the manufacturing workforce for sustainable manufacturing (Davim, 2013; Selinger, 2012).

However, since 2010, global production in the era of globalization and sustainable manufacturing encountered problems related to skills gap (Margoudi & Kiritsis, 2015). However, there are two projects underway to address this phenomenon: (1) ActionPlanT: European Forum for ICT (Information and communication technologies) in factories of the future project, and (2) the "Manuskills" project (Margoudi & Kiritsis, 2015). According to Margoudi and Kiritsis, ActionPlanT project helps leaders to develop e-skills for use in future manufacturing and defines the link between ICT in manufacturing and the required industrial learning approaches which could be adopted by manufacturing firms. The second project as reported by Margoudi et al. is the Manuskills project that identified the Skills Gap Phenomenon that blames the manufacturing education for being responsible for reducing the interest of younger generation in the industrial world by providing negative information. Margoudi et al. concluded the corresponding link between the two projects necessitates a unified manufacturing education approach from primary education to post-graduate studies including vocational training.

Future Trend in Manufacturing Location

In the era of globalization with advancement in manufacturing technology, a higher manufacturing output with lower employment in the manufacturing sector will reach equilibrium by the year 2100 (Kazmer, 2014). Global manufacturing moves toward

large-scale commodity production with less needed workforce and lower wages (Fratocchi, Di Mauro, Barbieri, Nassimbeni, & Zanoni, 2014; Kazmer, 2014). Relative to Jain, Hausknecht, and Mukherjee (2013), location decisions is becoming complicated and does not follow the model proposed in the international process (IP) model. The surge of a global factory will bring changes in the understanding of the future configuration of the world economy (Buckley, 2011). Mihalache, Jansen, Van Den Bosch, and Volberda (2012) posited that firms use offshoring to enhance innovativeness through global sourcing. Commissioned by the outsourcing firm Cognizant, Oshri, Kotlarsky, and Willcocks (2015) of the Warwick Business School, conducted a survey in 2011 comprised of 250 Chief Information Officers (CIOs) and Chief Financial Officers (CFOs). In their survey, Oshri et al., discovered that 70% of respondents believed outsourcing innovation was a major contributor to their organizations, 53% of the participants used vendor's innovation capabilities as the prime factor for outsourcing (Chen & Hu, 2016). Hence, the information provided by Oshri et al. and many other researchers suggests that in an era of globalization, the world economy depends on global factory and the exchange of innovations between countries and companies benefits all organizations.

Studies conducted by a different group of researchers contradicted the notion of a global factory, and indicated that rapidly rising offshore wages, as well as lower United States energy costs, has contributed to reshoring phenomenon (Moser, 2013; Ellram, Tate, & Petersen, 2013). Offshoring affects the home country, and in turn, negatively affects resident shareholders, who comprise approximately 80% of all shareholders (Moser, 2013). Offshoring of military grade product manufacturing compromises the

United States national security (Moser, 2013). Reshoring will reduce the United States dependence on the foreign country and their law, and protects the interests, and other assets of the United States companies (Moser, 2013; Tate, 2014). Clearly, above studies indicates a gap on whether or not manufacturing is returning to the United States or the global factory is a viable option for sustaining a healthy global economy.

Future Trend in Semiconductor Manufacturing

The United States advancement in semiconductor technology, both in the commercial and military application, became the victim of offshoring the manufacturing of those technologies abroad beginning early 1980's (Jiang et al., 2010). Semiconductor firms in the United States became more of a service organization in late 1990's, and businesses offshored manufacturing and technology (Jiang et al., 2010). However, the recession of 2007 in the United States brought about the reshoring phenomena, and the entire United States manufacturing industries should take advantage of this event to reduce production costs, improve delivery time, and employ well-qualified domestic workforce (Bigsten, Durevall, & Munshi, 2012).

By reducing the cost of manufacturing, the United States manufacturers may regain market share in the home country by meeting the needs of Original Equipment Manufacturers (OEMs) and deliver cost-effective products and services in reduced timeframe (Bigsten, Durevall, & Munshi, 2012). As the real cost of offshoring, which includes direct cost plus the hidden cost such as training becomes apparent to firm executives, manufacturing processes and components procurement will be reshored back to the United States (Barbu & Song, 2015). Consequently, businesses will retain future

activities in the home country (Acemoglu, Gancia, & Zilibotti, 2015; Larsen, Manning, & Pedersen, 2012; Lee, 2014).

Post-2007 recession, top company executive management began reevaluating their offshoring strategies and, in some instances, inshoring the high-end mobile activities back to the United States (Porter & Rivkin, 2012). Because of the high cost of semiconductor manufacturing equipment, which requires investment in the range of billions of dollars, reshoring of semiconductor manufacturing will be challenging for companies (Porter & Rivkin, 2012). From the three semiconductor manufacturing processes, reshoring of assembly and final test is feasible if top management make the United States economy and national security their highest priority (Naru, & Truitt, 2013; Porter & Rivkin, 2012). Reshoring of the fabrication process will indeed receive a no answer now (Porter & Rivkin, 2012). Thus, operation managers of semiconductor firms should account for hidden costs of offshoring and its' negative impact on home country's economy before making such a move.

What if Offshoring is Stopped?

According to Levy (2005), offshoring is just another form of trade that creates global commodity markets among countries and firms. However, offshoring raises income in developing countries, hence the demand for goods from the United States increases (Levy, 2005). In the opinion of Jain and Swarup (2011), eliminating offshore outsourcing of manufacturing processes and services globally can bring chaos in the global economy, have consequences for international collaboration, stops the economic growth of the developing countries, and hence threaten the world peace. Jain and Swarup recommended future research be required to determine the impact of offshoring and

reshoring on the global market, the global economy, global stability, and the collapse of the financial institutions both domestically and internationally (Battisti, 2014; Kumar, 2013). However, further research is required to verify this prediction.

Lack of the United States National Manufacturing Strategy

The United States' manufacturing employment post-2001 recession took place as it did post 2007 recession. The decline in manufacturing jobs in the United States amounted to 3.4 million jobs or 20% of the total available workforce in the period of 1997 to 2007 because of the closure of 8% of the manufacturing plant closures (Houseman, Kurz, Lengermann, & Mandel, 2011). The impact of the decline in the United States manufacturing sector was a decrease of 3.7% in GDP from 1997 to 2007 (Houseman et al., 2011). The decline in manufacturing industry accompanied by the recession of 2007 caused the government and the private sectors in the United States to work on the common goal of developing a proposal and corrective actions for revitalizing the manufacturing industry (Houseman et al., 2011). However, according to Spence (2011), the view of the influential public figures such as W. Buffet dominated the United States government policy and those views made it difficult for the decision makers systematically address the declining issues related to manufacturing and related unemployment.

As stated by the representatives of the Information Technology and Innovation Foundation (ITIF), in a competitive world, manufacturing sector has a fundamental role in large economies for five key reasons: (1) manufacturing enables countries to have trade balance, (2) manufacturing creates jobs with above average compensation, (3) innovations and new product research and development (R & D) depends on

manufacturing, (4) the national services sector depends on manufacturing and manufacturing depends on service sector, and (5) manufacturing is an essential part of the country's national security (Ezell, 2012). Australia, Brazil, Canada, China, Germany, Japan, Korea, and the United Kingdom, who compete with the United States in the manufacturing sector all recognize that 98% of manufacturing firms comprised of small and medium-sized enterprise (SME) in almost all economies (Ezell, 2012). Furthermore, a nation's industrial supply chain performance depends on the survival of these SME's (Ebiringa & Kule, 2014).

