2016

Strategies to Improve Data Quality for Forecasting Repairable Spare Parts

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Abstract

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MBA, University of Toledo, 2009

BS, Purdue University Calumet, 2005

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

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December 2016

Abstract

Poor input data quality used in repairable spare parts forecasting by aerospace small and midsize enterprises (SME) suppliers results in poor inventory practices that manifest into higher costs and critical supply shortage risks. Guided by the data quality management (DQM) theory as the conceptual framework, the purpose of this exploratory multiple case study was to identify the key strategies that the aerospace SME repairable spares suppliers use to maximize their input data quality used in forecasting repairable spare parts. The multiple case study comprised of a census sample of 6 forecasting business leaders from aerospace SME repairable spares suppliers located in the states of Florida and Kansas. The sample was collected via semistructured interviews and supporting documentation from the consenting participants and organizational websites. Eight core themes emanated from the application of the content data analysis process coupled with methodological triangulation. These themes were labeled as establish data governance, identify quality forecast input data sources, develop a sustainable relationship and collaboration with customers and vendors, utilize a strategic data quality system, conduct continuous input data quality analysis, identify input data quality measures, incorporate continuous improvement initiatives, and engage in data quality training and education. Of the 8 core themes, 6 aligned to the DQM theory’s conceptual constructs while 2 surfaced as outliers. The key implication of the research toward positive social change may include the increased situational awareness for SME forecasting business leaders to focus on enhancing business practices for input data quality to forecast repairable spare parts to attain sustainable profits.

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Dedication

I dedicate this doctoral research study to the love of my life, Valerie O. Eguasa, who has stood by me in love in our marriage and throughout this educational journey. Your constant encouragement, support, and belief in my abilities gave me the strength to attain this remarkable achievement. My parents, Mr. and Mrs. P.A.E Eguasa; my siblings, Eseosa, Omorodion, Osayuki, Ehis, and Oghogho; and my close friends who were great supporters. I will be forever grateful for the support, prayers, encouragement, and patience provided towards the completion of the doctoral research study.

Acknowledgments

The road to becoming a doctor was not without help, support, and guidance from special individuals along my doctoral journey. To my doctoral chair and mentor, Dr. Christos Makrigeorgis, I am graciously thankful for all the guidance provided to me throughout my doctoral study journey. Even through the difficult times, you showed support and challenged me to elevate my capabilities to succeed. Your commitment towards my graduation cannot be overstated. To my committee members, Dr. Charlotte Carlstrom and Dr. Denise Land, thank you for your professionalism, doctoral study assessments, and immense contribution towards the completion of a quality research. I am thankful for every Walden student and Faculty member that assisted in fostering a class environment for sharing knowledge and experiences and building long lasting relationships. I will be forever grateful to everyone who participated in this research to contribute valuable knowledge to the field of study and potentially enhanced the social welfare of the society. Lastly, I give special thanks to God Almighty, who gave me the abilities to accomplish this life achievement. Without God, none of my life achievements would be possible.

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Section 1: Foundation of the Study

Aircraft spare parts are essential to the maintenance and continuous safe operation of a plane (Tracht, von der Hagen, & Schneider, 2013). The four categories of aircraft spare parts are rotables, repairables, expendables, and consumables (Gu, Zhang, & Li, 2015). The focus of this study was identifying strategies aerospace forecasting business leaders use to achieve quality data inputs used in forecasting repairable spare parts demand. Such spare parts constitute the most critical category when compared to other categories because of their high cost, complexity, reparability, and functionality to an aircraft (Kapoor & Ambekar, 2015; Özkan, van Houtum, & Serin, 2015). Ensuring the timely availability of repairable spare parts needed for aircraft maintenance, while reducing long and short term inventory costs in the supply chain, continues to be a major focus and challenge for business leaders (Dudeja, 2014). Business leaders experience challenges created by the competitive nature of the aerospace industry and the complexity of the repairable supply chain (Tracht et al., 2013). The timely availability and exact quantity of such repairable parts greatly depend on the accuracy of demand forecasting (Tracht et al., 2013). Hellingrath and Cordes (2014) pointed out that the accuracy of aircraft repairable spare parts demand forecasting is dependent on the forecast input data.

Challenges exist in the availability of quality maintenance data in asset-intensive industries such as the aerospace industry because of unavailable or inaccurate maintenance records (Hodkiewicz & Ho, 2016). Because of these challenges, forecasts often exhibit forecast errors (Ucenic & Filip, 2012) and occurs in each level of a supply chain (Chang & Yeh, 2012), which negatively affects forecast accuracy. The cost of managing spare part inventories can be substantial (Lengu, Syntetos, & Babai, 2014). Data quality is critical in demand forecasting to improve forecast accuracy (Szozda & Werbińska-Wojciechowska, 2013). Yu (2012) indicated that an improvement in forecast accuracy by 10% could lead to a revenue gain of 1% to 4%. Increased forecast accuracy enhances parts availability, and thus inventory cost control, as well as, operational readiness cost control (Kourentzes, 2013). Hence, the importance of this study, which addressed the strategies to improve the quality of data inputs used in forecasting repairable spare parts to enhance forecast accuracy. An understanding of the background of the input data quality problem was vital before addressing the study business problem.

Background of the Problem

Aerospace repairable spares suppliers in the United States forecast annually what repairable spare parts to stock to support their customers when the need arises for maintenance, repair, and overhaul (MRO) activities (Gu et al., 2015; Ramlan, Atan, & Rakiman, 2012). Customers to the repairable spares suppliers include aircraft original equipment manufacturers (OEM), airline operators, and MRO service organizations (Koblen & Niznikova, 2013). There are 7,919 small and medium enterprises (SME) suppliers in the United States using the North American Industry Classification System code 423860 and Standard Industry Classifications codes 508803 and 55990104 in Hoover’s database. The aerospace SME repairable spares suppliers experience challenges with quality of data inputs used in demand forecasting because of the low quality of data in the industry (Tian, Yu, Yu, & Ma, 2013).

Challenges from the quality of forecast input data exist because of frequent engineering or configuration changes, cannibalization, customer ordering patterns, and inaccurate inventory-on-hand data, historical spend data, and maintenance records (Barabadi, Barabady, & Markeset, 2014). The various data quality challenges pose a number of operational risks to the aerospace SME repairable spares suppliers (Driessen, Arts, van Houtum, Rustenburg, & Huisman, 2014). The unavailability or excess repairable spare parts because of poor forecast data quality have led to high operating cost, lost revenues, customer dissatisfaction, and public safety hazard (Driessen et al., 2014). With the challenges suppliers experience from the quality of input data, suppliers require practical strategies to increase repairable parts input data quality levels before applying such data to the forecasting methodologies. Hence, the importance of this study to help the aerospace SME repairable spares suppliers improve forecast accuracy. With insight into the background of the problem, the next focus was on the problem statement.

Problem Statement

Poor quality of data inputs used in forecasting repairable spare parts, often cause aerospace SME repairable spares suppliers to over-forecast or under-forecast and incur financial losses (Kourentzes, 2013; Puurunen, Majava, & Kess, 2014; Tian et al., 2013). Despite over-forecasting by roughly 25% annually, aerospace SME repairable spares suppliers still do not achieve their target customer service levels because some repairable parts are over-forecasted while others are under-forecasted (Kourentzes, 2013). The general business problem was that business leaders focused on the algorithms used in forecasting repairable spare parts and not in the quality of the data inputs. The specific business problem was that some forecasting business leaders at aerospace SME repairable spares suppliers lack data quality strategies to improve the quality of data inputs used in forecasting repairable spare parts demand.

Purpose Statement

The purpose of the qualitative multiple case study was to explore the strategies forecasting business leaders at aerospace SME repairable spares suppliers use to achieve quality data inputs used in forecasting repairable spare parts demand. The target population was forecasting business leaders in aerospace SME repairable spares suppliers located in three states (Georgia, Florida, and Kansas). I selected two forecasting business leaders each from three aerospace SME repairable spares suppliers to extract research data. The implication for positive social change may include increased situational awareness for business leaders to enhance business practices to attain sustainable profits and contribute towards a stable societal economy through household income and the state budget.

Nature of the Study

The research method chosen for this proposed study was the qualitative research method. Researchers conduct qualitative research method to have the opportunity of exploring business processes, group, and the understanding of human experiences of a phenomenon (Erlingsson & Brysiewicz, 2013). The qualitative method was appropriate for this study because the aim of the study was to explore the strategies aerospace business leaders use to achieve quality data inputs used in forecasting repairable spare parts demand. The quantitative method was not appropriate for this study because there are no existing repairable parts input data quality strategies; I cannot test any hypotheses and determine relationships (Hoe & Hoare, 2012). Researchers have to utilize the qualitative and quantitative research methodologies to achieve the goal of a mixed-method research (Farrelly, 2012). Mixed-method research methodology did not apply to this study because the method did not align to the study research question and purpose. I selected the case study design after considering the other three types (ethnography, phenomenology, and narrative) of qualitative methods. A case study is a qualitative method that involves an in-depth exploration of a complex business phenomenon in its related contextual conditions (Baxter & Jack, 2008; Yin, 2014).

When compared to other qualitative methods, the case study was appropriate for this study because I can accomplish the goals of exploring cases to extract research data without influencing the behavior of the research participants. Klonoski (2013) stated that the use of case studies is quite prominent in business research. Therefore, the use of case study design to conduct this study aligned with this business research purpose. Other qualitative designs are appropriate when a researcher seeks to understand human experiences of a phenomenon (Ritchie, Lewis, Nichols, & Ormston, 2013). Phenomenology design is finding the meaning to a phenomenon by studying the lived experience of an individual (Conklin, 2013). Hence, the phenomenology design was not suitable for understanding this study business problem. To obtain detailed stories of one or more life events of an individual, researchers use the narrative design (Kelly & Howie, 2007). Researchers use ethnography design when the research goal is to gain an understanding of the behavior of a cultural group through intense observation (Petty, Thomson, & Stew, 2012). Therefore, the narrative and ethnography research designs did not fit this study because the business focus was not about a life event or behavior of a group.

Research Question

The research question for this study was as follows: What strategies do aerospace forecasting business leaders use to achieve quality data inputs for forecasting repairable spare parts demand? I utilized the research question to develop interview questions to address the specific business problem and achieve the study purpose.

Interview Questions

Crowe et al. (2011) and Yin (2014) stated that case study could enable a researcher capture information from how, why, and what questions. The following are the interview questions for this study:

1. What are the policies and procedures you use to select or develop strategies that focus on the quality of repairable parts data inputs for forecasting?
2. What strategy do you use to determine the data sources to extract repairable parts data inputs for demand forecasting?
3. What strategic data system do you utilize to conduct repairable parts input data quality?
4. What evaluation strategy do you utilize to detect and measure repairable parts data input errors?
5. What criteria or key performance indicator (KPI) do you strategically utilize to measure the repairable parts input data quality?

6. How do you strategically improve the measurement criteria or KPI of the repairable parts input data quality to fix data errors?
7. What strategy do you use to collaborate with repairable parts input data source providers to enhance data quality?
8. What strategy do you utilize to enhance your knowledge on input data quality to improve forecast accuracy?
9. What strategy do you use to validate the effectiveness of the data input quality controls for repairable spare parts forecasting?
10. What additional strategies to improve the quality of data inputs used in forecasting repairable spare parts would you like to add that I did not ask?

Conceptual Framework

Data quality management (DQM) was the conceptual framework for this doctoral study. Data Management Association developed the DQM conceptual theory (DAMA, 2008). I utilized the DQM conceptual theory as the foundation to study the research problem. The DQM conceptual theory is a description of an organizational function that applies total quality management concepts comprising of strategies, methods, and systems that business leaders utilize to analyze, improve, and maintain data quality (Ofner, Otto, & Osterle, 2013). Business leaders utilize DQM to develop strategies to attain effective supply chain management and other strategic business objectives (Ofner et al., 2013). The key concepts or constructs underlying the conceptual theory are (a) data governance, (b) data quality measurement, (c) data system/tool, (d) data quality analysis, (e) process improvement, and (f) data quality education (Ofner et al., 2013). As applied to this study, I utilized the DQM conceptual theory as a lens to explore the research participants' knowledge regarding repairable parts input data quality strategies.

Operational Definitions

The definitions of the operational terms provide a reader clarification in prior and subsequent sections of this doctoral study.

Bullwhip effect: The amplification of demand variance moving up the upstream of a supply chain driven by forecasts (Alizadeh, 2012; Ma, Wang, Che, Huang, & Xu, 2013).

Consumable parts: Aircraft spare parts used once during aircraft maintenance or component failures and are not economically repairable (Gu et al., 2015).

Expendable parts: Aircraft spare parts known as standard components that are not repairable and discarded after their useful life (Gu et al., 2015).

Repairable parts: Aircraft spare parts that are economically and technically repairable with limited restoration to original functional capability (Gu et al., 2015; Tracht et al., 2013). Aircraft mechanics swap out such parts with new parts during an aircraft maintenance or component failures (Gu et al., 2015).

Rotable parts: Aircraft spare parts that are serial number controlled with an unlimited number of repairs with no scrap expected (Gu et al., 2015).

Small and medium enterprises (SME): Aerospace spare parts suppliers in the United States that employ 10 to 249 employees (Waissi, Humble, & Demir, 2013).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are facts about a study researchers assume to be true but not verified (Kirkwood & Price, 2013; Marshall & Rossman, 2015). The following four assumptions shaped this study. The first assumption was the participants in the research are knowledgeable of the study business phenomenon. The second assumption was the participants would articulate their experiences of the researched phenomenon by providing honest and truthful information. The third assumption was the researcher is capable of extracting, analyzing, and comprehending the participants' responses. The fourth assumption of this study was patterns and themes will evolve from the participants' responses that the researcher will identify and categorized to address the research question.

Limitations

Limitations of a study are potential weaknesses that can affect the research findings and are out of the researcher's control (Leedy & Ormord, 2013; Marshall & Rossman, 2015). The small research population size may limit the research findings and affect generalization to a broader population. The strategies identified from the study to improve the quality of data inputs used in repairable spare parts demand forecasting may not apply to all size aerospace companies or other industries. The researcher's ability to extract research data from the participants may limit the richness of the data collected to answer the research question.

Delimitations

Delimitations are boundaries set for a study (Marshall & Rossman, 2015; Thomas, Nelson, & Silverman, 2011). In general, the factors that influence the quality of repairable spare parts forecast are the types and quality of input data, the appropriateness of the forecasting technique, and the people involved in the forecasting process. This study focused exclusively on the quality of the data inputs used. The study did not focus on identifying strategies for improving the quality of data inputs used for rotable, expendable, or consumable spare parts demand forecasting. The boundary of this study was the aerospace repairable spare parts industry in Georgia, Florida, and Kansas states. The research was limited to the six aerospace business leaders from three SME repairable spares suppliers. The aerospace business leaders' experiences on strategies to improve the quality of data inputs used for forecasting repairable spare parts in aerospace SME repairable spares suppliers was the primary focus.

Significance of the Study

Contribution to Business Practice

Spare parts forecasting has increasingly become an area of interest for aerospace business leaders in the last decade (Lengu et al., 2014; Romeijnders, Teunter, & van Jaarsveld, 2012; Şahin, Kizilaslan, & Demirel, 2013). With an increase in competition, demand uncertainty, and pressure to reduce inventory cost in the aerospace repairable spare part industry, the need arose to help SME repairable spares suppliers identify strategies to improve the quality of data inputs to forecast the demand for repairable spare parts (Dekker, Pinçe, Zuidwijk, & Jalil, 2013). To my knowledge, specifically to improve the quality of data inputs used to forecast repairable spare parts, there are no published specific strategies to address the business problem in the field of study. Therefore, the significance of this study may contribute to increased situational awareness for business leaders in aerospace SME repairable spares suppliers. Business leaders could utilize the identified strategies to enhance business forecasting practices on the quality of data inputs used in forecasting repairable parts demand. Such enhancement could increase the likelihood of improved forecast accuracy, inventory management performance, increased customer service levels, and sustainable competitive advantage and financial performance for the business. In addition, the identified strategies from this study could close the knowledge gap in the aerospace repairable spare parts industry and increase industry performance.

Implications for Social Change

As the need for societal mobility by air and competitiveness in the aerospace industry continue to increase, business leaders recognize the importance of the timely availability of repairable spare parts for continuous operation of the aircraft (Gu et al., 2015). Timely availability of repairable spare parts from aerospace SME repairable spares suppliers because of the study findings will reduce flight cancellations or delays, which will enhance societal mobility. With identified strategies to enhance the quality of data inputs for repairable spare parts forecasting, aerospace business leaders at SME repairable spares suppliers may be able to combat the effects of shortage costs and excess inventory on the economy and social balance of society. Such effects include inventory write-off, environment hazards from parts disposal, and employee layoffs from poor financial performance (Gu et al., 2015; Kozik & Sep, 2012). Reduction of disposal of excess repairable spare parts because of identified strategies from the study may lead to lower effects on the environment (Driessen et al., 2014). An improvement in organizational performance for aerospace SME repairable spares suppliers because of the identified strategies may contribute to increased job opportunities and income for the state budget (Demyen & Ciurea, 2014; Fujita, 2012; Lucky & Olusegun, 2012).

A Review of the Professional and Academic Literature

In this DBA doctoral study, I utilized a literature review matrix to track all related literature sources critically to conduct an in-depth analysis of the review of the professional and academic literature on the business problem. I conducted literature reviews on forecast input data quality, demand forecasting, data quality management, and conceptual framework theory topics from books, dissertations, peer-reviewed journal articles, and other scholarly research related to aerospace spare parts and repairable spare parts. A literature search strategy involved the use of the Walden University library, which provided rich sources for extracting journal articles, scholarly books, and research documents.

I explored the following databases from the Walden University Library: Business Source Complete/Premier, ScienceDirect, EBSCOhost, Academic Search Complete, ProQuest Central, ProQuest Dissertations & Theses databases, Thoreau Multi-Database Search, ABI/INFORM Complete, Emerald Management, SAGE Premier, and Google Scholar. The keywords used in the literature search included: *forecast data quality, data quality, demand forecasting, data quality management, data quality dimensions, data* *quality cost, data governance, information quality, conceptual framework theory, small and medium enterprises, aerospace industry and data quality, spare parts, aircraft spares, repairables spare parts, repairable spare parts and data quality, and supply chain and spare parts.* I utilized Boolean operators in the literature search process to maximize my search results. In addition, I selected the full-text and peer-reviewed articles published between 2012 and 2016 to limit the literature search. Table 1 contains the numbers of professional and academic literature reviewed and used in the study. The number of peer-reviewed references 5 or fewer years old used in this study literature review was 131. The percentage of peer-reviewed references 5 or fewer years old was 90%. The result from the search provided a wealth of knowledge.

Table 1

Reviewed Literature and All References Statistics

Reference Type	Total Count
Total number of all references:	146
Total number of all references 5 or fewer years old:	137
Percentage of all references 5 or fewer years old:	94%
Total number of all peer-reviewed references:	138
Percentage of all peer-viewed references:	95%
Total number of all peer-reviewed references 5 or fewer years old:	131
Percentage of all peer-viewed references 5 or fewer years old:	90%

I organized the literature review around the following three key themes: (a) data quality management theory, (b) aerospace spare parts and availability of repairable spare parts, and (c) SME and forecast input data quality. Below are details of each theme. Within the data quality management theory theme, I organized the literature into six subthemes. For the SME and forecast input data quality theme, I organized the literature into three subthemes.

Data Quality Management (DQM)

Data is a real object that an organization can create, transform, store, and use for business activities (Haug, Zachariassen, & van Liempd, 2011; Panahy et al., 2013a). Sáez, Martínez-Miranda, Robles, and García-Gómez (2012) viewed data as a product that organizations manufacture. Organizations also collect data from various sources outside the firm to conduct business activities. Haug et al. (2011), Panahy et al. (2013a), and Xiang, Lee, and Kim (2013) stated that organizations utilize data in their daily tactical, operational, and long- and short-term strategic business activities, such as demand forecasting to attain financial objectives. Fan and Geerts (2012) stated that real-life data usually consists of duplicated, inaccurate, incomplete, out-of-date, and inconsistent data. Further, Fan and Geerts pointed out that a typical enterprise can find about 1% to 5% of data error rates and can be above 30% for some companies. The quality of an organization data is a critical component of doing business (Eken, Sayar, & Topçuoğlu, 2014). Therefore, business leaders will benefit from well-defined organizational strategies to aid in managing and ensuring data quality. With SMEs playing a critical role in the social and economic aspect of a country (Demyen & Ciurea, 2014; Lucky & Olusegun, 2012), the need to improve the quality of forecast input data using the DQM is critical to sustaining the financial success of SMEs.

Data Management Association defined DQM as an organizational function that applies total quality management concepts comprising of practices, strategies, and systems that business leaders utilize to analyze, improve, and maintain data quality (Ofner et al., 2013). Liaw (2013) defined DQM as business activities that define data quality standards, data collection strategies, and data assessment to ensure organizational data are fit for use to achieve specific purposes. Therefore, data quality management practices are to assure data fitness for use or purpose in a business task the user intend to complete (Haug, Arlbjørn, Zachariassen, & Schlichter, 2013; Otto, Hüner, & Österle, 2012).

About the unusable data, Eken et al. (2014) highlighted that 75% of companies reported an effect on profit/loss because of poor data quality in a global data management survey. Organizations need high-quality data to achieve their enterprise business objectives (Ofner et al., 2013). Business leaders utilize data quality management to conduct various business practices to attain effectiveness in supply chain management and other strategic business functions (Ofner et al., 2013). Kwon, Lee, and Shin (2014) found significant positive relationships between an organization's ability to conduct DQM and the firm's usage of internal and external data to create value. The use of DQM in an organization aids business leaders to communicate: (a) the importance of DQM as a strategic organizational function, (b) data quality as a continuous improvement process, (c) qualified staffs to execute DQM tasks, and (d) the appropriate techniques or strategies for DQM (Ofner et al., 2013). Otto et al. (2012) described DQM as business initiatives focused on improving the quality of organizational data. In a DQM program, organizations focus improving the quality of internal and external data before utilizing the data as input to execute business processes.

The DQM concept is a preventive approach to improving the quality of organizational data through step by step quality improvement when conducting data quality that goes beyond the traditional reactive approach (Otto et al., 2012). Hence, DQM has to be a continuous improvement process. Through continuous improvement of data quality, an organization can utilize the DQM to maximize the value of the firm's data to achieve business objectives and gain competitive advantage (Ofner et al., 2013). O'Neill, Sohal, and Teng (2016) found in a study that SMEs, who implemented quality management initiatives, attained significant financial performance when compared to SMEs that did not engage in such initiatives. The implementation of quality models for SME processes is a critical success factor to attain competitive advantage and customer satisfaction (Denton & Maatgi, 2016). Therefore, the DQM concept is essential in addressing this study research question to assist the aerospace business leaders to achieve high data quality inputs for forecasting repairable spare parts and financial success.

Total quality management (TQM) was another quality management concept considered during this study literature review. The TQM concept is a quality control and continuous process improvement philosophy that organizational leaders use to improve efficiency and effectiveness to sustain competitive advantage and profitability (Prajogo, Oke, & Olhager, 2016; Sadikoglu & Olcay, 2014). The nine components of TQM are top management commitment, employee involvement, continuous improvement, training, empowerment, teamwork, organizational culture change, and democratic management style (Khanam, Siddiqui, & Talib, 2013). Although the TQM concept can be a catalyst for continuous quality improvement within an organization to enhance efficiency and effectiveness, Majumdar and Murali Manohar (2016) pointed out that SMEs have hesitated to embrace the concept because of the difficulties of implementation within their firms. The choice to use DQM conceptual framework instead of TQM for this study was because the concept aligned closely with the research focus of the quality of data inputs for forecasting repairable spare parts rather than the wider scope of quality management at the SME organizational level.

A firm has to consider factors such as size, resources, complexity and goals to implement DQM effectively in an organization (Ofner et al., 2013). Such considerations indicate that various components make up the DQM within an organization and a relationship between the components exist. I conducted a systemic review of the DQM components. The key concepts or constructs of the DQM conceptual theory are (a) data governance, (b) data quality measurement, (c) data quality system/tool, (d) data quality analysis, (e) process improvement, and (f) data quality education (Ofner et al., 2013).

Data governance. Rickards and Ritsert (2012) and Begg and Caira (2012) defined data governance as an organizational strategy to set guidelines and standards for DQM functions in alignment with the enterprise strategy. Another term for data governance is data stewardship (Rickards & Ritsert, 2012). Data governance include identifying professionals from the business and information technology aspect of an organization and defining their roles and responsibility to execute DQM functions (Liaw, 2013; Rickards & Ritsert, 2012). Liaw (2013) and Begg and Caira stated that a firm’s data governance specifies the individuals responsible and accountable for decision-making about the organization’s data asset.

Thompson, Ravindran, and Nicosia (2015) viewed data governance as the government of data. The legislative functions include establishing data standard documentation and policies; judicial functions focus on addressing data problems or breaches; and the executive functions addresses administration and ongoing service provision for data quality (Thompson et al., 2015). Elliott et al. (2013) mentioned the nine components of data governance as (a) mission, vision, purpose; (b) strategy, goals, objectives, and metrics; (c) guiding principles; (d) organizational structure; (e) policies and procedures; (f) user training and support; (g) technical operations; (h) security and risk; and (i) communication plan.

In a study, Rickards and Ritsert (2012) focused on data governance as a means of improving data quality critical for forecasting and planning. Despite the importance of data governance, Rickards and Ritsert indicated in a study that a recent survey showed that data governance is rarely adopted in organizations. No single approach exists to implement data governance in an organization (Begg & Caira, 2012). Begg and Caira (2012) conducted a study to focus on data governance practice in the SME sector. The study finding was, although some research stated that data governance were adaptable to SMEs, there is little information on published evidence on the application of data governance in SMEs (Begg & Caira, 2012). Furthermore, the study result indicated that SMEs do not value data as an organizational asset, and data management professionals responsible for organizational data need to be knowledgeable on terminologies associated with data.

Begg and Caira (2012) argued that there are possibilities of some SME's utilizing a greater amount of data than some large enterprises. Challenges exist to gather, cleanse, and access vast amounts of downstream data, which can be difficult to govern without a cohesive approach across the organization (Chase, 2014). Organizations can mitigate such challenges by establishing a well-defined data governance strategy. With a data governance strategy in place, organizations can institute check and balances of data quality that influences how data management professionals will perform other DQM functions (Thompson et al., 2015). Such strategy can assist aerospace SME spares suppliers in improving data quality utilized for demand forecasting to enhance forecast accuracy. An effective data governance strategy is instrumental in identifying the appropriate professionals to handle organizational data and establish the appropriate measurement criteria to determine the quality level of the data before intended use (AHIMA, 2012).

Data quality measurement. Quality measurement of any aspect of an organization is a critical component of assessing the firm's performance and identifying the appropriate strategies for improvement. Data quality measurement is using a quality criterion to assign a quantitative number to the quality of data (AHIMA, 2012). Salam (2014) stated that suppliers could not objectively measure data quality but have to judge the quality level of fitness of use. Data users have to determine how to measure the quality of data used in a specific business activity for proper evaluation of data quality and future strategies for data quality improvement. According to Moges, Dejaeger, Lemahieu, and Baesens (2012), to measure the quality of data, data users have to address what dimensions or attributes of data to evaluate. In addition, Moges et al. stated that data quality is best measured by using multiple dimensions of data to gain a holistic view of the quality.

Academic and professional literature revealed that data quality is a multidimensional concept (Chen, Hailey, Wang, & Yu, 2014; Hazen, Boone, Ezell, & Jones-Farmer, 2014; Huang, Stvilia, Jörgensen, & Bass, 2012; Král, Sobísek, & Stachová, 2014; Panahy et al., 2013a; 2013b; Rahimi, Liaw, Ray, Taggart, & Yu, 2014). Reznik and Lyshevski (2015) stated that data quality is a multidisciplinary concept that researchers have studied and discovered improvements. However, to gain an understanding of data quality and how to measure the quality level, an understanding of data quality dimensions (DQD) is critical (Huang et al., 2012).

DQDs are attributes or characteristics to define, measure, and manage data quality across various domains (Eken et al., 2014; Panahy et al., 2013a). Panahy et al. (2013a) defined DQD as a quality attribute that describes an aspect or construct of data quality. Huang et al. (2012) and Chen et al. (2014) defined DQD similar to Panahy et al. definition. Early researchers of data quality focused on accuracy as the only dimension to measure and determine the quality of data (Panahy et al., 2013a). Several researchers and practitioners to date have now mentioned various other DQDs to gain knowledge on how to assess data quality. Table 2 shows Pipino, Lee, and Wang (2002) definitions of 16 DQDs. The dimensions are KPIs critical in evaluating data quality. Therefore, the interview questions used in this case study attempt to identify the presence of strategies that will positively affect these KPIs.

Table 2

Dimensions or KPIs that Influence Data Quality

Dimensions	Definitions
Accessibility	The extent to which data is available, or easily and quickly retrievable
Appropriate Amount of Data	The extent to which the volume of data is appropriate for the task at hand
Believability	The extent to which data is regarded as true and credible
Completeness	The extent to which data is not missing and is of sufficient breadth and depth of the task at hand
Concise Representation	The extent to which data is compactly represented
Consistent Representation	The extent to which data is presented in the same format
Ease of Manipulation	The extent to which data is easy to manipulate and apply to different tasks
Free-of-Error	The extent to which data is correct and reliable
Interpretability	The extent to which data is in appropriate languages, symbols, and units and the definition are clear
Objectivity	The extent to which data is unbiased, unprejudiced, and impartial
Relevancy	The extent to which data is applicable and helpful for the task at hand
Reputation	The extent to which data is highly regarded in terms of its source or content
Security	The extent to which to data is restricted appropriately to maintain its security
Timeliness	The extent to which the data is sufficiently up-to-date for the task at hand
Understandability	The extent to which the data is easily comprehended
Value-Added	The extent to which data is beneficial and provides advantages from its use

Note. Adopted from “Data Quality Assessment,” by L. L. Pipino, Y. W. Lee, and R. Y. Wang, 2002, *Communications of the ACM, 45*, p. 212. Copyright 2002 by Association for Computing Machinery (ACM). Reprinted with permission (Appendix G).

The four critical DQDs of data quality are timeliness, accuracy, completeness, and consistency (Panahy et al., 2013a; 2013b). Haug et al. (2011) and Kahn, Raebel, Glanz, Riedlinger, and Steiner (2012) stated that accuracy, relevance, completeness, timeliness, and reliability are the important dimensions researchers often cite in the data quality literature. Conversely, Chen et al. (2014) pointed out that out of 49 dimensions of data quality, researchers often cited completeness, timeliness, and accuracy. Eken et al. (2014) pointed out that data quality criteria are accuracy, completeness, consistency and synchronization, currency, duplication, uniformity, usability, integrity, and timeliness and availability. Past researchers have shared various perspectives on the classification of DQD (Haug et al., 2011). Xiang et al. (2013) classified DQD into effectiveness (accuracy and consistency) and usability (accessibility, security, timeliness, and usefulness) for data quality measurement. According to Haug et al., the four categories of DQD classifications are namely intrinsic, representational, contextual, and accessibility.

From another perspective, Haug et al. (2013) mentioned that two categorizations of DQD for enterprise data problems are data value and data view issues. Data value issues include accuracy, completeness, currency, and consistency, whereas data view issues include granularity, relevance, and level of detail (Haug et al., 2013). Hazen et al. (2014) argued that DQD can be broken down into two categories: intrinsic (accuracy, completeness, consistency, and timeliness) and contextual (relevancy, value-added, quantity, accessibility, reputation, and believability). Although Haug et al. categorized data quality into four, the characteristics of the intrinsic (believability, accuracy, objectivity, and reputation) dimensions and contextual (value-added, relevancy, completeness, timeliness, and appropriate amount) dimensions differ from Hazen et al. list of the two classifications. Similar to Eken et al. (2014), Rahimi et al. (2014) stated that no industry standard or agreement exists for the type of DQD to measure data quality. Each data user such as aerospace SME repairable spares suppliers has to determine which DQD to utilize to effectively measure the quality level of data (e.g. forecast data) suitable for specific tasks such as demand forecasting for repairable spare parts.

Researchers in past studies stated that the DQD are not independent of each other but exhibit relationships to each other during data use (Král et al., 2014; Panahy et al., 2013a; 2013b). Panahy et al. (2013a) and (2013b) stated that the DQD dependency model could be broken down into three categories namely independency, partial dependency, and perfect dependency. Dependency discovery is the process or analysis to improve the dependency structure amongst DQD (Panahy et al., 2013a). The tradeoff relationships Panahy et al. (2013a) highlighted in a study are examples of dependency discovery. For instance, attaining accurate data can negatively affect the timeliness of data to complete a task (Panahy et al., 2013b). Furthermore, as data becomes complete to execute a business task, the consistency begins to decline (Fisher, Lauría, & Chengalur-Smith, 2012; Panahy et al., 2013b). Although gaining understanding into dependency discovery is important, further analysis on this aspect of DQD is beyond the scope of this doctoral study.

After deciding on which DQDs to utilize to determine the quality of data, the next decision will be to identify the appropriate data quality system/tool to measure the DQDs and conduct data analysis. An accurate measure of DQDs is essential to determine effective data quality improvement strategies. Next focus was on data-quality system or tool to evaluate the DQDs selected to measure data quality.

Data quality system/tool. Fan (2012) emphasized that the demand for data management systems or tools to measure the quality level of data has been increasing. Further, Fan stated the market for data quality tools had grown 16% annually; 7% above other information technology segments. Organizations use DQM tools to measure data quality and monitor the quality level to plan improvement activities (Kandel, Parikh, Paepcke, Hellerstein, & Heer, 2012). Butt and Zaman (2013) mentioned the three categories of data quality tools as auditing tools, cleaning tools, and migration tools. The use of the auditing tools are to evaluate the accuracy and correctness of data from the data source in comparison to business rules; the cleansing tools are for data parsing, standardization, correction, record matching, and documenting, while migration tools are for migrating data from data source to cleansing stage (Butt & Zaman, 2013).

An effective data quality system or tool used to store, analyze, and measure data quality can add business value to an organization and enhance the firm's competitive advantage. To create the business value, the data-quality system or tool at the organization used for DQM has to be precise and accurate (Liaw, 2013). Aerospace SME repairable spares suppliers have to identify the appropriate data quality system or tool to conduct input forecast data quality to increase the likelihood of improving forecast accuracy and create business value to the customers.

Data quality analysis. Analyzing the quality level of organizational data is essential to determine the fitness of use of the various business activities. Cooper and

Kahn (2012) pointed out that data users conduct data quality analysis to differentiate data of high quality to data of low quality. Data analysis can be complex and take multiple analysis steps to accomplish the goal of differentiating data of high quality to data of low quality (Pabinger et al., 2014). Data users conduct analysis using the data-quality system or tool to identify data errors and defects as well as determine the appropriate strategies for data quality process improvement.

Data quality process improvement. Wong (2013) defined a business process as a complete or coordinated set of tasks or logically related tasks performed to create value for customers and achieve other strategic objectives. Business process improvement is a critical business function for an organization's sustainability and maintenance of a competitive edge (Wong, 2013). Improving business processes such as input forecast data quality which increases the likelihood of improving forecast accuracy can enhance an organization's performance.

The mechanisms or philosophies organizations can use to improve a business process to become efficient, effective, and adaptable are Lean, Six Sigma, Lean Six Sigma, and total quality management (Wong, 2013; Zhang, Irfan, Khattak, Zhu, & Hassan, 2012). Rashid and Ahmad (2013) stated that the eight common methodologies for business process improvement as benchmarking, plan-do-check-act, super methodology, Six Sigma, Lean, kaizen, total quality management, and model-based integrated process improvement. Because of a large number of methodologies to improve business processes, SME business leaders can get confused on which is the appropriate methodology to utilize (Rashid & Ahmad, 2013).

The type of improvement process mechanism that an organization utilizes depends on the firm's culture, leadership understanding and value for process improvement, and employees' appreciation for the mechanism (Saljoughian, Allameh, Dabestani, & Rabbanimehr, 2014). However, Gijo and Scaria (2014) and Thomas, Mason-Jones, Davies, and John (2015) pointed out that Six Sigma methodology has become the most successful quality management initiative and widely used by some leading companies across the world to enhance organization competitiveness. Conversely, Zhang et al. (2012) noted that Lean Six Sigma (combination of Lean and Six Sigma methodologies) is the most widely used by top performing organizations. In addition, McAdam, Antony, Kumar, and Hazlett (2014) found in a study that Lean Six Sigma approach is used in SMEs to prevent the limitations of Six Sigma.

Deshmukh and Chavan (2012) found that management commitment is critical to Six Sigma implementation at SMEs. The commonly used Six Sigma approach for process improvement is the define-measure-analyze-improve-control approach when compared to the design for Six Sigma approach (Börner, Moormann, & Wang, 2012; Gijo & Scaria, 2014). In a study, Khan, Iqbal, and Mahboob (2015) proposed a data quality improvement process as part of a DQM framework. The improvement process included six stages namely assess, plan, implement, evaluate, adapt, and educate. With a focus on data quality improvement process, aerospace SME repairable spares suppliers can increase the likelihood of enhancing forecast accuracy to provide value to their customer and achieve their strategic objectives. Findings from data quality improvement process are critical to identifying the appropriate training or education for the professionals responsible for the organization data.

Data quality training/education. Continuous training and development to educate employees in an organization is critical to the survival of the business and remain competitive in the industry (Mehra, Langer, Bapna, & Gopal, 2014). Amongst others, training for human capital in SMEs is one of the sources of competitiveness (Agus, Isa, Farid, & Permono, 2015). Mehra et al. (2014) found in a study that an increase in training investment in SMEs is significantly related to the increase in revenue per employee. According to Mendes (2012), training and development are key factors in the success of a quality improvement program.

Jones, Beynon, Pickernell, and Packham (2013) conducted a study to evaluate the effects of various training methods on SME business performance. One of the findings were an overall recognition from SME owners and managers that various training methods for employees enhanced business performance. In contrast, Manimala and Kumar (2012) pointed out that although training is an important tool to enhance SMEs' internal capabilities, SME owners and managers view the importance of training differently. The reasons why some SME owners and managers might not value training are a lack of understanding of the value of training, high training cost, time requirement, and lack of resources and local unavailability of SMEs training needs (Jones et al., 2013).

Mendes (2012) and Bager, Jensen, Nielsen, and Larsen (2015) stated that SME managers usually focuses more on informal training (i.e., learning from experience) because the training can be easily integrated with daily operation and requires less time away from work. Although SME managers recognize that employee training can contribute towards business growth, Kisaka and Mwewa (2014) stated that the effect on growth is not statistically significant. Chuang (2013) pointed out that employee training implemented by SME managers often does not lead to increased organization performance because the training is not linked to the strategic business needs. Contrary to Chuang (2013), Shiryan, Shee, and Stewart (2012) stated that organizational performance is directly related to employee training.

Hashim and Wok (2013) found in a study that the increase in employees' knowledge and skills and the overall firm performance was greater in SMEs than in large companies after the implementation of a training scheme. Similarly, the individuals responsible or accountable for repairable forecast data quality in aerospace SME repairable spares suppliers have to be continually trained in the education of data quality process improvement to improve forecast accuracy and overall business performance. Moreover, poor continuous learning and education for SME owners, managers, and workers can lead to poor forecasting and planning, which results in low forecast accuracy (Augustine, Bhasi, & Madhu, 2012).

The purpose of this doctoral study was to address the knowledge gap on practical data quality strategies to conduct effective input data quality used in forecasting repairable spare parts demand. The six components of DQM from Ofner et al. (2013) study were used as the foundation to explore the practical strategies. Identifying such strategies could lead to enhanced repairable spare parts forecast accuracy and availability.

