

**A Synopsis of a Ph.D. Dissertation entitled “A Strategic Approach to Effectively
Manage Supplier Quality within the Construction Industry”**

Problem Statement

The aim of the research is to determine the best practices for supplier quality management (SQM) in the construction industry that ensure that the supplied materials and equipment for construction projects are within the quality requirements. The dissertation research evaluated supplier quality management (SQM) practices in the construction industry and from diverse industries by using multiple data sources. In total, 21 organizations specializing in Engineer-Procure-Construct (EPC) projects participated in this research. These organizations have each been in the construction industry for more than 70 years, and each have on average about 25,000 employees located across the globe with headquarters in the U.S., Asia, and Europe. The portfolio of projects in which these organizations are engaged range from 600,000 to 10 billion U.S. dollars. In addition to the 21 organizations who participated in this project, nine supplying companies (suppliers) provided important information regarding their supplier systems. These suppliers have each been active in the EPC industry for an average of 49 years. These nine suppliers range in size, with a number of employees ranging from 90 to 9,000, and annual sales ranging from 60 to 3 billion U.S. dollars.

The dissertation format utilizes the “three-paper model” supported by the University of Arkansas Graduate School. This dissertation consists of five publishable papers, two of them have been published, and two papers have been accepted for publication.

Research Methodology

The main data collection sources for the dissertation research include literature review, SQM documents (including reports and procedures) from the participating organizations, structured interviews with contractors, supplier focus groups. In addition, the research used Purchase Order (PO) instrument and inspection cost data to describe important effective SQM practices, the leading research effort for these two data sources are described in Neuman (2014)¹ and Ahmad (2014)² respectively. The table below presents the summary of the research methodology for each paper within the dissertation.

Paper title	Supplier quality management inside and outside the construction industry	A qualitative data analysis for supplier quality management practices within the construction industry	Analyzing supplier quality management practices in the construction industry	Using the balanced scorecard to implement effective supplier quality management practices in the construction industry	Analyzing effective supplier quality management using simple multi-attribute rating technique (SMART) and value focused thinking (VFT)
Status	Published in the Engineering Management Journal	Accepted for publication in the Journal of Construction Engineering and Management	Accepted for publication in the Quality Engineering Journal	To be re-submitted to the Journal of Management in Engineering	Accepted for publication in the Journal of Management in Engineering
Data sources	Literature	SQM documents, structured interviews	PO instrument	Literature, SQM documents, Interviews, PO instrument, supplier focus groups, inspection data	Literature, SQM documents, interviews, PO instrument, supplier focus groups, inspection data
Research methodology	Literature review taxonomy	Grounded theory	Principal components analysis (PCA), and analytic hierarchy process (AHP)	Cross analysis ,and balanced scorecard (BSC)	Simple multi-attribute rating technique (SMART), and value focused thinking (VFT)

¹ Neuman, Y. (2014). *A quantitative analysis of supplier quality in the engineer-procure-construct industry*. M.S. Thesis, Department of Civil, Construction and Environmental Engineering, San Diego State University, San Diego, CA.

² Ahmad, S. (2014). *An analysis of process vs. inspection capability in fabricated, engineered-to-order supply chains*. M.S. Thesis, San Diego State University, San Diego, CA.

Research Contributions

The dissertation employed a strategic approach to effectively manage supplier quality within the construction industry. This strategic approach involves examining SQM practices from the construction industry and from multiple industries found in the literature to identify practices that could be used by the engineering managers to improve SQM. The research also investigated the current SQM practices within the construction industry from multiple data sources, such as structured interviews and supplier focus groups to identify effective SQM practices that help improve the existing SQM. Effective SQM practices identified in the investigation are validated (cross analyzed) to verify that the findings from multiple data sources yield same conclusions. Effective SQM practices identified in the research are presented in multiple views, including the Supplier Quality (SQ) process map and the balanced scorecard (BSC), to help construction management adopt these practices within construction projects. The SQ process map indicates when SQM practices are best implemented within the project life cycle. The BSC organizes SQM practices along four perspectives: financial, customer (supplier), internal business, and innovation and learning. Performance metrics were then formulated for each practice within each perspective of the BSC to help engineering managers measure and compare performance of multiple projects. The research effort also includes an assessment of SQM practices aligned within the BSC framework to help the engineering managers of the construction organizations focus on key SQM practices within this framework. In order to promote strategic leadership for SQM and enable an effective implementation of SQM practices, the research identified important leadership practices for construction organizations.

Each paper in the dissertation provides an important contribution to the engineering management discipline. The first paper, involves investigating the practices of SQM inside and outside the construction industry. The investigation is beneficial to the engineering management by increasing the knowledge of effective SQM practices within the construction industry and within other industries with similar production complexities. Engineering professionals can benefit from these findings by not limiting the investigation to a particular industry.