Leaders of economically emerging countries view manufacturing activity as the doorway to broad-based national prosperity (Houldin, 2013), and they cultivate in different ways by government policy in countries throughout the world (Houldin, 2013). The United States semiconductor manufacturing industry is vital to the economy and national security of the country (Anamali, 2014; Atta & Slusarczuk, 2012). However, some semiconductor firms continue to favor offshoring manufacturing regardless of its negative impact on the United States economy and national security, and policymakers do not appear to focus on these issues and may not have the power to act on such matters (Atta & Slusarczuk, 2012). Atta and Slusarczuk reiterated the United States government involvement in funding this sector might be necessary to keep the cutting-edge semiconductor manufacturing in the United States. However, the United States government has been liberal toward policies concerning commercialization, and United States Congress will oppose changes in industrial policy (Bayard, Byrne, & Smith, 2015). From a critical analysis of existing literature (Harada, 2010; Perera, 2010), sustaining leadership in technological advancement and manufacturing should be of interest to the

United States department of defense (DOD) (Atta & Slusarczuk, 2012; Beladi & Oladi, 2014). The manufacturing of the nanotronic-based industries in offshore facilities was a major concern for Atta & Slusarczuk. Offshoring of nanotronic-based industries may cause the United States to lose its' leading edge in information technology advancement (Atta & Slusarczuk, 2012; Canal & Sener, 2014), and the loss will have cascading effects on other industries for continued boost in productivity.

Ezell (2012) reiterated the United States policy makers should recognize that manufacturing sector is a major factor in a country's economic health, and take the necessary steps to revitalize that industry. Ezell insisted for the policy makers to develop a comprehensive national manufacturing strategy including public policies to supports the United States manufacturers both small and large, in technology, finance, investment, trade, tax, and talent (Volosevici, 2013). Thus, the United States government involvement may be necessary to implement a domestic manufacturing policy to sustain the home economy (Volosevici, 2013). To bring enough jobs back to restore the United States economy and balance the trade deficit requires a broad range of actions and behavioral change across most sectors of the United States society (Foerstl, Kirchoff, & Bals, 2015; Moser, 2013). The priority should be on developing a stronger skilled workforce. Reshoring helps recruit that skilled labor force by demonstrating to students and community that local manufacturing is coming back and providing stable, long-term careers (Betts, 2014; Chaudhury, Gerdemann, & Kapoor, 2015; Moser, 2013). The fastest and cost-effective, and stable way for EDOs (Economic Development Organizations) to strengthen their local economies is to motivate and enable reshoring and help companies realize the benefits of not offshoring (Moser, 2013; Gray, Skowronski, Esenduran, &

Rungtusanatham, 2013). Therefore, reshoring can bring prosperity to the home country and create sustainable employment for manufacturing student.

The Impact of Sustainable Manufacturing on Offshoring

Researchers and firms are utilizing the power of computing to develop a sustainable manufacturing for the 21st-century industrial revolution (Davim, 2013). However, further research is required to address issues related to this event. The future research should include research on the impact of sustainable manufacturing on offshoring and the impact of offshoring on sustainable manufacturing. According to the NACFAM (National Council for Advanced Manufacturing USA), Sustainable Manufacturing addresses all issues related to the environment (Davim, 2013). One of the objectives of sustainable manufacturing is to protect the environment through conservation of energy, pollution control, and preservation of natural resources (Davim, 2013). However, environmentalist challenged the sustainable manufacturing in the era of globalization (Davim, 2013). In the opinion of Dahlman (2011), the rise of China and India is reshaping the global climate. There exists interdependencies between global power, global governance, technology, trade, economy, and the environment. The shift in global power will have implications on nations worldwide (Dahlman, 2011). The unchecked growth of China and India and many of the developing countries could ignite a trade, resource, or conventional wars if not addressed by current international governance (Dahlman, 2011). The related environmental issues such as pollution and climate change and control add to the problem as the sustainable manufacturing takes shape in the industrial world (Dahlman, 2011). Hence, outsourcing in the era of sustainable manufacturing will take on a different form, unless international governance

can address related environmental issues (Dahlman, 2011). Otherwise, reshoring and insourcing may further replace offshoring (Dahlman, 2011).

In conclusion, the United States policy makers should implement strategies on how to address upcoming events such as the rise of developing countries and their responsibilities toward the environment. The sustainable manufacturing phenomenon will exert tremendous pressure on developing countries to abide by the international law for protecting the environment to survive in the global manufacturing market. Future research will be required to study this phenomenon in detail.

Transition and Summary

In Section 1, the details include the general and specific business problem related to outsourcing semiconductor manufacturing to offshore facilities. The description provided in this section also represents specific content related to the purpose, nature, and the significance of the proposed study. The potential for the study findings contribution to positive social change and to improving business practice reflects the business need for the proposed research. The rationale and justification for the choice of qualitative single case design for the proposed study to obtain data from the participants through interviews using purposeful sampling as described in this section may reflect the intent to complete a quality and rigorous study.

Northern California and Arizona represented the geographical location of the study. I interviewed five United States mid-level managers from the semiconductor industry. I used triangulation for the interview data and analyzed against credible sources, annual fact sheet published by BLS to achieve a deeper level of analysis, also by using the backdrop of the location theory for a theoretical underpinning and perspective. The

discussion also included assumptions, limitations, and delimitations pertinent to this study.

Section 2 includes the research method selected for the proposed study. This section represents essential components of the proposed research study, with specific details on the research design, research participants, and sampling method. To set the stage for undertaking the proposed study, section 2 includes all the pertinent facts and choices on the proposed data collection technique, analysis, reliability, and validity. Furthermore, I presented my role as the researcher in the form of a comprehensive and supported discussion, indicating personal research choices, adequately supported by seminal and other credible sources.

Section 2: The Project

The purpose of this qualitative single case study was to explore the analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing internationally use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations. In Section 2, the details included the process of conducting the study. Specifically, I discussed (a) the role of the researcher, (b) qualification required for participation in the study, (c) the rationale for the research method and design, (d) data collection, and (e) measures to enhance reliability and validity. The overarching research question for my doctoral study was "What analytical approaches and strategies do business leaders of semiconductor firms that offshore manufacturing internationally use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations?"

Purpose Statement

The purpose of the qualitative single case study was to explore the analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations. The targeted population was comprised of five midlevel managers from the semiconductor industry in Northern California and Arizona who have experienced the impact of offshoring on product cost and the consequent lowered domestic employment. The implication for social change from the findings of this study may include the possible contribution to existing

knowledge and the potential increase in domestic manufacturing employment opportunities, leading to a more prosperous community.