Aerospace Spare Parts and Availability of Repairable Spare Parts

Aircraft spare parts are essential to the maintenance and continuous safe operation of an aircraft (Hellingrath & Cordes, 2014; Mortada, Carroll, Yacout, & Lakis, 2012; Tracht et al., 2013). Spare parts are different from other inventories such as finished goods, work-in-progress, and raw materials because of their high purchase cost, shortage cost, obsolescence cost, and sporadic demand pattern (Dekker et al., 2013). Raw materials are initial components or materials transformed into finished parts that aircraft manufacturers use to assemble an aircraft. Such materials or components are used in the manufacturing of spare parts. Raw materials in the transformation phase to becoming a finished part are called work-in-progress inventory. Another critical difference between spare parts and other inventories is spare parts are forecasted and stored specifically for MRO activities of an aircraft to eliminate downtime and increase the effectiveness of an aircraft (Aisyati, Jauhari, & Rosyidi, 2013; Liu, Huang, Mokasdar, Zhou, & Hou, 2014). The demands for aircraft spare parts occur when the need arises for component maintenance or failure (Gu et al., 2015; Syntetos, Babai, & Altay, 2012; Wang, 2012).

According to Lengu et al. (2014), the spare parts industry is an important component of the United States economy because it constitutes about 8% of the gross domestic product. Characteristics of the aerospace spare parts industry include a large number of spare parts, sporadic demand and repair time, difficult to forecast demand, expensive parts, and high shortage costs (Zanjani & Nourelfath, 2014). The ability to determine the appropriate aircraft spare parts inventory to stock is critical to maximizing profits, reduce operational cost, and attain satisfactory customer service levels in the aerospace industry.

Gu et al. (2015) stated that the four categories of aircraft spare parts are rotables, repairables, expendables, and consumables. From Aisyati et al. (2013) perspective, aircraft spare parts can be categorized into three types namely rotables, repairables, and consumables. In contrast to Gu et al. and Aisyati et al., Driessen et al. (2014) stated that repairable and nonrepairable are the two types of aircraft spare parts. The focus of this study is identifying strategies forecasting business leaders use to improve the quality of data inputs used in forecasting repairable spare parts demand. According to Kilpi, Toyli, and Vepsalainen (2009) and Özkan et al. (2015), such spare parts are the most critical category when compared to other categories because of their high cost, complexity, repairability, and functionality to an aircraft.

Repairable spare parts are aircraft components that can be technically and economically repaired rather than procuring a new component (Driessen et al., 2014; Guide & Srivastava, 1997). Aircraft repairable spare parts are more complicated than aircraft consumable spare parts because of their design (Fritzsche, 2012; Guide & Srivastava, 1997). Beyond the need for repairable parts in the aerospace industry, various other industries with systems such as electronics, transportation equipment, copying machine, and automobiles also require repairable parts for maintenance activities (Guide & Srivastava, 1997; Tracht, Funke, & Schneider, 2014). The critical need for repairable parts indicates the importance of forecasting parts accurately to increase availability during maintenance activities.

Because of the high cost of repairable spare parts, Tracht et al. (2013) emphasized the importance of repairable spare parts because of their repairability and ability to be back in stock for future use. After removal of repairable parts from an aircraft, the ability to repair and return to stock forms a closed-loop supply chain (Kilpi et al., 2009; Tracht et al., 2013). According to Mortada et al. (2012), repairable components could be in three phases: in-service on one of the aircraft, undergoing repairs at the repair shop, and in the repairable spare parts inventory. Examples of repairable aircraft parts are actuators, landing gear, radar systems, electric motors, engines, and flight computers (Tracht et al., 2013). Repairable components are a significant part of the complex systems in an aircraft.

Costantino, Di Gravio, and Tronci (2013) pointed out that the aerospace industry has complex systems which require high level repairable spare parts to satisfy availability requirements. Product availability is a critical factor in determining the effectiveness of the product (Ke, Yang, Sheu, & Kuo, 2013). To increase aircraft availability, OEMs design the complex functional systems within an aircraft to be quickly repairable and replaced in between flights to attain the maximum utilization of the aircraft (Kilpi et al., 2009; Tiemessen & van Houtum, 2013). Therefore, the unavailability of repairable spare parts to replace failed components or conduct preventive maintenance can cause disruption to planned and unplanned maintenance for OEM and MRO service organizations.

Grobbelaar and Visser (2015) stated that OEMs, operators, and MRO service organizations conduct three types of maintenance, which are preventive maintenance (to prevent component failures), corrective maintenance (upon failures), and predictive maintenance (based on component condition and a predictive model). Line replacement units are the easily replaceable repairable modules that are removed from an aircraft during maintenance (Basten, van der Heijden, Schutten, & Kutanoglu, 2015; Fritzsche, 2012). After removing the line replacement units from the aircraft, the decision process to repair or replace begins. Depending on the repair analysis on a repairable aircraft part, a maintenance staff could decide to repair the part to original functional capability or discard the part and replace with a new component (Tracht et al., 2013). Basten et al. (2015) described the level of repair analysis as the strategy used in making the decisions on what aircraft repairable spare parts to discard or repair. In addition, the level of repair analysis can aid in deciding what repair locations in the network can perform the repairs or discards and how many resources to deploy to the locations (Basten, van der Heijden, & Schutten, 2012; Kapoor & Ambekar, 2015).

If the decision is to repair a repairable aircraft part, the part is sent to the repair shop and replaced by a repairable spare part. Repairable spare parts could fail for three reasons (a) manufacturing flaw, (b) aging, and (c) failure mode outside the scope of standard MRO procedures (Mortada et al., 2012). In an aircraft hierarchical structure, Costantino et al. (2013) described an aircraft to have numerous repairable indentures of various costs and availability. Costantino et al. described shop replacement units as the second indenture and line replacement units as the first indenture of the various repairable components in an aircraft. Figure 1 shows Basten et al.'s (2015) example of an aircraft radar system indenture product structure.

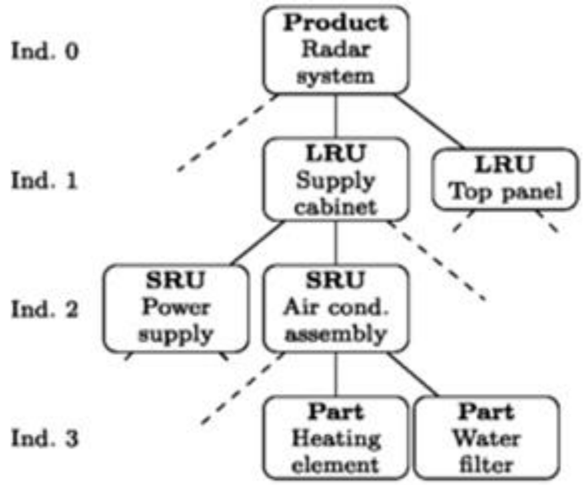

Figure 1. Radar system indenture product structure. Adopted from "An Approximate Approach for the Joint Problem of Level of Repair Analysis and Spare Parts Stocking," by R. J. Basten, M. C. Van der Heijden, J. M. J. Schutten, and E. Kutanoglu, 2015, *Annals of Operations Research*, *224*, p. 122. Copyright 2012 by Springer Science & Business Media, LLC. Reprinted with permission (Appendix H).

Fritzsche (2012) stated that the shop replacement units are the subcomponents of the line replacement repairable parts replaced at the repair shop to restore the component to original functionality. After the repaired repairable aircraft spare part is fully functional, the part is certified and put back into spares supply (Kilpi et al., 2009). Line replacement repairable spare parts are often repaired to put back in stock rather than scrapping the parts (Van der Heijden, Alvarez, & Schutten, 2013). Gu et al. (2015) pointed out that repairable spare parts have a limited number of repairs before the aircraft operators consider the parts as scrap.

High cycle service level is a critical requirement for the aircraft repairable spare parts industry to meet customer demands (Liu et al., 2014). Hence, fast repair and maintenance service are essential for returning the customer aircraft back to service. Walter, Holmström, and Yrjölä (2004) stated that non-functional aircraft on the ground because of component failures cause high operational expenses and revenue loss in the aerospace industry. Therefore, the availability of repairable spare parts in the repairable supply chain network is critical to the OEM, operators, and MRO organizations in the aerospace industry. Repairable spares network consists of repairable spare parts storage locations (e.g., warehouses and supplier stock) and repair facilities that restore failed components.

The stakeholders of a repairable spares network are OEMs, aircraft operators, MRO service organizations, and parts suppliers (Koblen & Niznikova, 2013; Özkan et al. 2015). Walter et al. (2004) stated that millions of parts make up an aircraft. Therefore, one stakeholder cannot possibly stock all aircraft repairable spare parts. To achieve the desired service levels, stakeholders throughout the repairable spares network have to stock repairable spare parts depending on their operation within the supply chain network (Lengu et al., 2014; Özkan et al., 2015). When aircraft operators, OEMs, and MRO service organizations need repairable parts that are not available in their inventory system, the repairable spares supplier has a critical role in fulfilling the part request (Gu et al., 2015). Suppliers that support the repairable spares network are mainly SMEs. Next, I defined an SME repairable spares supplier in the network, discuss SME use of demand forecasting, and the difficulty SMEs face in forecasting because of poor input forecast data quality.

Small and Medium Enterprises (SME) and Forecast Data Quality

The aerospace spare parts supply chain consists of mainly SMEs. The supply chain consists of 7,919 SME’s suppliers in the United States using the North American

Industry Classification System code 423860 and Standard Industry Classifications code 508803 and 55990104 in Hoover's database. The SME aerospace suppliers play significant roles in achieving effectiveness in the aerospace spare parts supply chain.

SME definition. The SME's are essential to the economic growth of developing and developed countries (Augustine et al., 2012; Begg & Caira, 2012; Majumdar & Murali Manohar, 2014; Monisola, 2013). The enterprises are crucial players in domestic economies and international trade in various countries and can be as significant as greater than 90% of a country's firms (Beifert, Maknyte, & Prause, 2013; Oyedijo, 2012). In addition, SMEs contribute innovative business solutions and value added activities to various industries in a country and have higher employment than large enterprises (Demyen & Ciurea, 2014). Various definitions of SME exist because of the global diversity and characteristics of economies (Lucky & Olusegun, 2012; Simpson, Padmore, & Newman, 2012; Zach, Munkvold, & Olsen, 2014). The specific criteria that differ in various SME definitions are size, industry, the number of employees, and gross revenue (Lucky & Olusegun, 2012; Majumdar & Murali Manohar, 2014). Britzelmaier, Kraus, Häberle, Mayer, and Beck (2013) pointed out that SME could be defined by using quantitative (gross revenue, total asset, and the number of employees) and qualitative (unity of ownership, management, and organization structure) criteria.

I utilized Waissi et al. (2013) classification of SME aerospace suppliers (See Table 3) to define an aerospace SME repairable spares supplier to achieve the purpose of this study. Waissi et al. description of SME aerospace suppliers are companies with the number of employees between 10 and 249. Furthermore, Waissi et al. stated that the SME aerospace suppliers play critical roles towards the effectiveness of the aerospace supply chain in the United States.

Table 3

Company Size Categories

Source	Enterprise Category	Headcount (Annual Work Unit)
New Classification of Aerospace Suppliers	Micro	1 - 9
	Small	10 - 49
	Medium Low (M-Lo)	50 - 99
	Medium High (M-Hi)	100 - 249
	Large Low (L-Lo)	250 - 499
	Large High (L-Hi)	or more

Note. Adopted from "Competitiveness of Small-and-Medium Enterprises of the Arizona Aerospace and Defense Supply Chain," by G. R. Waissi, J. E. Humble, and M. Demir, 2013, *Journal of Logistics Management*, *2*, p. 17. Copyright 2013 by Scientific & Academic Publishing. Reprinted with permission (Appendix I).

SME and forecasting. Forecasting is one of the early critical business activities businesses perform to initiate other supply chain management activities such as planning and inventory decisions to attain the desired service level (Albarune & Habib, 2015). Businesses have to conduct forecasting as a continuous process to learn and adapt to their business environment (Lakhani & Kleiner, 2014). Ramlan et al. (2012) identified SMEs as among industries that critically need forecasting to achieve their business goals. Aerospace SME repairable spares suppliers in the United States forecast annually what repairable spare parts to stock to support their customers when the need arises for MRO activities. The repairable spare parts represent 70% to 80% of spare parts inventories (Tracht et al., 2013). Accurate forecasting on such parts is critical to the survival of aerospace SME repairable spares suppliers to support the OEMs, aircraft operators, and MRO service organizations (Tracht et al., 2013).

Non-balance between the demands for repairable units and the returns of the repairable units and procurement policies for replacement units are factors that create challenges for accurate forecasting of repairable spare parts (Guide & Srivastava, 1997). Kontrec, Milovanovic, Panic, and Milosevic (2015) argued that even when the failure rate for repairable spare parts is known, demand forecast is still difficult to perform. According to Fritzsche (2012), failures for repairable components cannot be precisely forecasted leading to unscheduled maintenance. An accurate demand forecast is essential for SME repairable spares suppliers to achieve the availability of the appropriate repairable spares inventory to support their customers with the right quantity at the right time.

Demand forecasting is a critical business function to achieve inventory planning and control business objectives (Ma et al., 2013; Şahin et al., 2013). Rosienkiewicz (2013) defined a demand forecast as an estimate of future demand considering a set of assumptions. Similarly, Hassan, Khan, and Hasan (2012) defined spare parts demand forecast as an estimation of future demand for spare parts by considering components failures under various conditions. Business leaders conduct demand forecasting as a strategic business activity; essential to the success of organizational long-term and short-term business planning (Bhattacharyya, 2014; Lapide, 2014; Szozda & Werbińska-Wojciechowska, 2013).

An aerospace SME repairable spares supplier's ability to accurately forecast future product demand is critical to satisfying customer demands at a high level (Hussain, Shome, & Lee, 2012). Ghodrati, Ahmadi, and Galar (2013) pointed out that suppliers consider optimum repairable spare parts provision for product support as a competitive advantage. Effective demand forecast can enhance the competitive advantage of an organization on the firm's ability to deliver exceptional customer service (Bala, 2012; Tracht et al., 2013). With the competitive nature of the aerospace industry, the SME repairable spares suppliers have to utilize demand forecasting as a strategic tool to enhance their repairable spare parts availability to gain competitive advantage.

Dudeja (2014) pointed out that supply chain executives across industries identified forecasting spare parts demand as one of the top challenges they face. Aerospace SME repairable spares suppliers experience difficulties in forecasting the required repairable parts stock levels to satisfy customer needs because of inaccurate demand forecasts (Ramlan et al., 2012). The factors influencing repairable spare parts prediction and optimization are operational conditions, climatic conditions (e.g., temperature, snow, dust, ice, and wind), the skill of operator and maintenance crew, and history of the repair activities (Barabadi et al., 2014). Ghodrati, Benjevic, and Jardine (2012) found that the operating environment of a product/machine is an influential factor in determining the product's reliability and maintainability. Therefore, the operation environment can affect how to forecast repairable spare parts for product support (Ghodrati et al., 2012).

Similarly, Guide and Srivastava (1997) pointed out that the variability of repairable failure rates caused by subjection to various conditions such as geographic location and annual usage can affect business leaders' ability to accurately forecast the need for repairable spare parts. In addition, planes taken out of use, reduced airtime, and newer technology can affect the demand for repairable spare parts (Romeijnders et al., 2012). The effect on the repairable parts demand can cause SME repairable spares suppliers to experience difficulty in forecasting. Past researchers have mentioned various forecasting techniques or methods to perform demand forecasting for repairable spare parts for inventory management.

Repairable spare parts have intermittent or lumpy demand nature, which creates challenges for forecasters to predict future demand (Bacchetti & Saccani, 2012; Mukhopadhyay, Solis, & Gutierrez, 2012). Syntetos et al. (2012) noted that intermittent demand is often called sporadic, erratic, or lumpy demand. Intermittent demands are demand patterns for parts with sporadic requests characterized by some periods of zero demand (Kourentzes, 2013; Kourentzes, 2014; Syntetos et al., 2012). Table 4 shows an example of intermittent demand pattern in contrast to Table 4 that shows a normal demand pattern. Mukhopadhyay et al. (2012) and Lengu et al. (2014) stated that intermittent demand becomes lumpy when the sizes of the actual demand occurrences have large variations.

Table 4

Intermittent Demand Pattern vs. Normal Demand Pattern

Intermittent Demand Pattern															
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Demand	0	12	7	0	0	17	0	0	0	0	11	15	5	0	0
Normal Demand Pattern															
Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Demand	50	23	47	35	13	70	99	83	37	15	29	31	19	91	43

Traditionally, forecasters use single exponential smoothing forecasting method as the standard method to forecast intermittent demand (Gutierrez, Solis, & Mukhopadhyay, 2008). Bacchetti and Saccani (2012), Kourentzes (2014), and Kozik and Sep (2012) pointed out that although time-series methods (e.g., single exponential smoothing and moving average forecast methods) and regression analysis are the most used in business practices, the forecast methods result in overestimation of intermittent demand. Croston's method is a more effective forecast technique to forecast intermittent demand with improved accuracy when compared to conventional time series methods such as the single exponential smoothing (Kourentzes, 2013). Mukhopadhyay et al. (2012) stated that error exists in the Croston's forecast method of mathematical derivation of expected demand, which leads to a positive bias.

Gutierrez et al. (2008) found that the Syntetos-Boylan Approximation forecasting method performed better on forecast accuracy than the Croston and the single exponential smoothing forecast methods. The Syntetos-Boylan Approximation forecast method is a modification of the Croston's method that yields approximately unbiased estimator of the demand forecast (Gutierrez et al., 2008). Hellingrath and Cordes (2014) stated that the

Croston’s method and Syntetos-Boylan Approximation forecasting methods are commonly used in repairable spares management. Romeijnders et al. (2012) conducted a study on repairable spare parts demand forecasting using information of component repairs and found a two-step forecast method that reduces forecast error up to 20% better than the Croston’s method. Rosienkiewicz (2013) stated that forecasting techniques could be broken down into qualitative and quantitative forecasting techniques. Table 5 shows Rosienkiewicz perspective on the various types of quantitative and qualitative forecasting techniques.

Table 5

Qualitative and Quantitative Forecasting Methods

Qualitative Methods	Quantitative Methods	
	Time Series Methods	Causal Methods
Judgment	Moving Average, Weighted moving average	Regression
Historical Analogy	Exponential Smoothing	Econometric
Focus Group	Trend Analysis	Input-Output
Market Research	Decomposition	Disaggregated
Diffusion	Advanced Time Series Methods	Neural Networks
Markovian	Box-Jenkins (ARIMA)	

Note. Adopted from “Artificial Intelligence Methods in Spare Parts Demand Forecasting,” by M. Rosienkiewicz, 2013, *Logistics and Transport*, *18*, p. 42. Copyright 2013 by Open Journal Systems. Reprinted with permission (Appendix J).

Further explanation or descriptions of the forecasting techniques for the intermittent demand of repairable parts are beyond the scope of this doctoral study. The goal of an SME spare part supplier is to establish accurate forecasts with low forecast error regardless of the forecasting technique the supplier uses to perform repairable demand forecasting. Forecast error is the variance between forecasted and actual value (Ho & Ireland, 2012; Kamalapur, 2013). The most common measure of forecast error is mean absolute percentage error (Davydenko & Fildes, 2013; Kim & Kim, 2016). Although no data is available to assess the specific weighted mean for absolute percentage error for repairable spare parts, the error is expected to be higher than for non-repairable parts given the fact that repairable spare parts are forecasted in significantly low quantities.

Forecasts often exhibit forecast errors (Ucenic & Filip, 2012) and occur in each level of a supply chain (Chang & Yeh, 2012). Past researchers (Chang & Yeh, 2012; Kamalapur, 2013) have conducted studies pointing out the negative effects of demand forecast errors on organization supply chain performance, operational excellence, and overall financial performance. Kourentzes (2013) stated that forecast errors could induce cost into a company from unmet demand or obsolete stock. Demand forecast error is a cause of the bullwhip effect, which can paralyze an organization’s supply chain (Hussain et al., 2012; Ma et al., 2013). Cho and Lee (2012) defined the bullwhip effect as the demand variation amplification along a supply chain from downstream towards upstream. Inaccurate forecasts can lead to amplified demand variability in the upstream of a supply chain (Salam, 2014). The effects of the bullwhip effect on a supply chain are poor customer service, lost revenues (Ma et al., 2013), ineffective transportations, low capacity utilizations, and missed production schedules (Cho & Lee, 2012). The intensity of the bullwhip effect varies from industry to industry (Alizadeh, 2012). The four major causes of the bullwhip effect are demand forecast data updates, order batching, rationing and shortage gaming, and price fluctuation (Alizadeh, 2012).

The focus of this study scope was the input forecast data quality used in forecasting repairable spares demand. Data is a crucial element for forecasting the demand for repairable spare parts. Regardless of the forecasting technique used, Hellingrath and Cordes (2014) found that the accuracy of aircraft repairable spare parts demand forecasting is dependent on the forecast input data. Therefore, forecasting business leaders need input data quality strategies to attain quality data for forecasting repairable spare parts and reducing forecast errors. An understanding of repairable parts input forecast data quality and the challenges are essential to SME repairable spares suppliers to attain enhanced forecast accuracy and inventory optimization.

SME forecast input data quality. Forecast input data is any data utilized to forecast the future demand for a business aspect of an organization. The quality of such data is critical to reducing forecast errors and enhancing forecast accuracy (Silva Fonseca et al., 2012; Tum, Strauss, McCallum, Günther, & Schmid, 2012; Wang, Huisman, Stevels, & Baldé, 2013). Salam (2014) defined forecast data quality as forecast data that are accurate, timely, reliable, and accessible. According to Forslund and Jonsson (2007) and Ramanathan (2013), the further upstream in a supply chain, the lower the forecast data quality. The aerospace SME repairable spares suppliers face challenges with input forecast data quality in demand forecasting because of the low quality of data in the industry (Tian et al., 2013).

To forecast repairable spare parts demand, SME repairable spares suppliers utilize data from various sources from the industry and internal business data (Costantino et al., 2013; Gu et al., 2015; PricewaterhouseCooper, 2011). Barabadi et al. (2014) pointed out that the various sources repairable spare parts forecast input data can be extracted from are maintenance and inspection reports, historical data on similar or identical items, data from sensors on the aircraft, and manufacturer information. Puurunen et al. (2014) conducted a study to explore incomplete information in maintenance parts for inventory optimization. The findings were poor data quality of the input forecast data can significantly affect the service level, and the service level sensitivity is item specific.

Possible elements that can affect the repairable input forecast data quality are (a) frequent engineering or configuration changes, (b) inaccurate inventory-on-hand data, (c) customer ordering patterns, (d) inaccurate historical spend data, and (e) inaccurate maintenance records (Barabadi et al., 2014). Input forecast data with a high level of variability can induce forecast errors to the forecast, which leads to poor forecast accuracy (Aljumaili, Wandt, Karim, & Tretten, 2015). Data quality is critical in demand forecasting to improve forecast accuracy (Szozda & Werbińska-Wojciechowska, 2013). A detailed definition of data quality is vital to address the research question.

Yang et al. (2013) stated that data quality is difficult to define precisely. Practitioners and academics (Haug et al., 2013; Huang et al., 2012; Panahy et al., 2013a; 2013b) have attempted to define data quality to address the data quality business problem. Panahy et al. (2013a) defined data quality as a data user’s ability in judging the low or high quality of data in use. Similar to Haug et al. (2013), Haug et al. (2011)

defined data quality as “fitness for use” of the task the user intends to complete (p. 171). Although, practitioners and academics have offered various definitions of data quality, Liaw et al. (2013) stated that no universal definition exists. Data quality is the ability to satisfy stated or implied needs of a data user (Rahimi et al., 2014).

The ability for SME repairable spares suppliers to judge the quality of internal and external data utilized to execute the forecasting of repairable parts is crucial. Historical internal data and future external data such as customer orders and aerospace bulletin boards prediction are instrumental in forecasting the future demand of repairable parts. Eken et al. (2014), Hazen et al. (2014), and Ofner et al. (2013) identified data as a strategic asset and a success factor for an organization. The quality of an organization data is a critical part of doing business (Eken et al., 2014). Furthermore, Waller and Fawcett (2013) stated that data is a driver for improved organizational profitability.

Despite research data from several researchers showing the effects and cost of poor data quality, some organizations still do not consider data as a critical resource (Eken et al., 2014; Fisher et al., 2012; Haug et al., 2013; Hazen et al., 2014). Begg and Caira (2012) found in a study that SMEs do not recognize the value of their organization data and the effects on business processes. Although, Salam (2014) found that input forecast data quality correlates to positive supply chain performance. Poor repairable parts input forecast data quality can have significant negative effect on SME repairable spares suppliers’ effectiveness and efficiency. Augustine et al. (2012) found that forecasting is an influential factor to SME performance. Therefore, there is a need to understand factors that can cause inaccurate forecasting such as data quality to prevent the effects on SME performance.

The effect of poor data quality can either be tangible or non-tangible losses to an organization (Haug et al., 2013; Hazen et al., 2014). The unavailability of repairable spare parts because of forecast data quality could lead to lost revenues, customer dissatisfaction, and public safety hazard (Driessen et al., 2014). However, Basten and van Houtum (2014) point out that the unavailability of low-value spare parts such as consumable parts may have a similar effect on high-value spare parts such as repairable parts. Nevertheless, an inaccurate repairable forecast could lead to stockout and excess inventory for SME repairable spares suppliers (Rosienkewicz, 2013). Excess repairable spare parts can result in high carrying cost and impede cash flows, whereas repairable spare parts shortage or stockout can lead to costly flight cancellations or delays (Gu et al., 2015).

According to Kourentzes (2013) and Tian et al. (2013), aerospace SME repairable spares suppliers suffer high operating cost from excess inventory, obsolescence risk, and shortage cost because of poor forecast data quality. Van Kooten and Tan (2009) stated that obsolete repairable spare parts are often scrapped, which could result in lost profits of up to 1% annually. Fritzsche (2012) stated that a shortage of repairable spare parts could lead to aircraft-on-ground situations, which increases shortage costs and can damage brand image. From Wang (2012) and Roda, Macchi, Fumagalli, and Viveros (2014) perspective, unavailability of repairable spare parts causes product downtime, whereas excess stock leads to high carrying inventory costs and lower cash flow.

Tiemessen and van Houtum (2013) and Dekker et al. (2013) stated that a major challenge is balancing inventory holding cost, obsolescence cost, and stockout cost while providing fast recovery service to their customers.

Sáez et al. (2012) pointed out that data of poor quality can influence the optimization of organizational processes. Similarly, poor input forecast data quality could affect the ability for SME repairable spares suppliers to optimize the repairable demand forecasting process. Poor data quality can affect an organization’s culture and ability to build trust or confidence in user acceptance of the data to execute a process or make decisions (Haug et al., 2011; Haug et al., 2013; Hazen et al., 2014). In addition, poor data quality can cause mistrust within an organization and between organizations that conduct business (Haug et al., 2011).

The cost of poor repairable spare parts input data quality used in forecasting can have a significant effect on an SME spare part supplier performance. The growing concern for data quality in various industries is because of the cost and effects of data quality on organizational effectiveness and efficiency (Haug et al., 2011; Woodall, Borek, & Parlikad, 2013). Haug et al. (2013) argued that practitioners and academics in the past have had difficulty is estimating the total cost of low data quality because no clear standard measurement exists in data quality research. In Figure 2, Haug et al. (2011) represented the total cost an organization incurs from data quality in a graph.

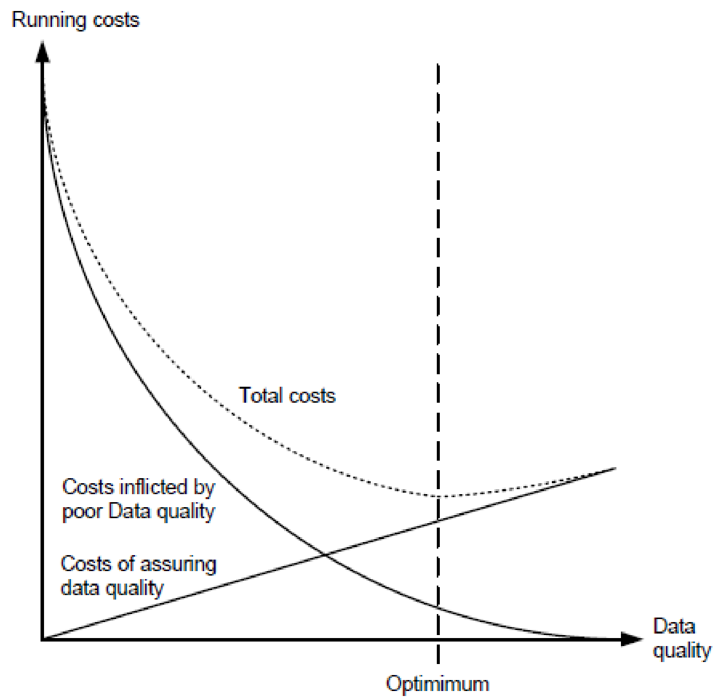

Figure 2. Total costs incurred by data quality of an organization. Adopted from "The Costs of Poor Data Quality," by A. Haug, F. Zachariassen, and D. van Liempd, 2011, *Journal of Industrial Engineering and Management*, *4*, p. 179. Copyright 2011 by OmniaScience. Reprinted with permission (Appendix K).

In past literature, researchers found that costs were stemming from poor data quality. Organizations in the United States lose an estimate of over $600 billion annually because of poor data quality (Eken et al., 2014; Fisher et al., 2012). Xiang et al. (2013) stated that the loss of poor data quality in United States organizations was $611 billion annually. Although no such cost data exists specifically for the effects from low repairable input forecast data quality in my review of the literature, the cost of poor data quality from Eken et al. (2014) and Xiang et al. provided some insight into how impactful it could be to SMEs.

Similar to Haug et al. (2011) and Hazen et al. (2014), Xiang et al. (2013) stated that the cost of poor data quality for a typical organization is 8% to 12% of the firm's revenue. For service organizations, expenses can increase up to 60% because of poor data quality (Haug et al., 2011; Hazen et al., 2014; Xiang et al., 2013). The type of effect poor data quality can cause a company is dependent on the nature of the data and the use. Since forecast errors are inevitable, to reduce the effect of low repairable input forecast data quality on SME repairable spares suppliers performance, the need arises to explore practical strategies to assist forecasting professionals in enhancing forecast accuracy. To achieve the purpose of this study, I utilized the DQM conceptual theory as a lens to explore practical strategies for improving repairable input forecast data quality.

Transition

Section 1 of the doctoral study was an introduction to the foundation and background of the study to highlight the relevance of the study. In addition, the focus in Section 1 was stating the relevant problem statement, purpose statement, research question, conceptual framework, operational terms, the significance of the study, and review of the literature. The specific business problem was that some forecasting business leaders at aerospace SME repairable spares suppliers lack data quality strategies to improve the quality of data inputs used in forecasting repairable spare parts demand. The purpose of the qualitative multiple case study was to explore the strategies forecasting business leaders at aerospace SME repairable spares suppliers use to achieve quality data inputs used in forecasting repairable spare parts demand.

An evaluation of possible research methodologies resulted in the selection of the qualitative multiple case study research to address the study. Conducting a literature review for this study in Section 1 revealed the criticality of input data quality to conduct demand forecasting to enhance the availability of aircraft repairable spare parts, SMEs performance is critical to the economy, and DQM as the conceptual framework. Furthermore, Section 1 highlighted the contribution of the study to business practice and implication to social change.

Section 2 was an in-depth description of the role of the researcher, research participants, research method, research design, and population and sampling. In addition, Section 2 will highlight assurance of ethical research, data collection, data analysis, and the approach used to support the study validity and reliability. Section 3 includes the presentation of research findings, application to professional practice, the implication to social change, recommendation for further research, and summary with study conclusion.

Section 2: The Project

Purpose Statement

The purpose of the qualitative multiple case study was to explore the strategies forecasting business leaders at aerospace SME repairable spares suppliers use to achieve quality data inputs used in forecasting repairable spare parts demand. The target population was forecasting business leaders in aerospace SME repairable spares suppliers located in three states (Georgia, Florida, and Kansas). I selected two forecasting business leaders each from three aerospace SME repairable spares suppliers to extract research data. The implication for positive social change may include increased situational awareness for business leaders to enhance business practices to attain sustainable profits and contribute towards a stable societal economy through household income and the state budget.

Role of the Researcher

Jones, Rodger, Ziviani, and Boyd (2012) pointed out that the research method a researcher chooses to conduct a study can influence their roles in the research. My roles in this qualitative study were that of a data collection mechanism and an executor of the research design. Merlo, Goodman, McClenaghan, and Fritz (2013) stated that researchers play integral roles in the data collection process. The Belmont report from the U.S. Department of Health and Human Services included ethical principles and guidelines for research involving extraction of data from human subjects (U.S. Department of Health & Human Services, 2014). During data collection, I upheld the protocols of the Belmont report for human protection in research through ethical conduct by providing informed consent, allowing voluntary participation, and granting participants the choice to decline to participate before or during the research process without any penalties.

I actively engaged in executing the research design. I identified the appropriate units of analysis and collected data from the research participants through semistructured interviews and documentation. There is potential to influence the data collection process as a human instrument in the semistructured qualitative interviews (Pezalla, Pettigrew, & Miller-Day, 2012). *Bracketing* is a method used in qualitative research to mitigate the effects of preconceptions of the researcher and participants that may influence the research process and outcome (Tufford & Newman, 2012). Although there is no clear definition of what elements constitute such preconceptions, researchers tend to include beliefs and values, interests, thoughts and hypotheses, theories, biases, emotions, presuppositions, and assumptions within the research project (Tufford & Newman, 2012). The preconceptions influence how research data are gathered, analyzed, interpreted, and presented.

My preconceptions about this study are a result of years of experience and the challenges experienced by practitioners in the areas of forecasting and data quality. For example, my personal experience dictates that technical expertise and business commitment, dollars, and time are required to ensure high data quality and forecast accuracy. Therefore, these were important considerations I used to define the research question, interview questions, and apply bracketing to mitigate the potential effects of my preconceptions.

I utilized three bracketing techniques to outline and mitigate my personal preconceptions at each stage of the research process to enable me objectively extract, process, analyze, and derive answers from the research data. Reflective journaling is a strategy a researcher utilizes to create transparency in the research process by documenting their personal assumptions, beliefs, and experience and examining the influence on their research (Ortlipp, 2008; Wall, Glenn, Mitchinson, & Poole, 2004). First, I applied the reflective journal technique to document my preconceptions and reflections of the study in Microsoft Word to mitigate potential effects throughout the research process. Research with a high degree of affinity between a researcher and the participants might raise questions of bias in the study (Chenail, 2011). Second, I conducted interviews with research participants that I had no professional or personal relationship with to avoid any potential influence on the data collection process. Third, I ensured no interjection to the participants' responses to the interview questions to avoid influencing the participants to respond in a manner that aligns with my views. During the data collection process, I collected data in a trustworthy manner to mitigate bias.

I analyzed the research data to identify meaning from the data to address the research question. To effectively conduct the semistructured interviews and extract the appropriate research data to discover meaning, I developed an interview protocol using Jacob and Furgerson (2012) and Rabionet (2011) approaches for successful interview protocols. The rationale for the interview protocol was to enhance consistency in the interview process applied to all research participants to extract data. The interview protocol (see Appendix D) included the process of scheduling an interview, an introductory approach to building rapport and sharing confidentiality guidelines with participants at the interview, presentation of open-ended research questions, conclusion approach, and follow-up strategy.

As a human instrument in this qualitative study, I needed to disclose any relationship with the research problem, participants, and ability to conduct the research as noted by Greenbank (2003) and Hanson, Balmer, and Giardino (2011). I had no direct relationship with the potential research participants. However, I had limited relationship with the research problem because of my 8 years of experience working in several supply chain positions managing relationships with SME production parts suppliers, who deliver major components to OEM's. The experience of a qualitative researcher and the ability to draw a conclusion from the research data can affect the accuracy of the study (Bernard, 2013; Rossiter, 2008). My current position as a purchasing manager for an aerospace company in Georgia and 8 years of experience in the supply chain field was an asset in conducting this study.

Participants

The research participants were business leaders at aerospace SME repairable spares suppliers in the states of Georgia, Florida, and Kansas, who had experience in forecasting repairable spare parts. The participants' eligibility criteria included stakeholders of the generated demand forecast and had deployed input data quality strategies that resulted in improved forecast accuracy of repairable spare parts last year. I utilized the supplier directory on the Aerospace Suppliers Association website to extract contact information of business leaders at SME repairable spares suppliers. I gained access to the participants by contacting the business leaders by phone and networking with the leaders to obtain permission to conduct studies within their companies through the participants. As the business leaders showed interest in the study, I sent a letter of cooperation (see Appendix A) through e-mail as an official request to gain permission. After I had gained approvals through signed letters of cooperation (see Appendix M) from the business leaders at the aerospace SME repairable spares suppliers, I sent invitation e-mails (see Appendix B) to the potential research participants at the suppliers to request voluntary participation in the study. The e-mail included the informed consent form (see Appendix C) to assure confidentiality.

To extract quality qualitative research data from research participants, Swauger (2011) emphasized the importance for researchers to build working relationship with the participants. As the research participants responded with attached signed informed consent forms (see Appendix N) in confirmation e-mails, I applied the ethic-of-care approach by Swauger through consistent communication with the participants by phone and e-mail to establish a working relationship. I was courteous and professional with the participants when discussing the possible times to schedule an interview. Further, I was clear about my intentions and position when establishing the working relationship with the participants as noted by Rubin and Rubin (2011) and Swauger to ensure the participants provided insight aligned to the overarching research question during the interviews. I did not use power to control the participants and ensured the participants were comfortable withdrawing at any point of the research process as noted by Swauger.

Research Method and Design

I chose the qualitative research method and multiple case study design to address the business problem and the fundamental research question. Upon consideration of other research methods and research designs, the qualitative method and multiple case design was appropriate to achieve the research purpose.

Research Method

I chose the qualitative research method for this study because the research problem was pertaining to exploring the strategies aerospace business leaders use to achieve the quality of data inputs used in repairable spare part demand forecasting. To my knowledge, there are no published specific strategies to address this study business problem. Hence, the qualitative research method was most suitable to explore this study business problem. In qualitative research, the researcher is part of the study (Erlingsson & Brysiewicz, 2013). The decision to utilize the qualitative research method over the quantitative research method was because I was able to integrate with the research participants and be part of the study. Yin (2014) stated that researchers use qualitative research method to explore a phenomenon from participants' understanding of the phenomenon in real life context by asking open-ended questions. I extracted in-depth research data from the aerospace business leaders on the business problem through how, why, and what questions as opposed to quantitative method inquiries of mainly yes or no survey questions. Mixed-method research is conducting an up-close exploration of a phenomenon and the testing the findings from the exploration to identify relationships that address a research question (Farrelly, 2012). Upon consideration of the mixed-method research methodology, I decided not to utilize the method because the method does not align with this proposed study purpose, which was just to focus on exploring the business phenomenon.

Research Design

I chose the case study research design over the other qualitative research designs (phenomenology, narrative, and ethnography) to conduct this study because of the appropriateness to achieve the research purpose (Petty et al., 2012). Other qualitative research designs are appropriate if the researcher's aim is to understand human experiences about a specific phenomenon (Erlingsson & Brysiewicz, 2013; Moustakas, 1994; Petty et al., 2012). Exploring the strategies to improve the quality of data inputs for forecasting repairable spare parts was the aim of this study. Therefore, the other designs were not appropriate for this study.

In case studies, researchers holistically analyze events, persons, decisions, projects, institutions, policies, process or other systems (Thomas & Myers, 2015). In this research, a case represents an aerospace SME repairable spares supplier. No published strategies exist because the data quality issues faced by the niche industry vary across companies. Therefore, the effort to identify such effective strategies required me to conduct a community assessment. I utilized Thomas and Myers (2015) case study design framework in Figure 3 to select the components of the case study design that aligns to this study.

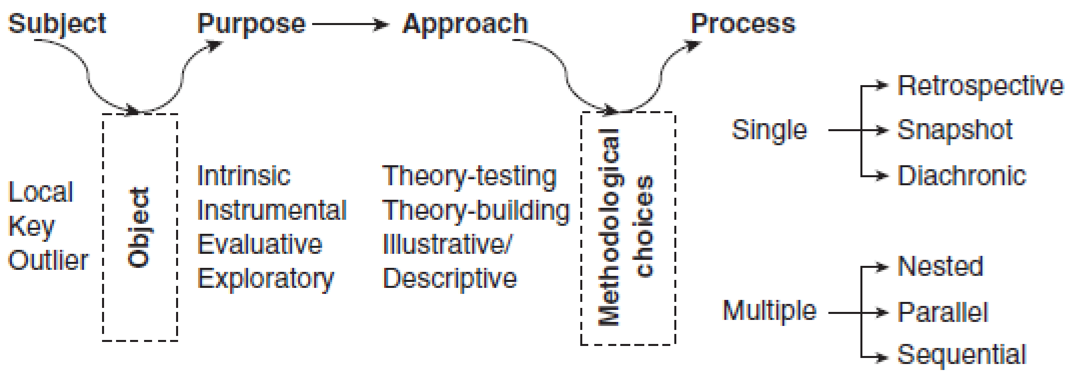

Figure 3. A typology of case studies. Adapted from "The Anatomy of the Case Study," by G. Thomas and K. Myers, 2015, p. 64. Copyright 2015 by Sage Publications Ltd. Reprinted with permission (Appendix L).