The second paper includes investigating the current SQM practices from construction organizations by using qualitative data analysis techniques of grounded theory. The research can benefit academic researchers and professionals in engineering management by helping them learn about qualitative data analysis techniques, because several sources of information (data) within construction projects are in qualitative forms such as inspection reports, suppliers' bids, and request for information reports. Also, the second paper discusses current SQM practices and classifies these practices according to the effectiveness of SQM of the organizations sampled in order to recognize what the organizations with highly effective SQM are presently practicing. The construction organizations can adopt these practices to improve their current SQM systems.

The third paper involves using principal components analysis (PCA) to analyze SQM practices in organizations with highly effective and includes an analysis method, analytic hierarchy process (AHP), based on expert judgment that can be used to support the conclusions drawn from small sample size analyses, and to understand the relative importance of the SQM practices. The findings of this paper can benefit the researchers

and professionals in the construction industry to invest in the most important SQM practices in order to implement them within construction projects.

The fourth paper includes proposing the use of balanced scorecard (BSC) framework for implementing the effective SQM practices during construction projects. The proposed framework is beneficial in assisting engineering managers in improving their current SQM. At the end of each project, the practices within the BSC can be assessed based on how well the goal was achieved given the utilization of these practices. Applying the BSC within construction projects can also help organizations compare project performance across multiple projects, thus suggesting areas of improvement.

The fifth paper includes analyzing SQM practices within the BSC framework according to their ease of implementation and impact on quality by using simple multi-attribute rating technique (SMART). This analysis can guide construction organizations assessing their SQM practices given their current capabilities to perform the practices and their effect on the SQM quality. The fifth paper also involves synthesizing leadership principles based on examining literature sources and developing leadership objectives and practices using value focused thinking (VFT) to help create strategic leadership for SQM within construction organizations. The findings from this contribution can help construction organizations select consistent SQM practices that have high impact on quality and are simple to implement across the construction projects and to recognize important leadership practices that help improve the current SQM and promote a positive long-term impact for project quality.

Research Publications - Conferences

- Specking, E., **AlMaian, R.**, & Nachtmann, H. (2013). An Analytic Hierarchy Process Approach to Engineering Outreach Decisions. *2013 Industrial Engineering Research Conference (IIE 2013)*. May 2013. Puerto Rico.
- Alves, T., Walsh, K., Neuman, Y., Needy, K., & **AlMaian, R.** (2013). Supplier Quality Surveillance Practices in Construction. *21st Annual Conference of the International Group for Lean Construction (IGLC-21)*. Fortaleza, Brazil, July-29-Aug.2, 2013, 833-842.
- **AlMaian, R.**, Needy, K., Walsh, K., Alves, T., & Neuman, Y. (2013). Supplier Quality Management Inside and Outside the Construction Industry. *34th ASEM International Conference. Proc. American Society for Engineering Management. 2013 International Annual Conference*, Bloomington, MN, October 2013, 11pp.
- **AlMaian, R.**, Needy, K., Walsh, K., & Alves, T. (2014). A Qualitative Data Analysis of Supplier Quality Management in Construction. *2014 Industrial Engineering Research Conference (IIE 2014)*. May 2014. Montreal, Canada.
- Neuman, Y., Alves, T., Walsh, K., Needy, K., & **AlMaian, R.** (2014). Analysis of Supplier Quality Surveillance in EPC Projects. *Proc. 22nd Annual Conference of the International Group for Lean Construction (IGLC-22)*. Oslo, Norway, June 23-27, 2014, 1083-1094.

Research Publications- Journals

- **AlMaian, R. Y.**, Needy, K. L., Walsh, K. D., & Alves, T. D. C. (2015). Supplier quality management inside and outside the construction industry. *Engineering Management Journal*, 27(1), 11-22.
- **AlMaian, R. Y.**, Needy, K. L., Walsh, K. D., & Alves, T. D. C. (2015). A Qualitative Data Analysis for Supplier Quality-Management Practices for Engineer-Procure-Construct Projects. *Journal of Construction Engineering and Management*, 142(2), 04015061.
- **AlMaian, R. Y.**, Needy, K. L., Walsh, K. D., Alves, T. D. C., & Scala, N. M. (2016). Analyzing supplier quality management practices in the construction industry. *Quality Engineering*, 28(2), 175-183.
- **AlMaian, R. Y.**, Needy, K. L., Alves, T. D. C., & Walsh, K. D. (2015). Analyzing Effective Supplier-Quality-Management Practices Using Simple Multiattribute Rating Technique and Value-Focused Thinking. *Journal of Management in Engineering*, 32(1), 04015035.