Role of the Researcher

The integral parts of a qualitative study are interpretivism (the importance of interpretation) and constructionism (the active construction of knowledge) (Ritchie, Lewis, Nicholls, & Ormston, 2013). My role as a qualitative researcher was to design the study, select the participants, determine the geographical location of the participants, collect and analyze the information attained from interviews, and present the findings to appropriate stakeholders (Bloomberg & Volpe, 2012). In addition, I provided careful consideration to the guidelines published in Belmont Report of 1979 and adhered to the three principals of the report, which consists of beneficence, justice, and respect for the participants (Zucker, 2013). I explained to participants the purpose of the study prior to the interview. I ensured that the participants understood the full extent of the study, any risks involved, that their participation was voluntary, and that they could withdraw from the study at any time by informing me by email. To ensure a successful interview, the researcher should establish an interview protocol to gather needed information (Bloomberg & Volpe, 2012). I applied an interview protocol (Appendix C). Researchers should consider the type of arguments that will lead to the credibility of study as well as arguments that may be used to contradict the findings (Bloomberg & Volpe, 2012). The researcher should be open and transparent about the study's limitations that may distort the results and anticipate criticism about the sampling strategy used (Ritchie, Lewis, Nicholls, & Ormston, 2013).

After IRB approval, I emailed an invitation to five midlevel managers who have conducted offshoring of semiconductor manufacturing. I outlined the intent of the study and attached the consent form to assure the participants and their company that all information provided by the participants will remain confidential. I secured all documents in a password-protected media which will be destroyed after 5 years. I then began the actual interview using video calling (Skype) and recorded the audio using Audacity software. I interviewed each participant, including follow-up interviews, until no new information surfaced. I continued this process until receiving repeat themes and information from participants, an indication that saturation of the data collection had occurred. Saturation is the phase in a research study when the researcher can no longer attain new themes by continued sampling (Fusch & Ness, 2015). All interviews were recorded using audio-recording software.

Many researchers recommend the use of semistructured interview approach to collect rich information from the participant (Adams, 2010; Rabionet, 2011; Whiting, 2008). I used the approach consistent with Whiting, Adams, and Rabionet, and similarly conducted the interviews in a semistructured format through video calling (Skype). The richness of information and the researcher's observations, along with thorough analysis, were necessary to give validity and creditability to the qualitative inquiry (Bloomberg & Volpe, 2012). Because I had the role of collecting and analyzing the data and my prior involvement in offshoring, the potential for researcher bias did exist. To remain unbiased, I continued to be neutral during the interview process and used reflexivity and bracketing (epoche) to mitigate the potentially personal preconceptions that might have tainted the research process (Tufford & Newman, 2010). Reflexivity is the ability to evaluate oneself

(Henwood, 2008). Reflexivity is necessary for reflecting on biases and preconceptions, so the researcher does not distort research data (Henwood, 2008). Bracketing is the process of setting aside personal experiences, biases, and preconceived notions about the research topic (Tufford & Newman, 2010). Bracketing is also about setting aside knowledge of previous research findings and theories about the research topic (Tufford & Newman, 2010). Researchers can accomplish bracketing in three ways: (a) having a dialogue with fellow researchers, (b) using memos/bracketing journals, and (c) addressing bracketing in the findings of the study (Tufford & Newman, 2010). I used Tufford and Newman's (2010) approach and similarly used bracketing in my research to reduce personal and other biases.

Participants

A purposeful sample is a sample of participants thoughtfully and purposefully recruited to answer the research question (Palinkas et al. 2013). I invited 10 midlevel managers in the semiconductor industry who had conducted offshoring of semiconductor manufacturing to participate in the study. However, only five managers who accepted the invitation to participate in the study met the criteria. The geographical location of the study was Silicon Valley and Folsom in Northern California, and Chandler in Arizona. According to Moustakas (1994), a criterion for the sample size in qualitative research is not set in a specific standard for the researcher to use. For the study, I chose a purposeful sample of participants who fulfilled the stipulated eligibility criteria to explore analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic location decisions conducive to sustainability and profitability of operations. Many executives in Silicon Valley,

California and Chandler, Arizona involved in semiconductor manufacturing R & D to the semiconductor firms met the participation guidelines of this study.

The information I received from the interviews of these executives, as well data from the annual report (fact sheet) published by Semiconductor Industry Association (SIA) and peer-reviewed journals, validated data triangulation and themes in the study. As reported by Denzin (2009), evaluating multiple forms of data addresses methodological triangulation in qualitative studies. Methodological triangulation increases the validity and accuracy of the data (Denzin, 2009). I used data from government websites and the annual factsheet published by BLS for the purpose of methodological triangulation. The eligibility to participate in the study required meeting the following criteria: (a) a participant must be a current or former manager in a semiconductor firm and (b) must have experience in offshoring manufacturing. I also intended to use snowball sampling to recruit additional participants if the results of the five participant interviews did not reach data saturation. Snowball sampling is the process of recruiting participants through informants to identify other participants relevant to the study (Noy, 2008).

Research Method and Design

Qualitative research methodologies are now a well-established important mode of inquiry in social sciences and applied fields (Marshal & Rossman, 2016). The merit of the qualitative method as a source of deep, meaningful advice is endorsed and frequently expressed by researchers (Packer, 2010). The aim of this qualitative research, with a single case study design, was to explore analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed

strategic location decisions conducive to sustainability and profitability of operations. Quantitative studies address relationships among variables and hypotheses (Watson, 2015). Qualitative research would therefore likely bring forth rich data by using interviews of qualified and screened participants who have the necessary subject matter expertise that aligns with the of the study. I used a qualitative research method to explore the patterns and themes from the analysis of the interviews of participants in respect to management decisions to offshore semiconductor manufacturing operation. The outcome of this qualitative study does suggest potential future research using quantitative or mixed method designs to expand upon the findings from my study could be beneficial.

Method

Researchers select the qualitative research method to explore what happened and what perspectives from the participant (Rowley, 2012; Stake, 1995; Yin, 2014). I used a qualitative research method to explore the patterns and themes from the analysis of the interviews of participants in respect to management decisions to offshore semiconductor manufacturing operation. A researcher should use a quantitative or mixed method when relationships between variables or factors are the focus of the study ((Ritchie, Lewis, Nicholls, & Ormston, 2013; Watson, 2015). The intent of my study was not to examine relationships or variables, so quantitative and mixed methods did not fit the purpose of my study. The outcome of this qualitative study may suggest potential future research using quantitative or mixed method designs to expand upon the findings from my study, however, a qualitative method was the most effective approach to meet the purpose of the study.

Research Design

Case study design is useful to study an intervention or phenomenon and the real-life context in which it occurred (Christensen, Johnson, & Turner, 2010). Case study research allows researchers to explore what has happened and is occurring relevant to the focus of the study (Newman, Lim, & Pineda, 2013; Ritchie et al., 2013; Yin, 2014). Other designs such as (a) ethnography, the study of a cultural group in a natural setting, (b) phenomenology, where the researcher explores the lived experiences of the participants, or (c) narrative research, where the researched studies the lives of individuals, were appropriate for my study. I used a single case study research design to attain in-depth information from the participants who conducted an offshoring process. Phenomenological, ethnography, and narrative designs did not apply to the study since I was interested in finding the process the management of semiconductor firms use to make informed decision with offshoring manufacturing. I interviewed each participant, including follow-up interviews, until no new information was attainable from the participants. Saturation is the phase in a research study that the researcher can no longer attain any new themes or information by continued sampling (Fusch & Ness, 2015). I continued the interview process until receiving repeat themes and information from participants, indicated saturation of the data collection.