In this research, my focus was on primary cases known as the SMEs because the key cases contain information-rich context relevant to the study. Because of the exploratory nature of this study, I utilized the exploratory case study to understand and find meaning to the business problem. Theory-testing was chosen from the approach layer of the typology of case study because I used the DQM theory as the roadmap to address the research question. I chose the multiple case study design to conduct the study. The process of studying multiple parallel cases (i.e., multiple individuals from several SMEs that exhibit high control on data quality) in a multiple case study enhanced my understanding of the business problem.

A multiple case study design gave me a broader perspective to extract repairable input data quality strategies in different environments compared to a single holistic case study in one environment, which has greater study limitations (Stewart, 2012; Yin, 2014). Further, I selected multiple case study because of the replication logic (Campbell & Ahrens, 1998; Stewart, 2012; Yin, 2014), in which each case is viewed individually. The replication of procedures for each case in a multiple case study could improve the validity and generalizability of the study findings (Campbell & Ahrens, 1998; Gerring, 2011; Zivkovic, 2012).

Bernard (2013) recommended six to eight research participants from a homogeneous population in qualitative research to gain an understanding of the inquiries about a study. For studies with homogeneity among the research population, a sample of six interviews is sufficient to develop meaningful themes and attain data saturation (Mason, 2010). Data saturation in research occurs when a researcher identifies no new information, no new coding, and no new themes from interviewing an additional participant and the ability to replicate the results exist (Fusch & Ness, 2015). I conducted interviews with six research participants for this study until I attain data saturation. I identified data saturation when no new information, no new coding, and no new themes occurred from interviewing the research participants and the ability to replicate the results existed.

Population and Sampling

The target population consisted of aerospace business leaders at SME repairable spares suppliers located in three states (Georgia, Florida, and Kansas). Eligibility criteria I used to select the study participants were (a) have deployed input data quality strategies that resulted in improved forecast accuracy of repairable spare parts last year, (b) experienced in forecasting repairable spare parts demand, and (c) stakeholders of the generated demand forecast. Through the signed consent form, I ensured all study participants met the eligibility criteria. Convenience, purposeful, and census samplings are the three sampling strategies I considered to sample the study participants.

Convenience sampling is drawing a representative data of a population by selecting individuals who are easily accessible and can volunteer (Singh, 2016). The advantages of convenience sampling are the ease and the quickness with which researchers can collect data (Singh, 2016). The disadvantages of convenience sampling are there is potential that the sample is not representative of the whole population, and the volunteers could induce bias in the research data (Singh, 2016). Therefore, convenience sampling was not appropriate for this study. Next, purposeful sampling is a participant sampling strategy used to address specific purposes related to the research questions (Gentles, Charles, Ploeg, & McKibbon, 2015). That is, a researcher selects each case with high information content to address a particular set of questions. Because of the general nature of the research question that seeks to identify strategies business leaders use to achieve quality data inputs for forecasting repairable spare parts, the sample design must seek a census across the participants. Therefore, census sampling was the appropriate choice. Census sampling is identifying a census sample and collecting research data from all participants in the population (Fowler, 2013; Najafi et al., 2014). I applied census sampling to seek information-rich cases relevant to the study to connect with the research participants.

The determination of the number of cases to study is critical in research because a researcher using a larger sample size than needed to uncover answers to a research problem can cause ethical issues (Francis et al., 2010; Onwuegbuzie & Leech, 2007). Similarly, a researcher using a smaller sample size of cases than needed to uncover answers to a research problem can cause ethical and quality issues (Carlsen & Glenton, 2011; Francis et al., 2010; Onwuegbuzie & Leech, 2007). To determine the sample size of cases, I considered which sample size would achieve saturation or redundancy and support variation within the target population (Onwuegbuzie & Leech, 2007). The sample size N = 3 cases for this study was determined based on three key references, Marshall, Cardon, Poddar, and Fontenot (2013), Onwuegbuzie and Leech (2007), and Rowley (2002).

Bowen (2008) stated that data saturation occurs when data shows up in greater than 70% of the interviews, member checking, resonated with research participants, and makes sense of a review of the past literature. For studies with homogeneity among the research population, a sample of six interviews is sufficient to develop meaningful themes and attain data saturation (Mason, 2010). Therefore, I selected two participants each from the three study cases to conduct interviews and extract research data. As noted by Carlsen and Glenton (2011), Fusch and Ness (2015), and Marshall et al. (2013), I identified data saturation when no new information, no new coding, and no new themes occurred from interviewing the six research participant and the ability to replicate the results existed. There was no need to interview additional participants beyond the six research participants to attain data saturation.

I selected two participants each from the first three aerospace SME repairable spares suppliers located at Florida and Kansas whose business leaders granted me permission to conduct studies on their companies as noted by Meyer (2001). In addition, I selected the six participants based on the criteria in the participant section of this study. The roles of the six participants were company presidents (50%), spare part product line manager (16.7%), an IT director (16.7%), and quality and process manager (16.7%). With six business leaders from the three SME repairable spares suppliers as the total census population, I eliminated the sampling errors as noted by Lindner, Murphy, and Briers (2001). Fusch and Ness (2015) stated that an interview is a method a researcher can utilize to attain data saturation. I conducted face-to-face interviews in-person or through Skype for the first interviews with the participants to extract research data and utilized telephone interviews for follow-up interviews until I attain data saturation. I scheduled the interviews based on the participant's availability.

I interviewed the participants face-to-face for the first interviews at a time and place outside of the participant's company workplace. I conducted the in-person face-to-face interviews for the first interviews in public places such as libraries where the participants are comfortable with to provide interview data with no interruptions. I used Skype to conduct the face-to-face interviews for the first interviews with participants at suitable times outside the participants' work schedule to manage my travel and lodging expenses. For follow-up interviews, I utilized the telephone to interview participants at suitable times outside the participants' workdays. After the first interviews with participants, I utilized the member checking strategy as described by Goldblatt, Karnieli-Miller, and Neumann (2011) and Harper and Cole (2012) in the follow-up interviews as a quality control process to validate the accuracy of interview data.

Ethical Research

For an ethical research process, a researcher must comply with the acceptable code of conduct, legal requirements, and social acceptability to add valuable knowledge to the field of study (Bell & Bryman, 2007; Stichler, 2014; Van Deventer, 2009). The key factors of ethical research I considered were Institutional Review Board (IRB) approval, informed consent, confidentiality, handling of sensitive research data, inducements, and voluntary participation. The IRB is the department at educational organizations that reviews research to prevent harm to human participants (Ghooi, 2014; Linder, Elek, & Calderon, 2014; Musoba, Jacob, & Robinson, 2014). I obtained permission from the Walden University IRB, whom validated my doctoral study for no risk to research participants. After IRB had approved the proposed study, I included the IRB approval number 07-06-16-0417122 on the informed consent form I sent to the research participants.

I began the data collection process after the IRB approval by contacting aerospace business leaders at SME repairable spares suppliers by phone and networking with the leaders to obtain permission to conduct studies within their companies through the participants. As the aerospace business leaders showed interest, I sent e-mails that include the letter of cooperation (Appendix A) to gain permission to access the participants. As I received approvals from the business leaders (see Appendix M), I sent the invitation e-mails (see Appendix B) including the informed consent forms (see Appendix C) to potential research participants to review, sign, and resend back. The informed consent form included detailed information about the study to enable the research participants to make voluntary informed decisions about participation in the study (Crow, Wiles, Heath, & Charles, 2006; Tamariz, Palacio, Robert, & Marcus, 2013). The participants received no incentive or consideration to participate in the research. However, I offered the participants a copy of the final report of the study. I informed each participant of their ability to decline participation in the study or withdraw during the interview process without any penalties. No participant declined or withdrew from the study during the research process.

I collected authorization from each participant to audio record the interviews. Microsoft Windows Voice Recorder was the software of choice to record the interviews. I conducted the first interviews through the face-to-face or Skype approach and the follow-up interviews through the telephone, depending on participant's availability and location. I ensured the confidentiality of every participant by designating alphanumeric codes to the participants from the transcribed interview data. I coded the participants and SMEs by the ascending order of the interviews conducted. Table 6 shows a summary of the use of the two interview mechanisms and anonymized participants' information used in the interview data for data analysis and the presentation of findings.

Table 6

Interview Mechanisms and Anonymized Participant Information

Interview Mechanism	Anonymized Company	Location	Number of Participants	Anonymized Participants
Skype face-to-face	Company-1	Florida	2	P1, P2
In-person face-to-face	Company-2	Kansas	2	P3, P4
Skype face-to-face	Company-3	Florida	2	P5, P6

According to American Psychological Association (2010), the recommendation for research data storage after study completion is 5 years. For the retention plan, I stored the audio recordings and documentation on an external hard drive to protect from disclosure, misuse, or misinterpretation to the public. I will place the interview data in a locked password-protected fire-rated safe for 5 years that only I can access. After 5 years, I will electronically destroy the audio-recorded files and shred transcribed interview data including company documents provided by the participants.

Data Collection Instruments

In qualitative research, the researcher is the primary research instrument used in collecting qualitative data (Pezalla et al., 2012). As the primary collection instrument in this study, I collected, processed, and interpreted qualitative data to answer the research question. Brod, Tesler, and Christensen (2009), Chenail (2011), and Polkinghorne (2005) stated that the three main data sources used to collect qualitative data are interviews, observation, and documentation. In addition to being the primary data collection instrument, I utilized semistructured interviews and documentation (company document, archival records, or public information) to ensure methodological triangulation. An advantage of using semistructured interview questions in qualitative research is that the researcher has the flexibility to adjust the questions as needed to extract extensive data from the participant (Hanson et al., 2011; Seaman, 1999). Using the semistructured interview process, I was flexible and utilized probing questions in addition to the open-ended interview questions when necessary during the interviews to gain a deeper understanding of the business problem. Researchers utilize interview protocols to structure the interview process used in extracting qualitative data (Jacob & Furgerson, 2012). I applied the interview protocol (see Appendix D) to enhance consistency during the semistructured interview process with all research participants.

Each interview began with an icebreaker conversation to engage the participant and create a relaxed environment. I provided each participant with a brief overview of the purpose of the study and shared my intent for the interview and confidentiality guidelines before I started asking interview questions. I asked the 10 semistructured interview open-ended questions based on the business problem of interest to each participant in the same order to mitigate bias as noted by Kyvik (2013). I took notes and clarified participants' nonverbal communication such as gestures, the tone of voice, and facial expressions. I asked probing questions when necessary to ensure the participants provided thorough responses to the interview questions. I monitored the interview time to ensure the research participants provided adequate research data to the interview questions. I concluded by thanking the participants for their time and inform the participants of the follow-up interview after their first in-person or Skype face-to-face interview.

Documentation is a data collection instrument that researchers use to enhance their knowledge of the research topic and support other qualitative data sources (Bowen, 2009). I extracted company documents such as policies and procedures, data users' roles and responsibilities, data quality process map flow, and training programs. For archival records, I extracted documents such as data records for repairable spare parts. The information from the public domain I plan to extract are documents such as minutes of meetings and event programs from press releases, SME company website, industry magazines and any other open public source. I utilized keywords to search for information in the public domain. During the interviews, I asked the research participants to share documentation about the research topic after the interviews through an e-mail to support their responses and my understanding of the business problem. I utilized the information from the documentation related to the research topic to corroborate the data collected from interviewing the research participants.

I enhanced the reliability and validity of the semistructured interview and documentation data collection instruments by conducting methodological triangulation and member checking. Member checking is a quality control process researchers use in qualitative research to enhance the accuracy and validity of the data collected during a research interview (Harper & Cole, 2012). After each interview, I summarized the research participants’ responses to each interview question from the transcribed data and interpreted the summaries to develop an understanding of the participants’ responses. Research participants received a copy of the interpretation of my summarization of their transcribed interview data prior to the scheduled follow-up interviews. During the follow-up interviews, I asked the participants to validate the information for accuracy and provide adjustments or addition where necessary. I made all appropriate adjustments to my summaries and interpretations of the transcribed data where necessary after the follow-up interviews with the participants. Thus, the use of member checking helped enhance the validity and reliability of the study data collection instruments.

Data Collection Technique

Irvine, Drew, and Sainsbury (2013) stated that the use of face-to-face interviews for data collection is critical for researchers to generate rich qualitative data. Although, Stoop et al. (2012) found that telephone interviews can be an alternative data collection technique for face-to-face interviews. The face-to-face semistructured interview was the main data collection technique for this study to extract research data from participants at the first interviews. Telephone semistructured interview was the secondary data collection technique to extract research data from participants at follow-up interviews. I conducted the semistructured interviews following an interview protocol (see Appendix D). First, I conducted two Skype face-to-face semistructured interviews with two participants from the state of Florida. Second, I conducted two in-person face-to-face semistructured interviews with two participants from the state of Kansas. Last, I conducted two Skype face-to-face semistructured interviews with two participants from the state of Florida.

I scheduled the first semistructured interviews face-to-face at a time, date, and location that the participants and I agreed to conduct the interviews. I scheduled the in-person face-to-face interview for the first interviews at public places and at suitable times outside the participants' company time. Janghorban, Roudsari, and Taghipour (2014) found that researchers can use Skype interviews as an alternative or supplement to face-to-face interviews. When I used Skype face-to-face interview, I scheduled the interviews at suitable times outside the participants' work schedule. For the follow-up interviews, I scheduled telephone interviews at suitable times outside the participants' workdays. Petty et al. (2012) stated that researchers often use between 30 and 90 minutes to complete qualitative interviews. The scheduled time duration for semistructured interviews conducted in this study was for an hour each.

To achieve successful interview sessions and interview protocol (see Appendix D), I ensured the following occurred (a) tested the voice recorder occasionally prior to the interviews, (b) asked the participants one question at a time, (c) maintained normal expressions during the interview to avoid influencing participants responses, and (d) maintained proper control of the interview time on when to move to another question to ensure I extracted adequate data from all interview questions. Nordstrom (2015), Runeson and Host (2009), and Villar, Arciuli, and Paterson (2014) recommended the use of audio or video recorders to record qualitative interviews to ensure research data quality. During the semistructured interviews, I audiotaped the interviews using Microsoft Windows Voice Recorder to ensure transcribing of the interview data would detail accurate responses from the participants.

I gained permission to audiotape the interview through the signed informed consent document in addition to asking the participants for approval before I began asking interview questions during each interview. In addition to audiotaping, I took notes of nonverbal expressions of participants at the face-to-face interviews and key comments during face-to-face and telephone interviews. Documentation is existing information about the research topic that researchers can use as a data collection technique (Hanson et al., 2011). I augmented data collected from the interviews with documentation from company documents (e.g., data management policies and procedures), archival records, or public information to conduct data analysis and address the research question.

I used the TranscriptionPuppy company two days turnaround service to transcribe the interview data file into the textual form in Microsoft Word. Walden University IRB requires a doctoral student to obtain a confidentiality agreement from any individual or organization before granting access to the research data. As stated on the TranscriptionPuppy company's quality control and privacy policy (see Appendix E), before accessing and transcribing any interview data, the company provided me a signed non-disclosure agreement (see Appendix F). As I received the transcribed data from the transcription company for each interview, I utilized the ATLAS.ti software to conduct summaries of the research participants' responses to each interview question and interpreted the summaries to develop an understanding of the participants' responses. Research participants received a copy of the interpretation of my summarization of their transcribed interview data prior to a scheduled follow-up interview. I asked the participants to validate the information for accuracy and provide adjustments or addition where necessary. I made all appropriate adjustments to my summaries and interpretations of the transcribed data where necessary after the follow-up interviews with the participants. Using the member checking approach enabled me to validate the credibility of the research data used for data analysis, which enhanced the trustworthiness of the study findings.

The advantage of semistructured face-to-face interviews is that I was able to build rapport, trust, and relationship with the participant to enhance engagement and response quality as noted by Curasi (2001) and Stoop et al. (2012). Researchers use Skype interviews instead of in-person face-to-face interviews to save travel expenses and lodging (Janghorban, Roudsari, & Taghipour, 2014; Szolnoki & Hoffmann, 2013). I utilized Skype instead of being in person to conduct the face-to-face interviews where necessary to mitigate the disadvantage of face-to-face interviews. The advantages of using the semistructured telephone interviews for follow-up interviews are that I could save money and time, reduce nervousness of participants, and enhance accessibility to participants as noted by Rapp et al. (2012), Stoop et al., and Thomas (2011). A disadvantage of the telephone interview data collection technique is that participants' interview environment over the phone can affect response quality and my ability to capture nonverbal cues (Curasi, 2001; Wright & Ogbuehi, 2014). Despite disadvantages of semistructured telephone interviews, Stoop et al. stated the telephone interviews could be an alternative data collection technique for face-to-face interviews. Further, Rapp et al. found in a study that using the face-to-face and telephone interviews could yield equivalent results from participants.

During the interviews, I asked the research participants to share company documents (e.g., data management policies and procedures), archival records (e.g., repairable spare parts data records), or public information about the research topic or firm after the interview through an e-mail to support their responses and my understanding of the business problem. As I received documentation from the research participants, I reviewed the data for relevant information to answer the research question. In addition to documentation from research participants, I conducted searches in the public domain (e.g., Internet or industry magazines) on the aerospace SME repairable spares suppliers to extract research data related to the research topic. I conducted internet searches with keywords such as the *SME company name* and the *SME company forecasting practices.* I ensured information extracted from the public domain was relevant to data quality strategies business leaders of the aerospace SME repairable spares suppliers utilized to enhance the repairable input data quality used in demand forecasting. I utilized the documentation collected from participants and the public domain in conjunction with the interview data to conduct methodological triangulation during data analysis.

The advantages of documentation are researchers can use the qualitative data to understand the historical background of the research topic and verify the information from other research data sources (Bowen, 2009; Polkinghorne, 2005). Other advantages include the documentation are more accessible and cost effective to extract when compared to interview data and participant observation (Bowen, 2009; Hanson et al., 2011). The disadvantage of documentation is the qualitative data sometimes contain information produced for other purposes and not specific to the research topic (Bowen, 2009).

Data Organization Technique

Gibson, Benson, and Brand (2012) pointed out that assigning generic codes to each research participant as a data organization technique is a strategy researchers use to achieve anonymity for research participants. I utilized alphanumeric codes to represent each participant and research data. For example, I coded the two participants, SME, and the audiotapes of the first interviews as P1, Audiotape-P1, P2, Audiotape-P2, and Company-1. Researchers can achieve data integrity by applying organization techniques for the research data (Anyan, 2013). As I received documentation from the participants and public information about the firm or topic from my personal research, I organized the data into an electronic folder. Microsoft Word and notebooks are means a researcher could use to conduct reflective journaling (Pack, 2014). I documented my reflection of the weekly research data collected and activities onto a reflective journal in Microsoft Word and kept track of emerging understanding of the research.

Data organization for this study also included creating an electronic folder to store the audiotaped interview files, reflective journal, documentation related to the research, transcribed interview data, documents from member checking, and the transposed research data suitable for the qualitative data analysis software to conduct data analysis (Yin, 2014). Researchers use qualitative data analysis software such as ATLAS.ti, QSR NVivo, HyperRESEARCH, and MAXqda to organize qualitative data and conduct data analysis to uncover meaning to address a research question (Leech & Onwuegbuzie, 2007). Magasi et al. (2013) used the ATLAS.ti software tool in qualitative research to conduct content analysis to address a research topic. ATLAS.ti software was the qualitative data analysis tool of choice used in this case study to perform a content analysis of the interview and company documentation data to determine themes and derive meanings from the data.

The external hard drive was the storage tool for the audiotaped interview files, notes from the interview, transcribed data, reflective journal, company documents, and any other research-related documents such data analysis records. According to American Psychological Association (2010) and IRB protocol, a researcher is required to secure the research data for a period of 5 years before disposing of the data. I will secure the external hard drive for 5 years in a locked password-protected fire-rated safe cabinet to ensure privacy, confidentiality, and prevent misuse of the research data as recommended by Fein and Kulik (2011). Walden University requires destruction of all research data after 5 years of completing research. After 5 years of research completion, I will shred research documents such as notes, reflective journal, and company documents and electronically destroy electronic files such as audiotaped and transcribed data files.

Data Analysis

In this study, data analysis of the data sources (interview data and documentation) consisted of coding, developing construct maps to identify patterns and emergent themes, and interpreting the data to answer the research question. As I received the transcribed data from the transcription company for each interview, I utilized the ATLAS.ti software to conduct summaries of the research participants' responses to each interview question and interpreted the summaries to develop an understanding of the participants' responses. Research participants received a copy of the interpretation of my summarization of their transcribed interview data prior to a scheduled follow-up interview. I asked the participants to validate the information for accuracy and provide adjustments or addition where necessary. I made all appropriate adjustments to my summaries and interpretations of the transcribed data where necessary after the follow-up interviews with the participants. After I had completed member checking with each participant, I compiled the data from all participants' responses to begin the research data analysis. I transposed all interview data after member checking into readable language for ATLAS.ti software to conduct data analysis.

Transposing the interview data included converting the text data into a survey data representation on Microsoft Excel and adding ATLAS.ti prefixes to column headers on the Excel spreadsheet to make the data readable to the ATLAS.ti software. Afterward, I imported the generated survey data representation of the interview data into the ATLAS.ti software. In addition, I imported documentation related to the research topic generated from company documents, archival records, or public information into the data analysis software for content data analysis. After importing the data sources into the ATLAS.ti software, I utilized the documentation to triangulate the transcribed interview data during data analysis to ensure the validity of the interview data from participants and uncover meaning to answer the research question.

Verner and Abdullah (2012) stated that one of the principles of the case study is the use of multiple data sources of evidence for data analysis. To achieve the purpose of this case study, I applied methodological triangulation, of which interview data and documentation were the two data sources (Denzin, 2009). I conducted a content analysis of the interview data and documentation in the ATLAS.ti software to identify themes that were in alignment with the conceptual framework. Vaismoradi, Turunen, and Bondas (2013) emphasized that content analysis is appropriate for exploratory work, where not much is known about the phenomenon. For this exploratory qualitative multiple case study, where no published strategies exist to promote the quality of data inputs for repairable spare parts forecasting at SMEs, content analysis was appropriate to identify the data quality strategies. The three levels of conducting content data analysis are preparation, organization, and reporting (Elo & Kyngas, 2008; Elo et al., 2014; Vaismoradi et al., 2013). The three levels of content analysis were broken down into six phases of data analysis for this study.

The preparation level of qualitative content data analysis is when a researcher get immersed with the research data to identify the unit of analysis and make sense of the whole data set (Vaismoradi et al., 2013). The preparation level included phase 1 of this study content data analysis. In phase 1, I conducted the following two data analysis activities (a) identified the unit of analysis within the ATLAS.ti software, and (b) read transcribed interview data and documentation multiple times to attain familiarity with the data set. The organization level of qualitative content analysis is conducting open/deductive coding, categorization of the codes, and grouping the codes under overarching headings (Elo et al., 2014). The organization level included phase 2 through phase 5 of this study content data analysis. In phase 2, I executed following three activities (a) imported deductive codes I identified from existing literature into ATLAS.ti software, (b) conducted a line by line analysis of the transcribed interview data and documentation to break down into chunks of data (words, phrases, sentences, and paragraphs); and (c) used the imported deductive codes or one or two words of inductive codes I created in ATLAS.ti software (open coding) to summarize the chunk of data.

In phase 3, I executed two activities (a) identified the list of all codes and quotations from the coding process, and (b) utilized the network view in ATLAS.ti software to review complex codes to gain a better understanding of how the quotations relate to the codes. The three data analysis activities executed in phase 4 were (a) reviewed the codes to search for themes and sub-themes, (b) utilized the network view in ATLAS.ti to identify sub-themes patterns to develop construct maps in relation to the conceptual research framework, and (c) identified overarching themes that were meaningful to the overall information from the dataset and the research. In phase 5, I executed five activities (a) reviewed the relationships and interaction between codes to confirm relation to the overarching themes, (b) utilized the Word Cruncher and Code Co-occurrence tools in ATLAS.ti software to identify any overlooked codes and to review code relationships, (c) repeated review of the relationship of codes to identify potential new emerging themes, (d) focused on key overarching themes evolving within the data, and (e) correlated the identified key overarching themes with the literature (including new studies published after writing this proposal) and the conceptual framework.

The reporting level of qualitative content data analysis is reporting the analysis process and the findings of the overarching themes in relation to literature and conceptual framework (Elo & Kyngas, 2008). The reporting level included phase 6 of this study content data analysis. For phase 6, I finalized the content data analysis process by writing up about the data analysis process and findings of the relationship of the codes to the identified key overarching themes to address the research question.

Reliability and Validity

To ensure the quality of this qualitative research, I focused on reliability and validity of the study. Reliability of this research study is the accuracy of the quality of research data I gather and analyze (Hanson et al., 2011). Research with high validity address questions such as (a) where there an accurate representation of significant research events, (b) are the research participants representative of the business problem, and (c) did the research participants validate their interview responses (Zachariadis, Scott, & Barrett, 2013). The four quality criteria to establish reliability and validity for a qualitative study to enhance the trustworthiness of the study are creditability, transferability, dependability, and confirmability (Goldblatt et al., 2011; Hanson et al., 2011; Petty et al., 2012). I utilized various strategies within this qualitative multiple case study to establish the four quality criteria.

Fusch and Ness (2015) stated that an interview is a method a researcher can utilize to attain data saturation. I conducted face-to-face interviews in person or through Skype for the first interviews with the six forecasting professionals to extract research data. I utilized telephone interviews for follow-up interviews until I attain data saturation. As noted by Carlsen and Glenton (2011), Fusch and Ness, and Marshall et al. (2013), I identified data saturation when no new information, no new coding, and no new themes occurred from interviewing the six research participants and the ability to replicate the results existed.

Dependability

Dependability is the extent to which other researchers could repeat a study to uncover the research findings and variations are understood (Petty et al., 2012). Therefore, a study is dependable when another researcher can duplicate the study with similar or same results. I applied the dependability quality criterion to establish the reliability of this qualitative study as noted by Golafshani (2003). The strategies I utilized to achieve dependability in this study are rigorous procedures and member checking (Hanson et al., 2011; Yin, 2014). I documented and provided a thick description of the study procedures (the purpose of proposed study, research design and implementation, sample selection, data collection, and data analysis) in this research to ensure proper audit trail to enhance the study findings reproducibility by other researchers. Participants' ability to validate the accuracy of my understanding of the interview data during member checking enhanced the quality of research data I utilized for data analysis and the reliability of this study (Harper & Cole, 2012).

Creditability

Creditability is the degree to which a researcher could validate the quality of the research data from participants to conduct data analysis and establish trust in the study findings (Petty et al., 2012). Hence, a study with high creditability implied that the result of the study is from the participants' point of view. I applied the creditability quality criterion to establish the validity of this qualitative study. The strategy I utilized to achieve creditability in this study are member checking and methodological triangulation (Petty et al., 2012; Yin, 2014). Research participants received a copy of the interpretation of my summarization of their transcribed interview data prior to a scheduled follow-up interview (Harper & Cole, 2012). I asked the participants to validate the information for accuracy and provide adjustments or addition where necessary. I made all appropriate adjustments to my summaries and interpretations of the transcribed data where necessary after the follow-up interviews with the participants. The member checking approach enabled me to validate the credibility of the research data used for data analysis, which enhanced the trustworthiness of the study findings. I utilized multiple research data (interview data and documentation) to conduct methodological triangulation on the quality of research data during data analysis to enhance the trustworthiness of the study findings as noted by Denzin (2012) and Hanson et al. (2011).

Confirmability

Confirmability is the degree to which other researchers could confirm or concur with the study findings (Zachariadis et al., 2013). I applied the confirmability quality criterion to establish the validity of this qualitative study. The strategy I utilized to achieve confirmability in this study was the audit trail approach as noted by Hanson et al. (2011) and Petty et al. (2012). I documented detailed information of the data analysis process to identify findings to the research question. The detailed information would provide an audit trail for other researchers to review the data analysis process, make sense of my reasoning, and confirm or concur with the study findings.

Transferability

Transferability is the extent to which the study findings are applicable in other contexts (Petty et al., 2012; Zachariadis et al., 2013). I applied the transferability quality criterion to establish the validity of this qualitative study. The strategy I utilized to achieve transferability of this study was through a detailed description of the study (Hanson et al., 2011). I provided detailed descriptions of the research concepts and assumptions central to the study, research sample, settings, and results to enable other readers and future researchers determine transferability to their own settings (Hanson et al., 2011).

Transition and Summary

In Section 2 of the doctoral study, the focus was an in-depth description of the role of the researcher, research participants, research method and design, and population and sampling. In addition, Section 2 was a review of the assurance of ethical research, data collection, data analysis, and the strategies used to support the study validity and reliability. Section 3 includes the presentation of research findings, application to professional practice, the implication to social change, recommendation for further research, and summary with study conclusion.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this exploratory multiple case study was to identify the key strategies that aerospace SME repairable spares suppliers use to maximize the quality of their data inputs used in forecasting for repairable spare parts. Previous scholars have conducted thorough research on the algorithms business leaders use for generating the forecasts for repairable spare parts, but little on the strategies for improving the quality of the actual data inputs feeding these algorithms. Researchers such as Hellingrath and Cordes (2014) pointed out the clear dependence of the accuracy of the generated aircraft repairable spare parts demand forecast on the input data itself. Hence, the importance of this study, which compiled the key strategies business leaders at aerospace SME repairable spare parts suppliers could utilize to improve the quality of data inputs used in forecasting repairable spare parts and in order to ultimately enhance forecast accuracy.

I utilized the DQM conceptual theory developed by the Data Management Association as a lens to explore the research participants' knowledge regarding repairable spare parts input data quality strategies. The content data analysis of the multiple case study comprised of an analysis of the data collected from a census sample of six forecasting business leaders from aerospace SME repairable spares suppliers located in the states of Florida and Kansas. Data analysis of codes from the coding process and their relationships within the ATLAS.ti qualitative data software resulted in a discovery of 15 subthemes that evolved emerged into eight core themes. The following eight core themes emerged based on methodological triangulation during the data analysis process: (a) establish data governance, (b) identify quality input data sources, (c) develop a sustainable relationship and collaboration with customers and vendors, (d) utilize a strategic data quality system, (e) conduct continuous input data quality analysis, (f) identify input data quality measures, (g) incorporate continuous improvement initiatives, and (h) engage in data quality training and education.

Presentation of the Findings

A reminder that overarching research question for this study was:

RQ: What strategies do aerospace forecasting business leaders use to achieve quality data inputs for forecasting repairable spare parts demand?

I answered the RQ by executing the research data analysis process within the ATLAS.ti qualitative data software as stated in the data analysis section of this study. Table 7 highlights the ATLAS.ti artifacts generated from inputs into the software and outputs from the data analysis process. Executing the data analysis process within the ATLAS.ti database generated primary documents, quotations, and codes to uncover core themes that addressed the RQ.

Table 7

ATLAS.ti Artifacts

Atlas.ti Artifacts	Input/Output	Count	DBA Study Artifacts	Descriptions
Primary Documents	Input	9	Figure 4	6 interview transcripts data and 3 documents with documentation from participants and organizational websites
Quotations	Output	309	Figure 5	Meaningful interview quotations
Codes	Output	93	Figure 6, Appendix O	Representation for quotations
Code - Primary Document Tables	Output	8	Tables 8, 10, 12, 14, 16, 18, 20, 22	Codes Occurrences in the 9 Primary Documents
Network Maps of Subthemes	Output	15	Figures 8, 9, 10, 12, 14, 15, 17, 18, 20, 22, 23, 25, 26, 28, 29	Grouping of related codes
Semantic Network Maps of Core Themes	Output	8	Figures 7, 11, 13, 16, 19, 21, 24, 27	Top level grouping of related subthemes

The research data imported into ATLAS.ti database translated into nine primary documents as shown in Table 8. Conducting a line by line data analysis of the nine primary documents and breaking down the data into chunks of meaningful interview quotations resulted in 309 quotations. Table 9 shows a subset of the 309 quotations. Next, I performed deductive and inductive coding on the research data to represent various quotations from the participants’ responses, which resulted in 93 codes. Table 10 shows a subset of the 93 codes from the coding process. The detailed list of the 93 codes is shown in Appendix O.

Table 8

Nine Primary Documents for Data Analysis in ATLAS.ti

Primary Document	Name
P 1	Case 1
P 2	Case 2
P 3	Case 3
P 4	Case 4
P 5	Case 5
P 6	Case 6
P 7	P1- Documentation.pdf
P 8	P2 - Documentation Justifications and Public Information.doc
P 9	P3 - Document Evidence Attachments.pdf

Table 9

Subset of the 309 Quotations from Data Analysis of Nine Primary Documents

ID	Name	Primary Doc
1:1	We have several different stra..	Case 1
1:2	The sources come from a couple..	Case 1
1:3	The data is input automaticall..	Case 1
1:4	Okay. Uhm, we would have to ma..	Case 1
1:5	Uhm, that's similar in that th..	Case 1
1:6	Uhm, it's very seldom that the..	Case 1
1:7	We don't really work with any ..	Case 1
1:8	Uhm, I would say it's just my ..	Case 1
1:11	The main tool that we use is s..	Case 1
1:12	And it gives us a snapshot of ..	Case 1
1:18	And then the third tool would ..	Case 1
1:19	One reports two or three times..	Case 1
1:20	There are long lead times and ..	Case 1
1:21	Yearly, there's a lot of check..	Case 1
1:23	Because some of them is subjec..	Case 1

Table 10

Subset of the 93 Codes from Deductive and Inductive Coding

Codes
Data Governance
Data Quality Analysis
Data Quality Key Performance Indicators (KPI)
Data Quality Measurement
Data Quality System
DG: 10 years or more forecasting experience
DG: AS9100 and 9110 Certified
DG: Continuous improvement and monitoring procedures
DG: Customer Input Data Knowledge
DG: Data Control
DG: Data Maintenance Policy
DG: Data Sources -Policy
DG: Data System Backup Policy
DG: Data System Input Data Procedures
DG: Data Tracking Policy
DG: Data Update Policy
DG: Data user system access
DG: Input Data Recovery Policy
DG: Knowledge & Experience Level
DG: Lead Time Data Policy

I assessed data saturation by applying the data analysis methodology on ATLAS.ti data from the first five research participants, which resulted in the identification of the 93 codes. Additional data analysis of the research data from the last participant resulted in the identification of no additional codes leading to a strong assumption that I had attained data saturation. The results reported are inclusive of codes from all six participants' responses even though five would have sufficed. The next step was constructing ATLAS.ti semantic network maps by reviewing the relationships between the 93 codes, which rolled up to tree structures identified as the study core themes.

Eight core themes emerged based on methodological triangulation during the data analysis process. Specifically, the following themes emerged: (a) establish data governance, (b) identify quality input data sources, (c) develop a sustainable relationship and collaboration with customers and vendors, (d) utilize a strategic data quality system, (e) conduct continuous input data quality analysis, (f) identify input data quality measures, (g) incorporate continuous improvement initiatives, and (h) engage in data quality training and education. To derive each of the core themes, I constructed a detailed network diagram within Atlas.ti by mapping key interview quotes to key codes (nodes) and arcs relating nodes in an upward or inverted rooted tree leading to the top level node representing the overarching or core theme itself. The majority of themes is in alignment with the adopted DQM conceptual framework and directly linked to its constructs. Of the eight core themes, six aligned to the DQM theory's conceptual constructs while two surfaced as outliers. The next focus is the presentation of the rigorous analysis by core theme.

Core Theme 1: Establish Data Governance

Data governance emerged as the first core theme and a significant strategy from the research data employed to assure input data quality used in forecasting repairable spare parts demand. This core theme is in alignment with the data governance construct of the DQM conceptual framework to improve input data quality. Figure 4 shows an ATLAS.ti semantic network representation of the emergence of core theme 1. Table 11 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the establish data governance core theme.

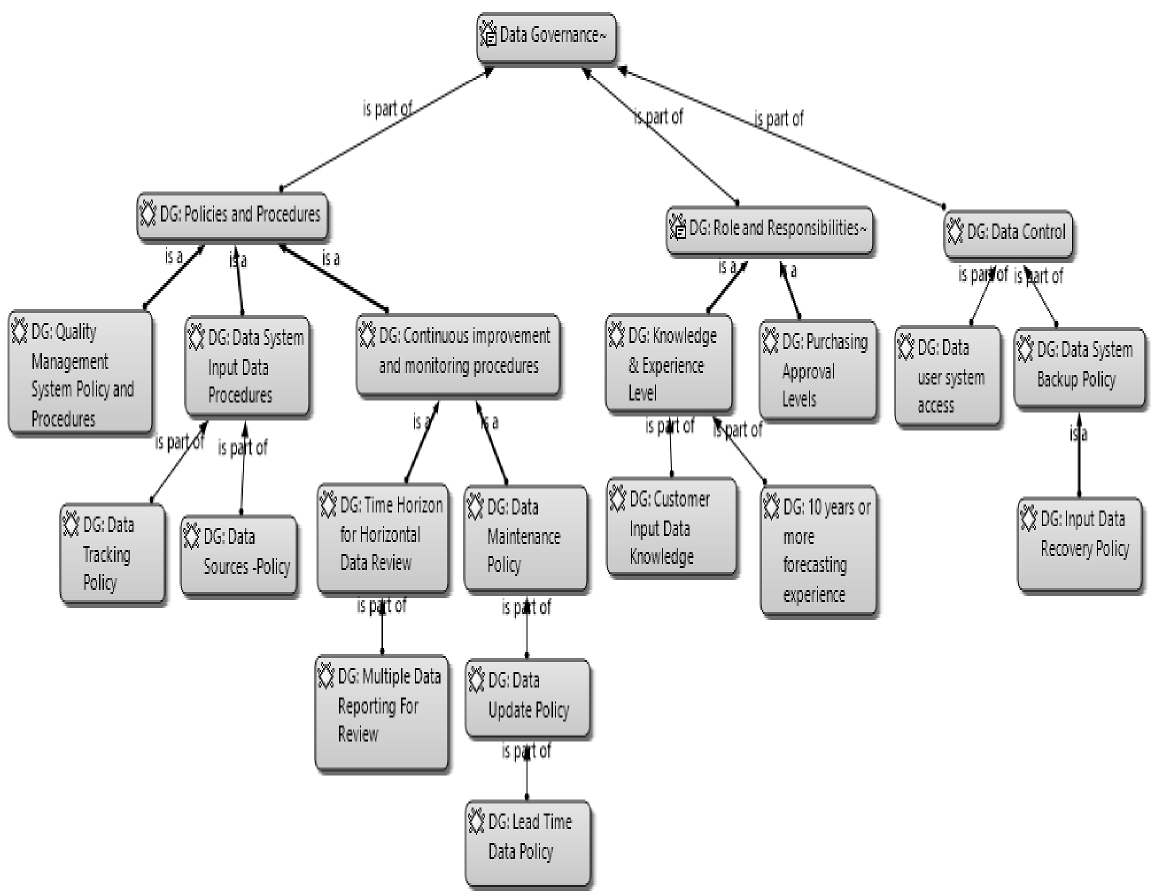

Figure 4. Core theme 1: Establish data governance.