Population and Sampling

The target population for research study was midlevel managers of semiconductor firms in Northern California and Arizona who have conducted offshoring of semiconductor component manufacturing. I used purposeful sampling, also referred to as a judgmental or expert sample, but not a probability sample to interview five midlevel

managers. The purposeful sample is a sample of participants thoughtfully and purposefully recruited, to answer the research question (Palinkas et al., 2013). The logic behind selecting purposeful sampling was to obtain rich information from the participants that related to the problem (Marshall & Rossman, 2016). In addition, saturation or informational redundancy adds relevance to the sample size in qualitative research (Guest, Bunce, & Johnson, 2006).

Theoretical saturation is the phase in a research study when the researcher can no longer attain new themes or information by continued sampling (Fusch & Ness, 2015). I used theoretical saturation to justify the sample size of five. I interviewed participants until receiving repeat themes and information from participants, indicated saturation of the data collection.

Ethical Research

The researcher should ensure confidentiality by signing a confidentiality agreement by both the participants and the researcher, and a letter of consent (The Belmont Report, 1979) from the participants. I ensured conformance to the guidelines mandated by the IRB (Institutional Review Board) and the Belmont Report of 1979 (Shore, 2006). Participation in the proposed study was voluntary without compensation, and the interviews began after IRB approval.

According to O'Reilly and Parker (2013), the researcher should communicate the nature of the study, research process, and the results of the study to participants to establish credibility. I invited 10 purposefully sampled participants for the study and informed them of the nature of the research study. Furthermore, I provided the details of the study, the research process, and after the conclusion of the study, communicated the

findings to participants to establish credibility. I also assured the participants that individual identity and the name and affiliation of any organization remained confidential, by using pseudonyms. The duration of the interview was less than 1 hour and the participants were advised that they could withdraw from the interview at any time, for any reason, and without any negative consequences by letting me know. I secured the data collected from the interviews digitally on a personal password protected flash drive to ensure the safeguarding of all study data, and will save the flash drive for 5 years following completion of the study. After 5 years, I will delete the text file on a flash drive that houses all data, destroy the physical flash drive, and will shred all hand-written documents.

Data Collection Instruments

In qualitative research, interviews are used as the primary data collection instrument as stated by Brod, Tesler, and Christensen (2009). I was the primary instrument to collect information using in-depth, semistructured interviews once the participants and I signed the consent and confidentiality forms. Qu and Dumay (2011), Barriball a d While, (1994), and Merriam, (2014) emphasized the interview should be conducted in person, using private settings, and in a semistructured format. I interviewed the participants through video calling (Skype) for less than 1 hour, using a semistructured format, and using private settings. I saved a digital copy of all transcripts on a personal password protected flash drive in a secure place, and I will maintain security, confidentiality, and integrity of the data for 5 years. To enhance the reliability of the instrument and process, I used member checking by providing a copy of the interview transcript after completion of each interview to participants to verify the data provided.

Data Collection Technique

Brod, Tesler, and Christensen (2009) noted that researchers use different techniques to collect raw data. The primary technique for collection of data for the study included interviewing the participants through video calling (Skype). The goal of the semistructured interviews was to enable members to stay engaged in the discussion and to help uncover the approaches and strategies used by the participant relevant to the problem under study, and what outcome their decision produced (Moustakas, 1994; Yin, 2011). To assure trustworthiness of the data, as well as the researcher's accurate interpretation of the data, the researcher provides the interpretation to the participants' responses to each interview for member checking (Caretta, 2015). The secondary technique for collection of data includes the review of government data from online databases. Using the first technique, I had the advantage of collecting a complete set of data interviewing through video calling (Skype) in minimal time. I recorded all interviews using Audacity audio recording software. I also used actual data from BLS and SIA for data triangulation.

Data Organization Technique

Brod, Tesler, and Christensen (2009) concluded that data collection and management are necessary during and after the interview. I organized the data in a coherent manner. I used Trint transcribing software to transcribe the recorded interviews. I ensured the interview data were transcribed accurately. The use of a computerized database software enables researchers to store, organize, and analyze the raw data (Sassi, Touzi, & Ounelli, 2008). I used Microsoft word and the third-party add-ins macro for coding and exported the coded data to Microsoft excel software for analysis. I saved the

transcript of these interviews and the database and related files on a password protected Flash drive for the duration of the study, and for 5 years after the completion of the study.

Data Analysis

Methodological triangulation will serve to facilitate deeper analysis and will include scrutinizing the information from the hand-written field notes, against the data gathered from the interviews and other influential journals and reports, a practice favored by many researchers (Li & Seal, 2007; Marshall & Rossman, 2016). I used data from government websites, BLS for methodological triangulation. To analyze qualitative data, the researcher should have a process in place for organizing and coding of the interview responses (Brod, Tesler, & Christensen, 2009). Yin (2014) recommended the use of a database for storing and organizing the data for analysis of the raw data obtained by the researcher. I used Microsoft word for coding themes from the information gathered during the interviews. The input to the Microsoft word was the transcript of all interviews generated by Trint transcribing software. I manually generated the codes and themes based on the input data. I exported the generated codes and themes to Microsoft excel for analysis. I created table and chart to present the themes and its frequency from the interview data.

Reliability and Validity

Achieving reliability and validity is an integral part any research study (Riege, 2003). According to Seidman (2012), in qualitative study, reliability is referred to as dependability, and dependability, credibility, confirmability, and transferability of the information received from the participants in the interview sets the basis for validity (Maxwell, 2012). In a qualitative study, methodological triangulation can provide

dependability and data saturation and member checking can establish validity (Maxwell, 2012). I used methodological triangulation, member checking, and data saturation to assure the proposed study provides both dependability and validity to the research.

Reliability

Researchers refer to reliability as dependability in a qualitative research study, and in qualitative research, the concept of dependability coincides with consistency or credibility (Seidman, 2012). There must be credibility to have dependability, and the rigor of the study can provide credibility. Methodological triangulation in qualitative studies is having multiple forms of data collection (Moran-Ellis, 2006). Methodological triangulation increases the validity and accuracy of the data (Moran-Ellis). To address dependability, I used methodological triangulation, and reviewed the data from the United States Department of Labor. All interviews followed the same protocol used by Moran-Ellis in which I interviewed each participant through video conferencing (Skype) for less than one hour in a private setting (See Appendix C). I recorded the interview using Audacity audio recording software. I ensured dependability using member checking by providing the transcript of the interview responses to each participant for verification that my data is representative of the intent of their interview responses. For research to be dependable, it must have acceptable data collection and data analysis techniques that are free from outside influence (Merriam, 2014). I used Microsoft word and Microsoft excel software to analyze the interview data and identify themes.

Validity

In qualitative study dependability, credibility, confirmability, and transferability of the information received from the participants in the interview sets the basis for

validity (Maxwell, 2012). Methodological triangulation in qualitative studies from multiple forms of data collection increases the validity and accuracy of the data (Moran-Ellis). I used data from government websites, BLS, for the purpose of methodological triangulation. The researcher will use interview questions consistent with the research study as well as bracketing of potential biases, which is the process researchers describe to set aside personal viewpoints and biases and ensure confirmability (Marshall & Rossman, 2016). Likely, I used interview questions that were relevant to analytical approaches and strategies business leaders of semiconductor firms, that offshore manufacturing uses in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations. I was open and transparent about the study's limitation that may have distorted the results and anticipated criticism about the sampling strategy used, consistent with the views of some researchers cited (Ritchie, Lewis, Nicholls, & Ormston, 2013).

Member checking is providing the researcher's analysis of the interview responses to each participant for verification the researcher analysis is representative of the intent of their interview responses and that will help ensure credibility and dependability (West & Kreuter, 2013; Schmidt, 2010). I ensured dependability by use of member checking and shared the transcript of the interview and summary of my analysis with each participant for accuracy and verification. In the opinion of Seidman (2012), credibility addressed by methodological triangulation, reviewing of the individual transcripts to recognize similarities between them, and sharing the data with the participants to assure that summary of the interview responses accurately reflected the interview responses (Thomas & Magilvy, 2011). Information richness of the interview and my observation and

analytical capability were a key factor to provide validity and meaning to the qualitative inquiry (Marshall, & Rossman, 2016; Patton, 1990). I conducted the study in two stages. First, I interviewed the mid-level managers until saturation reached. Finally, I reviewed manufacturing employment data from BLS database.

Transferability reveals the findings applicable to other contexts and the readers can make a connection between the study and their experience (Thomas & Magilvy, 2011). I enhanced transferability by describing the research context in detail and the assumptions I made that were central to the research study. Finally, I validated the result of the study by assuring the data saturation reached after completion of the interviews using member checking with the interview transcript provided to each participant. Saturation is the phase in a research study the researcher can no longer attain new themes by continued sampling (Fusch & Ness, 2015).

Transition and Summary

Section 2 outlined the research method for the proposed study and the components of the research study. I explained the role of the researcher, participant, research method and design, population and sampling, ethical research, data collection instruments, data collection technique, data organization technique, data analysis, and reliability and validity. Section 3 includes the detailed analysis of data gathered from the interviews and the findings of the study. Section 3 also includes the identified themes and sub-themes from the data analysis. In Section 3, I also presented application of the findings to professional practice, implication for social change, recommendation for action, recommendation for future research, and the reflection of my experience in the study. Finally, I presented a summary and my conclusion of the research study.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of my qualitative single case study was to explore the analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations. The goal of the study was to explore the patterns and themes from the analysis of the interviews of participants in respect to management decisions to offshore semiconductor manufacturing operations. Location theory provided a contextual framework for this qualitative case. Location theory aligned with the problem statement and overarching research question since the objective was to study the analytical approaches and strategies that business leaders of the United States' semiconductor manufacturing firms use to make informed strategic outsourcing and offshoring decisions (Ellram, 2013).

The target population was midlevel managers of semiconductor firms who have conducted offshoring of semiconductor manufacturing since 1985. Three participants from Northern California and two participants from Chandler, Arizona participated in this research study. I interviewed the participants using Skype and the audio was recorded using Audacity software. I used Trint software to transcribe the interview recordings. Then, I used Microsoft Word to code the themes from the transcribed data and the output was exported to Microsoft Excel for analysis to create charts for visual presentation of the themes.

All participants reported that offshoring of the semiconductor manufacturing process contributed to lower product cost and a sustainable average product profit margin

of 30%. Participants reported that the world's best assembly and test engineers are located in Asia and they will continue to win those jobs because of the labor cost. The recommendation by participants was to keep existing offshored product manufacturing offshore. However, participants recommended a national manufacturing program by the United States government providing subsidies to firms and educational institution to increase focus on manufacturing in the education system to build skills to regain expertise in highly technical manufacturing processes. Furthermore, the participants emphasized that automation of the assembly and test process may contribute to greater onshore manufacturing. However, automation will eliminate jobs worldwide.

Presentation of the Findings

The overarching research question for the doctoral study was "What analytical approaches and strategies business leaders of semiconductor firms that offshore manufacturing use in making informed strategic outsourcing and offshoring decisions conducive to sustainability and profitability of operations?" Participants stated that offshoring is a process to reduce manufacturing cost, which contributes to lower product cost. As reported by participants, firms use competitive cost analysis to determine the cost-effective method of manufacturing semiconductor products. However, one participant exhibited emotion based on the financial impact offshoring has on people. The participant stated the salary of one U.S. engineer supports a family of four. However, when five engineers offshore replace one U.S. engineer, they support a family of 100 in the offshore host country.

Furthermore, the participants stated that offshoring of the semiconductor manufacturing will continue, and opposed reshoring of the existing product manufacturing operation

because of cost. Automation may contribute to onshore manufacturing of the semiconductor products, but automation does not contribute to an increase in employment and will eliminate jobs worldwide as argued by the participants. The findings of the study confirm that lower manufacturing cost is the major fact that influences firm leaders' decision for selecting manufacturing sites. However, the findings disconfirm that reshoring or onshoring semiconductor manufacturing is occurring. The latest announcement by Intel Corporation to build a fabrication plant in Chandler, Arizona may have been for political reasons, and it may not be an indication that onshoring phenomena in the entire semiconductor industry is developing. Intel Corporation's culture has been to keep 90% of the manufacturing operation in U.S. Furthermore, the findings indicated that the firms' leaders only considered the cost of direct jobs during competitive analysis. The impact of offshoring on indirect jobs who support semiconductor industry will add to existing knowledge base. The actual data from factsheet published by SIA indicated that for every direct job loss in semiconductor industry contributes to 4.89 additional jobs to other industries that support the semiconductor industry (SIA, 2016).

Analysis of the interview data resulted in 10 main themes (Table 3) (Figure 1) and 22 subthemes. I have presented the themes that supported the research findings and addressed the research study by their order of frequency as follows:

Theme 1: Manufacturing cost.

All participants reported that lower semiconductor product manufacturing cost was the main reason management of semiconductor firms offshored manufacturing. Participants identified Asia as the top continent that provided cheap labor, facilities,

utility cost, and educated labor force, which attracted firms to offshore manufacturing process to that continent. One of the participants stated the cost of employing five engineers in a host country was equivalent to the cost of one engineer in the United States.

Theme 2: Onshore manufacturing.

When I asked the participants about the possibility of onshore manufacturing, the response was that it was costly at present time. However, upcoming automation in semiconductor assembly and testing, plus consolidation and merger in the next 510 years, will make onshore manufacturing ideal. However, this phenomenon will not create jobs in the United States and will reduce jobs globally.

Theme 3: Offshoring site selection.

Participants stated the factors that determine a suitable offshoring manufacturing site depends on first the political stability of the host country. Firms' leaders then evaluate the availability of educated English speaking employees and the cost of labor. Finally, participants stated that total manufacturing cost including quality, and support and services influences the final decision.

Theme 4: Competitive cost analysis.

Participants reported that leaders make sure that the manufacturing operation that they set up in an offshore location is competitive from point of view of cost, availability of talented employees, delivery, and quality for every site. One participant stated that they made sure all facilities met the same benchmarks, whether onshore or offshore. Furthermore, the participant stated that in addition to a lower cost of manufacturing, the host facility must deliver the product on time, and deliver it at a competitive quality level.

Participants reported that semiconductor manufacturing is a worldwide competitive business. Therefore, leaders of semiconductor firms must compete in worldwide competition and deliver to worldwide customers, and they should not believe their home country is always the best and should not implement aggressive foreign policy to limit offshoring. Managers should evaluate offshoring from a worldwide perspective. All participants reported that noncompetitiveness of the salary and the cost to operate the onshore sites compared to offshore sites, resulted in closure of many of the U. S. semiconductor manufacturing facilities since 1985.

Theme 5: Offshoring advantages.