Table 11

Codes – Primary Documents Table for Establish Data Governance Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1-Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments .pdf	TOTALS: Code Occurrence
Core Theme - Data Governance	1	1	1	1	1	1	0	0	0	6
Subtheme 1 - DG: Policies and Procedures	1	1	0	1	0	1	0	1	0	5
- DG: Quality Management System Policy and Procedures	0	1	0	2	0	3	0	1	0	7
- DG: Data System Input Data Procedures	1	5	0	0	2	0	1	1	0	10
- DG: Data Tracking Policy	0	0	0	1	0	1	0	0	0	2
- DG: Data Sources -Policy	0	0	0	0	2	0	0	0	0	2
- DG: Continuous improvement and monitoring procedures	0	4	0	1	2	2	0	0	0	9
- DG: Time Horizon for Horizontal Data Review	2	0	0	3	0	0	0	0	0	5
- DG: Multiple Data Reporting For Review	3	1	0	0	2	3	0	0	0	9
- DG: Data Maintenance Policy	4	0	0	0	0	0	0	1	0	5
- DG: Data Update Policy	2	4	0	0	1	0	0	0	0	7
- DG: Lead Time Data Policy	1	0	0	0	0	0	0	0	0	1
Subtheme 2 - DG: Roles and Responsibilities	2	2	1	0	0	0	0	1	0	6
- DG: Knowledge & Experience Level	9	0	0	0	1	0	0	0	0	10
- DG: Customer Input Data Knowledge	0	0	1	0	0	0	0	0	0	1
- DG: 10 years or more forecasting experience	1	0	0	0	0	0	0	0	0	1
- DG: Purchasing Approval Levels	0	0	1	0	0	0	0	0	1	2
Subtheme 3 - DG: Data Control	0	1	0	0	0	0	0	0	0	1
- DG: Data user system access	0	1	0	0	0	0	0	0	0	1
- DG: Data System Backup Policy	2	0	0	0	0	0	0	0	0	2
- DG: Input Data Recovery Policy	1	0	0	0	0	0	0	0	0	1
TOTALS:	30	21	4	9	11	11	1	5	1	93

The core theme was pervasive throughout the literature reviews. Rickards and Ritsert (2012) focused on data governance as a means of improving data quality critical for forecasting and planning. As showed in Figure 4, three emergent subthemes similar to components of the data governance conceptual constructs noted by Elliott et al. (2013) evolved into the core theme from the data analysis: (a) policies and procedures, (b) role and responsibilities, and (c) data control. I derived the results shown in Table 12 from analyzing the Code – Primary Document Table for core theme 1 (see Table 11). Table 12 showed that five participants (83% of the participants) shared information that generated codes used in mapping the emergence of the policies and procedures subtheme, four participants (67% of the participants) shared information that generated codes used in mapping the emergence of the roles and responsibilities subtheme, and two participants (33% of the participants) shared information that generated codes used in mapping the emergence of the data control subtheme.

Table 12

Frequency of Participants (max n=6) Using Subthemes for Establish Data Governance Core Theme

Subtheme	n	% of frequency of participants
Policies and Procedures	5	83%
Roles and Responsibilities	4	67%
Data Control	2	33%

Note. *n* = frequency of participants

Subtheme 1.1: Policies and procedures. Within the DQM framework, Vaast and Kaganer (2013) mentioned policies and procedures as one of the key tools of organizational governance established by business leaders to shape the actions and perception of the employees of particular topics. The majority of the participants (83%) voiced the use of policies and procedures strategy in relation to various business activities to guide the actions of employees to assure input data quality used for forecasting. Figure

5 shows a network map of the policies and procedures subtheme that contains codes and quotations from participants (83%) on topics focused on quality management system policies and procedures, data system input data procedures, and continuous improvement and monitoring procedures.

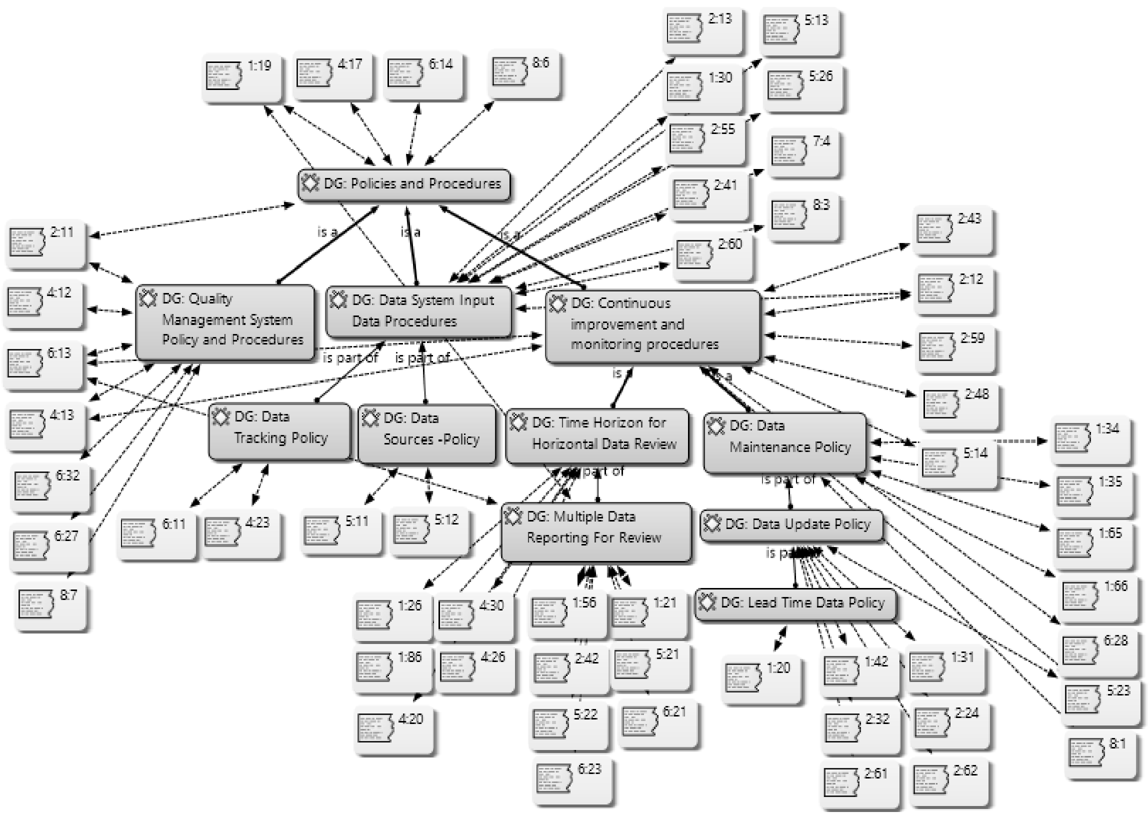

Figure 5. Subtheme 1.1: Policies and procedures.

Fifty percent of the participants conveyed the use of a quality management system policies and procedures. P2 mentioned that an alignment exists between Company-1's data quality processes and the ISO9001:2008 policies and procedures. I obtained information from Company-1's website that supported the statement from P2, which showcased the firm's ISO9001:2008 certification to communicate to their customers their commitment to quality. Although İlkay and Aslan (2012) found in a study that there was no significant difference in the performance for ISO9001 certified and non-certified SME firms, the certified SME firms had higher quality practices. AS9001 and AS9110 are other quality management system policies and procedures that SME business leaders used to improve the quality culture of their organization (P4). In addition, P6 pointed out that their organization references the AS9120 manual to improve data quality within the firm.

Participants (83%) highlighted data system input data procedures as a process to ensure input data quality used for forecasting repairable spare parts demand. P1, P2, and P5 noted that the ability to extract quality input data from the data system to conduct demand forecasting is dependent on the execution of the data system input procedures. Establishing such procedures assist in controlling employees' behavior on input data quality. Organizational documents provided by P1 and P2 detailed input data procedures to assist their employees accurately input data into the data system used for forecasting. P1 and P5 mentioned during the interview that data systems are programmed to lead the employees to input forecast data in a specific way to assure input data quality. Further, P2 added, "the strategy I guess that's most important to me would be ensuring that the information is controlled when it is being put into the system."

P2 conveyed in the interview that Company-1's basic policies and procedures are centered on continuous improvement and monitoring concepts from their quality management policies and procedures. Furthermore, P2 stated that the strategic plan is to monitor the quality of the input forecast data continuously. As part of the policies and procedures, forecasting business leaders ensured the organization is executing weekly and monthly monitoring of input data quality to identify areas of improvement (P1 & P2). Company-1 has a policy for Information Technology (IT) department to regularly maintain the firm's data system to ensure the system is capturing data inputs accurately (P1). Forecasting business leaders have to continuously monitor lead time data and update accordingly to assure input data quality for forecasting repairable spare parts (P1). Company-1's continuous improvement procedures included tasks for forecasting business leaders to monitor input data within the data system continuously and make adjustments to data errors immediately (P1 & P2). Documentation shared by P2 affirmed the organizational procedures on continuously fixing data errors to enhance forecast accuracy.

Subtheme 1.2: Roles and responsibilities. Sixty-seven percent of the participants pointed out within the research data the roles and responsibilities of forecast input data users. Figure 6 shows a network map of the roles and responsibilities subtheme that contains codes and quotations from participants on topics focused on knowledge and experience levels and purchasing approval levels.

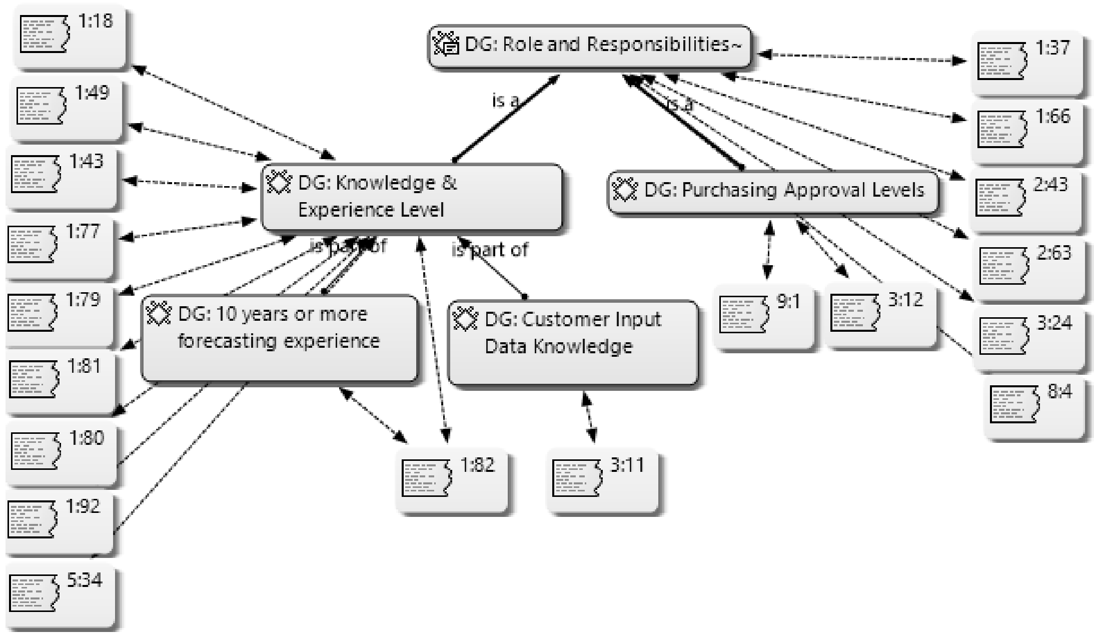

Figure 6. Subtheme 1.2: Roles and responsibilities.

The roles and responsibilities subtheme aligned with the data governance construct of the DQM conceptual framework and is pervasive throughout the literature review. Liaw (2013) and Begg and Caira (2012) stated that a firm's data governance specifies the individuals responsible and accountable for decision-making about the organization's data asset. P1 and P2 mentioned that different forecasting professionals are responsible for different product lines or programs in order to develop mastery of the input data used in forecasting repairable spare parts demand. P1 noted that forecasting professionals are required to have 10 years or more in forecasting experience at Company-1. Furthermore, P1 emphasized that such roles require the forecasting professionals to be knowledgeable on making effective decisions on what quality data inputs to utilize to perform demand forecasting. According to P1 and P5, forecasting professionals are responsible for understanding organizational and market factors that could impact the quality level of the data inputs used in making decisions for repairable spare parts forecasting. Forecasting professionals are responsible for inputting quality data into the data system used for demand forecasting (P2). Because of the significant investment to stock repairable spare parts components, forecasting professionals are required to gain approval from SME business leaders depending on the dollar threshold before the forecast is approved (P3). The IT personnel are responsible for the data system maintenance to assure the quality of input data extracted for forecasting repairable spare parts (P1).

Subtheme 1.3: Data control. Thirty-three percent of the participants shared statements on data control as one of the key components of organizational data governance as noted by Elliott et al. (2013). Figure 7 shows a network map of the data control subtheme that contains codes and quotations from participants on topics focused on data user system access and data system backup.

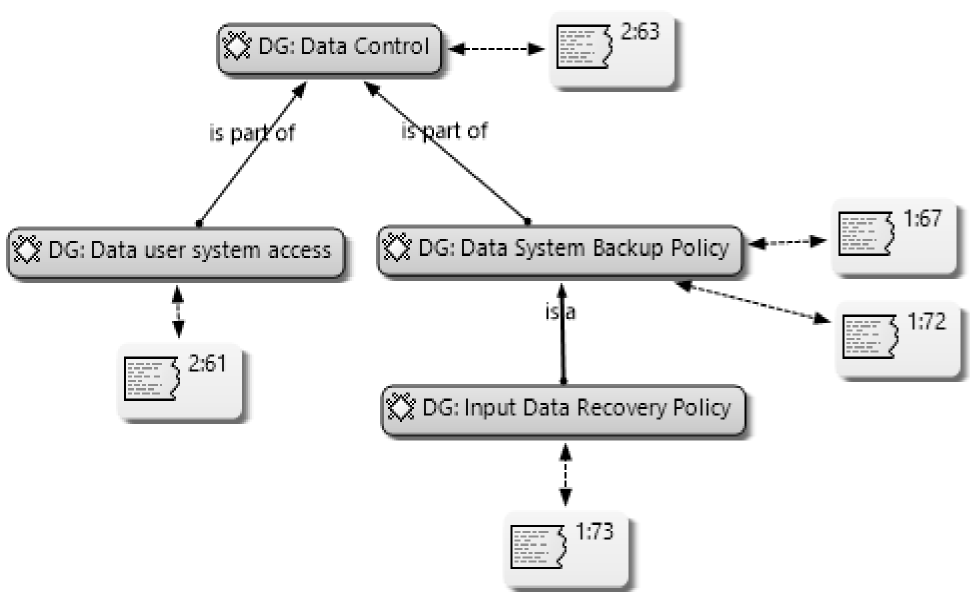

Figure 7. Subtheme 1.3: Data control.

P2 noted that not everyone within the organization could update or make edits to the forecast input data in the data system. Every employee can view the firm's data, but not everyone can manipulate the data (P2). All data users have logins and have access to specific areas of the data system (P2). According to P2, only the IT department can access the restricted areas of the data system and grants access to data users depending on their roles and responsibilities. P2 added that the data system has a tracking process within the system for data quality control and ease of identifying data errors to determine training opportunities.

Data backup is vital to any organization to assure data control and security (Xia, Yin, Lopez, Machida, & Trivedi, 2014). P1 emphasized the importance of having a data system backup policy and procedure to ensure data recovery in the event of any disruption to assure input data quality used to forecasting repairable spare parts. During the data collection process, P1 shared an event about a natural disaster that caused an impact to Company-1's data system. Because there was a data backup in another state, the IT department was able to restore the system data with validation to the accuracy of the data inputs and demand forecasts (P1).

Core Theme 2: Identify Quality Forecast Input Data Sources

The second core theme that emerged from the research data was identifying quality forecast input data sources for forecasting business leaders to extract data for repairable spare parts forecasting. The core theme emerged as an outlier from one of the DQM conceptual constructs but is pervasive throughout the literature review. SME repairable spares suppliers utilize forecast input data from various sources from the industry and internal business data (Costantino et al., 2013; Gu et al., 2015; PricewaterhouseCooper, 2011). Figure 8 shows an ATLAS.ti semantic network representation of the emergence of core theme 2. Table 13 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the identify quality forecast input data sources core theme.

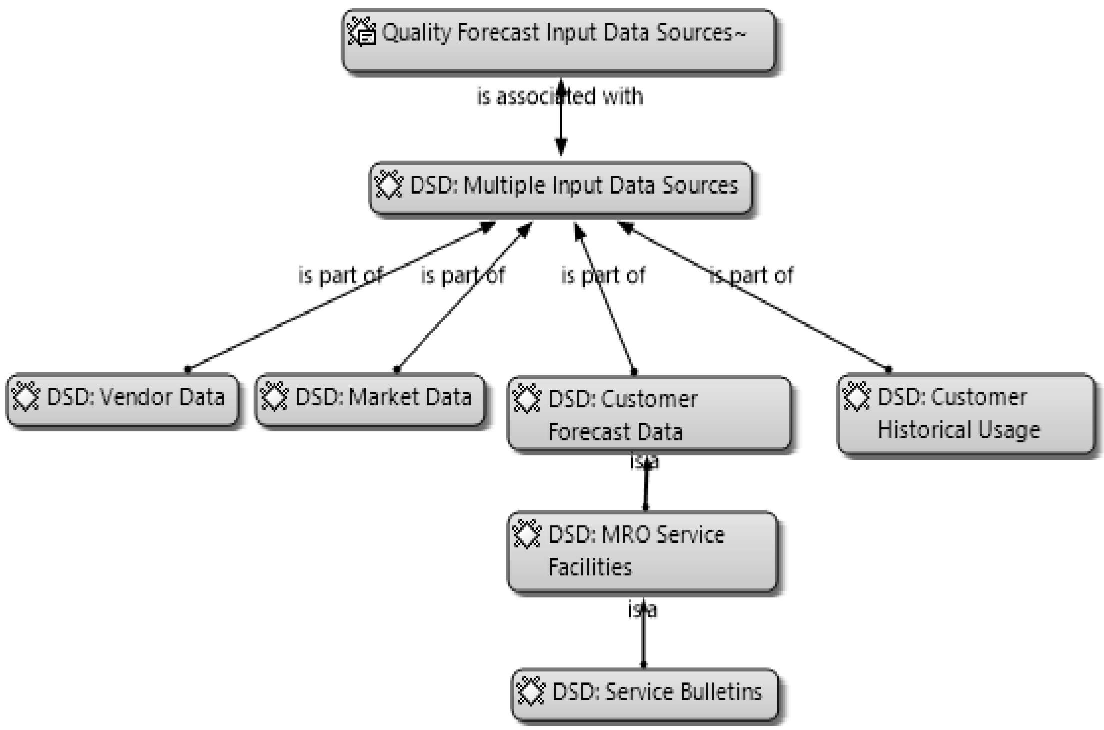

Figure 8. Core theme 2: Identify quality forecast input data sources.

Table 13

Codes – Primary Documents Table for Identify Quality Forecast Input Data Sources Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1- Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments .pdf	TOTALS: Code Occurrence
Core Theme - Quality Forecast Input Data Sources	1	1	1	1	1	1	0	0	0	6
Subtheme 1 - DSD: Multiple Input Data Sources	1	1	0	0	0	0	0	0	0	2
- DSD: Vendor Data	2	1	0	0	0	0	0	0	0	3
- DSD: Market Data	0	1	1	1	3	0	0	0	1	7
- DSD: Customer Forecast Data	1	4	3	0	0	1	0	0	0	9
- DSD: MRO Service Facilities	0	0	1	0	0	0	0	0	0	1
- DSD: Service Bulletins	0	0	1	0	0	2	0	0	0	3
- DSD: Customer Historical Usage	1	3	0	1	4	1	1	0	0	11
TOTALS:	6	11	7	3	8	5	1	0	1	42

As showed in Figure 8, one emergent subtheme evolved from the data analysis into the core theme. I derived the results shown in Table 14 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 2 (see Table 13). Table 14 showed that all participants (100% of the participants) shared information that generated codes used in mapping the emergence of the multiple input data sources subtheme.

Table 14

Frequency of Participants (max n=6) Using Subtheme for Identify Quality Forecast Input Data Sources Core Theme

Subtheme	n	% of frequency of participants
Multiple Input Data Sources	6	100%

Note. *n* = frequency of participants

Subtheme 2.1: Multiple input data sources. All research participants (100%) indicated the use of multiple input data sources to forecast repairable spare parts demand. Figure 9 shows a network map of the multiple input data sources subtheme that contains codes and quotations from participants.

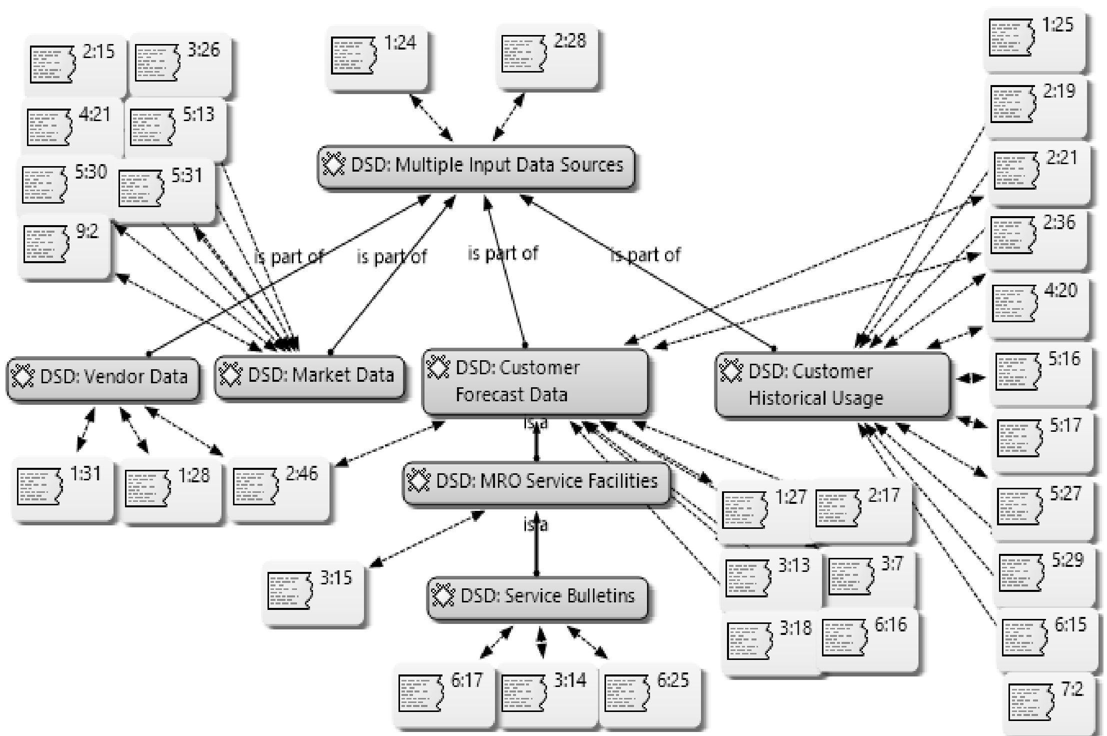

Figure 9. Subtheme 2.1: Multiple input data sources.

Barabadi et al. (2014) pointed out that the various sources repairable spare parts forecast input data can be extracted from are maintenance and inspection reports, historical data on similar or identical items, data from sensors on the aircraft, and manufacturer information. “The sources come from a couple of different places” was a statement voiced by P1 during the interview, which affirms statements of past scholars. Likewise, P5 stated that Company-3 uses a variety of input data sources. The forecast input data sources identified from the research data to forecast repairable spare parts are historical data, customer data, market data, and vendor data.

The majority of the participants (83%) indicated that historical data from customer usage is the most used input data sources. P5 stated that historical customer usage plays a significant role in forecasting repairable spare parts. Forecasting business leaders reviewed the historical data of quotes and no quotes sales data to forecast what repairable spare parts to stock (P5 & P6). Further, forecasting business leaders used historical customer usage data between 12 months to 24 months for short-term forecasting and 36 months to 60 months for long-term forecasting (P1 & P5). Participants (83%) extracted their historical data from their data system. P2 stated that customer usage historical data have a higher quality than customer forecast data provided to forecasting business leaders.

Participants (67%) mentioned customer forecast data as another input data used in forecasting repairable spare parts demand. The participants work with their customers such OEMs and MRO service facilities to acquire their forecast data to incorporate into their demand forecasting to effectively support their customers. P3 stated, “we will talk to service facilities in the field … major FBOs on how many installs they're doing so we know does that add or take away from the business that we're doing.” P3 added that two outside sale representative frequently visited the service facilities to acquire forecast input data required for forecasting repairable spare parts demand. Aircraft service bulletin data about aircraft modifications was another forecast input data that participants mentioned they extract from the customers (P3 & P6). Product pricing and lead times are vendor data forecasting business leaders extract to conduct forecasting, although the lead time data is the more important vendor data (P1 & P2).

According to P2, P3, P4, and P5, aircraft market data are critical to forecasting business leaders to forecast repairable spare parts. Market data include part obsolescence (P2), technological changes (P3), airplanes in service, maintenance schedule, aircraft retirement (P4 & P5), and seasonal repairable spares components (P5). Business leaders at aerospace SME repairable spares suppliers need to keep up with the market to continuously improve the quality of data inputs used for forecasting repairable spare parts and enhancing forecast accuracy (P5).

Core Theme 3: Develop a Sustainable Relationship and Collaboration with Customers and Vendors

Develop a sustainable relationship and collaboration with customers and vendors was the next core theme that emerged from the data analysis of the research data. The core theme emerged as another outlier from the DQM conceptual constructs but is pervasive throughout the literature review. Liao and Kuo (2014) found in a study that supply chain collaboration and relationship can enhance a firm’s performance. Business leaders at aerospace SME repairable spares suppliers need to develop a sustainable relationship and collaboration with customers and vendors to improve the quality of forecast input data. Figure 10 shows an ATLAS.ti semantic network representation of the emergence of core theme 3. Table 15 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the develop a sustainable relationship and collaboration with customers and vendors core theme.

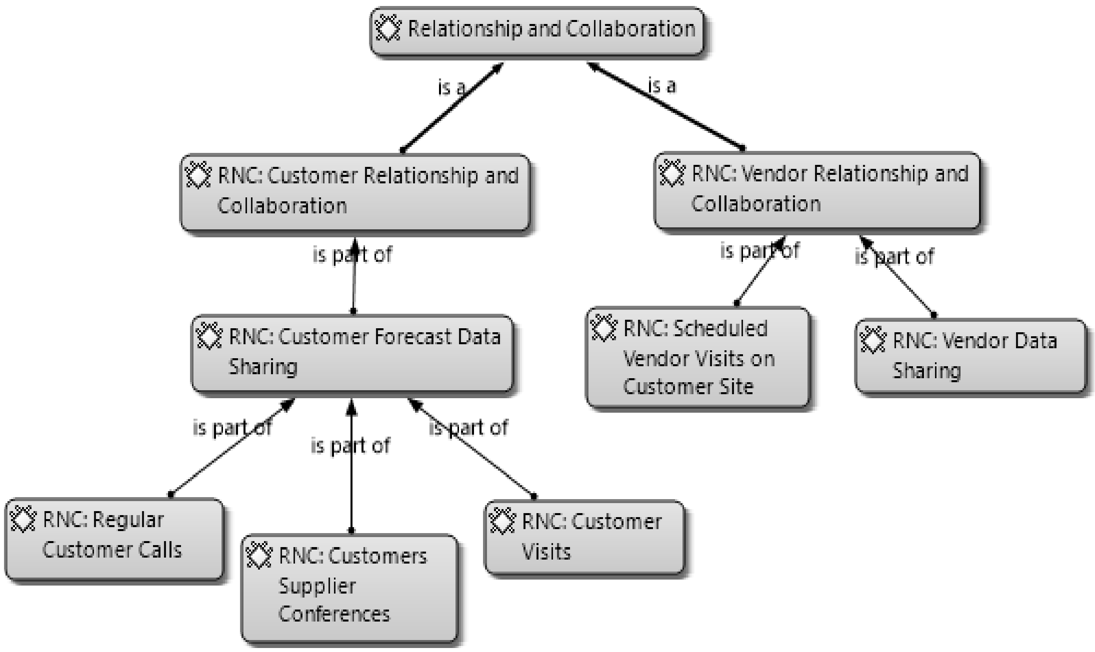

Figure 10. Core theme 3: Develop a sustainable relationship and collaboration with customers and vendors.

Table 15

Codes – Primary Documents Table for Develop a Sustainable Relationship and Collaboration with Customers and Vendors Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1-Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments .pdf	TOTALS: Code Occurrence
Core Theme - Relationship and Collaboration	1	1	1	1	0	1	0	0	0	5
Subtheme 1 - RNC: Customer Relationship and Collaboration	1	4	4	1	0	3	0	1	1	15
- RNC: Customer Forecast Data Sharing	0	3	0	2	0	3	0	0	0	8
- RNC: Regular Customer Calls	1	0	1	0	0	0	0	0	0	2
- RNC: Customers Supplier Conferences	0	0	1	0	0	0	0	0	0	1
- RNC: Customer Visits	0	2	0	0	0	1	0	0	1	4
Subtheme 2 - RNC: Vendor Relationship and Collaboration	3	3	0	3	0	0	0	0	0	9
- RNC: Scheduled Vendor Visits on Customer Site	0	1	0	0	0	0	0	0	0	1
- RNC: Vendor Data Sharing	0	2	0	1	0	0	0	0	0	3
TOTALS:	6	16	7	8	0	8	0	1	2	48

As showed in Figure 10, two emergent subthemes evolved from the data analysis into the core theme. I derived the results shown in Table 16 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 3 (see Table 15). Table 16 showed that five participants (83% of the participants) shared information that generated codes used in mapping the emergence of the customer relationship and collaboration subtheme and three participants (50% of the participants) shared information that generated codes used in mapping the emergence of the vendor relationship and collaboration subtheme.

Table 16

Frequency of Participants (max n=6) Using Subthemes for Develop a Sustainable Relationship and Collaboration with Customers and Vendors Core Theme

Subtheme	n	% of frequency of participants
Customer Relationship and Collaboration	5	83%
Vendor Relationship and Collaboration	3	50%

Note. *n* = frequency of participants

Subtheme 3.1: Customer relationship and collaboration. Customer data with high quality can offer organizations the opportunity to develop competitive advantage and enhance customer relationship, collaboration, and satisfaction (Peltier, Zahay, & Lehmann, 2013). Five of the six research participants mentioned information on customer relationship and collaboration. In addition, the participants shared information on the effects of customer relationship and collaboration on information sharing from the customer and forecast data quality. Figure 11 shows a network map of the customer relationship and collaboration subtheme that contains codes and quotations from the participants.

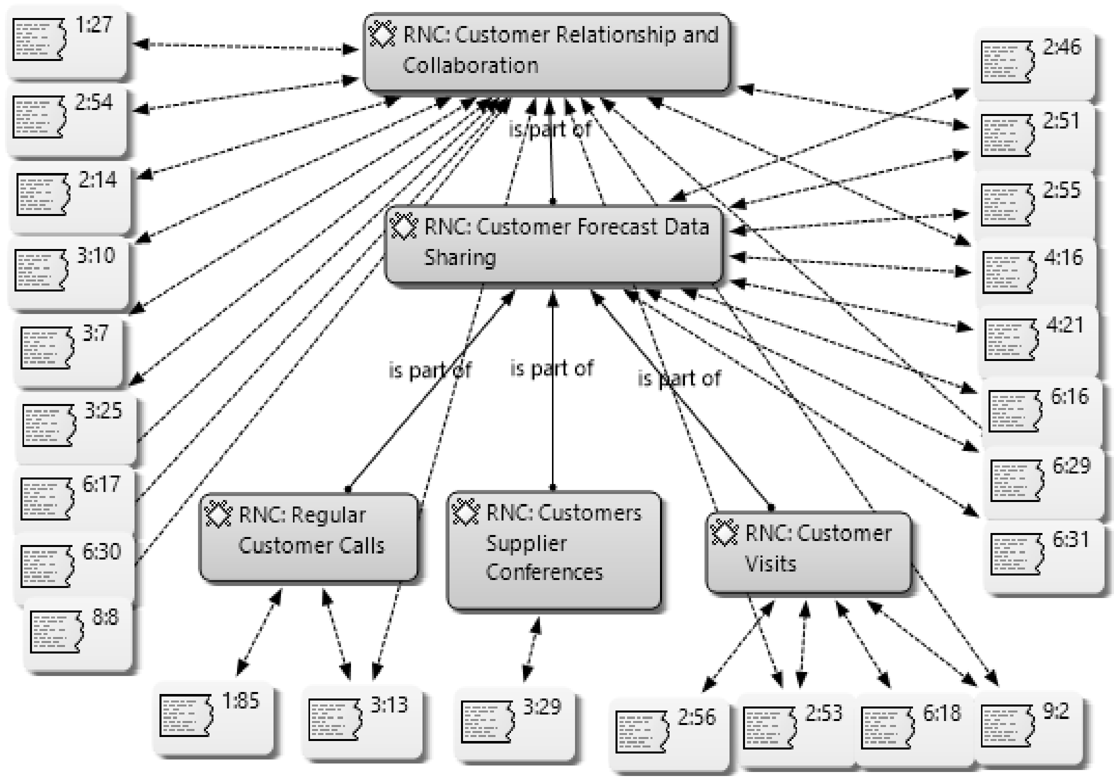

Figure 11. Subtheme 3.1: Customer relationship and collaboration.

Participants (50%) indicated that regular customer calls, customers supplier conferences, and on-site customer visits are the three means used in sustaining customer relationship and collaboration to improve forecast input data quality. P6 mentioned that forecasting business leaders utilized their relationships with the customer base to yield high-quality forecast input data for forecasting repairable spare parts. For example, P6 stated that forecasting business leaders develop relationships with aircraft field engineers at the airports to gain insights and improve the quality of forecast data inputs. From the research data, P4 emphasized the importance of customer relationship to improve their firm’s challenge of low input data visibility from their large customers as noted by Tian et al. (2013).

P1 and P3 pointed out that the forecasting business leaders regularly talked with their customers to improve forecast input data. According to P3, company executives at Company-2 have scheduled quarterly customer calls to discuss the forecast input data needed to stock the appropriate repairable spare parts to support the customer effectively. P3 added that forecasting business leaders attended customers spare parts supplier conferences to develop a relationship and collaborate with the customers to improve the quality of data inputs used for forecasting. Similar to P2, P3 and P6 stated that regular on-site customer visits are critical to sustaining customer relationship and extracting quality forecast input data. P3 provided documentation that contained travel schedules for one-on-one customer meetings to collaborate on forecast input data quality.

Subtheme 3.2: Vendor relationship and collaboration. Another subtheme that emerged into the core theme was vendor relationship and collaboration as a means to improve input forecast data quality. Three of the six research participants mentioned information on vendor relationship and collaboration and the effects on forecast input data quality. Figure 12 shows a network map of the vendor relationship and collaboration subtheme that contains codes and quotations from the participants.

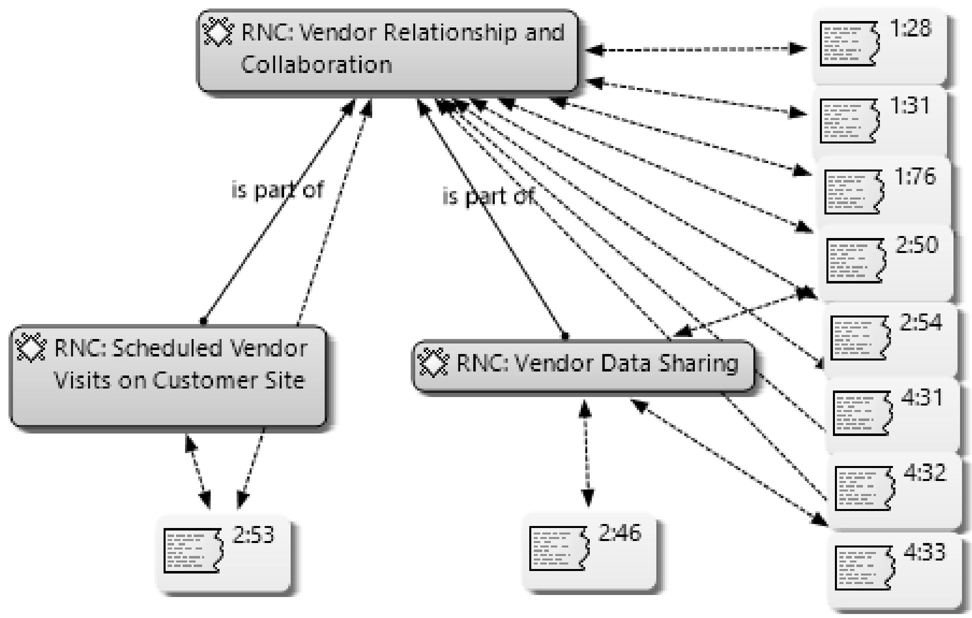

Figure 12. Subtheme 3.2: Vendor relationship and collaboration.

Participants (50%) highlighted this subtheme in the research data. Repairable spare parts lead times and prices are part of the data inputs forecasting business leaders need to conduct demand forecasting (P1). Lead time data is the most important vendor data used by the business leaders in their forecast analysis to determine repairable spare parts demand and parts availability to their customers (P1). Similarly, Bacchetti and Saccani (2012) pointed out lead times as a factor to consider in forecasting decisions of spare parts components. According to P1, P2, and P4, their relationships with vendors aided their collaboration to attain quality data inputs. P1 stated, “we have to rely on our vendors to work with us.”

Repairable spares vendors share lead time and pricing data with the forecasting business leaders on a yearly basis to update their data systems (P1 & P4). Forecasting business leaders talk with their vendors regularly and attend trade shows to enhance vendor relationship and collaboration (P2 & P4). For scheduled customer visits, forecasting business leaders invite the parts vendors to customer sites to enhance business relationships. P4 highlighted the importance of understanding the vendors because they are different in various ways and that can affect how a forecasting business leader develop relationships and collaborate with the vendors. Bergvall, Norén, and Lindquist (2014) stated that is critical for all stakeholders to communicate and collaborate to improve the quality of data. From P2 perspective, when data provided by the vendor are viewed as inaccurate, they collaborate with the vendor to discuss and improve the quality of the data.

Core Theme 4: Utilize a Strategic Data Quality System

Using a strategic data quality system for data management and integrity was the fourth core theme that emerged from the research data. This core theme is in alignment with the data system/tool construct of the DQM conceptual framework to improve input data quality. The inclusion of this core theme aligns with the literature review. Fan (2012) emphasized that the demand for data management systems or tools to measure the quality level of data has been increasing. An effective data quality system or tool used to store, analyze, and measure data quality can add business value to an organization and enhance the firm’s competitive advantage. Figure 13 shows an ATLAS.ti semantic network representation of the emergence of core theme 4. Table 17 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the utilize a strategic data quality system core theme.

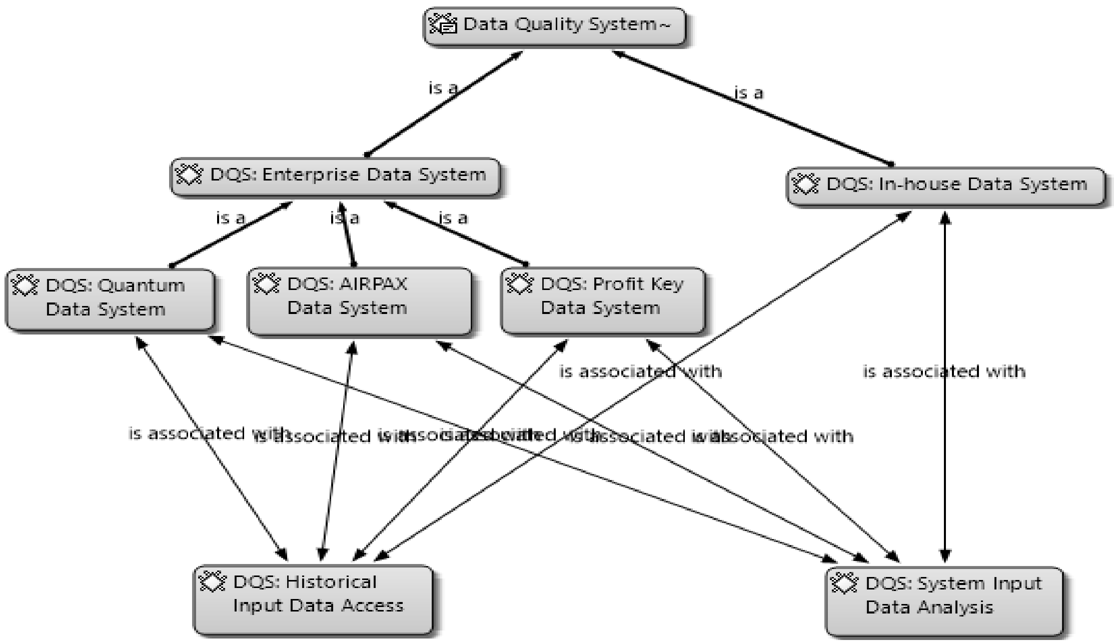

Figure 13. Core theme 4: Utilize a strategic data quality system.