The primary advantage of offshoring is cost, as reported by participants. Participants also reported that the host country provides highly educated talent that contributes to the success of firms that offshore manufacturing. One participant stated that time zone differences is an advantage because engineers in the home country can start an activity and have the engineers overseas to continue investigation after the work hours for the host country have ended, which contributes to productivity when resolving any issues.

Theme 6: Offshoring disadvantages.

Participants stated that time zone differences can also be a disadvantage and create communication problems. One participant reported that when the U.S. team is collaborating with an offshore team, firms need employees in the U.S. that willingly attend meetings outside of the standard working hours.

Theme 7: National manufacturing program.

Participants recommended that the U.S. policy makers, educational institutions, and semiconductor firms should establish a program for industrial type of knowledge to build skills in the United States. One participant stated "there is a perception now in the United States that if you are a manufacturing worker, they kind of look down at you." If firms promote manufacturing jobs and programs to educate people on the importance of programs that build industrial knowledge and skills, it is possible to onshore and reshore semiconductor product manufacturing.

Theme 8: Offshoring.

Primarily, offshoring as it relates to contract manufacturing is that contractors provide a consolidation function and reduce startup costs, according to one of the participants. Another participant stated that offshoring removes manufacturing abilities within the United States that impact production potential if onshore manufacturing is required and moves jobs away from local skilled labor. All participants reported that cost of operation is lower with offshoring.

Theme 9: Reshoring.

One participant stated that because of the current political situation and terrorist activities, firms are focusing on onshore sites development. Another participant stated that reshoring of manufacturing is possible if adequate government subsidies are provided to motivate firms to plant new factories in the U.S. where potentially available employees have a reasonable level of education and can be trained to operate this high-tech equipment.

Theme 10: Social impact.

One participant reported that offshoring of semiconductor manufacturing had major impact on developing countries economic growth and social life. He stated that salary of one engineer in those counties supported a family of 20. The participants further stated that five engineers offshore, supporting a family of 100, replaces one U.S. engineer, which supports a family of four in the United States. The participant viewed that as a major social impact. However, other participants were more patriotic and preferred jobs to stay in the United States, but they stated that unfortunately accounting rather than good engineering practices typically leads the offshoring drive.

Table 3.

Identified themes and frequency of occurrence

Themes	Frequency of occurrence
Competitive cost analysis	18
Manufacturing cost	36
National manufacturing program	10
Offshoring	8
Offshoring advantages	11
Offshoring disadvantages	10
Offshoring site selection	20
Onshore manufacturing	25
Reshoring	8
Social impact	7

Note: Identified themes and frequency of occurrence from interview data.

Figure 1. Themes and frequency of occurrence

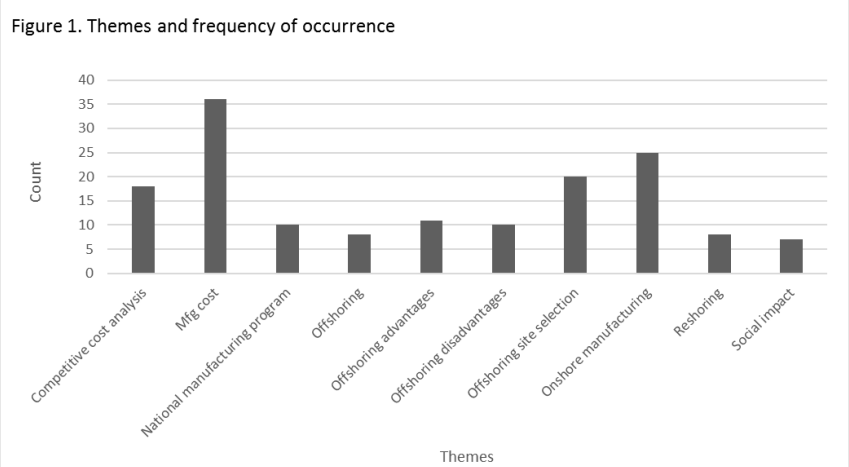

Figure 1. Identified themes from interview data gathered from participants.

The finding of the interview confirms that the offshoring of semiconductor manufacturing will continue. The result of the finding triangulated by data published by BLS. According to BLS (2017a), the United States manufacturing sector gained 650,000 new jobs from 2011 to 2017 (Figure 2).

Figure 2. U.S. national manufacturing industry total employees

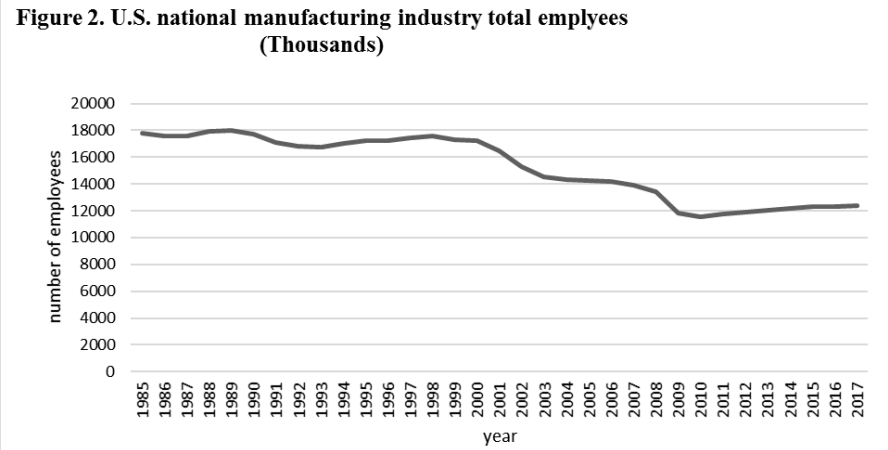

Figure 2. Total number of manufacturing employees in the United States . The U.S. Bureau of Labor Statistics. (2017a). The United States national manufacturing employment data. Retrieved from http://www.bls.gov/webapps/legacy/cesbtab1.htm

However, the Semiconductor manufacturing sector lost 26,300 jobs in the same period (BLS, 2017b) (Figure 3).

Figure 3. U.S. Semiconductor and electronic components manufacturing total employees

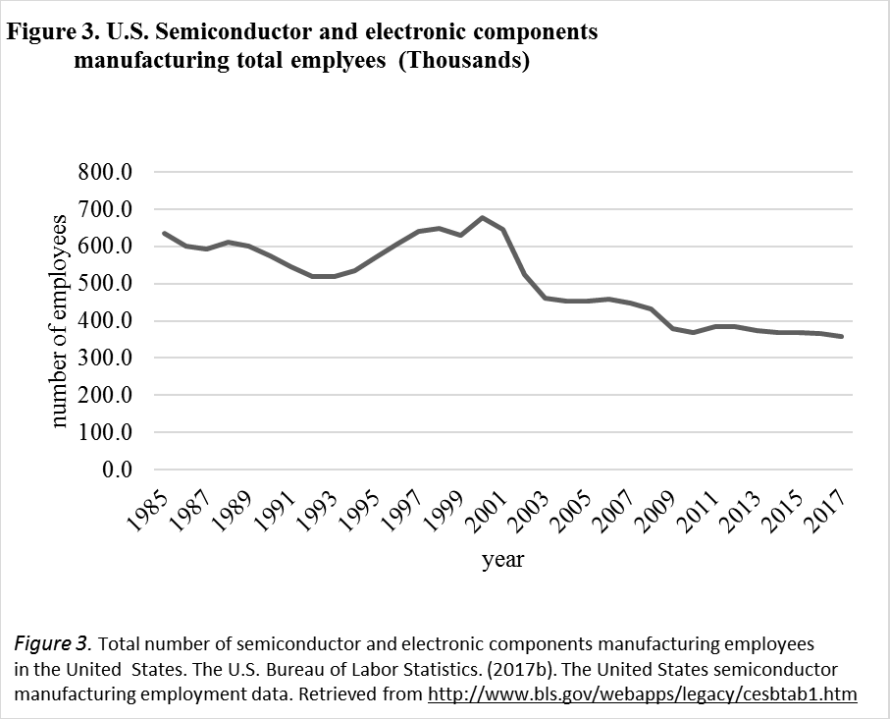

Figure 3. Total number of semiconductor and electronic components manufacturing employees in the United States. The U.S. Bureau of Labor Statistics. (2017b). The United States semiconductor manufacturing employment data. Retrieved from http://www.bls.gov/webapps/legacy/cesbtab1.htm