Table 17

Codes – Primary Documents Table for Utilize a Strategic Data Quality System Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1-Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments .pdf	TOTALS: Code Occurrence
Core Theme - Data Quality System	1	1	1	2	1	1	0	0	0	7
Subtheme 1 - DQS: Enterprise Data System	0	0	0	0	0	0	0	0	0	0
- DQS: Quantum Data System	3	5	0	0	2	4	1	1	0	16
- DQS: AIRPAX Data System	0	0	0	0	2	2	0	0	0	4
- DQS: Profit Key Data System	0	0	1	4	0	0	0	0	0	5
- DQS: Historical Input Data Access	1	0	0	2	3	1	0	0	0	7
Subtheme 2: DQS: In-house Data System	4	2	1	1	0	0	2	0	0	10
- DQS: System Input Data Analysis	1	0	0	0	0	0	0	0	0	1
TOTALS:	10	8	3	9	8	8	3	1	0	50

As showed in Figure 13, two emergent subthemes evolved from the data analysis into the core theme. I derived the results shown in Table 18 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 4 (see Table 17). Table 18 showed that all participants (100% of the participants) shared information that generated codes used in mapping the emergence of the enterprise data system subtheme and four participants (67% of the participants) shared information that generated codes used in mapping the emergence of the in-house data system subtheme.

Table 18

Frequency of Participants (max n=6) Using Subthemes for Utilize a Strategic Date Quality System Core Theme

Subtheme	n	% of frequency of participants
Enterprise Data System	6	100%
In-house Data System	4	67%

Note. *n* = frequency of participants

Subtheme 4.1: Enterprise data system. All research participants (100%) indicated the use of a strategic enterprise data system for data management and quality. Figure 14 shows a network map of the enterprise data system subtheme that contains codes and quotations from participants. The three strategic enterprise data systems mentioned throughout the research data by participants were Quantum system (P1, P2, P5, & P6), AIRPAX (P5 & P6), and Profit Key (P3 & P4).

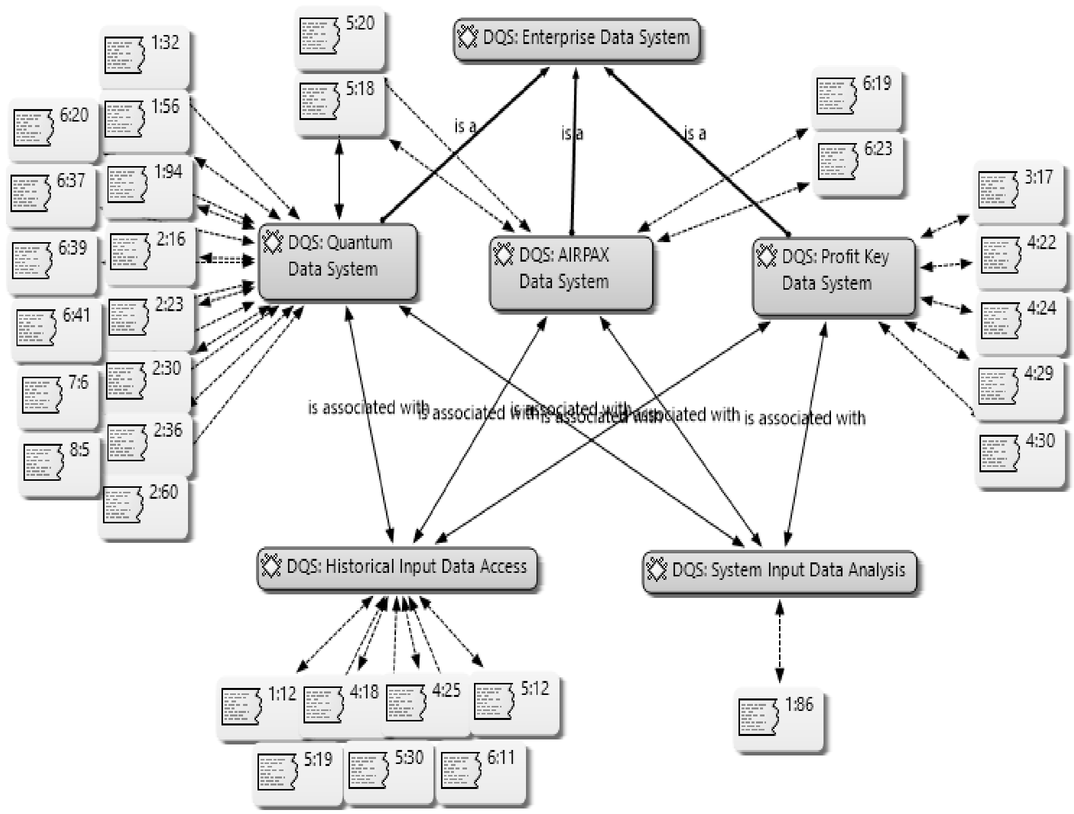

Figure 14. Subtheme 4.1: Enterprise data system.

The Quantum System is also known as the Component Controls (P1). The use of the Quantum system is growing within the spare parts industry because the system is geared towards the aftermarket support and can assist a firm in creating competitive advantage (P6). P2 at Company-1 stated that the Quantum system is the enterprise resource planning system used by the firm to track repairable spares input forecast data and other firm data. Documentation provided by P1 supported the strategic use of the Quantum system to support other systems within the SME firm to execute business activities such as forecasting and inventory management. In addition, the system is critical in conducting system data quality analysis by cross checking values with other systems (P1 & P2).

Participants (67%) emphasized the benefit of the Quantum system to access historical quality data used as data inputs for forecasting repairable spare parts. Participants stated the use of the Quantum system to track business data such sales quotes, price, lead time, and historical sales needed for forecasting repairable spare parts demand (P1, P2, P5, & P6). Forecasting business leaders extract daily reports from the system (P1 & P2). To create the business value, the data-quality system or tool at the organization used for DQM has to be precise and accurate (Liaw, 2013). The Quantum system is a user-friendly and interactive system that aids forecasting business leaders to conduct data quality and management (P1 & P2). The forecasting business leaders reply on the Quantum system for quality data (P2). Therefore, data inputs into the system have to be accurately inputted using the input data procedures (P2). P2 stated that the “strategy I guess that's most important to me would be ensuring that the information is controlled when it is being put into the system” to ensure repairable forecast input data quality.

AIRPAX is an enterprise data system mentioned by P5 and P6 that Company-3 has used for over 30 years for data management and quality. According to P5 and P6, forecasting business leaders utilized the AIRPAX system to access historical data and conduct system data quality for the past 30 years. The participants stated that AIRPAX is their current data quality system but are transitioning to the Quantum system because of the enhanced benefits of the system (P5 and P6). P5 pointed out that the Quantum system will present Company-3 the opportunity to conduct data management and reporting and forecast input data quality better than the AIRPAX system.

Lastly, Profit Key is an enterprise data system that P3 and P4 mentioned in the research data. Similar to the other four participants (P1, P2, P5, and P6), the Profit Key is a system that Company-2 utilize for data management and quality. Using the Profit Key, P3 and P4 at Company-2 were able to access historical data for forecasting repairable spare parts and conduct system data quality. In addition, the Profit key is a strategic data system for tracking inventory in an organization (P4). Company-2 customized the Profit Key system to align to their repairable spares business, which enabled the firm to generate and track various input forecast data (P3 & P4).

Subtheme 4.2: In-house data system/tool. Business leaders develop in-house data system/tool to support the enterprise data system and conduct data quality. Sixty-seven percent of the participants highlighted this subtheme within the research data. Figure 15 shows a network map of the in-house data system/tool subtheme that contains codes and quotations from participants.

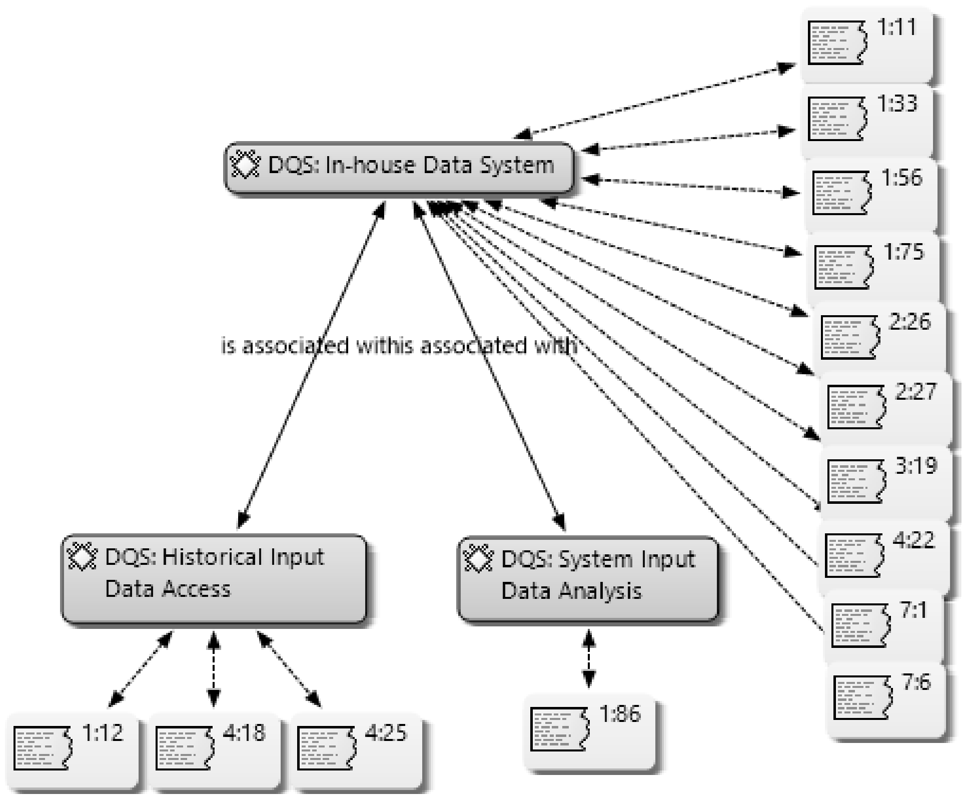

Figure 15. Subtheme 4.2: In-house data system.

P1 and P2 stated that their company programmers developed an internal forecasting and reporting system named the Dashboard to support the Quantum data system and to assure data integrity. P1 provided organizational documents that showed a snapshot of the Dashboard data system and standard extract requirements from the Quantum data system. Another internal data tool used by P1 and P2 was the Report App used for extracting information from the Quantum to cross check input forecast data before conducting forecast analysis. P3 mentioned in the research data that Company-2's internal data tool that supported their enterprise data system was an Excel-based data tool. Similar to P1 and P2 from Company-1, P3 from Company-2 used the Excel-based data tool to cross check and validate input forecast data from their customers and data from their Profit Key data system before conducting forecasting. The SME forecasting business leaders used the in-house data system/tool to access historical input forecast data (P1 & P4) and conduct data system/tool analysis on data quality (P1).

Core Theme 5: Identify Input Data Quality Measures

Identifying input data quality measures was the fifth core theme that emerged from the research data. The core theme was in alignment with the data quality measurement construct of the DQM conceptual framework. Business leaders attempting to identify the appropriate data quality measures is a common topic throughout the literature review. P2 stated that forecasting business leaders are required to review reports with input forecast data to measure the errors within the data and determine the appropriate adjustments. According to Moges et al. (2012), to measure the quality of data, data users have to address what dimensions or attributes of data to evaluate. In addition, Moges et al. stated that data quality is best measured by using multiple dimensions of data to gain a holistic view of the quality. Figure 16 shows an ATLAS.ti semantic network that represents the emergence of core theme 5. Table 19 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the identify input data quality measures core theme.

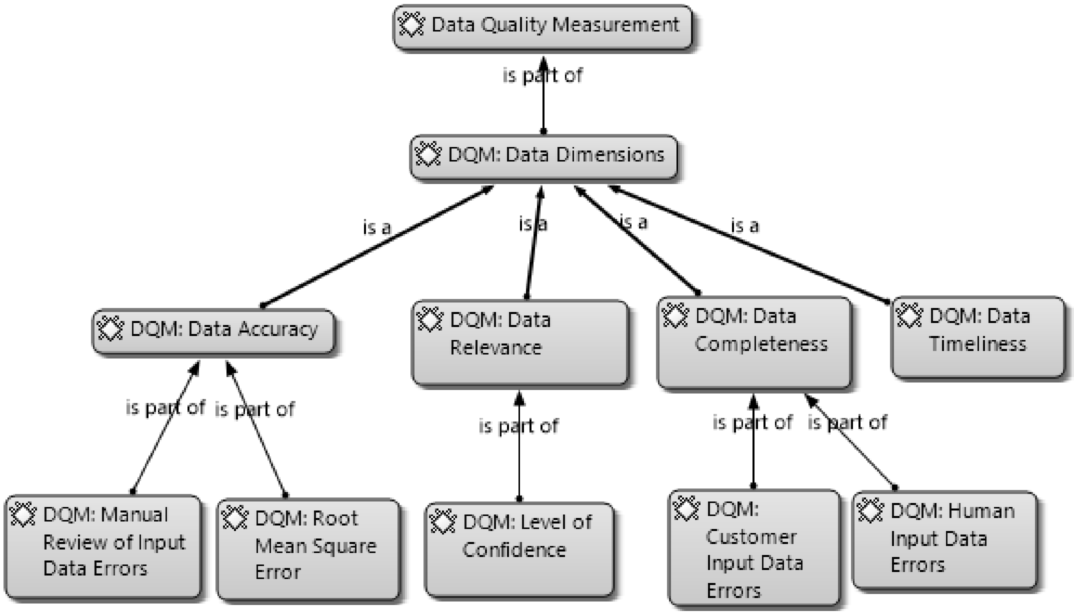

Figure 16. Core theme 5: Identify input data quality measures.

Table 19

Codes – Primary Documents Table for Identify Input Data Quality Measures Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1-Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments.pdf	TOTALS: Code Occurrence
Core Theme - Data Quality Measurement	2	5	0	0	0	1	0	0	0	8
Subtheme 1 - DQM: Data Quality Dimensions	1	1	0	1	1	0	0	0	0	4
- DQM: Data Accuracy	0	0	0	1	1	0	1	0	0	3
- DQM: Manual Review of Input Data Errors	1	1	0	0	0	0	0	0	0	2
- DQM: Root Mean Square Error	0	0	0	1	0	0	0	0	0	1
- DQM: Data Relevance	0	2	0	0	0	0	0	0	0	2
- DQM: Level of Confidence	0	0	0	1	0	0	0	0	0	1
- DQM: Data Completeness	0	1	0	0	0	0	0	0	0	1
- DQM: Customer Input Data Errors	0	1	0	0	0	0	0	0	0	1
- DQM: Human Input Data Errors	1	1	0	0	1	1	0	0	0	4
- DQM: Data Timeliness	3	1	0	1	0	0	0	0	0	5
TOTALS:	8	13	0	5	3	2	1	0	0	32

As showed in Figure 16, one emergent subtheme evolved from the data analysis into the core theme. I derived the results shown in Table 20 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 5 (see Table 19). Table 20 showed that five participants (83% of the participants) shared information that generated codes used in mapping the emergence of the data quality dimensions subtheme.

Table 20

Frequency of Participants (max n=6) Using Subtheme for Identify Input Data Quality Measures Core Theme

Subtheme	n	% of frequency of participants
Data Quality Dimensions	5	83%

Note. *n* = frequency of participants

Subtheme 5.1: Data quality dimensions. Out of the 6 participants, 5 participants discussed various data quality dimensions that are used in measuring the quality of input forecast data for forecasting repairable spare parts demand. Figure 17 shows a network map of the data quality dimensions subtheme that contains codes and quotations from participants.

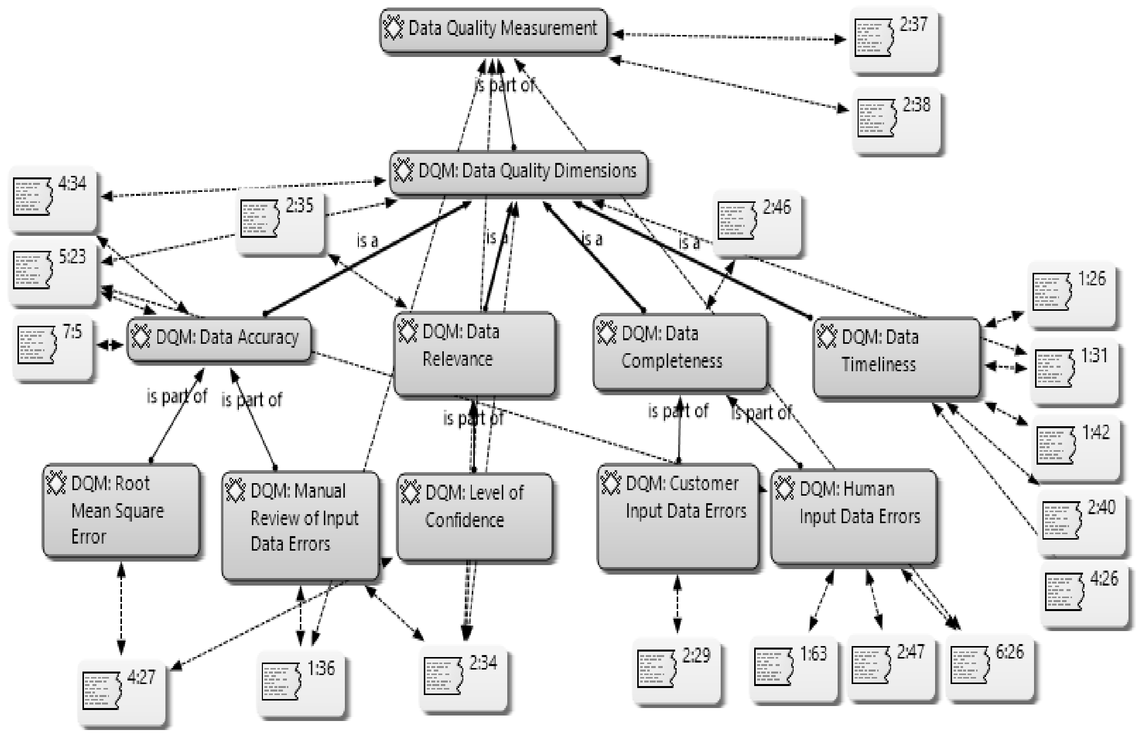

Figure 17. Subtheme 5.1: Data quality dimensions.

Data quality dimensions (DQD) is an aspect of data quality that is prevalent in the literature review. Several researchers and practitioners to date have mentioned various DQDs to gain knowledge on how to assess data quality. Similar to Kahn et al. (2012), the participants (83%) mentioned data accuracy, data relevancy, data completeness, and data timelines as DQDs used in measuring data quality, which is often cited in the literature.

The accuracy of an organizational data can affect the firm's performance (Zhou et al., 2014). Participants (P1, P4, & P5) made comments related to the data accuracy quality dimension. P4 stated that forecasting business leaders review 24 months historical data from various reports needed as input data to predict the future demand of repairable spare parts. The forecasting business leaders review the data to measure the accuracy of the data and determine a root mean square error to evaluate the level of confidence (P4).

According to P1 and P5, they manually review input forecast data in the data system to determine data accuracy. P1 shared an organizational document that contained reports on the accuracy of the input data extracted from the Quantum system needed to conduct repairable spare parts forecasting. P2 stated that “we won't use it for forecasting unless we're absolutely certain that it's correct.”

Data relevance is a critical quality dimension to achieve forecast accuracy because data relevant to achieving one task might not be relevant to achieving another task. P2 discussed the measure of data in terms of the relevance to the task of forecasting the demand for repairable spare parts. P2 conveyed a process of continuously identifying data errors from forecast data in Excel sheet and moving the cleaner data to another Excel sheet until the forecasting business leaders determine the forecast data relevant to conduct the demand forecast to enhance forecast accuracy.

P1 and P2 made comments related to the data completeness quality dimension. P2 mentioned stripping down the customer and vendor forecast data by reviewing each field to identify any missing values and the depth of the data to conduct repairable spare parts forecasting. P1 communicated the review of forecast data for any human input data errors to determine the completeness of the data before conducting demand forecasting.

Participants (P1, P2, & P4) made comments about the data timeliness quality dimension. P1 and P4 indicated that is critical to use input forecast data within 12 months to 24 months of historical customer usage to determine future demand for repairable spare parts. Forecast data over 3 years are not of high quality to execute the task of forecasting repairable spare part demand and attain forecast accuracy. Timely updates on lead time data from the vendors are important to the forecasting business leaders to accurately forecast the future demand for repairable spares and availability to the customers (P1 & P2).

Core Theme 6: Conduct Continuous Input Data Quality Analysis

The sixth core theme that emerged from the research data was conduct continuous input data quality analysis. Within the DQM conceptual framework, this core theme is in alignment with the data quality analysis construct and is prevalent throughout the literature review. Fan and Geerts (2012) pointed out that a typical enterprise can find about 1% to 5% of data error rates and can be above 30% for some companies, hence the importance of conducting the continuous input data quality analysis. Table 21 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the conduct continuous input data quality analysis core theme. Figure 18 shows an ATLAS.ti semantic network representation of the emergence of core theme 6.

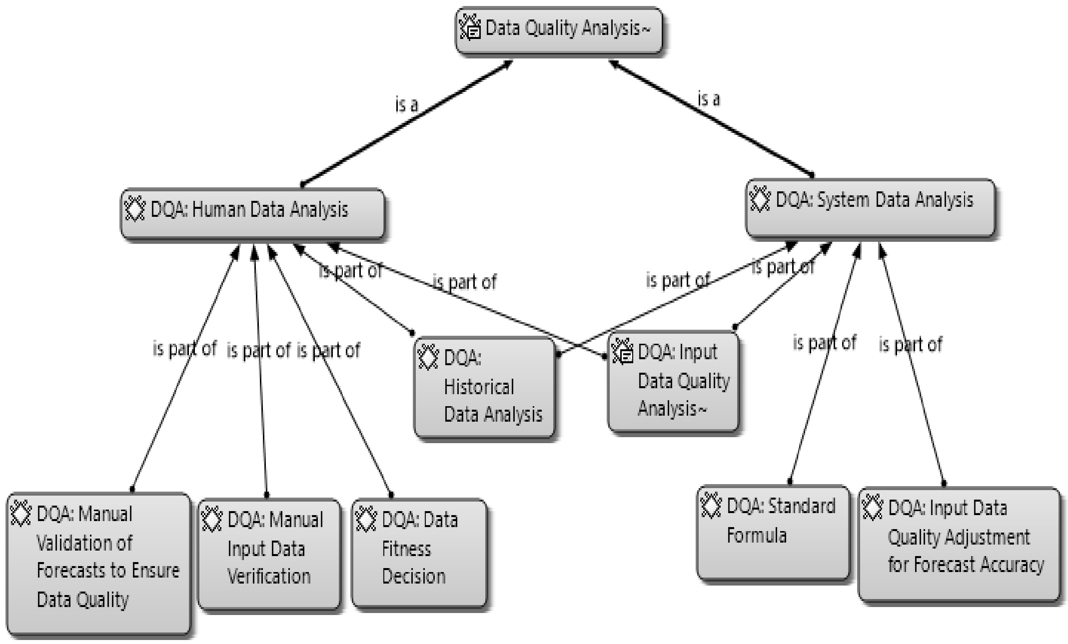

Figure 18. Core theme 6: Conduct continuous input data quality analysis.

Table 21

Codes – Primary Documents Table for Conduct Continuous Input Data Quality Analysis Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1-Documentation.pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments .pdf	TOTALS: Code Occurrence
Core Theme - Data Quality Analysis	1	1	1	1	1	1	0	0	0	6
Subtheme 1 - DQA: System Data Analysis	0	1	0	0	0	0	0	0	0	1
- DQA: Standard Formula	3	0	0	0	0	0	0	0	0	3
- DQA: Input Data Quality Adjustment for Forecast Accuracy	5	2	0	1	1	0	0	0	0	9
- DQA: Historical Data Analysis	0	3	2	2	1	3	0	0	0	11
- DQA: Input Data Quality Analysis	6	11	1	3	4	2	1	1	0	29
Subtheme 2 - DQA: Human Data Analysis	13	0	0	0	0	2	0	0	0	15
- DQA: Manual Input Data Verification	3	0	0	0	0	0	0	0	0	3
- DQA: Manual Validation of Forecasts to Ensure Data Quality	3	0	0	0	0	0	0	0	0	3
- DQA: Data Fitness Decision	6	3	0	0	0	0	0	0	0	9
TOTALS:	40	21	4	7	7	8	1	1	0	89

As showed in Figure 18, two emergent subthemes evolved from the data analysis into the core theme. I derived the results shown in Table 22 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 6 (see Table 21). Table 22 showed that all participants (100% of the participants) shared information that generated codes used in mapping the emergence of the system data analysis and the human data analysis subthemes.

Table 22

Frequency of Participants (max n=6) Using Subthemes for Conduct Continuous Input Data Quality Analysis Core Theme

Subtheme	n	% of frequency of participants
System Data Analysis	6	100%
Human Data Analysis	6	100%

Note. *n* = frequency of participants

Subtheme 6.1: System data analysis. Kandel et al. (2012) conducted a study that emphasized the use of data system to perform data quality analysis or assessment processes to improve the quality of data. All participants (100%) mentioned the use of a data system to conduct data analysis to improve the quality of input forecast data for forecasting repairable spare parts. Figure 19 shows a network map of the system data analysis subtheme that contains codes and quotations from participants.

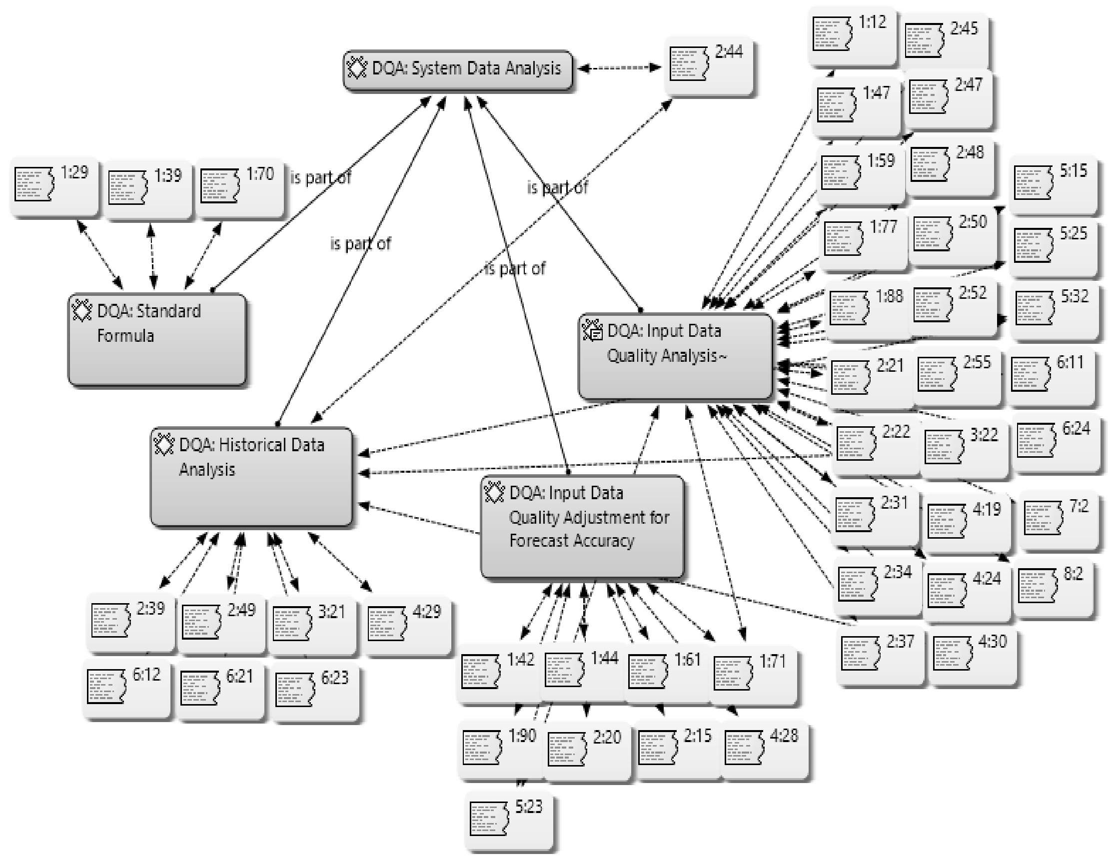

Figure 19. Subtheme 6.1: System data analysis.

Participants (P2, P3, P4, & P6) conducted system data quality analysis on historical data to enhance forecast accuracy. P2 conducted data quality analysis on historical trend data (upwards or downwards) on various repairable spare components to determine the input forecast data for future demand. The data system monitors the quality of the input data to highlight forecast demand that reflects 20% off the expected margin, which signals the forecasting business leaders to make necessary adjustments to the input data (P2).

Similar to Fan and Geerts (2012), Kandel et al. (2012) stated that data usually contain data errors that could undermine the results of data analysis. P2, P3, and P4 highlighted the importance of reviewing customer forecast data for data errors before utilizing the data as inputs for forecasting future repairable spare parts demand to stock. P2 reviewed input forecast data to determine which are useful to forecast repairable spare parts demand within +10 and -10 of expected future demand. In addition, the participants (P3 & P4) mentioned the review of the quality of historical customer data for the past 12 months to 24 months in relation to the currently provided customer data to make the appropriate adjustments before utilizing for forecasting.

P1 stated that "after [the] information is provided by the vendor and you upload it, you would routinely verify [by conducting] a random sampling that all your data went [in incorrectly]" to assure input data quality for forecasting. Furthermore, P1 and P6 performed the review of market data for input data quality before forecasting the repairable components to stock. P5 stated that their daily interactions as forecasting business leaders are ensuring within the data system that Company-3 is gathering quality input data to forecast future demand. P1 shared an organizational document that contained system reports of data quality analysis of input data needed for forecasting repairable spare parts. The data system contained standard formulas set up by the forecasting business leaders to review the input forecast data and determine the future demand (P1). According to P1, P2, P4, and P5, forecasting business leaders have the ability to make immediate changes to improve the quality of input data depending on the system data analysis.

Subtheme 6.2: Human data analysis. Despite the benefits of data system to conduct data quality analysis to uncover issues, human judgment is critical to confirm the validity of the data issue to develop the appropriate improvement activities (Kandel et al., 2012). All participants (100%) discussed the importance of human factor in data quality analysis. Chen, Chen, and Capistrano (2013) mentioned human factor as one of the factors that could influence a task within an information system. Figure 20 shows a network map of the human data analysis subtheme that contains codes and quotations from participants.

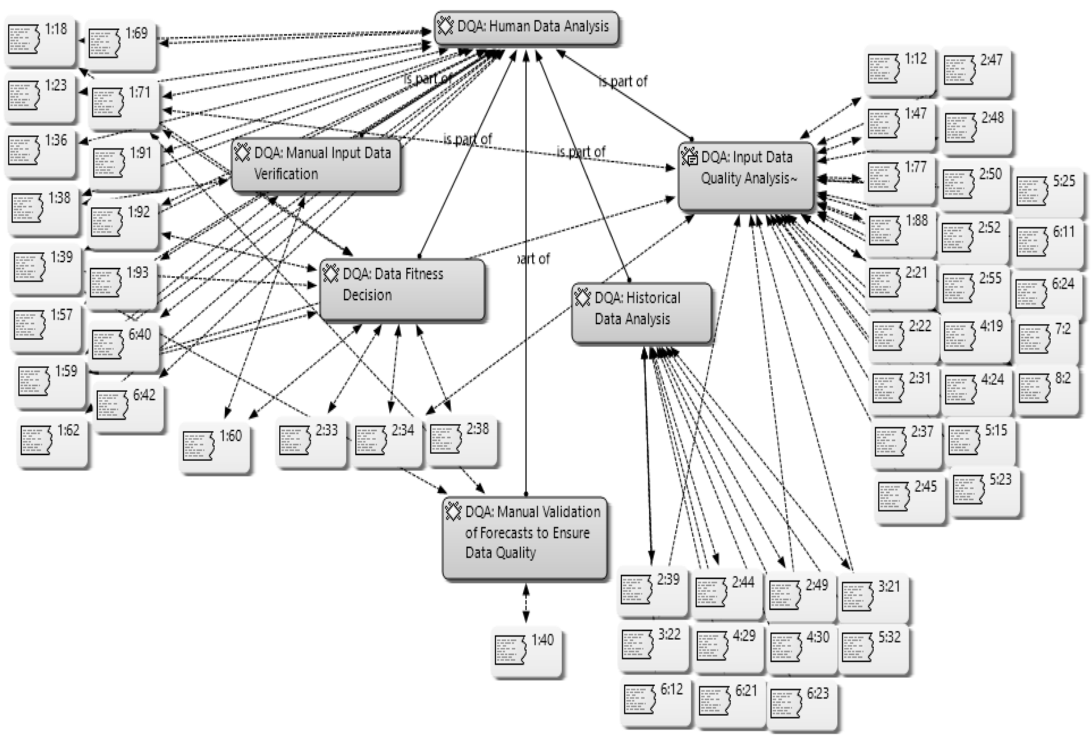

Figure 20. Subtheme 6.2: Human data analysis.

Human experience and knowledge are considered as data tools to analysis data, make a decision on fitness for use, and improve the quality of input data (P1). The decision on what is high-quality data input is subjective (P1 & P6). Therefore, human experience plays a critical role in improving the quality of data (P1 & P6). According to P6, forecasting business leaders sometimes have to make “gut decisions” in a short amount of time on the quality of input data needed to forecast repairable spare parts. Participants (67%) conveyed that forecasting business leaders conduct manual review and verification of the quality of historical input data. Forecasting business leaders and other department personnel conduct double or triple checks of input forecast data manually to ensure the data is of high quality before conducting forecasting (P1). P2 stated that “we won't use it for forecasting unless we're absolutely certain that it's correct.”

Core Theme 7: Incorporate Continuous Improvement Initiatives

The seventh core theme that emerged from the research data was incorporate continuous improvement initiatives. This core theme is in alignment with the continuous process improvement construct of the DQM conceptual framework to improve input data quality. The inclusion of this core theme aligns with the literature review. Fryer and Ogden (2014) pointed out that without continuous improvement as a key component in a firm, the organization cannot be a high quality performing firm. The DQM concept is a preventive approach to improving the quality of organizational data through step by step quality improvement when conducting data quality that goes beyond the traditional reactive approach (Otto et al., 2012). Hence, DQM has to be a continuous improvement process. Figure 21 shows an ATLAS.ti semantic network representation of the emergence of core theme 7. Table 23 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the incorporate continuous improvement initiatives core theme.

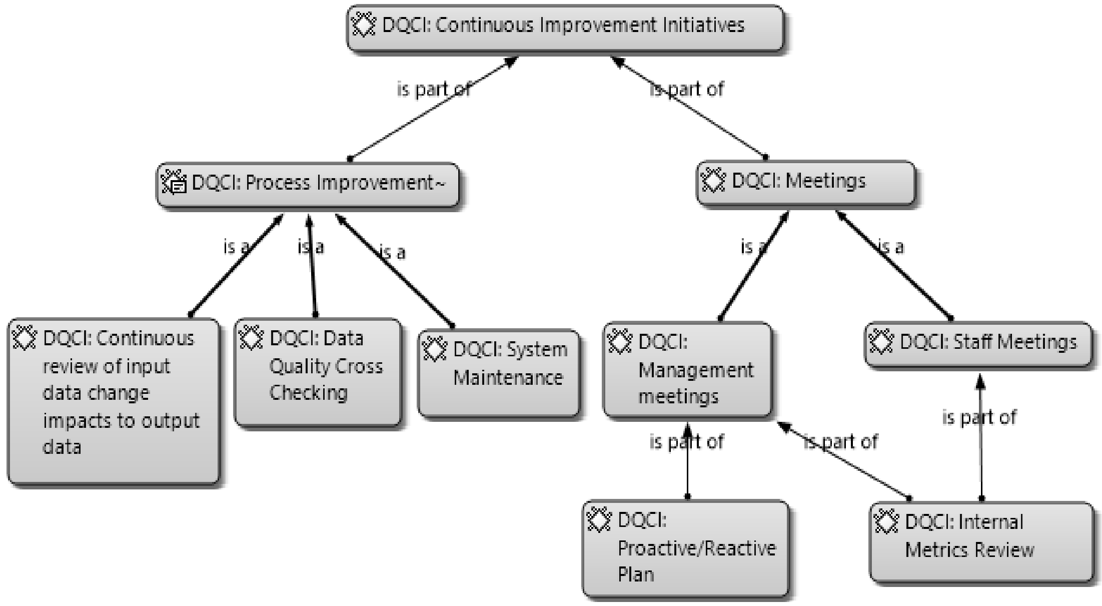

Figure 21. Core theme 7: Incorporate continuous improvement initiatives.

Table 23

Codes – Primary Documents Table for Incorporate Continuous Improvement Initiatives Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1- Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachment s.pdf	TOTALS: Code Occurrence
Core Theme - DQCI: Continuous Improvement Initiatives	1	0	1	1	0	1	0	0	0	4
Subtheme 1 - DQCI: Process Improvement	3	3	0	2	0	0	0	1	0	9
- DQCI: Continuous review of input data change impacts to output data	1	4	0	0	0	2	0	0	0	7
- DQCI: Data Quality Cross Checking	3	6	0	0	0	1	0	0	0	10
- DQCI: System Maintenance	2	0	0	0	0	0	0	0	0	2
Subtheme 2 - DQCI: Meetings	0	0	0	0	0	0	0	0	0	0
- DQCI: Management meetings	0	0	1	1	0	4	0	0	0	6
- DQCI: Proactive/Reactive Plan	0	0	0	1	0	0	0	0	0	1
- DQCI: Staff Meetings	0	0	0	0	1	0	0	0	0	1
- DQCI: Internal Metrics Review	0	1	3	2	1	1	1	0	1	10
TOTALS:	10	14	5	7	2	9	1	1	1	50

As showed in Figure 21, two emergent subthemes evolved from the data analysis into the core theme. I derived the results shown in Table 24 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 7 (see Table 23). Table 24 showed that four participants (67% of the participants) shared information that generated codes used in mapping the emergence of the process improvement subtheme and five participants (83% of the participants) shared information that generated codes used in mapping the emergence of the meeting subtheme.

Table 24

Frequency of Participants (max n=6) Using Subthemes for Incorporate Continuous Improvement Initiatives Core Theme

Subtheme	n	% of frequency of participants
Process Improvement	4	67%
Meetings	5	83%

Note. *n* = frequency of participants

Subtheme 7.1: Process improvement. Figure 22 shows a network map of the process improvement subtheme that contains codes and quotations from participants. Business process improvement is a critical business function for an organization's sustainability and maintenance of a competitive edge (Wong, 2013). Sixty-seven percent of participants made comments related to conducting data quality process improvement.

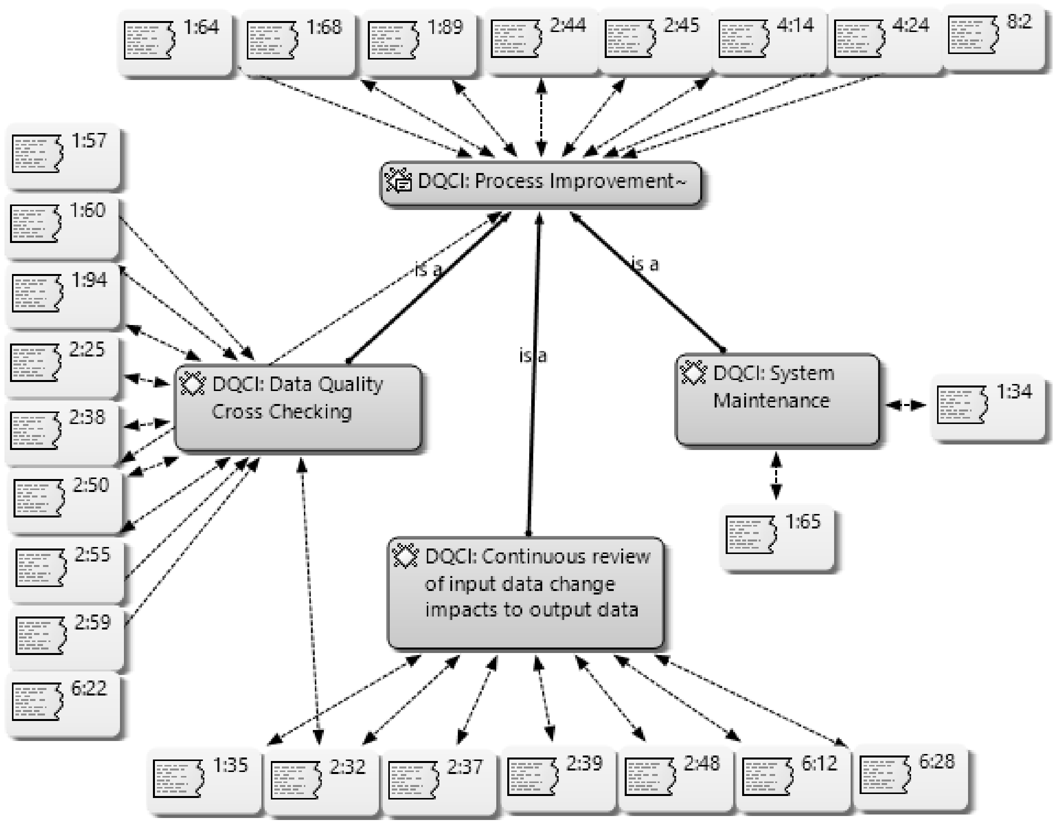

Figure 22. Subtheme 7.1: Process improvement.

Documentation provided by P2 supported the fact of a process improvement process for forecasting business leaders to utilize to improve data quality. Forecasting business leaders conducted a monthly review of their inventory levels to determine the quality of their input forecast data (P1, P2, & P4). Depending on the monthly reviews if the repairable spare parts are aging or decreasing rapidly, the forecasting business leaders make the improvement to the data inputs quality to enhance forecast accuracy moving forward (P1, P2, & P4). P2 pointed out that if inventory review indicated 10% over or 10% below, forecasting business leaders strip the report to uncover the data discrepancies.

Similar to P1, P2 stated that forecasting business leaders continuously review the process of extracting data from vendors and the quality of the input data such as lead time. Drach-Zahavy, Goldblatt, and Maizel (2015) mentioned in a study the use of cross-checking strategy to detect data errors and improve data quality. According to P1, P2, and P6, cross-checking is a process improvement initiatives forecasting business leaders utilize to improve the quality of the input data. Participants (50%) mentioned using the various data systems (enterprise and in-house data systems) within their companies and human reviews of the input data process to cross-check data quality used in repairable spare parts forecasting. Regularly, Company-1 conducted system maintenance and periodic checks on the input data process to enhance the system to accurately capture the data needed for forecasting (P1). Forecasting business leaders continuously reviewed the impact of input data changes on forecast accuracy to improve the process of attaining high-quality input data to forecast future demand (P1, P2, & P6).

Subtheme 7.2: Meetings. Kauffeld and Lehmann-Willenbrock (2011) stated that team meetings are part of the continuous improvement process that could lead to problem solving, action planning, and organizational success. Participants (83%) shared information related to using meetings as a continuous improvement process to improve the quality of input data used in forecasting and make the necessary adjustments to enhance the forecast accuracy. Figure 23 shows a network map of the meeting subtheme that contains codes and quotations from participants.

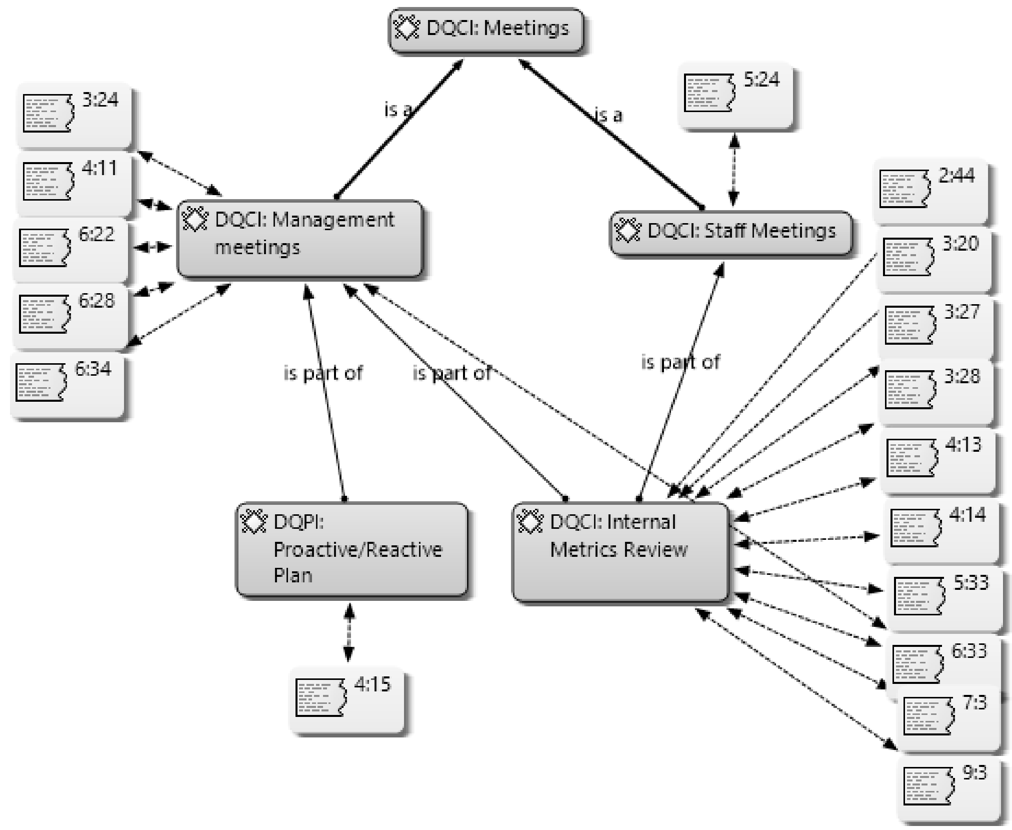

Figure 23. Subtheme 7.2: Meetings.

Staff and management meetings are two types of meetings used by the participants to review internal metrics and develop action plans to address the quality of data inputs used for forecasting repairable spare parts. P5 stated that regulatory staff meetings are a means where forecasting business leaders collaborate with other internal departments to enhance the process of capturing input data to improve the quality. Participants noted the review of input data for forecasting and internal metrics on past performance of forecast accuracy to make appropriate adjustments to the quality of data inputs to enhance forecast accuracy at meetings (P2, P3, P4, P5, & P6). Documentation shared by P1 and P3 reflected the internal metrics reviewed at meetings. Forecasting business leaders conducted management meetings on a periodic basis to also review internal metric and the quality of input data used for forecasting future demand (P3, P4, & P6). According to P3 and P4, action plans and accountability chart are products of the management meetings to improve the quality of input data and forecast accuracy towards sustainable profits.

Core Theme 8: Engage in Data Quality Training and Education

Lastly, engaging in data quality training and education emerged from the research data as a strategy forecasting business leaders utilized to improve the quality of data inputs used in repairable spare parts forecasting. Within the DQM conceptual framework, this core theme is in alignment with the data quality training and education construct and is prevalent throughout the literature review. Training and education are critical means for enhancing an organization's ability to utilize the firm's data to create maximum value (Hashim & Wok, 2013). Figure 24 shows an ATLAS.ti semantic network representation of the emergence of core theme 8. Table 25 shows codes occurrences derived from analyzing the Code – Primary Document Table from ATLAS.ti of related codes that evolved into the engage in data quality training and education core theme.

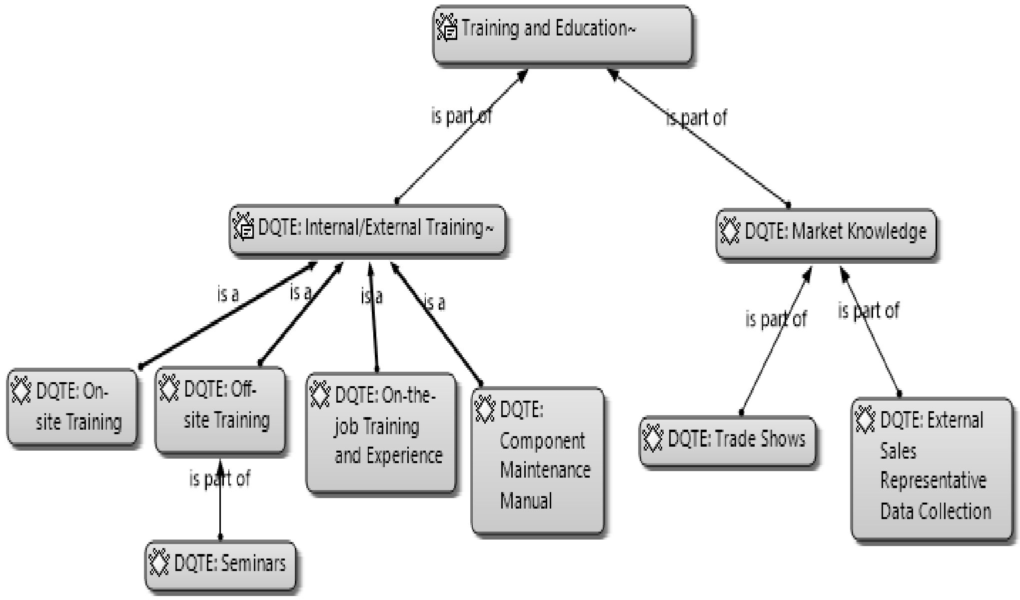

Figure 24. Core theme 8: Engage in data quality training and education.

Table 25

Codes – Primary Documents Table for Engage in Data Quality Training and Education Core Theme

	P 1: Case 1	P 2: Case 2	P 3: Case 3	P 4: Case 4	P 5: Case 5	P 6: Case 6	P 7: P1-Documentation .pdf	P 8: P2 - Documentation Jusfification and Public Information.doc	P 9: P3 - Document Evidence Attachments .pdf	TOTALS: Code Occurrence
Core Theme - Training and Education	1	1	1	1	1	1	0	0	0	6
Subtheme 1 - DQTE: Internal/External Training	2	0	0	0	0	1	0	0	0	3
- DQTE: On-site Training	1	1	0	0	0	0	0	0	0	2
- DQTE: Off-site Training	0	1	0	0	0	0	0	0	0	1
- DQTE: Seminars	0	0	0	0	0	1	0	0	0	1
- DQTE: On-the-job Training and Experience	1	0	0	0	1	0	0	0	0	2
- DQTE: Component Maintenance Manual	2	0	0	0	1	0	0	0	0	3
Subtheme 2 - DQTE: Market Knowledge	6	2	2	0	1	0	0	1	0	12
- DQTE: Trade Shows	0	2	0	0	0	0	0	0	1	3
- DQTE: External Sales Representative Data Collection	0	3	1	0	0	0	0	0	1	5
TOTALS:	13	10	4	1	4	3	0	1	2	38

As showed in Figure 24, two emergent subthemes evolved from the data analysis into the core theme. I derived the results shown in Table 26 from analyzing the Code – Primary Document Table from ATLAS.ti for core theme 8 (see Table 25). Table 26 showed that four participants (67% of the participants) shared information that generated codes used in mapping the emergence of the internal/external subtheme and four participants (67% of the participants) shared information that generated codes used in mapping the emergence of the market knowledge subtheme.

Table 26

Frequency of Participants (max n=6) Using Subthemes for Engage in Data Quality Training and Education Core Theme

Subtheme	n	% of frequency of participants
Internal/External Training	4	67%
Market Knowledge	4	67%

Note. *n* = frequency of participants

Subtheme 8.1: Internal/External training. According to Mendes (2012), training and development are key factors in the success of a quality improvement program. According to sixty-seven percent of the participants, on-site training, on-the-job training, off-site training, and component maintenance manual update are training methods for enhancing forecasting business leaders knowledge on input forecast data quality. Figure 25 shows a network map of the internal/external training subtheme that contains codes and quotations from participants.

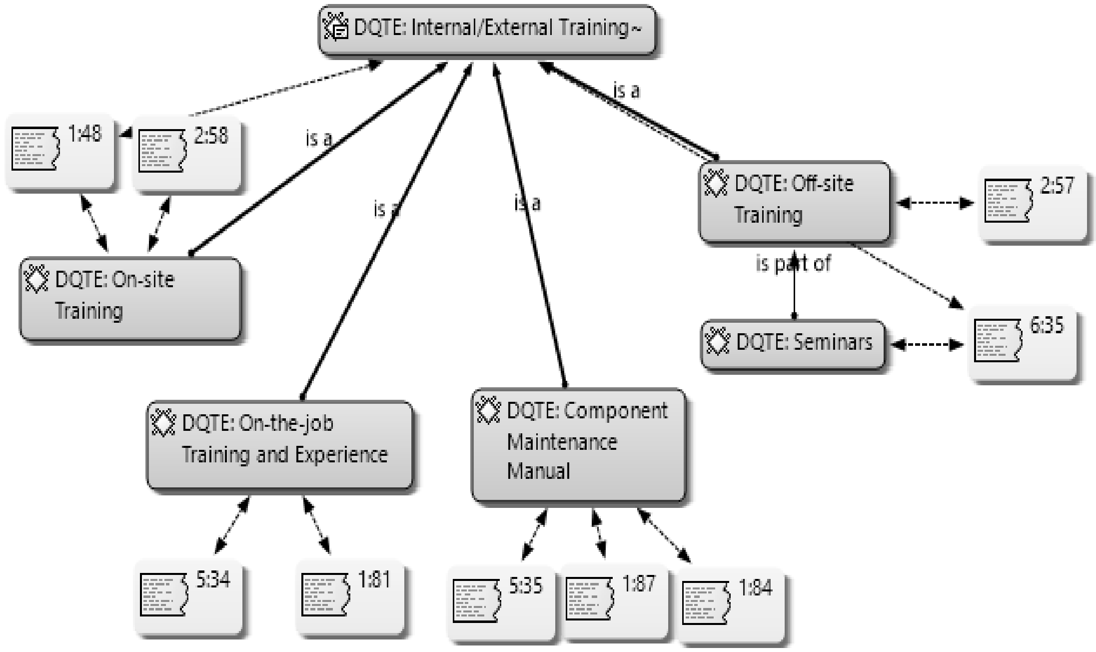

Figure 25. Subtheme 8.1: Internal/External training.

Amongst others, training for human capital in SMEs is one of the sources of competitiveness (Agus et al., 2015). P1 stated that Company-1 organized internal training to educate the forecasting business leaders on how to utilize the various reports extracted from the data systems and detect reports with data errors before utilizing to forecast repairable spare parts. According to P2, Company-1 conducted training for forecasting business leaders when the company decides to add a new product line to the stock list to enhance their knowledge on the quality of input data needed to attain forecast accuracy.

Mendes (2012) stated that SME managers usually focuses more on informal training (i.e., learning from experience) because the training can be easily integrated with daily operation and requires less time away from work. Similar to Mendes, Bager et al. (2015) pointed out that experience-based training is the main learning method for SME managers. P1 stated having 30 years experience in forecasting repairable spare parts and has amassed a significant amount of knowledge from on-the-job training to continue to enhance the quality of the input data used in demand forecasting. In addition, P5 pointed out that forecasting business leaders utilized their on-the-job training to actually create input forecast data or adjust existing input data to enhance the quality level before conducting forecasting.

P2 and P6 communicated the use of off-site training as another means to enhance forecasting business leaders knowledge on improving the quality of input data used for forecasting. P6 noted that forecasting business leaders attend seminars to enhance their knowledge and share their knowledge through on-site training to the employees that did not attend. Similar to P6, Afsana, Parvin, Sumon, and Nazim (2015) mentioned seminar training as a training program to improve the skills at SMEs. According to P1 and P5, continuous review of the component maintenance manual aided the forecasting business leaders to stay updated on when repairable spare parts need to be stocked to support their customers.

Subtheme 8.2: Market knowledge. Participants (67%) shared information in the research data related to forecasting business leaders using market knowledge to enhance their understanding to improve the quality of data inputs. Figure 26 shows a network map of the market knowledge subtheme that contains codes and quotations from participants. Keeping up with the market is an important aspect of enhancing the quality of data inputs and forecast accuracy (P5).

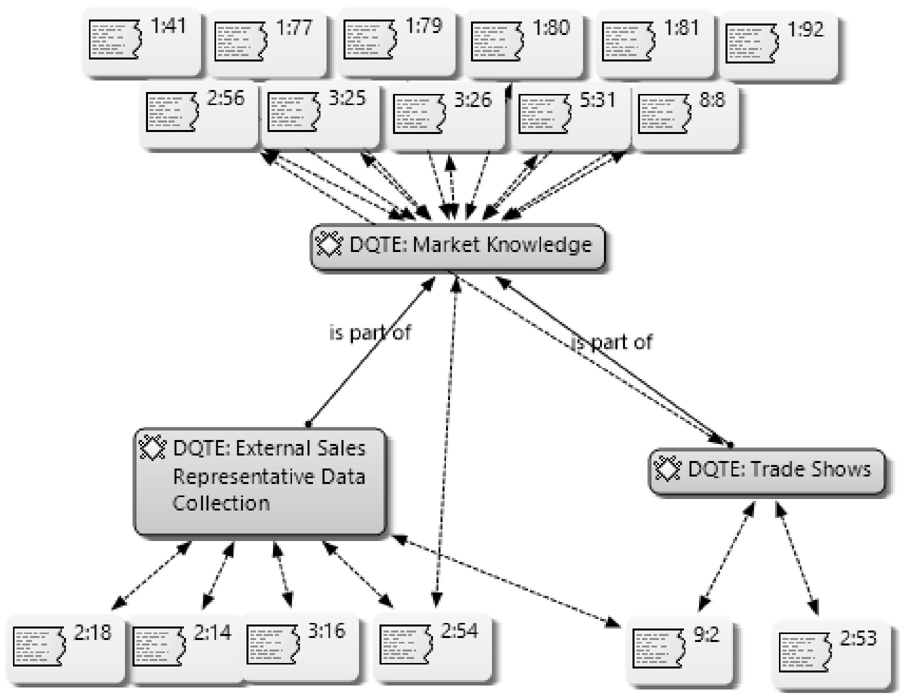

Figure 26. Subtheme 8.2: Market knowledge.

Data from Company-1's website contained information of having 50 years experience of the market to deliver exceptional customer service by always having repairable spare parts for same-day shipments. P1 stated that forecasting business leaders need to be aware of all factors including market knowledge to guide their decisions on quality data inputs needed to forecast repairable spare parts demand. Forecasting business leaders stay in constant communication with their customers and vendors to gain information on technological changes and market trends of components need (P2 & P3).

Participants (P2 & P3) highlighted external sales representatives and trade shows as the means to extract market knowledge to enhance forecasting business leaders knowledge to improve the quality of forecast data inputs. External sales representatives conduct market analysis on a daily basis to gain market information to support the forecasting business leaders in improving the quality of forecast data inputs (P2). P2 and P3 stated that external sales representatives frequently visit customers to gather market intellect to ensure their companies are not under-forecasting or over-forecasting repairable spare parts to support their customers. Forecasting business leaders attend trade shows to collect market information used in improving the quality of data inputs used for repairable spare parts demand forecasting and forecast accuracy (P2). An organizational document shared by P3 contained travel schedules and plan to attend trade shows to obtain market information, which supported the statement made by P2.

Applications to Professional Practice

With an increase in competition, demand uncertainty, and pressure to reduce inventory cost in the aerospace repairable spare parts industry, the need arose to help SME repairable spares suppliers identify the dimensions and related strategies to improve the quality of data inputs to forecast the demand for repairable spare parts (Dekker et al., 2013). Specifically, to improve the quality of data inputs used to forecast repairable spare parts, there are no published specific strategies to address the business problem in the field of study to my knowledge. Therefore, the aerospace SME repairable spares suppliers' potential use of the eight data quality strategies identified in this study could contribute towards business practices to enhance the quality of input forecast data and forecast accuracy of repairable spare parts demand.

The eight data quality strategies identified from the data analysis of participants' responses and documentation are: (a) establish data governance, (b) identify quality input data sources, (c) develop a sustainable relationship and collaboration with customers and vendors, (d) utilize a strategic data system for data management, (e) conduct continuous input data quality analysis, (f) identify input data quality measures, (g) incorporate continuous improvement initiatives, and (h) engage in data quality training and education. Florea, Cheung, and Herndon (2013) stated that the success and sustainability of any organization are dependent on the execution of sound management business practices or strategies. Forecasting business leaders at aerospace SME repairable spares suppliers could apply the identified eight data quality strategies to enhance their firm's data quality and forecasting practices to improve the quality of data inputs.

The quality of an organization data is a critical component of doing business (Eken et al., 2014). Results from this study might aid forecasting business leaders to understand the importance of establishing data governance to provide their organizations guiding principles to assure high input forecast data quality. Strategies shared by the participants might influence forecasting business leaders' decisions on selecting input data sources with high quality to conduct forecast for repairable spare parts demand. Study results could enhance forecasting business leaders' understanding of the importance of developing a sustainable relationship and collaboration with customers and vendors to enhance forecast input data quality. Forecasting business leaders could apply the strategy of utilizing a strategic data quality system capable of effective data management and quality of new forecast data inputs and historical data used as data inputs for forecasting. Study findings could influence forecasting business leaders to develop continuous input data quality analysis initiatives to enhance input forecast data quality used in forecasting repairable spare parts. Results from this study could enable forecasting business leaders to identify input data quality measures for improving the quality of data inputs used in forecasting repairable spare parts. Forecasting business leaders could apply the continuous improvement strategy to develop data quality activities that result in identifying and implementing input data quality improvement on an ongoing basis. Data quality training and educational support from business leaders could equip the forecasting professionals at the firms with insightful information on how to continue to enhance the data inputs used for demand forecasting. Such enhancements from forecasting business leaders executing the eight strategies could increase the likelihood of improved forecast accuracy and inventory management performance. Other benefits from the enhancements include increased customer service levels, sustainable competitive advantage, and overall financial performance for the SME repairable spares suppliers.

Implications for Social Change

The study findings create implications for positive social change for aerospace SME repairable spares suppliers, forecasting business leaders, employees, and surrounding society. According to Kourentzes (2013) and Tian et al. (2013), aerospace SME repairable spares suppliers suffer high operating cost from excess inventory and obsolescence risk due to over-forecasting, and shortage costs due to under-forecasting attributable in part due to poor forecast input data quality and perhaps to algorithms used and other forecast consumption process factors. With the potential application of the identified strategies to enhance the quality of input data quality for forecasting, aerospace forecasting business leaders at SME repairable spares suppliers may be able to combat the effects of poor forecast input data quality. Such effects include inventory write-off, customer dissatisfaction, and employee layoffs from poor financial performance (Gu et al., 2015; Kozik & Sep, 2012). A sustainable aerospace SME repairable spares suppliers may lead to employees with stable employments and increased job opportunities, which contributes towards social balance in their surrounding societies.

As the need for societal mobility by air and competitiveness in the aerospace industry continue to increase, timely availability of repairable spare parts for continuous operation of airplanes will continue to be a critical focus (Gu et al., 2015). Timely availability of repairable spare parts from aerospace SME repairable spares suppliers because of the study findings may reduce flight cancellations or delays, which will enhance societal mobility. Reduction of disposal of excess repairable spare parts because of the identified strategies from the study findings may lead to lower effects on the environment (Driessen et al., 2014). The study findings could lead to an improvement in aerospace SME repairable spares suppliers' supply chain and overall financial performances, which could result in an increase in state budgets. Such increase in state budgets could create positive implications for social changes on the societies.

Recommendations for Action

Synthesizing research data from interviewing six forecasting business leaders at aerospace SME repairable spares suppliers and the documentation provided resulted in eight recommended actions. The financial success and sustainability of organizations depend on the business leaders' ability to execute business strategies and influence the behavior of the firm employees (McDermott, Conway, Rousseau, & Flood, 2013).

Business leaders within the aerospace repairable spare parts industry could consider the eight strategies as recommendations to improve the quality of input data used in forecasting repairable spare parts demand to enhance forecast accuracy. The eight recommendations are components of the study findings, which are: (a) establish data governance, (b) identify quality input data sources, (c) develop a sustainable relationship and collaboration with customers and vendors, (d) utilize a strategic data quality system, (e) conduct continuous input data quality analysis, (f) identify input data quality measures, (g) incorporate continuous improvement initiatives, and (h) engage in data quality training and education.

First, forecasting business leaders at aerospace SME repairable spares suppliers should assess their current business state of data governance within their organization to assure quality input data used for forecasting repairable spare parts. I recommend that the forecasting business leaders should ensure their organizations obtain quality management system certification such as ISO9001:2008, AS9100, AS9110, and AS9120, which aids a firm to shape their data governance. The process of attaining such certification will help the SME firm integrate a quality focus environment into their culture. Forecasting business leaders should develop policies and procedures to governance the extraction, quality, storage, and usage of forecast input data. Furthermore, the business leaders should develop well-written roles and responsibilities for forecasting professionals handling forecast input data and ensure the professionals have an understanding of their roles. I recommend the SME forecasting business leaders develop data control processes such as data access levels to assure data integrity and security of input data used for forecasting repairable spare parts.

To forecast repairable spare parts demand, SME repairable spares suppliers utilize data from various sources from the industry and internal business data (Costantino et al., 2013; Gu et al., 2015; PricewaterhouseCooper, 2011). Second, I recommend SME forecasting business leaders identify quality forecast data sources within the industry to utilize for forecasting repairable spare parts demand. Data sources to consider are historical data, customer data, vendor data, and market data. The business leaders should develop effective processes to extract the selected quality input forecast data and assure data quality. Further, assurance of effective data management of the SME internal historical data would be critical to obtaining high input forecast data quality used for forecasting.

Third, I recommend that the forecasting business leaders at aerospace SME repairable spares suppliers develop a sustainable relationship and collaboration with their customers and vendors. Several authors have discussed customer and vendor relationship and collaboration as means to enhance forecast data quality. Bergvall et al. (2014) emphasized that communication between stakeholders is essential to improve data quality. Building the appropriate relationship to enhance collaboration between the forecasting business leaders and their customers and vendors could improve the quality of the forecast input data extracted to forecast repairable spare parts demand. I recommend forecasting business leaders at the aerospace SME repairable spares suppliers conduct monthly or quarterly customer and vendor calls and plan frequent on-site visits to develop an effective relationship and enhance collaboration.

Fourth, aerospace SME forecasting business leaders need to assess their data quality system to ensure the system is capable of effective input data management and quality analysis for demand forecasting. Sixty-seven percent of the participants indicated the use of the Quantum data system. The participants added that the data system is user-friendly, interactive, and the use of the tool for data management and quality is growing within the aerospace spare parts industry (P1, P2, P5, & P6). I recommend that forecasting business leaders should consider investing in the Quantum data system for their firms if and when they consider transitioning into a new data system. In addition, the forecasting business leaders could collaborate with their IT departments to develop in-house data tools to supplement their strategic data system to create an opportunity for data quality cross-checking.

Fifth, aerospace SME forecasting business leaders should recognize that continuous input data analysis to determine low data quality from high data quality is critical to making the appropriate adjustments to the input forecast data. Such adjustments could lead to enhance forecast accuracy and customer satisfaction. I recommend that the SME forecasting business leaders frequently execute input data quality analysis in addition to scheduled input data quality analysis by the firm data system. The decision on how frequent (e.g., daily, weekly, monthly, or quarterly) the forecasting business leaders conduct the input data quality analysis will depend on the SME organizational strategy. I recommend conducting the input data quality analysis at least on a weekly basis. The forecasting business leaders need to schedule management meetings to discuss the findings and make adjustments to the repairable spare parts forecast when necessary.

Salam (2014) stated that suppliers could not objectively measure data quality but have to judge the quality level of fitness of use. According to Moges et al. (2012), to measure the quality of data, data users have to address what dimensions or attributes of data to evaluate. Study findings revealed that SME forecasting business leaders measuring the forecast input data quality need to focus on the accuracy, completeness, timeliness, and relevancy aspects of the data. Sixth, I recommend the SME forecasting business leaders ensure appropriate procedures are in place to manually and systematically measure the input data quality before making forecasting decisions. Furthermore, the SME forecasting business leaders need to emphasize the use of the cross-checking process to execute data quality measurement activities.

Seventh, I recommend the forecasting business leaders at the SME aerospace repairable spares suppliers cultivate a continuous improvement culture and environment to enhance the input data quality process and overall forecasting performance. Fryer and Ogden (2014) pointed out that without continuous improvement as a key component in a firm, the organization cannot be a high quality performing firm. SME forecasting business leaders should engage in continuous review of input data quality and the impact on forecast accuracy, data quality cross checks, and assure scheduled data system maintenance execute as planned. Such activities enable the SME organizations to optimize their input data quality process.

Lastly, SME forecasting business leaders should engage in data quality training and education. In addition to on-the-job training, the SME forecasting business leaders should ensure to engage in on-site training. SME forecasting business leaders should seek opportunities to attend seminars and trade shows to enhance their knowledge about the market and apply their learning to improve the forecast input data quality used in repairable spare parts forecasting.

The stakeholders who will benefit from this study findings include business leaders at aerospace SME repairable spares suppliers, forecasting business professionals, data professionals, academic practitioners, and business consultants. Future researchers may utilize the study findings to build upon future research and contribute towards the body of knowledge in the aerospace SME repairable spares industry. I will disseminate the study findings through (a) training seminars, (b) scholarly and business journals, (c) small business workshops and conferences, and (d) interaction into organizational training and development programs.

Recommendations for Further Research

Based on the study findings and limited information on this research topic, I would recommend future researchers conduct further research and expand on the study limitations identified in Section 1 to contribute to the body of knowledge. Future researchers could use these study findings to conduct a qualitative research focusing on the challenges and successful implementation of the data quality strategies. I recommend future researchers to utilize the identified strategies from this research to conduct quantitative research to test any hypotheses and determine relationships.

I limited my research to extracting research data from forecasting business leaders in aerospace SME repairable spares suppliers located in Georgia, Florida, and Kansas states. I recommend future researchers to broaden the scope of the research population to other geographical locations within and outside the United States. Expanding the geographical coverage could enhance the study findings on what strategies do SME forecasting business leaders use to improve the quality of data inputs for forecasting repairable spare parts demand. I recommend increasing the sample size of the number of aerospace SME forecasting business leaders to extract research data and enhance the generalization of the study findings. In addition, I recommend duplicating the research in other industries beyond the aerospace spares industry. Conducting researches on other industries could provide diverse perspectives on the strategies to improve the quality of data inputs used for forecasting repairable spares.

I recommend future researchers conduct similar multiple case qualitative research on large aerospace repairable spares suppliers with greater than 250 employees focused on forecasting repairable spare parts to support the aerospace spares industry. The focus of this study was identifying strategies aerospace SME forecasting business leaders use to achieve quality data inputs used in forecasting repairable spare parts demand. I suggest that future researchers should conduct similar studies on what strategies do the SME forecasting business leader use to improve the quality of data inputs of other types of aerospace spare parts (rotables, expendables, and consumables) demand forecasting. Study findings from such research could uncover similarities and differences of strategies

SME forecasting business leaders deploy to improve the quality of data inputs used for forecasting the various aerospace spare parts.

Reflections

My perspectives on past research scholars, the level of work required to execute a DBA doctoral study, the online education process, and my knowledge of the aerospace repairable spares industry has evolved during my journey at Walden University. I have developed greater respect for past scholars, who have executed the research process to obtain their doctorate degrees and contributed to the body of knowledge in their fields of study. Several difficult moments surfaced as I executed the research process that challenged me to elevate my capabilities to accomplish the tasks towards the end goal.

I underestimated the difficulty in gaining approval from the business leaders at aerospace SME repairable spares suppliers to access potential research participants. The ability to convey the potential benefits of the study findings to the SME business leaders while assuring confidentiality was critical for me to gain approval and access the research participants to ask for voluntary participation. The time, coordination, and effort required to collect interview data and documentation, in addition to conducting the data analysis process to address the research question cannot be understated.

Prior to data collection, my preconceptions about this study were a result of years of aerospace experience in supply chain and the challenges experienced by practitioners in the areas of forecasting and data quality. I reflected on my preconceptions and documented the information on Microsoft Word to mitigate potential effects throughout the research process. I conducted interviews with six participants from the states of

Florida and Kansas. I had no professional or personal relationships with the participants to avoid any potential influence on the data collection process. The opportunity to interview the six forecasting business leaders at three aerospace SME repairable spares suppliers to understand the research problem confirmed the significance of this study to the business leaders, organizations, and the industry. I remained objective as I executed the data analysis process on the research data to uncover core themes identified as the strategies the aerospace SME forecasting business leaders utilized to improve the quality of input data used in forecasting repairable spare parts. Six core themes aligned with the DQM conceptual framework and two core themes surfaced as outliers. The execution of this research and study findings uncovered has elevated my worldview of the business phenomenon and aerospace SME repairable spares industry.

Conclusion

The quality of forecast input data is critical to reducing demand forecast errors and enhancing forecast accuracy (Silva Fonseca et al., 2012; Tum et al., 2012; Wang et al., 2013). Within the aerospace SME repairable spares industry, some forecasting business leaders lacked the data quality strategies to improve the quality of data inputs used in forecasting repairable spare parts demand. With the use of the DQM conceptual framework as a foundation to study the research problem, strategies emerged from the data analysis process to answer the research question for this exploratory multiple case qualitative research.

Eight data quality strategies forecasting business leaders at aerospace SME repairable spares suppliers used to improve the quality of input data used in forecasting repairable spare parts were (a) establish data governance, (b) identify quality input data sources, (c) develop a sustainable relationship and collaboration with customers and vendors, (d) utilize a strategic data quality system, (e) conduct continuous input data quality analysis, (f) identify input data quality measures, (g) incorporate continuous improvement initiatives, and (h) engage in data quality training and education. Six of the eight data quality strategies aligned to the DQM conceptual constructs and two were outliers from the conceptual constructs. The study findings suggest that forecasting business leaders at aerospace SME repairable spares suppliers need to execute the eight data quality strategies to combat the effects from poor forecast repairable spare parts input data quality. Executing such strategies could lead to improved SME data quality and forecasting practices, supply chain and financial performances, and positive implication to social change within the societies the suppliers operate. The findings from this study are now subject to further research by future researchers to contribute towards the body of knowledge in data quality and supply chain management.

References

Afsana, J., Parvin, A., Sumon, S., & Nazim, M. (2015). SME financing in Bangladesh: A comparison between BASIC Bank Limited and BRAC Bank Limited. *ASA University Review*, *9*, 60-74. Retrieved from http://www.asaub.edu.bd/asaubreview/

Agus, A. A., Isa, M., Farid, M. F., & Permono, S. P. (2015). An assessment of SME competitiveness in Indonesia. *Journal of Competitiveness*, *7*(2), 60-74. doi:10.7441/joc.2015.02.04

AHIMA. (2012). Data quality management model (Updated). *Journal of AHIMA*, *83*(7), 62-67. Retrieved from http://journal.ahima.org/

Aisyati, A., Jauhari, W. A., & Rosyidi, C. N. (2013). Determination inventory level for aircraft spare parts using continuous review model. *International Journal of Business Research and Management (IJBRM)*, *4*, 1-12. Retrieved from http://www.cscjournals.org/journals/IJBRM/description.php

Albarune, A. R. B., & Habib, M. M. (2015). A study of forecasting practices in supply chain management. *International Journal of Supply Chain Management*, *4*(2), 55-61. Retrieved from http://ojs.excelingtech.co.uk/index.php/IJSCM

Alizadeh, P. (2012). The role of forecasting parameters in reducing bullwhip effect. *Advances in Production Engineering & Management*, *7*, 177-186. Retrieved from http://apem-journal.org/

Aljumaili, M., Wandt, K., Karim, R., & Tretten, P. (2015). eMaintenance ontologies for data quality support. *Journal of Quality in Maintenance Engineering*, *21*, 358-374. doi:10.1108/JQME-09-2014-0048

American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.

Anyan, F. (2013). The influence of power shifts in data collection and analysis stages: A focus on qualitative research interview. *The Qualitative Report*, *18*(18), 1-9. Retrieved from http://tqr.nova.edu/

Augustine, B., Bhasi, M., & Madhu, G. (2012). Linking SME performance with the use of forecasting planning and control: Empirical findings from Indian firms. *European Journal of Scientific Research*, *73*(1), 86-105. Retrieved from http://www.europeanjournalofscientificresearch.com/

Bacchetti, A., & Saccani, N. (2012). Spare parts classification and demand forecasting for stock control: Investigating the gap between research and practice. *Omega*, *40*, 722-737. doi:10.1016/j.omega.2011.06.008

Bager, T. E., Jensen, K. W., Nielsen, P. S., & Larsen, T. A. (2015). Enrollment of SME managers to growth-oriented training programs. *International Journal of Entrepreneurial Behavior & Research*, *21*, 578-599. doi:10.1108/IJEBR-12-2014-0224

Bala, P. K. (2012). Improving inventory performance with clustering based demand forecasts. *Journal of Modelling in Management*, *7*, 23-37. doi:10.1108/17465661211208794

Barabadi, A., Barabady, J., & Markeset, T. (2014). Application of reliability models with covariates in spare part prediction and optimization – A case study. *Reliability Engineering & System Safety*, *123*, 1-7. doi:10.1016/j.ress.2013.09.012

Basten, R. J., van der Heijden, M. C., & Schutten, J. M. J. (2012). Joint optimization of level of repair analysis and spare parts stocks. *European Journal of Operational Research*, *222*, 474-483. doi:10.1016/j.ejor.2012.05.045

Basten, R. J., van der Heijden, M. C., Schutten, J. M. J., & Kutanoglu, E. (2015). An approximate approach for the joint problem of level of repair analysis and spare parts stocking. *Annals of Operations Research*, *224*, 121-145. doi:10.1007/s10479-012-1188

Basten, R. J. I., & van Houtum, G. J. (2014). System-oriented inventory models for spare parts. *Surveys in Operations Research and Management Science*, *19*(1), 34-55. doi:10.1016/j.sorms.2014.05.002

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*, 544-559. Retrieved from http://www.nova.edu/ssss/QR/QR13-4/baxter.pdf

Begg, C., & Caira, T. (2012). Exploring the SME quandary: Data governance in practise in the small to medium-sized enterprise sector. *Electronic Journal Information Systems Evaluation Volume*, *15*(1), 3-13. Retrieved from http://www.ejise.com/main.html

Beifert, A., Maknytė, L., & Prause, G. (2013). Sustainable supply chain management issues: Case of regional SMEs involvement in the air cargo. *Journal of Security and Sustainability Issues*, *3*(2), 41-52. doi:10.9770/jssi.2013.3.2(4)

Bell, E., & Bryman, A. (2007). The ethics of management research: An exploratory content analysis. *British Journal of Management, 18*(1), 63-77. doi:10.1111/j.1467-8551.2006.00487.x

Bergvall, T., Norén, G. N., & Lindquist, M. (2014). vigiGrade: A tool to identify well-documented individual case reports and highlight systematic data quality issues. *Drug Safety, 37,* 65-77. doi:10.1007/s40264-013-0131-x

Bernard, H. R. (2013). *Social research methods: Qualitative and quantitative approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Bhattacharyya, S. (2014). Improving inventory demand forecasting by using the sales pipeline: A case study. *Journal of Business Forecasting*, *33*(1), 7-11. Retrieved from https://ibf.org/index.cfm

Börner, R., Moormann, J., & Wang, M. (2012). Staff training for business process improvement: The benefit of role-plays in the case of KreditSim. *Journal of Workplace Learning*, *24*, 200-225. doi:10.1108/13665621211209276

Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: A research note. *Qualitative Research*, *8*, 137-152. doi:10.1177/1468794107085301

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, *9*(2), 27-40. doi:10.3316/QRJ0902027

Britzelmaier, B., Kraus, P., Häberle, M., Mayer, B., & Beck, V. (2013). Cost of capital in SMEs: Theoretical considerations and practical implications of a case study. *EuroMed Journal of Business*, *8*(1), 4-16. doi:10.1108/EMJB-05-2013-0017

Brod, M., Tesler, L. E., & Christensen, T. L. (2009). Qualitative research and content validity: Developing best practices based on science and experience. *Quality of Life Research*, *18*, 1263-1278. doi:10.1007/s11136-009-9540-9

Butt, M. A., & Zaman, M. (2013). Data quality tools for data warehousing: Enterprise case study. *IOSR Journal of Engineering*, *3*(1), 75-76. doi:10.9790/3021-03117576

Campbell, R., & Ahrens, C. E. (1998). Innovative community services for rape victims: An application of multiple case study methodology. *American Journal of Community Psychology*, *26*, 537-571. doi:10.1023/A:1022140921921

Carlsen, B., & Glenton, C. (2011). What about N? A methodological study of sample size reporting in focus group studies. *BMC Medical Research Methodology*, *11*(1), 26-35. doi:10.1186/1471-2288-11-26

Chang, S., & Yeh, T. (2012). Applying TLFs to design the exception thresholds in collaborative forecasting. *International Journal of Production Research*, *50*, 1932-1941. doi:10.1080/00207543.2011.564669

Chase, C. W. (2014). Innovations in business forecasting: Predictive analytics. *Journal of Business Forecasting*, *33*(2), 26-30. Retrieved from https://ibf.org/

Chen, H., Hailey, D., Wang, N., & Yu, P. (2014). A review of data quality assessment methods for public health information systems. *International Journal of*

Environmental Research and Public Health, *11*, 5170-5207. doi:10.3390/ijerph110505170

Chen, V. J., Chen, Y., & Capistrano, E. P. S. (2013). Process quality and collaboration quality on B2B e-commerce. *Industrial Management & Data Systems*, *113*, 908-926. doi:10.1108/IMDS-10-2012-0368

Chenail, R. J. (2011). Interviewing the investigator: Strategies for addressing instrumentation and researcher bias concerns in qualitative research. *The Qualitative Report*, *16,* 255-262. Retrieved from http://tqr.nova.edu/

Cho, D., & Lee, Y. (2012). Bullwhip effect measure in a seasonal supply chain. *Journal of Intelligent Manufacturing*, *23*, 2295-2305. doi:10.1007/s10845-011-0573-x

Chuang, S. F. (2013). Evaluating training and development practices in Taiwan: Challenges and opportunities. *Human Resource Development International*, *16*, 230-237. doi:10.1080/13678868.2012.756154

Conklin, T. A. (2013). Work worth doing: A phenomenological study of the experience of discovering and following one's calling. *Journal of Management Inquiry*, *21*, 298-317. doi:10.1177/1056492611414426

Cooper, J. S., & Kahn, E. (2012). Commentary on issues in data quality analysis in life cycle assessment. *The International Journal of Life Cycle Assessment*, *17*, 499-503. doi:10.1007/s11367-011-0371-x

Costantino, F., Di Gravio, G., & Tronci, M. (2013). Multi-echelon, multi-indenture spare parts inventory control subject to system availability and budget constraints.