Applications to Professional Practice

The findings of this study are relative to countries that manufacture semiconductor products as a contractor, and semiconductor firms because the leaders need to recognize the effects of consolidation, mergers, and automation on future semiconductor product manufacturing locations and employment occurring within the next 5 to 10 years. I recommend for the semiconductor firms that offshore product manufacturing to plan on a backup manufacturing site in the United States because of current political situation and possible tariff that might be imposed by current U.S.

administration on firms that offshore manufacturing and sell those products in the United States. Additionally, the data gathered from the interviews and the 2016 factsheet published by Semiconductor Industry Association (SIA) suggest that leaders of firms should also consider the impact of offshoring on indirect jobs that support the semiconductor industry. The finding indicates that for every direct job loss in semiconductor industry, 4.89 additional indirect jobs that support the semiconductor industry are lost.

Implications for Social Change

I concluded that offshoring of semiconductor manufacturing will benefit the semiconductor firms and host country. Based on the findings of the research, I found that five engineers offshore, supporting a family of 100 replaces one U.S. engineer, which supports a family of four in the U.S. However, leaders of firms that offshore semiconductor manufacturing eliminate jobs in the United States. I agree that offshoring has a major positive social impact globally rather than locally. I discovered from the interview data that in the next 5 to 10 years semiconductor firms will focus on consolidation and mergers and that may contribute to onshore manufacturing as well as offshoring. Automation of manufacturing in assembly and testing of semiconductor products can contribute to onshore operation. However, it may have a negative impact on jobs globally. Leaders of semiconductor firms should understand that for every new direct job they create onshore will contribute to an additional 4.89 indirect jobs to U.S. economy.

Recommendations for Action

Based on the findings of this study, interviewed participants felt that consolidation and mergers within the semiconductor industry plus process automation within the next 5 to 10 years results in only a few major semiconductor firms remaining in operation because of consolidation and mergers. Future semiconductor firms should consider both onshore and offshore manufacturing operations to reduce the risk of host country political situations as well as reducing the risk of the current United States administration, imposing tariff on products manufactured offshored. Therefore, leaders of firms who manufacture semiconductor products offshore should consider a backup manufacturing site in the United States, which not only reduces the risk of manufacturing shutdown, but also adds 5.89 new jobs to U.S. economy. I will disseminate the findings of this study via publishing follow up papers and participating in related conferences.

Recommendations for Further Research

I presented the research study that only addresses the offshoring of commercial-grade semiconductor product manufacturing. The outcome of this study does not include manufacturing of military-grade semiconductor product and the military requirement for semiconductor firms who manufacture military-grade semiconductor products used in the U.S. military and aerospace applications. My first recommendation is to study the military-grade semiconductor manufacturing process to determine if the manufacturing process is offshored and if so, its impact on U.S. national security. My second recommendation is to study the impact of automation of semiconductor assembly and testing process on onshore manufacturing and on the global job market.

Reflections

I moved to United States in 1978 to continue my education after obtaining my associate degree in computer programming from institute technology of Tehran, Iran. My interest was always to become a doctor of medicine. However, because of personal and financial circumstances I chose to obtain a bachelor degree in electrical engineering. In 1983, I joined the semiconductor industry as a product test engineer immediately after graduating. However, my interest was to continue my education and in 2011, after obtaining my MBA degree, I deciding to join Walden University Doctor of Business Administration degree program.

I overcame all challenges and stayed in the program with supports and encouragement I received from Walden University faculty. I also increased my knowledge base by learning new software and tools during this journey. I personally became stronger and more interested to make a positive social impact. Hence, I chose the topic of offshoring semiconductor manufacturing and its impact on U.S. employment market. Prior to conducting this study, my preconceived idea was to promote reshoring of the semiconductor manufacturing to the United States. I focused on capturing the participants' experience and exploring their experience related to offshoring semiconductor manufacturing during the interview sessions. Moreover, I agree with the participants that reshoring of the offshored processes are costly and not recommended. Furthermore, I discovered that leaders of semiconductor manufacturing industry failed to consider United States as a viable manufacturing site and its impact on U.S. job market, because for every direct semiconductor job offshored an additional 4.89 indirect jobs were eliminated as well from U.S. economy.

Summary and Study Conclusions

I used a qualitative case study to explore the lived experiences of managers who conducted offshoring of semiconductor manufacturing. This study was significant because U.S. lawmakers, semiconductor firm executives, and U.S. citizens need to understand management strategy and approaches for offshoring the United States semiconductor manufacturing and its impact on U.S. manufacturing job loss and loss of technology and national security. During the interview process, there was consensus that offshoring of the semiconductor product manufacturing contributed to firms' profitability at the cost associated with loss of U.S. employment and technology. The findings from this study suggest that offshoring of the semiconductor assembly and testing process will continue in the next 5 to 10 years because talent and manufacturing sites are primarily located in Asia. Future semiconductor manufacturing locations will depend on upcoming phenomenon that consists of mergers, consolidation, and automation that may contribute to onshore manufacturing sites with minimal increase in U.S. semiconductor manufacturing employment.

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Appendix A: United States Manufacturing Employment Data 1985-2014