Reliability Engineering & System Safety, *119*, 95-101. doi:10.1016/j.ress.2013.05.006

Crow, G., Wiles, R., Heath, S., & Charles, V. (2006). Research ethics and data quality: The implications of informed consent. *International Journal of Social Research Methodology*, *9*(2), 83-95. doi:10.1080/13645570600595231

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology, 11*, 100-108. doi:10.1186/1471-2288-11-100

Curasi, C. F. (2001). A critical exploration of face-to-face interviewing vs. computer-mediated interviewing. *International Journal of Market Research*, *43*, 361-375. Retrieved from https://www.mrs.org.uk/ijmr/

DAMA. (2008). *The DAMA Dictionary of Data Management*. Denville, NJ: Technics Publications, LLC.

Davydenko, A., & Fildes, R. (2013). Measuring forecasting accuracy: The case of judgmental adjustments to SKU-level demand forecasts. *International Journal of Forecasting*, *29*, 510-522. doi:10.1016/j.ijforecast.2012.09.002

Dekker, R., Pinçe, Ç., Zuidwijk, R., & Jalil, M. N. (2013). On the use of installed base information for spare parts logistics: A review of ideas and industry practice. *International Journal of Production Economics*, *143*, 536-545. doi:10.1016/j.ijpe.2011.11.025

Demyen, S., & Ciurea, J. (2014). Trends and implications regarding strategy development at SME level. *Analele Universitatii ‘Eftimie Murgu’ Resita.*

Fascicola II. Studii Economice, 2014, 66-71. Retrieved from http://www.analefseauem.ro/index/language-english/

Denton, P. D., & Maatgi, M. K. (2016). The development of a work environment framework for ISO 9000 standard success. *International Journal of Quality & Reliability Management*, *33*, 231-245. doi:10.1108/IJQRM-12-2013-0196

Denzin, N. K. (2009). *The research act: A theoretical introduction to sociological methods*. New York, NY: Aldine Transaction.

Denzin, N. K. (2012). Triangulation 2.0. *Journal of Mixed Methods Research, 6*, 80-88. doi:10.1177?1558689812437186

Deshmukh, S. V., & Chavan, A. (2012). Six Sigma and SMEs: A critical review of literature. *International Journal of Lean Six Sigma*, *3*, 157-167. doi:10.1108/20401461211243720

Drach-Zahavy, A., Goldblatt, H., & Maizel, A. (2015). Between standardization and resilience: Nurses' emergent risk management strategies during handovers. *Journal of Clinical Nursing*, *24*, 592-601. doi:10.1111/jocn.12725

Driessen, M., Arts, J., van Houtum, G. J., Rustenburg, J. W., & Huisman, B. (2014). Maintenance spare parts planning and control: A framework for control and agenda for future research. *Production Planning & Control*, (ahead-of-print), 1-20. Retrieved from http://cms.ieis.tue.nl/Beta/Files/WorkingPapers/wp_325.pdf

Dudeja, V. K. (2014). Forecasting and supply planning for spare parts. *Journal of Business Forecasting*, *33*(1), 23-28. Retrieved from https://ibf.org//

Eken, S., Sayar, A., & Topçuoğlu, K. (2014). AutoTest: Automation to test tabular data quality. *International Journal of Computer & Electrical Engineering*, *6*, 365-368. doi:10.7763/ijcee.2014.v6.854

Elliott, T. E., Holmes, J. H., Davidson, A. J., La Chance, P. A., Nelson, A. F., & Steiner, J. F. (2013). Data warehouse governance programs in healthcare settings: A literature review and a call to action. *EGEMS*, *1*(1), 1-7. doi:10.13063/2327-9214.1010

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative content analysis. *SAGE Open*, *4*(1), 1-10. doi:10.1177/2158244014522633

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107-115. doi:10.1111/j.1365-2648.2007.04569.x

Erlingsson, C., & Brysiewicz, P. (2013). Orientation among multiple truths: An introduction of qualitative research. *African Journal of Emergency Medicine*, *3*(2), 92-99. doi:10.1016/j.afjem.2012.04.005

Fan, W. (2012). Data quality: Theory and practice. In H. Gao, L. Lim, W. Wang, C. Li, & L. Chen (Eds.), *Lecture Notes in Computer Science, 7418, Web-Age Information Management* (pp. 1- 16). doi:10.1007/978-3-642-32281-5_1

Fan, W., & Geerts, F. (2012). *Foundations of data quality management*. San Rafael, CA: Morgan and Claypool Publishing.

Farrelly, P. (2012). Selecting a research method and designing the study. *British Journal of School Nursing*, *7*, 508-511. doi:10.12968/bjsn.2012.7.10.508

Fein, E. C., & Kulik, C. T. (2011). Safeguarding access and safeguarding meaning as strategies for achieving confidentiality. *Industrial and Organizational Psychology*, *4*, 479-481. doi:10.1111/j.1754-9434.2011.01378.x

Fisher, C., Lauría, E., & Chengalur-Smith, S. (2012). *Introduction to information quality*. Bloomington, IN: AuthorHouse Publishing.

Florea, L., Cheung, Y. H., & Herndon, N. C. (2013). For all good reasons: Role of values in organizational sustainability. *Journal of Business Ethics*, *114*, 393-408. doi:10.1007/s10551-012-1355-x

Forslund, H., & Jonsson, P. (2007). The impact of forecast information quality on supply chain performance. *International Journal of Operations & Production Management*, *27*(1), 90-107. doi:10.1108/01443570710714556

Fowler Jr., F. J. (2013). *Survey research methods*. Thousand Oaks, CA: Sage Publications.

Francis, J. J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M. P., & Grimshaw, J. M. (2010). What is an adequate sample size? Operationalising data saturation for theory-based interview studies. *Psychology and Health*, *25*, 1229-1245. doi:10.1080/08870440903194015

Fritzsche, R. (2012). Cost adjustment for single item pooling models using a dynamic failure rate: A calculation for the aircraft industry. *Transportation Research Part E: Logistics and Transportation Review*, *48*, 1065-1079. doi:10.1016/j.tre.2012.04.003

Fryer, K. J., & Ogden, S. M. (2014). Modelling continuous improvement maturity in the public sector: Key stages and indicators. *Total Quality Management & Business Excellence, 25*, 1039-1053. doi:10.1080/14783363.2012.733262

Fujita, M. (2012). *The transnational activities of small and medium sized enterprises*. Boston, MA: Kluwer Academic Publishing.

Fusch, P., & Ness, L. (2015). Are we there yet? Data saturation in qualitative research. *The Qualitative Report*, *20*, 1408-1416 Retrieved from http://tqr.nova.edu/

Gentles, S. J., Charles, C., Ploeg, J., & McKibbon, K. A. (2015). Sampling in qualitative research: Insights from an overview of the methods literature. *The Qualitative Report*, *20*, 1772-1789. Retrieved from http://tqr.nova.edu/

Gerring, J. (2011). How good is good enough? A multidimensional, best-possible standard for research design. *Political Research Quarterly, 64*, 625-636. doi:10.1177/1065912910361221

Ghodrati, B., Ahmadi, A., & Galar, D. (2013). Spare parts estimation for machine availability improvement addressing its reliability and operating environment—Case study. *International Journal of Reliability, Quality and Safety Engineering*, *20*, 1340005-1-1340005-15. doi:10.1142/S0218539313400056

Ghodrati, B., Benjevic, D., & Jardine, A. (2012). Product support improvement by considering system operating environment: A case study on spare parts procurement. *International Journal of Quality & Reliability Management*, *29*, 436-450. doi:10.1108/02656711211224875

Ghooi, R. B. (2014). Institutional review boards: Challenges and opportunities. *Perspectives in Clinical Research, 5*, 60-65. doi:10.4103/2229-3485.128020

Gibson, S., Benson, O., & Brand, S. L. (2012). Talking about suicide: Confidentiality and anonymity in qualitative research. *Nursing Ethics*, *20*, 18-29. doi:10.1177/0969733012452684

Gijo, E., & Scaria, J. (2014). Process improvement through Six Sigma with beta correction: A case study of manufacturing company. *International Journal of Advanced Manufacturing Technology*, *71,* 717-730. doi:10.1007/s00170-013-5483-y

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report*, *8*, 597-606. Retrieved from http://www.nova.edu/ssss/QR/QR8-4/golafshani

Goldblatt, H., Karnieli-Miller, O., & Neumann, M. (2011). Sharing qualitative research findings with participants: Study experiences of methodological and ethical dilemmas. *Patient Education and Counseling*, *82*, 389-395. doi:10.1016/j.pec.2010.12.016

Greenbank, P. (2003). The role of values in educational research: The case for reflexivity. *British Educational Research Journal*, *29*, 791-801. doi:10.1080/0141192032000137303

Grobbelaar, S., & Visser, J. K. (2015). Determining the cost of predictive component replacement in order to assist with maintenance decision-making. *South African Journal of Industrial Engineering*, *26*, 150-162. doi:10.7166/26-1-713

Gu, J., Zhang, G., & Li, K. W. (2015). Efficient aircraft spare parts inventory management under demand uncertainty. *Journal of Air Transport Management, 42*, 101-109. doi:10.1016/j.jairtraman.2014.09.006

Guide, V. D. R., & Srivastava, R. (1997). Repairable inventory theory: Models and applications. *European Journal of Operational Research*, *102*, 1-20. doi:10.1016/S0377-2217(97)00155-0

Gutierrez, R. S., Solis, A. O., & Mukhopadhyay, S. (2008). Lumpy demand forecasting using neural networks. *International Journal of Production Economics, 111*, 409-420. doi:10.1016/j.ijpe.2007.01.007

Hanson, J. L., Balmer, D. F., & Giardino, A. P. (2011). Qualitative research methods for medical educators. *Academic Pediatrics*, *11*, 375-386. doi:10.1016/j.acap.2011.05.001

Harper, M., & Cole, P. (2012). Member checking: Can benefits be gained similar to group therapy? *The Qualitative Report*, *17*, 510-517. Retrieved from http://www.nova.edu

Hashim, J., & Wok, S. (2013). Who benefits from training: Big guy or small fry?. *Development and Learning in Organizations*, *27*(3), 14-17. doi:10.1108/14777281311315856

Hassan, J., Khan, F., & Hasan, M. (2012). A risk-based approach to manage non-repairable spare parts inventory. *Journal of Quality in Maintenance Engineering*, *18*, 344-362. doi:10.1108/13552511211265938

Haug, A., Arlbjørn, J. S., Zachariassen, F., & Schlichter, J. (2013). Master data quality barriers: An empirical investigation. *Industrial Management & Data Systems, 113*, 234-249. doi:10.1108/02635571311303550

Haug, A., Zachariassen, F., & van Liempd, D. (2011). The costs of poor data quality. *Journal of Industrial Engineering and Management*, *4*, 168-193. doi:10.3926/jiem.2011.v4n2.p168-193

Hazen, B. T., Boone, C. A., Ezell, J. D., & Jones-Farmer, L. A. (2014). Data quality for data science, predictive analytics, and big data in supply chain management: An introduction to the problem and suggestions for research and applications. *International Journal of Production Economic*s, *154*, 72-80. doi:10.1016/j.ijpe.2014.04.018

Hellingrath, B., & Cordes, A. K. (2014). Conceptual approach for integrating condition monitoring information and spare parts forecasting methods. *Production & Manufacturing Research*, *2*, 725-737. doi:10.1080/21693277.2014.943431

Ho, C., & Ireland, T. C. (2012). Mitigating forecast errors by lot-sizing rules in ERP-controlled manufacturing systems. *International Journal of Production Research, 50*, 3080-3094. doi:10.1080/00207543.2011.592156

Hodkiewicz, M., & Ho, M. T. W. (2016). Cleaning historical maintenance work order data for reliability analysis. *Journal of Quality in Maintenance Engineering*, *22*(2), 1-26. doi:10.1108/JQME-04-2015-0013

Hoe, J., & Hoare, Z. (2012). Understanding quantitative research: Part 1. *Nursing Standard*, *27*, 52-57. doi:10.7748/ns2012.12.27.15.52.c9485

Huang, H., Stvilia, B., Jörgensen, C., & Bass, H. W. (2012). Prioritization of data quality dimensions and skills requirements in genome annotation work. *Journal of the American Society for Information Science and Technology, 63,* 195-207. doi:10.1002/asi.21652

Hussain, M., Shome, A., & Lee, D. (2012). Impact of forecasting methods on variance ratio in order-up-to level policy. *International Journal of Advanced Manufacturing Technology, 59,* 413-420. doi:10.1007/s00170-011-3485-1

Irvine, A., Drew, P., & Sainsbury, R. (2013). 'Am I not answering your questions properly?' Clarification, adequacy, and responsiveness in semi-structured telephone and face-to-face interviews. *Qualitative Research*, *13*(1), 87-106. doi:10.1177/1468794112439086

Jacob, S. A., & Furgerson, S. (2012). Writing interview protocols and conducting interviews: Tips for students new to the field of qualitative research. *Qualitative Report*, *17,* 1-10. Retrieved from http://www.nova.edu/ssss/QR/QR17/jacob

Janghorban, R., Roudsari, L., & Taghipour, A. (2014). Skype interviewing: The new generation of online synchronous interview in qualitative research. *International Journal of Qualitative Studies on Health and Well-being*, *9,* 24152-24152. doi:10.3402/qhw.v9.24152

Jones, F., Rodger, S., Ziviani, J., & Boyd, R. (2012). Application of a hermeneutic phenomenologically orientated approach to a qualitative study. *International Journal of Therapy and Rehabilitation*, *19,* 370-378. Retrieved from http://www.ijtr.co.uk/

Jones, P., Beynon, M. J., Pickernell, D., & Packham, G. (2013). Evaluating the impact of different training methods on SME business performance. *Environment and Planning C: Government and Policy*, *31*(1), 56-81. doi:10.1068/c12113b

Kahn, M. G., Raebel, M. A., Glanz, J. M., Riedlinger, K., & Steiner, J. F. (2012). A pragmatic framework for single-site and multisite data quality assessment in electronic health record-based clinical research. *Medical Care*, *50*, 1-13. doi:10.1097/MLR.0b013e318257dd67

Kamalapur, R. (2013). Impact of forecast errors in CPFR collaboration strategy. *American Journal of Industrial and Business Management*, *3*, 389-394. doi:10.4236/ajibm.2013.34046

Kandel, S., Parikh, R., Paepcke, A., Hellerstein, J. M., & Heer, J. (2012). Profiler: Integrated statistical analysis and visualization for data quality assessment. *Proceedings of the International Working Conference on Advanced Visual Interfaces, USA, 2012*, 547-554. doi:10.1145/2254556.2254659

Kapoor, R., & Ambekar, S. (2015). Closed loop repairable parts inventory system: A literature review. *Indian Journal of Economics and Business*, *14*(1), 31-47. Retrieved from http://ijeb.com/cms/

Kauffeld, S., & Lehmann-Willenbrock, N. (2012). Meetings matter effects of team meetings on team and organizational success. *Small Group Research*, *43*, 130-158. doi:10.1177/1046496411429599

Ke, J., Yang, D., Sheu, S., & Kuo, C. (2013). Availability of a repairable retrial system with warm standby components. *International Journal of Computer Mathematics*, *90*, 2279-2297. doi:10.1080/00207160.2013.783695

Kelly, T., & Howie, L. (2007). Working with stories in nursing research: Procedures used in narrative analysis. *International Journal of Mental Health Nursing*, *16*, 136-144. doi:10.1111/j.1447-0349.2007.00457.x

Khan, N., Iqbal, S., & Mahboob, T. (2015). A comparative study of data quality management in data warehouses. *International Journal of Computer and Communication System Engineering*, *2*, 464-471. Retrieved from www.ijccse.com

Khanam, S., Siddiqui, J., & Talib, F. (2013). Role of information technology in total quality management: A literature review. *International Journal of Advanced Research in Computer Engineering and Technology*, *2*, 2433-2445. Retrieved from www.ijarcet.org

Kilpi, J., Töyli, J., & Vepsäläinen, A. (2009). Cooperative strategies for the availability service of repairable aircraft components. *International Journal of Production Economics*, *117*, 360-370. doi:10.1016/j.ijpe.2008.12.001

Kim, S., & Kim, H. (2016). A new metric of absolute percentage error for intermittent demand forecasts. *International Journal of Forecasting*, *32*, 669-679. doi:10.1016/j.ijforecast.2015.12.003

Kirkwood, A., & Price, L. (2013). Examining some assumptions and limitations of research on the effects of emerging technologies for teaching and learning in higher education. *British Journal of Educational Technology*, *44*, 536-543. doi:10.1111/bjet.12049

Kisaka, S. E., & Mwewa, N. M. (2014). Effects of micro-credit, micro-savings and training on the growth of small and medium enterprises in Machakos County in Kenya. *Research Journal of Finance and Accounting*, *5*(7), 43-49. Retrieved from http://www.iiste.org/Journals/index.php/RJFA

Klonoski, R. (2013). The case for case studies: Deriving theory from evidence. *Journal of Business Case Studies (JBCS)*, *9*, 261-266. doi:10.19030/jbcs.v9i3.7805

Koblen, I., & Niznikova, L. (2013). Selected aspects of the supply chain management in the aerospace industry. *INCAS Bulletin*, *5,* 135-149. doi:10.13111/2066-8201.2013.5.1.13

Kontrec, N. Z., Milovanović, G. V., Panić, S. R., & Milošević, H. (2015). A reliability-based approach to nonrepairable spare part forecasting in aircraft maintenance system. *Mathematical Problems in Engineering*, *2015,* 1-7. doi:10.1155/2015/731437

Kourentzes, N. (2013). Intermittent demand forecasts with neural networks. *International Journal of Production Economics*, *143*, 198-206. doi:10.1016/j.ijpe.2013.01.009

Kourentzes, N. (2014). On intermittent demand model optimisation and selection. *International Journal of Production Economics*, *156*, 180-190. doi:10.1016/j.ijpe.2014.06.007

Kozik, P., & Sęp, J. (2012). Aircraft engine overhaul demand forecasting using ANN. *Management and Production Engineering Review*, *3*(2), 21-26. doi:10.2478/10270-012-0012-2

Král, P., Sobíšek, L., & Stachová, M. (2014). A distance based measure of data quality. *Advances in Methodology & Statistics / Metodoloski Zvezki*, *11*(2), 107-120. Retrieved from http://www.stat-d.si/mz/

Kwon, O., Lee, N., & Shin, B. (2014). Data quality management, data usage experience and acquisition intention of big data analytics. *International Journal of Information Management*, *34*, 387-394. doi:10.1016/j.ijinfomgt.2014.02.002

Kyvik, S. (2013). The academic researcher role: Enhancing expectations and improved performance. *Higher Education*, *65*, 525-538. doi:10.1007/s10734-012-9561-0

Lakhani, S., & Kleiner, B. H. (2014). Improving business forecasting. *Industrial Management*, 56(2), 26-30. Retrieved from https://www.iienet2.org/Details.aspx?id=652

Lapide, L. (2014). Planning and forecasting work hand in hand. *Journal of Business Forecasting*, *33*(1), 12-14. Retrieved from https://ibf.org

Leech, N. L., & Onwuegbuzie, A. J. (2007). An array of qualitative data analysis tools: A call for data analysis triangulation. *School Psychology Quarterly*, *22*, 557-584. doi:10.1037/1045-3830.22.4.557

Leedy, P. D., & Ormord, J. E. (2013). *Practical research: Planning and design* (10th ed.). Upper Saddle River, NJ: Pearson Education.

Lengu, D., Syntetos, A. A., & Babai, M. Z. (2014). Spare parts management: Linking distributional assumptions to demand classification. *European Journal of Operational Research*, *235*, 624-635. doi:10.1016/j.ejor.2013.12.043

Liao, S. H., & Kuo, F. I. (2014). The study of relationships between the collaboration for supply chain, supply chain capabilities and firm performance: A case of the Taiwan′ s TFT-LCD industry. *International Journal of Production Economics*, *156*, 295-304. doi:10.1016/j.ijpe.2014.06.020

Liaw, S. (2013). Clinical decision support systems: Data quality management and governance. *Studies in Health Technology and Informatics*, *193*, 362-369. doi:10.3233/978-1-61499-291-2-362

Liaw, S., Rahimi, A., Ray, P., Taggart, J., Dennis, S., de Lusignan, S., & ... Talaei-Khoei, A. (2013). Towards an ontology for data quality in integrated chronic disease management: A realist review of the literature. *International Journal of Medical Informatics*, *82*(1), 10-24. doi:10.1016/j.ijmedinf.2012.10.001

Linder, K. E., Elek, E. D., & Calderon, L. (2014). SoTL and the institutional review board: Considerations before navigating the application process for classroom research in higher education. *Journal of the Scholarship of Teaching & Learning*, *14*(2), 1-14. doi:10.14434/josotl.v14i2.4217

Lindner, J. R., Murphy, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, *42*(4), 43-53. doi:10.5032/jae.2001.04043

Liu, P., Huang, S. H., Mokasdar, A., Zhou, H., & Hou, L. (2014). The impact of additive manufacturing in the aircraft spare parts supply chain: Supply chain operation reference (SCOR) model based analysis. *Production Planning and Control, 25*, 1169-1181. doi:10.1080/09537287.2013.808835

Lucky, E. O., & Olusegun, A. I. (2012). Is small and medium enterprises (SMEs) an entrepreneurship?. *International Journal of Academic Research in Business and Social Sciences*, *2*, 487-496. Retrieved from http://hrmars.com/index.php/pages/detail/IJARBSS

Ma, Y., Wang, N., Che, A., Huang, Y., & Xu, J. (2013). The bullwhip effect on product orders and inventory: A perspective of demand forecasting techniques. *International Journal of Production Research*, *51*, 281-302. doi:10.1080/00207543.2012.676682

Magasi, S., Mallick, R., Kaiser, K., Patel, J. D., Lad, T., Johnson, M. L., ... & Cella, D. (2013). Importance and relevance of pulmonary symptoms among patients receiving second-and third-line treatment for advanced non–small-cell lung cancer: Support for the content validity of the 4-item pulmonary symptom index. *Clinical Lung Cancer*, *14*, 245-253. doi:10.1016/j.cllc.2012.07.001

Majumdar, J. P., & Murali Manohar, B. (2014). Strengths and weakness of Indian manufacturing SMEs for adopting TQM. *CBS Journal of Management Practices*, *1*(1), 29-40. Retrieved from http://calcuttabusinessschool.org/wp-content/uploads/2014/07/CBS-Journal.pdf

Majumdar, J. P., & Murali Manohar, B. (2016). Why Indian manufacturing SMEs are still reluctant in adopting total quality management. *International Journal of Productivity and Quality Management*, *17*(1), 16-35. doi:10.1504/IJPQM.2016.073273

Manimala, M. J., & Kumar, S. (2012). Training needs of small and medium enterprises: Findings from an empirical investigation. *IIM Kozhikode Society & Management Review*, *1*(2), 97-110. doi:10.1177/2277975213477299

Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research?: A review of qualitative interviews in IS research. *Journal of Computer Information Systems*, *54*(1), 11-22. Retrieved from http://www.iacis.org/jcis/jcis.php

Marshall, C., & Rossman, G. B. (2015). *Designing qualitative research* (6th ed.). Thousand Oaks, CA: Sage Publications.

Mason, M. (2010). Sample size and saturation in PhD studies using qualitative interviews. *Forum: Qualitative Social Research*, *11*(3), 1-13. Retrieved from http://www.qualitative-research.net/index.php/fqs

McAdam, R., Antony, J., Kumar, M., & Hazlett, S. A. (2014). Absorbing new knowledge in small and medium-sized enterprises: A multiple case analysis of Six Sigma. *International Small Business Journal*, *32*(1), 81-109. doi:10.1177/0266242611406945

McDermott, A. M., Conway, E., Rousseau, D. M., & Flood, P. C. (2013). Promoting effective psychological contracts through leadership: The missing link between HR strategy and performance. *Human Resource Management*, *52*, 289-310. doi:10.1002/hrm.21529

Mehra, A., Langer, N., Bapna, R., & Gopal, R. (2014). Estimating returns to training in the knowledge economy: A firm-level analysis of small and medium enterprises. *MIS Quarterly*, *38*, 757-771. Retrieved from http://www.misq.org/

Mendes, L. (2012). Employees involvement and quality improvement in manufacturing small and medium enterprise (SME): A comparative analysis. *African Journal of Business Management*, *6*, 6980-6996. doi:10.5897/AJBM12.234

Merlo, A. R., Goodman, A., McClenaghan, B. A., & Fritz, S. L. (2013). Participants' perspectives on the feasibility of a novel, intensive, task-specific intervention for individuals with chronic stroke: A qualitative analysis. *Physical Therapy*, *93*, 147-157. doi:10.2522/ptj.20110147

Meyer, C. B. (2001). A case in case study methodology. *Field Methods*, *13*, 329-352. doi: 10.1177/1525822X0101300402

Moges, H. T., Dejaeger, K., Lemahieu, W., & Baesens, B. (2012). A total data quality management for credit risk: New insights and challenges. *International Journal of Information Quality*, *3*(1), 1-27. doi:101504/IJIQ.2012.050036

Monisola, O. (2013). An assessment of inventory management in small and medium scale industrial enterprises in Nigeria. *European Journal of Business and Management*, *5*(28), 150-158. Retrieved from http://www.ejobm.org/

Mortada, M., Carroll III, T., Yacout, S., & Lakis, A. (2012). Rogue components: Their effect and control using logical analysis of data. *Journal of Intelligent Manufacturing*, *23*, 289-302. doi:10.1007/s10845-009-0351-1

Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage

Mukhopadhyay, S., Solis, A. O., & Gutierrez, R. S. (2012). The accuracy of non-traditional versus traditional methods of forecasting lumpy demand. *Journal of Forecasting*, *31*, 721-735. doi:10.1002/for.1242

Musoba, G. D., Jacob, S. A., & Robinson, L. J. (2014). The institutional review board (IRB) and faculty: Does the IRB challenge faculty professionalism in the social sciences?. *The Qualitative Report*, *19*(51), 1-14. Retrieved from http://www.nova.edu/ssss/QR/QR19/musoba101.pdf

Najafi, M., Alimadadi, H., Arastoo, L., Motamed, F., Khodadad, A., Fallahi, G., … Doroudian, R. (2014). The clinical manifestations, treatment efficacy and adverse drug reactions in 62 Iranian children with Wilson disease. *International Journal of Pediatrics*, *2*, 25-29. Retrieved from http://ijp.mums.ac.ir/

Nordstrom, S. N. (2015). Not so innocent anymore making recording devices matter in qualitative interviews. *Qualitative Inquiry*, *21*, 388-401. doi:10.1177/1077800414563804

O'Neill, P., Sohal, A., & Teng, C. W. (2016). Quality management approaches and their impact on firms′ financial performance – An Australian study. *International Journal of Production Economics*, *171*, 381-393. doi:10.1016/j.ijpe.2015.07.015

Ofner, M., Otto, B., & Osterle, H. (2013). A maturity model for enterprise data quality management. *Enterprise Modelling and Information Systems Architectures*, *8*(2), 4-22. doi:10.1007/s40786-013-0002-z

Onwuegbuzie, A. J., & Leech, N. L. (2007). A call for qualitative power analyses. *Quality & Quantity*, *41*(1), 105-121. doi:10.1007/s11135-005-1098-1

Ortlipp, M. (2008). Keeping and using reflective journals in the qualitative research process. *The Qualitative Report*, *13*, 695-705. Retrieved from http://tqr.nova.edu/

Otto, B., Hüner, K. M., & Österle, H. (2012). Toward a functional reference model for master data quality management. *Information Systems and E-Business Management*, *10*, 395-425. doi:10.1007/s10257-011-0178-0

Oyedijo, A. (2012). Competitive strategy orientations of small and medium business owners and their performance impacts: The case of paint manufacturing SMEs in South-Western Nigeria. *Journal of Asian Business Strategy, 2*(1), 1-8. Retrieved from http://www.aessweb.com/journals/5006

Özkan, E., van Houtum, G. J., & Serin, Y. (2015). A new approximate evaluation method for two-echelon inventory systems with emergency shipments. *Annals of Operations Research*, *224*, 147-169. doi:10.1007/s10479-013-1401-9

Pabinger, S., Dander, A., Fischer, M., Snajder, R., Sperk, M., Efremova, M., ... Trajanoski, Z. (2014). A survey of tools for variant analysis of next-generation genome sequencing data. *Briefings in Bioinformatics*, *15*(2), 256-278. doi:10.1093/bib/bbs086

Pack, M. (2014). Practice journeys: Using online reflective journals in social work fieldwork education. *Reflective Practice*, *15*, 404-412. doi: 10.1080/14623943.2014.883304

Panahy, P. H. S., Sidi, F., Affendey, L. S., Jabar, M. A., Ibrahim, H., & Mustapha, A. (2013a). A framework to construct data quality dimensions relationships. *Indian*

Journal of Science and Technology, *6*, 4422-4431. doi:10.17485/ijst/2013/v6i5/33242

Panahy, P. H. S., Sidi, F., Affendey, L. S., Jabar, M. A., Ibrahim, H., & Mustapha, A. (2013b). Discovering dependencies among data quality dimensions: A validation of instrument. *Journal of Applied Sciences*, *13*(1), 95-102. doi:10.3923/jas.2013

Peltier, J. W., Zahay, D., & Lehmann, D. R. (2013). Organizational learning and CRM success: A model for linking organizational practices, customer data quality, and performance. *Journal of Interactive Marketing*, *27*(1), 1-13. doi:10.1016/j.intmar.2012.05.001

Petty, N. J., Thomson, O. P., & Stew, G. (2012). Ready for a paradigm shift? Part 2: Introducing qualitative research methodologies and methods. *Manual Therapy*, *17*, 378-384. doi:10.1016/j.math.2012.03.004

Pezalla, A. E., Pettigrew, J., & Miller-Day, M. (2012). Researching the researcher-as-instrument: An exercise in interviewer self-reflexivity. *Qualitative Research*, *12*, 165-185. doi:10.1177/1468794111422107

Pipino, L. L., Lee, Y. W., & Wang, R. Y. (2002). Data quality assessment. *Communications of the ACM*, *45*, 211-218. doi:10.1145/505248.50601

Polkinghorne, D. E. (2005). Language and meaning: Data collection in qualitative research. *Journal of Counseling Psychology*, *52*, 137-145. doi:10.1037/0022-0167.52.2.137

Prajogo, D. I., Oke, A., & Olhager, J. (2016). Supply chain processes: Linking supply logistics integration, supply performance, lean processes and competitive performance. *International Journal of Operations & Production Management*, *36*, 220-238. doi:10.1108/IJOPM-03-2014-0129

PricewaterhouseCooper. (2011). *Spares forecasting: A commercial aviation perspective on value chain maturity and best practices* [Industry Report]. Retrieved from PricewaterhouseCooper website: http://www.pwc.com/us/en/industrial-products/assets/commercial-aviation-spares-forecasting.pdf

Puurunen, A., Majava, J., & Kess, P. (2014). Exploring incomplete information in maintenance materials inventory optimization. *Industrial Management & Data Systems*, *114*(1), 144-158. doi:10.1108/IMDS-01-2013-0025

Rabionet, S. E. (2011). How I learned to design and conduct semi-structured interviews. *The Qualitative Report*, *16*, 563-566. Retrieved from http://www.nova.edu/ssss/QR/WQR/rabionet

Rahimi, A., Liaw, S. T., Ray, P., Taggart, J., & Yu, H. (2014). Ontological specification of quality of chronic disease data in EHRs to support decision analytics: A realist review. *Decision Analytics*, *1*(1), 1-31. doi:10.1186/2193-8636-1-5

Ramanathan, U. (2013). Aligning supply chain collaboration using analytic hierarchy process. *Omega*, *41*, 431-440. doi:10.1016/j.omega.2012.03.001

Ramlan, R., Atan, S. A., & Rakiman, U. S. (2012). Demand forecasting in SME's inventory management. *Proceedings of the International Conference of Technology Management, Business and Enterprenuership, Malaysia, 2012*, 792-796. Retrieved from http://eprints.uthm.edu.my/3396/1/ENT075.pdf

Rapp, S. R., Legault, C., Espeland, M. A., Resnick, S. M., Hogan, P. E., Coker, L. H., … Shumaker, S. A. (2012). Validation of a cognitive assessment battery administered over the telephone. *Journal of the American Geriatrics Society, 60*, 1616-1623. doi:10.1111/j.1532-5415.2012.04111.x

Rashid, O. A., & Ahmad, M. N. (2013). Business process improvement methodologies: An overview. *Journal of Information Systems Research and Innovation*, 45-53. Retrieved from http://seminar.utmspace.edu.my/jisri/

Reznik, L., & Lyshevski, S. E. (2015). Data quality indicators composition and calculus: Engineering and information systems approaches. *Sensors & Transducers, 185*(2), 140-148. Retrieved from http://www.sensorsportal.com/

Rickards, R. C., & Ritsert, R. (2012). Data governance challenges facing controllers. *International Journal Of Business, Accounting, & Finance*, *6*(1), 25-42. Retrieved from http://www.iabpad.com/journals/international-journal-of-business-accounting-finance/

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2013). *Qualitative research practice: A guide for social science students and researchers*. Thousand Oaks CA: Sage.

Roda, I., Macchi, M., Fumagalli, L., & Viveros, P. (2014). A review of multi-criteria classification of spare parts: From literature analysis to industrial evidences. *Journal of Manufacturing Technology Management, 25*, 528-549. doi:10.1108/JMTM-04-2013-0038

Romeijnders, W., Teunter, R., & van Jaarsveld, W. (2012). A two-step method for forecasting spare parts demand using information on component repairs. *European Journal of Operational Research*, *220*, 386-393. doi:10.1016/j.ejor.2012.01.019

Rosienkiewicz, M. (2013). Artificial intelligence methods in spare parts demand forecasting. *Logistics and Transport*, *18*(2), 41-50. Retrieved from http://www.logistics-and-transport.eu/index.php/main

Rossiter, J. R. (2008). Qualitative research rules. *International Journal of Advertising*, *27*, 915-919. doi:10.1016/j.jbusres.2010.11.005

Rowley, J. (2002). Using case studies in research. *Management Research News*, *25*(1), 16-27. doi:10.1108/01409170210782990

Rubin, H. J., & Rubin, I. S. (2011). *Qualitative interviewing: The art of hearing data* (3rd ed.). Thousand Oaks, CA: Sage.

Runeson, P., & Höst, M. (2009). Guidelines for conducting and reporting case study research in software engineering. *Empirical Software Engineering*, *14*, 131-164. doi:10.1007/s10664-008-9102-8

Sadikoglu, E., & Olcay, H. (2014). The effects of total quality management practices on performance and the reasons of and the barriers to TQM practices in Turkey. *Advances in Decision Sciences*, *2014*, 1-17. doi:10.1155/2014/537605

Sáez, C., Martínez-Miranda, J., Robles, M., & García-Gómez, J. M. (2012). Organizing data quality assessment of shifting biomedical data. *Studies in Health Technology and Informatics*, *180*, 721-725. doi:10.3233/978-1-61499-101-4-721

Şahin, M., Kizilaslan, R., & Demirel, Ö. F. (2013). Forecasting aviation spare parts demand using Croston based methods and artificial neural networks. *Journal of Economic and Social Research*, *15*, 1-21. Retrieved from http://jesr.journal.fatih.edu.tr/

Salam, M. A. (2014). Forecast information quality and supply chain performance: An empirical study of air conditioning industry. *Life Science Journal*, *11*(4s), 49-58. Retrieved from http://www.lifesciencesite.com/

Saljoughian, M., Allameh, S. M., Dabestani, R., & Rabbanimehr, M. (2014). The relationship between critical success factors of total quality management and process improvement: A case study. *International Journal of Business Excellence*, *7*, 411-427. doi:10.1504/IJBEX.2014.060783

Seaman, C. B. (1999). Qualitative methods in empirical studies of software engineering. *Software Engineering, IEEE Transactions on*, *25*, 557-572. doi:10.1109/32.799955

Shiryan, S., Shee, H., & Stewart, D. (2012). Employee training effectiveness in Saudi Arabian SME performance. *International Journal of Business and Social Science*, *3*(14), 46-52. Retrieved from http://www.hrmars.com/

Silva Fonseca, J. G., Oozeki, T., Takashima, T., Koshimizu, G., Uchida, Y., & Ogimoto, K. (2012). Use of support vector regression and numerically predicted cloudiness to forecast power output of a photovoltaic power plant in Kitakyushu, Japan. *Progress in Photovoltaics: Research and Applications*, *20*, 874-882. doi:10.1002/pip.1152

Simpson, M., Padmore, J., & Newman, N. (2012). Towards a new model of success and performance in SMEs. *International Journal of Entrepreneurial Behavior & Research*, *18*, 264-285. doi:10.1108/13552551211227675

Singh, K. (2016). A small study on impact of crime against women news stories on Indian urban women. *Imperial Journal of Interdisciplinary Research, 2*(3), 60-68. Retrieved from http://www.onlinejournal.in/ijir/

İlkay, S. M., & Aslan, E. (2012). The effect of the ISO 9001 quality management system on the performance of SMEs. *International Journal of Quality & Reliability Management*, *29*, 753-778. doi:10.1108/02656711211258517

Stewart, J. (2012). Multiple-case study methods in governance-related research. *Public Management Review*, *14*(1), 67-82. doi:10.1080/14719037.2011.589618

Stichler, J. F. (2014). The ethics of research, writing, and publication. *Health Environments Research & Design Journal (HERD)*, *8*(1), 15-19. doi:10.1177/193758671400800103

Stoop, E. M., de Wijkerslooth, T. R., Bossuyt, P. M., Stoker, J., Fockens, P., Kuipers, E. J., ... van Leerdam, M. E. (2012). Face-to-face vs telephone pre-colonoscopy consultation in colorectal cancer screening; A randomised trial. *British Journal of Cancer*, *107*, 1051-1058. doi:10.1038/bjc.2012.358

Swauger, M. (2011). Afterword: The ethics of risk, power, and representation. *Qualitative Sociology*, *34*, 497-502. doi:10.1007/s11133-011-9201-5

Syntetos, A. A., Babai, M. Z., & Altay, N. (2012). On the demand distributions of spare parts. *International Journal of Production Research*, *50*, 2101-2117. doi:10.1080/00207543.2011.562561

Szolnoki, G., & Hoffmann, D. (2013). Online, face-to-face and telephone surveys—Comparing different sampling methods in wine consumer research. *Wine Economics and Policy*, *2*(2), 57-66. doi:10.1016/j.wep.2013.10.001

Szozda, N., & Werbińska-Wojciechowska, S. (2013). Influence of the demand information quality on planning process accuracy in supply chain: Case studies. *Logforum*, *9*(2), 73-90. http://www.logforum.net

Tallon, P. P. (2013). Corporate governance of big data: Perspectives on value, risk, and cost. *Computer*, *4*, 32-38. doi:10.1109/MC.2013.155

Tamariz, L., Palacio, A., Robert, M., & Marcus, E. N. (2013). Improving the informed consent process for research subjects with low literacy: A systematic review. *Journal of General Internal Medicine*, *28*, 121-126. doi:10.1007/s11606-012-2133-2

Thomas, A. J., Mason-Jones, R., Davies, A., & John, E. G. (2015). Reducing turn-round variability through the application of Six Sigma in aerospace MRO facilities. *Journal of Manufacturing Technology Management*, *26*, 314-332. doi:10.1108/JMTM-07-2012-0070

Thomas, G. (2011). A typology for the case study in social science following a review of definition, discourse, and structure. *Qualitative Inquiry*, *17*, 511-521. doi:10.1177/1077800411409884

Thomas, G., & Myers, K. (2015). *The anatomy of the case study*. Thousand Oaks, CA: Sage Publications.

Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2011). *Research methods in physical activity* (6th ed.). Champaign, IL: Human Kinetics.

Thompson, N., Ravindran, R., & Nicosia, S. (2015). Government data does not mean data governance: Lessons learned from a public sector application audit. *Government Information Quarterly*, *32*, 316-322. doi:10.1016/j.giq.2015.05.001

Tian, J., Yu, B., Yu, D., & Ma, S. (2013). Clustering-based multiple imputation via gray relational analysis for missing data and its application to aerospace field. *Scientific World Journal*, *2013*, 1-10. doi:10.1155/2013/720392

Tiemessen, H. G. H., & van Houtum, G. J. (2013). Reducing costs of repairable inventory supply systems via dynamic scheduling. *International Journal of Production Economics*, *143*, 478-488. doi:10.1016/j.ijpe.2012.08.008

Tracht, K., Funke, L., & Schneider, D. (2014). Varying repair capacity in a repairable item system. *Procedia CIRP*, *17*, 446-450. doi:10.1016/j.procir.2014.01.064

Tracht, K., von der Hagen, F., & Schneider, D. (2013). Applied repairable-item inventory modeling in the aviation industry. *Procedia CIRP*, *11*, 334-339. doi:10.1016/j.procir.2013.07.020

Tufford, L., & Newman, P. (2012). Bracketing in qualitative research. *Qualitative Social Work*, *11*(1), 80-96. doi:10.1177/1473325010368316

Tum, M., Strauss, F., McCallum, I., Günther, K., & Schmid, E. (2012). How sensitive are estimates of carbon fixation in agricultural models to input data?. *Carbon Balance* *and Management*, *7*(1), 1-13. doi:10.1186/1750-0680-7-3

Ucenic, C., & Filip, D. (2012). Forecasting as modelling instrument applied in supply chain management. *Review of Management & Economic Engineering*, *11*(4), 131-142. Retrieved from http://www.rmee.amier.org/

U.S. Department of Health and Human Services. (2014). The Belmont Report. Retrieved from http://www.hhs.gov/ohrp/humansubjects/guidance/belmont.html

Vaast, E., & Kaganer, E. (2013). Social media affordances and governance in the workplace: An examination of organizational policies. *Journal of Computer-Mediated Communication*, *19*(1), 78-101. doi:10.1111/jcc4.12032

Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, *15*, 398-405. doi:10.1111/nhs.12048

Van der Heijden, M. C., Alvarez, E. M., & Schutten, J. M. J. (2013). Inventory reduction in spare part networks by selective throughput time reduction. *International Journal of Production Economics*, *143*, 509-517. doi:10.1016/j.ijpe.2012.03.020

Van Deventer, J. P. (2009). Ethical considerations during human centered overt and covert research. *Quality & Quantity*, *43*, 45-57. doi:10.1007/s11135-006-9069-8

Van Kooten, J. P., & Tan, T. (2009). The final order problem for repairable spare parts under condemnation. *Journal of the Operational Research Society*, *60*, 1449-1461. doi:10.1057/jors.2008.111

Verner, J. M., & Abdullah, L. M. (2012). Exploratory case study research: Outsources project failure. *Information and Software Technology*, *54*, 866-886. doi:10.1016/j.infsof.2011.11.001

Villar, G., Arciuli, J., & Paterson, H. M. (2014). Remorse in oral and handwritten false confessions. *Legal and Criminological Psychology, 19*, 255-269. doi:10.1111/lcrp.12012

Waissi, G. R., Humble, J. E., & Demir, M. (2013). Competitiveness of small-and-medium enterprises of the Arizona aerospace and defense supply chain. *Journal of Logistics Management, 2*(1), 15-25. doi:10.5923/j.logistics.20130201.03

Wall, C., Glenn, S., Mitchinson, S., & Poole, H. (2004). Using a reflective diary to develop bracketing skills during a phenomenological investigation. *Nurse Researcher*, *11*, 20-29. doi:10.7748/nr2004.07.11.4.20.c6212

Waller, M. A., & Fawcett, S. E. (2013). Data science, predictive analytics, and big data: a revolution that will transform supply chain design and management. *Journal of Business Logistics*, *34*(2), 77-84. doi: 10.1111/jbl.12010

Walter, M., Holmström, J., & Yrjölä, H. (2004, September). *Rapid manufacturing and its impact on supply chain management*. Paper presented at Logistics Research Network Annual Conference, Dublin, Ireland. Abstract retrieved from http://www.lrg.tkk.fi/?q=content/rapid-manufacturing-and-its-impact-supply-chain-management

Wang, F., Huisman, J., Stevels, A., & Baldé, C. P. (2013). Enhancing e-waste estimates: Improving data quality by multivariate input–output analysis. *Waste Management*, *33*, 2397-2407. doi:10.1016/j.wasman.2013.07.005

Wang, W. (2012). A stochastic model for joint spare parts inventory and planned maintenance optimization. *European Journal of Operational Research, 216*(1), 127-139. doi:10.1016/j.ejor.2011.07.031

Wong, W. P. (2013). Business-process management: A proposed framework for future research. *Total Quality Management & Business Excellence*, *24*, 719-732. doi:10.1080/14783363.2013.776773

Woodall, P., Borek, A., & Parlikad, A. K. (2013). Data quality assessment: The hybrid approach. *Information & Management*, *50*, 369-382. doi:10.1016/j.im.2013.05.009

Wright, B., & Ogbuehi, A. O. (2014). Surveying adolescents: The impact of data collection methodology on response quality. *Electronic Journal of Business Research Methods*, *12*(1), 41-53. Retrieved from http://www.ejbrm.com

Xia, R., Yin, X., Lopez, J. A., Machida, F., & Trivedi, K. S. (2014). Performance and availability modeling of IT systems with data backup and restore. *IEEE Transactions on Dependable and Secure Computing*, *11*, 375-389. doi:10.1109/TDSC.2013.50

Xiang, J., Lee, S., & Kim, J. (2013). Data quality and firm performance: Empirical evidence from the Korean financial industry. *Information Technology & Management*, *14*(1), 59-65. doi:10.1007/s10799-012-0145-6

Yang, X., Blower, J. D., Bastin, L., Lush, V., Zabala, A., Masó, J., ... & Lumsden, J. (2013). An integrated view of data quality in earth observation. *Philosophical*

Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, *371*, 20120072. doi:10.1098/rsta.2012.0072

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: Sage.

Yu, G. (Ed.). (2012). *Operations research in the airline industry* (Vol. 9). New York, NY: Springer Science & Business Media.

Zach, O., Munkvold, B. E., & Olsen, D. H. (2014). ERP system implementation in SMEs: Exploring the influences of the SME context. *Enterprise Information Systems*, *8,* 309-335. doi:10.1080/17517575.2012.702358

Zachariadis, M., Scott, S., & Barrett, M. (2013). Methodological implications of critical realism for mixed-methods research. *MIS Quarterly, 37*, 855-879. Retrieved from http://www.misq.org/

Zanjani, M. K., & Nourelfath, M. (2014). Integrated spare parts logistics and operations planning for maintenance service providers. *International Journal of Production Economics*, *158*, 44-53. doi:10.1016/j.ijpe.2014.07.012

Zhang, Q., Irfan, M., Khattak, M. A. O., Zhu, X., & Hassan, M. (2012). Lean six sigma: A literature review. *Interdisciplinary Journal of Contemporary Research in Business, 3*, 599-605. Retrieved from http://www.ijcrb.com/

Zhou, H., Shou, Y., Zhai, X., Li, L., Wood, C., & Wu, X. (2014). Supply chain practice and information quality: A supply chain strategy study. *International Journal of Production Economics*, *147*, 624-633. doi:10.1016/j.ijpe.2013.08.025

Zivkovic, J. (2012). Strengths and weakness of business research methodologies: Two disparate case studies. *Business Studies Journal*, *4*(2), 91-99. Retrieved from http://www.alliedacademies.org/business-studies-journal/

Appendix A: Letter of Cooperation from SME Company leaders

[SME Company Leader Name]
[Title]
[Company Name]

Date

Dear SME Company Leader Name,

My name is Uyi H. Eguasa, a doctoral student at Walden University working to obtain a Doctor of Business Administration (DBA) degree with a specialization in Global Supply Chain Management. I am conducting a doctoral study to explore the strategies aerospace business leaders use to achieve quality data inputs used in forecasting repairable spare parts demand. Uyi Eguasa's background is in supply chain functions.

This is an invitation for your company to take part in research. Your company is of interest because you have been identified as an aerospace small and medium-sized enterprise (SME), who forecasts repairable spare parts annually to support aerospace OEMs, MRO service organizations, and aircraft operators. You are receiving this e-mail because of your position as a business leader in an SME that has the authority to grant permission to conduct a case study on your company. A requirement for company acceptance to participate in the research is for the company leader to provide e-mail addresses and contact phone numbers for two business leaders (research participants) at the firm. The criteria for the business leaders are employees who have deployed input data quality strategies that resulted in improved forecast accuracy of repairable spare parts last year, experienced in forecasting repairable spare parts demand, and are stakeholders of the generated demand forecast.

Company/Employee
- As I receive the SME company leader's e-mail confirmation with the business leaders contacts, I will conduct an initial meeting to discuss the research process in more detail with the business leader.
- I will send an e-mail invitation including an inform consent form to the forecasting professionals, where the company leader granted permission to conduct the study.

Research Method
I will meet the research participants' face-to-face in person or through Skype for the first interviews to extract research data and utilize the telephone for follow-up interviews. As the business leaders provide e-mail confirmations with a signed informed consent form to participate in the research, I will call to introduce myself further and set up interviews. Time commitment involves two audiotaped interviews for the face-to-face and follow-up telephone interviews for an hour each. I will audiotape the interview to ensure accurate transcription of the interview data. In addition, I will require documentation (company

documents, archival records, or public information) that could help me enhance my understanding of the research.

Location of Research
The face-to-face interview will take place at a time, date, and location outside the participant's company workplace and time that aligns with their schedule. For a follow-up telephone interview, the time scheduled to conduct the interview will depend on a time suitable for the participants to provide research data.

Confidentiality
I will ensure the information the research participants provide is kept confidential. I will not utilize the information beyond the purpose of this study. The study report will not include any of the research participants personal or company information or any other identifying characteristics. For example, designated alphanumeric codes to ensure confidentiality will include P1, P2, and Company-1. I will keep all information in a locked password-protected fire-rated safe for a period of 5 years, accessible only to me. After 5 years of the research completion, I will destroy all research information.

Research Dissemination
I will publish the study report in a peer-reviewed journal for a variety of readers. The participants who participate will receive a summary of the research findings. Potential benefits of this project are a better understanding of data quality strategies to achieve quality data inputs used in forecasting repairable spare parts to enhance aerospace SME repairable spares suppliers' forecast accuracy, customer service levels, inventory management, and overall financial performance.

We understand that our organization's responsibilities include: provide e-mail addresses and contact phone numbers for potential research participants, accommodate the potential participants to consent to the study, to interview with the researcher, and to review a summarized copy of the interview data to validate accuracy for data analysis use. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I can authorize the approval for the research in this setting.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University Institutional Review Board.

Sincerely,

____

Name:

Contact Information
This form can be signed via e-mail if the accompanying e-mail is attached with the signer's personal e-mail address included. The form cannot be completed by phone, rather should be handled via post.

Walden University policy on electronic signatures: An electronic signature is just as valid as a written signature as long as both parties have agreed to conduct the transaction electronically. Electronic signatures are regulated by the Uniform Electronic Transactions Act. Electronic signatures are only valid when the signer is either (a) the sender of the e-mail, or (b) copied on the e-mail containing the signed document. Legally an "electronic signature" can be the person's typed name, their e-mail address, or any other identifying marker. Walden University staff verifies any electronic signatures that do not originate from a password-protected source (i.e., an e-mail address officially on file with Walden).

Appendix B: Research Participants E-mail Introduction

Hello [potential participant's name],

My name is Uyi H. Eguasa, a doctoral student at Walden University working to obtain a Doctor of Business Administration (DBA) degree with a specialization in Global Supply Chain Management. I am conducting a doctoral study to explore the strategies aerospace business leaders use to achieve quality data inputs used in forecasting repairable spare parts demand.

You are receiving an invitation to be part of this research because you are a business leader who has deployed input data quality strategies that resulted in improved forecast accuracy of repairable spare parts last year at a small and medium size enterprise (SME), experienced in forecasting repairable spare parts demand, and are stakeholders of the generated demand forecast. I understand time can be a constraint, but the face-to-face and telephone interviews will be an hour each. The first interview will be a face-to-face meeting in person or through Skype to extract research data while the second interview will be a telephone interview to review the accuracy of the summarized transcribed interview data or include any other additional new information. I believe your participation can contribute vital knowledge towards this project and existing literature. If you agree to participate, you will receive a summary of the study findings. Potential benefits of this project are a better understanding of data quality strategies to achieve quality data inputs used in forecasting repairable spare parts to enhance aerospace SME repairable spares suppliers' forecast accuracy, customer service levels, inventory management, and overall financial performance. The interview will take place at a time, date, and location outside your company's workplace and time that you and I agree to conduct the interview.

If you are interested in participating in the study, please take few minutes to complete the attached consent form and return by e-mail. Additional information about the study is available in the informed consent form. After receipt of your e-mail, I will call you to set up an interview time suitable to you. Please contact me at 219-588-1885 if you have any questions. Appreciate your participation in advance as I look forward to speaking with you.

Thank you

Uyi H. Eguasa
Walden University Doctoral Student

Appendix C: Informed Consent Form

CONSENT FORM

Invitation to Participate
This is an invitation for you to take part in a research study to identify strategies to improve data quality for forecasting repairable spare parts. You were chosen for this study because you are a business leader who has deployed input data quality strategies that resulted in improved forecast accuracy of repairable spare parts last year at a small and medium sized enterprise, experienced in forecasting repairable spare parts demand, and are stakeholders of the generated demand forecast. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

Background Information
Uyi Eguasa, a doctoral student at Walden University, will conduct the research. The purpose of the qualitative case study is to explore the strategies business leaders use to achieve quality data inputs used in forecasting repairable spare parts demand.

Procedures
If you agree to participate in the study, you will be asked to take part in a face-to-face audio-recorded interview for the first interview in person or through Skype and a telephone audio-recorded interview for the follow-up interview. The face-to-face interview will take an hour to respond to 10 open-ended questions. The researcher will transcribe the interviews and e-mail a summary of the interview data back to the participant to either make amendments, deletions, or additions in a second scheduled telephone interview for an hour. In addition, the researcher will require documentation (company documents, archival records, or public information) that could help enhance the understanding of the research topic.

Here are some sample questions:

- What systems or tools do you utilize to conduct repairable parts input data quality?
- How do you enhance your knowledge on input data quality to improve forecast accuracy?

Voluntary Nature of the Study
Your decision to participate in the study is voluntary. Whether you decide or participate or not, everyone will respect your decision. If you decide to participate in the study, you have the right to terminate your participation at any time. You can make a decision to leave during an interview.

Risk and Benefits of Being in a study
There is minimal risk to participants who participate in this study. Participants will experience no risk to their safety or welfare. In addition, no psychological effect will exist after participating in the study. Participants have the right to withdraw or terminate their involvement in the study at any time without no consequences.

A benefit of participating in this study is to assist business leaders at aerospace SME repairable spares suppliers gain an understanding of the data quality strategies to achieve quality data inputs used in forecasting repairable parts. An additional benefit is the participants receives a final copy of the doctoral study.

Compensation
Participants will receive no compensation for participating in this doctoral study.

Confidentiality
The researcher will ensure the information you provide is kept confidential. The researcher will not utilize the information you provide beyond the purpose of this study. The study report will not include any of your personal information or any other identifying characteristics. For example, labels will include participant 1 and Company A. The researcher will keep all information in a locked password-protected fire-rated safe for a period of 5 years, accessible only to the researcher. After 5 years of the research completion, the researcher will destroy all research information.

Contact and Questions
You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent
After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant ________________________

Date of Consent ______________________

Participant's Signature ______________________

Researcher's Signature ______________________

Appendix D: Interview Protocol

1. Schedule face-to-face (Skype or in-person) interviews for the first interviews and telephone interviews for the follow-up interviews with participants at suitable times, dates, and locations outside the participants' company workplace and time.
2. Prepare notes as reminders about the business problem under study to ensure extraction of quality research data at the interviews to address the research question.
3. Each interview will begin with an icebreaker conversation to engage the participant and create a relaxed environment.
4. Provide each participant with a brief overview of the purpose of the study and share my intent for the interview and confidentiality guidelines before I start asking interview questions.
5. Ask the 10 semistructured interview open-ended questions for the study to each participant in the same order.
6. Take note and clarify participants' nonverbal communication such as gestures, the tone of voice, and facial expressions.
7. Ask probing questions when necessary to ensure the participants provide thorough responses to the interview questions.
8. Monitor the interview time to ensure adequate research data are extracted from the participants using the interview questions.
9. Document reflective notes throughout the interview process.
10. Conclude by thanking the participants for their time and inform the participants of the follow-up interview to conduct member checking.

Appendix E: TranscriptionPuppy Quality Control and Privacy Policy

TranscriptionPuppy
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Frequently Asked Questions

About Services & Rates

About Ordering and Delivery

About Quality Control & Privacy

- Who does the transcription work?
- How do you make sure the transcription is accurate?
- Do you have a satisfaction guarantee?
- How do you protect my information privacy?

We're happy to sign a non-disclosure agreement before beginning work on your transcription. You can send us your preferred NDA or we can provide our standard form. Our freelance transcriptionists also sign NDAs.

Your credit card information is encrypted and securely transmitted to the credit card processor / bank and is not stored on our servers.

Appendix F: Signed TranscriptionPuppy Non-Disclosure Agreement

Confidentiality Agreement

It is understood and agreed to that the below identified discloser of confidential information may provide certain information that is and must be kept confidential. To ensure the protection of such information, and to preserve any confidentiality necessary under patent and/or trade secret laws, it is agreed that

1.The Confidential Information to be disclosed can be described as and includes:

Transcription Audio File Uploaded by Client

Transcription Video File Uploaded by Client

2. Subject to full payment of service fee(s), the recipient agrees not to disclose the confidential information obtained from the discloser to anyone unless required to do so by law.

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WHEREFORE, the parties acknowledge that they have read and understand this Agreement and voluntarily accept the duties and obligations set forth herein.

Recipient of Confidential Information:

Name: Evolution World Wide Limited

Signature:

Date: **Aug/12/2016**

Discloser of Confidential Information:

Name: **Uyi Eguasa**

Signature:

Date: 08/12/2016

Appendix G: Pipino Permission License

ASSOCIATION FOR COMPUTING MACHINERY, INC.
LICENSE
TERMS AND CONDITIONS

Nov 23, 2015

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Licensed Content Author	Leo L. Pipino, et al
Licensed Content Date	Apr 1, 2002
Volume number	45
Issue number	4
Type of Use	Thesis/Dissertation
Requestor type	Academic
Format	Print and electronic
Portion	figure/table
Number of figures/tables	1
Will you be translating?	No
Order reference number	None
Title of your thesis/dissertation	Supply Chain Strategies to Improve Data Quality used in Forecasting Repairable Spare Parts
Expected completion date	Dec 2016
Estimated size (pages)	1
Billing Type	Invoice
Billing Address	Uyi H Eguasa 17 Springwater Dr. None None PORT WENTWORTH, GA 31407 United States Attn: Uyi H Eguasa
Total	**8.00 USD**
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Appendix H: Basten Permission License

Fwd: Permission to Use Figure 1 "Product Structure of Radar System" From Your Article
Uyi Eguasa
to:
uyi.eguasa
11/22/2015 08:25 PM
Hide Details
From: Uyi Eguasa <uyi.eguasa@waldenu.edu>
To: uyi.eguasa@gulfstream.com,

---------- Forwarded message ----------
From: **Uyi Eguasa** <uyi.eguasa@waldenu.edu>
Date: Fri, Nov 20, 2015 at 2:07 AM
Subject: Re: Permission to Use Figure 1 "Product Structure of Radar System" From Your Article
To: "Basten, R.J.I." <R.J.I.Basten@tue.nl>

Dr. Basten,

Appreciate your quick response. I am very grateful for the permission. It would be a pleasure of mine to send you a copy of my study at a later stage.

Have a great weekend.

Uyi E.

On Fri, Nov 20, 2015 at 1:56 AM, Basten, R.J.I. <R.J.I.Basten@tue.nl> wrote:

> Dear Uyi,
>
> Thank you for your e-mail. Your topic sounds very interesting. Please feel free to use the figure. I would also be interested to seeing your output at a later stage, if that's possible.
>
> By the way, I've moved to the Eindhoven University of Technology. I send this reply from the right e-mail address.
>
> With kind regards,
>
> Rob
>
> **From:** Uyi Eguasa [mailto:uyi.eguasa@waldenu.edu]
> **Sent:** Friday, November 20, 2015 7:35 AM
> **To:** Basten, R.J.I. (CTW) <r.j.i.basten@utwente.nl>

Subject: Permission to Use Figure 1 "Product Structure of Radar System" From Your Article

Good day Dr. Basten,

My name is Uyi H. Eguasa, a doctoral student at Walden University working to obtain a Doctorate in Business Administration (DBA) degree with a specialization in Global Supply Chain Management. I am conducting a doctoral study to explore *how* and *why* forecasting professionals at successful aerospace small and medium size enterprises (SME) spare parts suppliers achieve high quality in repairable data inputs used for demand forecasting. The aim of this email is to gain permission to use Figure 1. "Product Structure of Radar System" from your article "An approach for the joint problem of level of repair analysis and spare parts stocking" in my doctoral study. The figure will enhance the purpose of my study.

I look forward to your favorable response. I truly appreciate your support in advance. If you have any questions, please feel free to send me an email or call at (219)588-1885.

Uyi Eguasa

Walden University Doctoral Student

Appendix I: Waissi Permission License

Fwd: Permission to Use Table 1 "Company Size Categories Used in this Study" From Your Article
Uyi Eguasa
to:
uyi.eguasa
11/22/2015 08:26 PM
Hide Details
From: Uyi Eguasa <uyi.eguasa@waldenu.edu>
To: uyi.eguasa@gulfstream.com,

---------- Forwarded message ----------
From: **Uyi Eguasa** <uyi.eguasa@waldenu.edu>
Date: Sun, Nov 22, 2015 at 2:44 AM
Subject: Re: Permission to Use Table 1 "Company Size Categories Used in this Study" From Your Article
To: Gary Waissi <Gary.Waissi@asu.edu>

Dr. Gary Waissi,

Thanks for granting me approval to use Table 1 "Company Size Categories Used in this Study" from your article.

Take care and have a great weekend.

Uyi Eguasa
Walden University Doctoral Student

On Sun, Nov 22, 2015 at 2:12 AM, Gary Waissi <Gary.Waissi@asu.edu> wrote:

> Dear Uyi,
>
> Yes, of course. You may use the table, provided that your properly reference the table, and identify the source.
>
> Good luck with your thesis.
>
> Gary Waissi

From: Uyi Eguasa [mailto:uyi.eguasa@waldenu.edu]
Sent: Saturday, November 21, 2015 10:28 AM
To: Gary Waissi
Subject: Permission to Use Table 1 "Company Size Categories Used in this Study" From Your Article

Good day Dr. Waissi,

My name is Uyi H. Eguasa, a doctoral student at Walden University working to obtain a Doctorate in Business Administration (DBA) degree with a specialization in Global Supply Chain Management. I am conducting a doctoral study to explore *how* and *why* forecasting professionals at successful aerospace small and medium size enterprises (SME) spare parts suppliers achieve high quality in repairable data inputs used for demand forecasting. The aim of this email is to gain permission to use Table 1. "Company Size Categories Used in this Study" from your article "Competitiveness of small-and-medium enterprises of the Arizona aerospace and defense supply chain" in my doctoral study. The table will help describe the scope of my research and enhance the purpose of my study.

I look forward to your favorable response. I truly appreciate your support in advance. If you have any questions, please feel free to send me an email or call at (219)588-1885.

Uyi Eguasa

Walden University Doctoral Student

Appendix J: Rosienkiewicz Permission License

---------- Forwarded message ----------
From: **Uyi Eguasa** <uyi.eguasa@waldenu.edu>
Date: Tue, Nov 24, 2015 at 1:31 PM
Subject: Re: Permission to Use Table 1 "Qualitative and Quantitative Forecasting Methods" From Your Article
To: Maria Rosienkiewicz <maria.rosienkiewicz@pwr.edu.pl>

Dr. Rosienkiewicz,

Thanks for the quick response and approval to use Table 1. "Qualitative and Quantitative Forecasting Methods" from your article "Artificial Intelligence Methods in Spare Parts Demand Forecasting" in my doctoral study.

Take care and have a great week.

Uyi Eguasa
Walden University Doctoral Student.

On Tue, Nov 24, 2015 at 12:13 PM, Maria Rosienkiewicz <maria.rosienkiewicz@pwr.edu.pl> wrote:

> Dear Uyi,
>
> Of course, you may use the table. I wish you good luck with your thesis. If I can be of any help, don't hesitate to write me.
>
> Best regards,
>
> Pozdrawiam,
>
> **Maria Rosienkiewicz**
>
> dr inż. Maria Rosienkiewicz
>
> maria.rosienkiewicz@pwr.edu.pl
>
> Politechnika Wrocławska
>
> Wydział Mechaniczny

Katedra Technologii Laserowych, Automatyzacji i Organizacji Produkcji

ul. Łukasiewicza 5

50-371 Wrocław

tel. 71 320 43 84

From: Uyi Eguasa [mailto:uyi.eguasa@waldenu.edu]
Sent: Saturday, November 21, 2015 6:45 PM
To: maria.rosienkiewicz@pwr.edu.pl
Subject: Permission to Use Table 1 "Qualitative and Quantitative Forecasting Methods" From Your Article

Good day Dr. Rosienkiewicz,

My name is Uyi H. Eguasa, a doctoral student at Walden University working to obtain a Doctorate in Business Administration (DBA) degree with a specialization in Global Supply Chain Management. I am conducting a doctoral study to explore *how* and *why* forecasting professionals at successful aerospace small and medium size enterprises (SME) spare parts suppliers achieve high quality in repairable data inputs used for demand forecasting. The aim of this email is to gain permission to use Table 1. "Qualitative and Quantitative Forecasting Methods" from your article "Artificial Intelligence Methods in Spare Parts Demand Forecasting" in my doctoral study. The table will enhance the purpose of my study.

I look forward to your favorable response. I truly appreciate your support in advance. If you have any questions, please feel free to send me an email or call at (219)588-1885.

Uyi Eguasa

Walden University Doctoral Student

Appendix K: Huag Permission License

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Appendix L: Permission Letter from Dr. Thomas

Fwd: Permission to Use a Figure 5.1 from "The Anatomy of the Case Study" Book
Uyi Eguasa
to:
uyi.eguasa
11/22/2015 08:29 PM
Hide Details
From: Uyi Eguasa <uyi.eguasa@waldenu.edu>
To: uyi.eguasa@gulfstream.com,

---------- Forwarded message ----------
From: **Uyi Eguasa** <uyi.eguasa@waldenu.edu>
Date: Sat, Nov 21, 2015 at 12:18 PM
Subject: Re: Permission to Use a Figure 5.1 from "The Anatomy of the Case Study" Book
To: Gary Thomas <g.thomas.3@bham.ac.uk>

Dr. Gary Thomas,

Thanks for granting me approval to use Figure 5.1 "A typology of case study" from your book.

Take care and have a great weekend.

Uyi Eguasa
Walden University Doctoral Student

On Sat, Nov 21, 2015 at 12:08 PM, Gary Thomas <g.thomas.3@bham.ac.uk> wrote:

> Hello Uyi
> Yes, this is fine with me.
> Gary Thomas
>
> **From:** Uyi Eguasa [uyi.eguasa@waldenu.edu]
> **Sent:** 21 November 2015 16:43
> **To:** Gary Thomas; Kevin Myers
> **Subject:** Permission to Use a Figure 5.1 from "The Anatomy of the Case Study" Book
>
> Good day Authors,
>
> My name is Uyi H. Eguasa, a doctoral student at Walden University working to obtain a Doctorate in Business Administration (DBA) degree with a specialization in Global Supply Chain Management. I am conducting a doctoral study to explore *how* and *why* forecasting professionals at successful aerospace small and medium size enterprises (SME) spare parts suppliers achieve high quality in repairable data inputs used for demand forecasting. The aim of this email is to gain permission to use Figure 5.1 "A typology of case study" from the book 'The Anatomy of the Case Study" in my doctoral study. The figure will enhance the purpose of my qualitative case study.
>
> I look forward to your favorable response. I truly appreciate your support in advance. If you have any questions, please feel free to send me an email or call at (219)588-1885.
>
> Uyi Eguasa
> Walden University Doctoral Student

Appendix M: Snapshots of Signature Pages from the Letters of Voluntary Cooperation from Three SME Business Leaders

Signature of SME Business Leader from Company-1

Confidentiality and Privacy
I will ensure the information the research participants provide is kept confidential. I will not utilize the information beyond the purpose of this study. The study report will not include any of the research participants personal or company information or any other identifying characteristics. For example, designated alphanumeric codes to ensure confidentiality will include P1, P2, and Company-1. Any documentation collected during research from the participants will keep confidential and used for the sole purpose of this research. I will keep all information in a locked password-protected fire-rated safe for a period of 5 years, accessible only to me. After 5 years of the research completion, I will destroy all research information.

Research Dissemination
I will publish the study report in a peer-reviewed journal for a variety of readers. The participants who participate will receive a summary of the research findings. Potential benefits of this project are a better understanding of data quality strategies to achieve quality data inputs used in forecasting repairable spare parts to enhance aerospace SME spare parts suppliers' forecast accuracy, customer service levels, inventory management, and overall financial performance.

We understand that our organization's responsibilities include: provide e-mail addresses and contact phone numbers for potential research participants, accommodate the potential participants to consent to the study, to interview with the researcher, and to review a summarized copy of the interview data to validate accuracy for data analysis use. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I can authorize the approval for the research in this setting.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University Institutional Review Board.

Sincerely,

[redacted]

Signature of SME Business Leader from Company-2

Confidentiality and Privacy

I will ensure the information the research participants provide is kept confidential. I will not utilize the information beyond the purpose of this study. The study report will not include any of the research participants personal or company information or any other identifying characteristics. For example, designated alphanumeric codes to ensure confidentiality will include P1, P2, and Company-1. Any documentation collected during research from the participants will keep confidential and used for the sole purpose of this research. I will keep all information in a locked password-protected fire-rated safe for a period of 5 years, accessible only to me. After 5 years of the research completion, I will destroy all research information.

Research Dissemination

I will publish the study report in a peer-reviewed journal for a variety of readers. The participants who participate will receive a summary of the research findings. Potential benefits of this project are a better understanding of data quality strategies to achieve quality data inputs used in forecasting repairable spare parts to enhance aerospace SME spare parts suppliers' forecast accuracy, customer service levels, inventory management, and overall financial performance.

We understand that our organization's responsibilities include: provide e-mail addresses and contact phone numbers for potential research participants, accommodate the potential participants to consent to the study, to interview with the researcher, and to review a summarized copy of the interview data to validate accuracy for data analysis use. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I can authorize the approval for the research in this setting.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University Institutional Review Board.

Sincerely,

[redacted]

Signature of SME Business Leader from Company-3

Confidentiality and Privacy
I will ensure the information the research participants provide is kept confidential. I will not utilize the information beyond the purpose of this study. The study report will not include any of the research participants personal or company information or any other identifying characteristics. For example, designated alphanumeric codes to ensure confidentiality will include P1, P2, and Company-1. Any documentation collected during research from the participants will keep confidential and used for the sole purpose of this research. I will keep all information in a locked password-protected fire-rated safe for a period of 5 years, accessible only to me. After 5 years of the research completion, I will destroy all research information.

Research Dissemination
I will publish the study report in a peer-reviewed journal for a variety of readers. The participants who participate will receive a summary of the research findings. Potential benefits of this project are a better understanding of data quality strategies to achieve quality data inputs used in forecasting repairable spare parts to enhance aerospace SME spare parts suppliers' forecast accuracy, customer service levels, inventory management, and overall financial performance.

We understand that our organization's responsibilities include: provide e-mail addresses and contact phone numbers for potential research participants, accommodate the potential participants to consent to the study, to interview with the researcher, and to review a summarized copy of the interview data to validate accuracy for data analysis use. We reserve the right to withdraw from the study at any time if our circumstances change.

I confirm that I can authorize the approval for the research in this setting.

I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University Institutional Review Board.

Sincerely,

[redacted] 7-8-16

Appendix N: Snapshots of Signature Pages of Informed Consent Forms from Six Research Participants

P1 Signature on Informed Consent Form

Contact and Questions
You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent
After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant [redacted]

Date of Consent 8-2-16

Participant's Signature [redacted]

Researcher's Signature

P2 Signature on Informed Consent Form

Contact and Questions

You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent

After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant [redacted]

Date of Consent 8/2/16

Participant's Signature [redacted]

Researcher's Signature 

P3 Signature on Informed Consent Form

Contact and Questions

You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent

After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant [redacted]

Date of Consent 7.27.16

Participant's Signature [redacted]

Researcher's Signature

P4 Signature on Informed Consent Form

Contact and Questions

You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent

After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant [redacted]

Date of Consent 7/21/2016

Participant's Signature [redacted]

Researcher's Signature

P5 Signature on Informed Consent Form

Contact and Questions

You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent

After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant [redacted]

Date of Consent 8-2-2016

Participant's Signature [redacted]

Researcher's Signature

P6 Signature on Informed Consent Form

Contact and Questions

You may ask any questions that you have now. If you have questions later, you may contact the researcher via telephone at 219-588-1885 or e-mail at uyi.eguasa@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **07-06-16-0417122** and it expires on **July 5, 2017.**

The researcher will e-mail or fax you a copy of this form to keep for your records.

Statement of Consent

After reading the information above, I have an understanding of the study and can make a decision about my involvement. By signing below, I understand that I agree to the terms described above and will receive a copy of the signed form for my records.

Name of Participant [redacted]

Date of Consent 8-9-16

Participant's Signature [redacted]

Researcher's Signature

Appendix O: List of 93 codes in ATLAS.ti from Deductive and Inductive Coding

HU: Doctoral Study Data Analysis - 8 Data Quality Strategies 20161007
File: [C:\Users\Uyi\Desktop\Walde...\Doctoral Study Data Analysis - 8 Data Quality Strategies 20161007.hpr7]
Edited by: Super
Date/Time: 2016-10-25 12:17:25

Data Governance
Data Quality Analysis
Data Quality Key Performance Indicators (KPI)
Data Quality Measurement
Data Quality System
DG: 10 years or more forecasting experience
DG: AS9100 and 9110 Certified
DG: Continuous improvement and monitoring procedures
DG: Customer Input Data Knowledge
DG: Data Control
DG: Data Maintenance Policy
DG: Data Sources -Policy
DG: Data System Backup Policy
DG: Data System Input Data Procedures
DG: Data Tracking Policy
DG: Data Update Policy
DG: Data user system access
DG: Input Data Recovery Policy
DG: Knowledge & Experience Level
DG: Lead Time Data Policy
DG: Multiple Data Reporting For Review
DG: Policies and Procedures
DG: Purchasing Approval Levels
DG: Quality Management System Policy and Procedures
DG: Role and Responsibilities
DG: Time Horizon for Horizontal Data Review
DQA: Data Fitness Decision
DQA: Historical Data Analysis
DQA: Human Data Analysis
DQA: Input Data Quality Adjustment for Forecast Accuracy
DQA: Input Data Quality Analysis
DQA: Manual Input Data Verification
DQA: Manual Validation of Forecasts to Ensure Data Quality
DQA: Standard Formula
DQA: System Data Analysis

DQCI: Continuous Improvement Initiatives
DQCI: Continuous review of input data change impacts to output data
DQCI: Data Quality Cross Checking
DQCI: Internal Metrics Review
DQCI: Management meetings
DQCI: Meetings
DQCI: Process Improvement
DQCI: Staff Meetings
DQCI: System Maintenance
DQM: Customer Input Data Errors
DQM: Data Accuracy
DQM: Data Completeness
DQM: Data Quality Dimensions
DQM: Data Relevance
DQM: Data Timeliness
DQM: Human Input Data Errors
DQM: Level of Confidence
DQM: Manual Review of Input Data Errors
DQM: Root Mean Square Error
DQCI: Proactive/Reactive Plan
DQS: AIRPAX Data System
DQS: Enterprise Data System
DQS: Historical Input Data Access
DQS: In-house Data System
DQS: Profit Key Data System
DQS: Quantum Data System
DQS: System Input Data Analysis
DQTE: Component Maintenance Manual
DQTE: External Sales Representative Data Collection
DQTE: Internal/External Training
DQTE: Market Knowledge
DQTE: Off-site Training
DQTE: On-site Training
DQTE: On-the-job Training and Experience
DQTE: Sales Representative - Daily Market Analysis
DQTE: Seminars
DQTE: Trade Shows
DSD: Customer Forecast Data
DSD: Customer Historical Usage
DSD: Market Data
DSD: MRO Service Facilities
DSD: Multiple Input Data Sources
DSD: Service Bulletins
DSD: Vendor Data

Quality Forecast Input Data Sources
Improvement of Measurement Criteria
Knowledge Enhancement on Data Quality
Relationship and Collaboration
RNC: Customer Forecast Data Sharing
RNC: Customer Relationship and Collaboration
RNC: Customer Visits
RNC: Customers Supplier Conferences
RNC: Regular Customer Calls
RNC: Scheduled Vendor Visits on Customer Site
RNC: Vendor Data Sharing
RNC: Vendor Relationship and Collaboration
Training and Education
Validation of Data Quality Controls