Table A1

United States manufacturing employment data 1985-2014 (in thousands)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	18009	17966	17939	17886	17855	17819	17776	17756	17718	17708	17697	17693
1986	17686	17663	17624	17616	17593	17530	17497	17489	17498	17477	17472	17478
1987	17465	17499	17507	17525	17542	17537	17593	17630	17691	17729	17775	17809
1988	17790	17823	17844	17874	17892	17916	17926	17891	17914	17966	18003	18025
1989	18057	18055	18060	18055	18040	18013	17980	17964	17922	17895	17886	17881
1990	17796	17893	17868	17846	17796	17777	17703	17649	17609	17577	17428	17395
1991	17329	17211	17140	17094	17069	17044	17015	17025	17010	16999	16961	16916
1992	16840	16828	16805	16831	16835	16826	16820	16783	16761	16750	16758	16768
1993	16791	16805	16795	16772	16766	16742	16740	16741	16769	16778	16800	16815
1994	16855	16862	16897	16933	16962	17010	17025	17081	17114	17145	17186	17217
1995	17261	17265	17263	17278	17259	17247	17217	17240	17246	17217	17209	17230
1996	17208	17230	17193	17204	17221	17226	17222	17255	17252	17268	17278	17284
1997	17298	17316	17340	17350	17362	17387	17389	17452	17465	17513	17556	17588
1998	17619	17627	17637	17637	17624	17608	17422	17563	17558	17511	17465	17449
1999	17427	17395	17368	17343	17333	17295	17308	17288	17281	17273	17282	17280
2000	17283	17284	17302	17298	17279	17298	17322	17288	17230	17218	17203	17182
2001	17102	17027	16937	16802	16661	16517	16381	16233	16117	15973	15826	15712
2002	15585	15514	15443	15392	15337	15299	15256	15172	15120	15061	14993	14912
2003	14869	14782	14722	14609	14556	14493	14401	14377	14347	14334	14315	14300
2004	14291	14278	14287	14316	14342	14332	14329	14344	14330	14332	14308	14288
2005	14258	14274	14269	14250	14255	14228	14225	14202	14175	14192	14187	14194
2006	14211	14210	14214	14226	14202	14212	14188	14158	14125	14074	14041	14014
2007	14008	13997	13970	13945	13928	13910	13889	13829	13790	13763	13757	13746
2008	13725	13697	13659	13598	13564	13504	13430	13358	13275	13149	13036	12851
2009	12560	12381	12207	12029	11862	11726	11666	11625	11590	11540	11511	11477
2010	11462	11453	11458	11493	11527	11543	11571	11550	11557	11557	11581	11592
2011	11620	11653	11675	11704	11711	11723	11755	11763	11766	11773	11771	11798
2012	11837	11859	11901	11916	11928	11939	11979	11956	11942	11947	11951	11965
2013	11982	12004	12007	12001	11994	11991	11982	11990	11993	12011	12046	12054
2014	12075											

Note. Adapted from United States Bureau of Labor Statistics, January 2014

Appendix B. United States Semiconductor and Related Devices Manufacturing Employment Data 1985-2013

Table B1

United States Semiconductor and related devices manufacturing employment data 1985-2013 (in thousands)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	285.8	284.6	283.2	280.5	279.1	275.7	272.0	270.4	267.8	265.5	263.2	263.7
1986	262.7	262.4	263.1	261.4	260.6	259.4	257.8	255.9	253.5	251.4	246.7	245.5
1987	243.7	242.3	240.6	240.2	239.8	239.6	240.6	241.4	243.4	245.1	246.7	248.6
1988	250.4	252.1	253.7	254.7	254.7	256.1	256.1	256.3	256.5	256.4	256.2	256.3
1989	253.8	251.4	248.6	247.3	246.0	245.2	244.5	243.9	242.5	241.4	240.8	239.7
1990	239.6	238.7	237.7	236.0	236.9	235.6	235.3	235.2	234.8	234.8	234.1	232.9
1991	233.4	233.2	232.5	231.1	230.8	229.7	228.5	226.9	224.9	223.3	222.5	220.5
1992	218.9	217.2	215.4	215.4	214.8	214.2	213.4	212.5	211.8	211.5	211.1	211.0
1993	210.7	211.0	212.1	211.1	210.1	208.0	208.3	209.5	210.5	210.8	211.4	212.1
1994	212.9	213.1	213.9	214.3	214.8	215.9	217.2	218.9	219.8	220.7	221.1	222.0
1995	224.0	223.8	224.6	226.1	227.3	229.1	230.6	233.4	236.4	238.8	241.3	243.8
1996	246.6	250.4	251.6	253.4	255.3	257.0	257.9	258.1	258.4	258.8	259.6	260.4
1997	261.0	262.8	265.7	266.4	268.3	271.1	274.5	277.1	278.6	281.2	282.6	285.1
1998	287.3	287.1	286.8	286.4	285.5	282.1	279.6	277.1	275.3	272.3	270.5	268.2
1999	265.5	264.1	264.5	265.2	266.4	267.2	267.7	269.2	271.1	271.3	272.1	273.2
2000	274.3	276.5	277.8	279.2	280.5	285.5	292.2	295.0	297.7	302.9	304.6	305.0
2001	309.4	311.6	309.2	305.6	301.5	294.9	289.1	282.4	280.7	277.7	274.0	271.0
2002	266.9	261.6	259.7	258.0	257.1	255.4	252.9	248.8	243.3	240.6	237.5	234.8
2003	233.8	232.3	230.1	228.1	225.5	223.7	222.0	222.0	221.6	221.9	222.0	223.3
2004	222.1	221.2	221.5	221.5	222.3	222.1	223.0	223.3	223.3	223.1	223.1	221.3
2005	221.9	222.3	222.1	222.3	222.2	222.5	222.0	222.3	223.0	224.0	224.2	224.9
2006	225.3	227.4	228.8	231.3	230.4	232.6	232.1	231.7	230.5	228.3	226.9	223.9
2007	223.0	222.2	220.0	219.1	219.5	218.5	218.1	216.3	216.1	215.1	214.6	214.9
2008	213.8	212.0	210.7	209.3	208.3	207.6	206.9	206.8	206.3	205.1	204.3	202.1
2009	199.1	196.1	193.6	190.4	187.1	184.7	180.7	179.6	179.2	179.2	178.9	179.1
2010	179.5	180.5	180.0	180.7	180.6	180.0	179.8	179.8	180.3	181.6	181.6	182.3
2011	183.1	184.3	187.0	187.1	187.0	187.0	188.2	188.5	189.0	188.2	188.8	188.2
2012	188.9	189.9	190.5	189.8	190.6	191.7	192.6	191.8	190.8	191.3	189.9	190.3
2013	189.3	187.3	187.5	186.9	186.8	187.8	186.6	186.5	186.0	184.5	185.8	185.9

Note. Adapted from United States Bureau of Labor Statistics. January 2014

Appendix C: Interview Protocol

What I will do	What I will say—script
Introduce the interview and set the stage—often over a meal or coffee	Hello. My name is Oscar Mostofi and I thank you for participating in this research study. This is an informal semistructured interview and you can stop at anytime by letting me know.
	1. How would you describe your experiences with offshoring semiconductor manufacturing?
	2. What are the advantages and disadvantages of offshoring?
	3. What analytical approach did managers use to select manufacturing sites outside of the United States?
	4. Does your firm allow the onshore test facility to compete for the production business?
	5. How do you measure the outcome of the offshoring product manufacturing from expectation?
	6. What recommendations do you offer for selecting future manufacturing sites?

	7. What is required for your firm to reshore semiconductor manufacturing to the United States?
	8. What else would you like to discuss in relation to outsourcing of manufacturing that we have not covered in this interview?
Wrap up interview thanking participant	Thank you for participating in this research study
Schedule follow-up member checking interview	I will contact you in 2 days for a follow-up interview to assure summary of the interview responses accurately reflected the interview responses you have provided
Follow–up Member Checking Interview	
Introduce follow-up interview and set the stage	Hello. My name is Oscar Mostofi and I thank you again for participating in this research study. This is a follow-up for the interview we had earlier. This is an informal semistructured interview and you can withdraw at any time.
	This is a copy of my interpretation for the responses you provided to questions in the first interview.
	1. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	2. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed

Bring in probing questions related to other information that you may have found—note the information must be related so that you are probing and adhering to the IRB approval. Walk through each question, read the interpretation and ask: Did I miss anything? Or, What would you like to add?	3. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	4. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	5. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	6. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	7. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	8. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed