

# Benchmarking the Maturity of Quality Management Systems in Western Australia

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## Abstract

This paper describes the development of a benchmarking approach that assesses the maturity of Quality Management Systems. It was a collaborative study commissioned by the Western Australia Quality Forum involving industry and academia. The aim of the study was to provide a tool that would enable companies to assess their own level of maturity against an overall benchmark derived from medium to large AEC sector companies in Western Australia. A descriptive structured approach was adopted using a survey instrument that included both quantitative and qualitative elements. The survey questions were based on the ISO 9004:2009 standard. The analysis of the survey data used a frequency analysis framework to determine the benchmark levels. The study extends the understanding of maturity levels of quality management system implementation. Further research will be required to monitor how the tool is used by the participating organizations to improve their quality management systems. The outcome of this research was a maturity-level based benchmarking approach that can be used to improve the implementation and effectiveness of Quality Management Systems.

**Keywords:** Benchmarking, Collaboration, Quality, ISO 9000, Strategy

## Introduction

The modern era of quality has seen a steady increase in the number of enterprises adopting quality conformance as a national standard, and in effect many organisations are feeling pressured to implement such quality systems (Prajogo and Sohal, 2006). In 1999 the Singapore government introduced the ISO 9000 quality management certification scheme where it became a legal prerequisite that all contractors and consultancies involved in projects greater than \$30 million must have ISO 9000 certification (Netto, Low and Lo, 1997). Although it is not currently legislation within Australia for contractors to have certified quality procedures, the drive for the construction industry to increase technical innovations and compliances is highly driven by the government and other industry standards seen in today's construction industry.

The adoption of the modern concept of quality in terms of the need for third party accreditation & certification of quality management systems, within Western Australia and throughout Australia, has steadily increased in popularity. There is, however, no clear indication as to the levels at which quality management is embraced and employed across organisations. Some hold the view that Quality Management Systems (QMS) are under performing and that quality as a theory and practice is underutilized within construction,

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engineering and related industries (primarily mining, and oil and gas firms). In some cases companies will often engage in quality practices and certification to satisfy externally orientated factors; i.e. to enhance their image and tendering advantages, as opposed to employing a QMS in order to benefit from the actual internal organisational benefits that can be achieved through the implementation of such systems (Prajogo and Sohal, 2006).

The Western Australian Quality Forum (WAQF) provides leadership and builds relationships that foster quality through a constructive and informative environment for sharing quality experiences and knowledge across all sectors. The core objectives are to raise quality awareness; involve and unite stakeholders; and, promote quality as an inherent component of effective business management. The membership is made up of individual quality practitioners from various industry sectors operating in WA.

The WAQF decided to collaborate with an academic institution in order to gain a better understanding of the levels of implementation of Quality Management Systems in their members' organisations. The academic engagement would provide a more independent assessment and more rigorous approach. It would also allow for sensitive commercial information to be handled by a neutral entity. It must be emphasized that this research looks at the level of QMS implemented by the WAQF members' organisations which are mainly from the construction, mining, and oil and gas companies. The study was focused at an organisational level (Process Quality) rather than quality measures conducted on a construction site level (Product Quality) (Arditi and Gunaydin, 1997).

## **Research Aims**

The primary aim of the research was to establish a tool that can be used in the benchmarking, and subsequent improvement, of the maturity of quality management systems within medium to large organisations involved in the construction, engineering resource industries operating within Western Australia. These industries have a similarity in nature (production of the built environment) and this would allow comparisons to be drawn between these interdependent industries. The interdependency lies in the fact that the resource production industry requires large investment in constructed facilities, and the construction industry requires raw materials from the resource industry and draws heavily on the resource industry as a customer base. The research was designed to provide a reference point for companies within the Western Australian Quality Forum and wider construction and resource industries to benchmark their company against those competing in the same market place.

The scope of the research was based around the following objectives in sequential order to achieve the primary aim of the research.

- Develop a questionnaire to determine the level of quality management maturity for medium to large construction and resource based enterprises operating in the Western Australia marketplace.
- Evaluate the levels of quality management maturity within the examined demographic based on ISO 9000 self-assessment protocols.
- Provide findings from the research to allow companies to benchmark their quality systems against their competitors in order to be used in future self-improvement.

## **Background: Quality in Construction**

The origins of quality in manufacturing are well documented and the benefits of quality management systems are widely recognized. There are many definitions of quality, but one that is generally accepted is 'the degree to which a set of inherent characteristics fulfill requirements' taken from the ISO 9000:2000 standard (ISO, 2014). Quality in the construction industry involves meeting the requirements of all the parties and individuals involved in the delivery of projects or provision of services, including: contractors,

consultants, project clients, suppliers and all relevant stakeholders (Willar, 2012). Another view on quality in construction from Bathika (2002), looks at the finished state of a project, and its level of variation from established requirements i.e. requiring rectification works, as a means of measuring quality. This definition also reflects quality explained by Iruobe et al. (2012), where quality was seen as a concept of, conformity to requirements i.e. satisfying clients and hence save costs for re-work.

Quality is an important aspect within the construction industry due to the complex nature of the construction industry and the high degree of risk inherent in all projects, (Bubshait and Al-Atiq, 1999). The management of quality is a critical component towards successful construction management and is receiving increasing attention on a global perspective (Ahmed et al, 2005). The study also indicated that due to the complex nature of the construction industry where companies often engage in 'one of a kind' projects, quality 'management' systems at an organizational level are a more appropriate practice (Ahmed et al, 2005). Results drawn from the survey done by Parast et al (2010) concluded that since top management is the driving force behind the implementation of QMS, it is directly responsible for company performance outcomes in quality. Research by Hoonaker (2010) found that the construction industry can anticipate a greater return on investment with successful quality systems due to its magnitude compared to other service industry sectors.

A vast majority of quality in the construction industry is based around the adoption of the International Organization of Standardization (ISO) 9000 suite of Standards (ISO 2014). Companies can use the ISO 9001:2008 standards to gain certified ISO quality compliance, whereas ISO 9004 (2009) focuses on how to make a QMS more efficient and effective. On a global perspective construction companies are increasingly beginning to implement the ISO 9000 standards for their quality management systems, shown by a study conducted by Low and Omar (1997). This research suggested that contractors with certified ISO 9000 Standards were considered to score better on the Construction Quality Assessment System (CONQUAS), compared to those that were uncertified (Low et al, 1999). Another perspective, reported by Low and Yeo (1997) and also supported by (Ahmed et al 2005), showed that ISO 9001 certification increased their eligibility to tender due to certification being a preferred or stipulated requirement. Taking into account economic considerations the operational costs of maintaining ISO certification could, in certain cases, cost more than savings suggested through its increased quality output (Low and Yeo, 1997). This can act as a barrier for companies to seek certification in an industry where project profits are already small in nature with little margin for error.

Quality in the construction industry is seen to be lagging behind that of other industries due to a number of contributing reasons that have been identified by researchers. In the studies conducted by Janipha and Ismail (2013) and CQI (2013) one of the reasons for this poor reputation for quality were reported to be based on the underlying culture towards quality found in the industry. A study by Janipha and Ismail (2013) concluded that the problems concerning poor quality in industry are a due to a lack of poor management focus on quality, and that an improved culture needs to be created. They also concluded that many construction companies implemented quality to increase their image rather than meeting performance outcomes (Janipha and Ismail, 2013). The CQI (2013) study reported that the senior managers in companies in the United Kingdom do not regard quality as an important process within their business.

The American Society of Quality (ASQ), an international quality organization, recently conducted a research project into the global state of quality, including adoption of quality management systems (ASQ, 2013). The study used the ISO standards as a framework to carry out a comparison of quality in organizations across 15 nations including Australia (ASQ, 2013). The results reported that Australia was placed 14<sup>th</sup> out of the fifteen countries

with only 57% of the organizations participating in the survey in Australia stating the use of ISO-9000 standards as a quality framework (ASQ, 2013). Australia also recorded the second highest ranking of companies having 'no' organizational quality framework with 17% of the Australian companies reporting that no quality systems are implemented.

## **Research Methodology**

The research methodology followed a descriptive structured approach where a set of predetermined objectives, design features and questions were created before carrying out the formal process (Kumar, 2011). A descriptive study describes the outcome of the research objectives and attempts to emphasise a correlation between the findings of the research i.e. relationships between variables from the data collection (Kumar 2011). This structured approach allows the research process a more appropriate method in determining the extent of the research objective.

### **Creating a Benchmarking Survey Based on ISO 9004**

As part of the structured research approach, data collection from the respondents was predominately conducted in a quantitative process via a survey. The process used predetermined questions that restricted respondents in order to provide their perception of quality only within the context of the question. The research followed a simple cross-sectional approach where the research questions were specifically designed to be quality related and sent out to an identified study population consisting of quality professionals within the West Australian construction, engineering and resource industries (Kumar, 2011). Responses gathered from the quantitative approach allowed for the data variables to be easily quantified and used to develop a benchmarking tool. Within McCabe (2001), benchmarking has been defined as, a process of continuous improvement by comparison of an organizations process or products, against those determined to be best practice. For a benchmarking approach to be effective it must identify the potential for improvement (Moriarty, 2011). Langston (2012) explains how benchmarking in the AEC industry can provide a basis for comparison performance and measurement of productivity rates against prescribed benchmarks with similar demographics.

The survey questionnaire consisted of a prescribed list of questions in two sections: the first section asking for the respondent to identify the company demographics that they are providing their views and perceptions for, and secondly the series of quality related questions. Similar to the research conducted by ASQ (2013), demographics including, company size, industry, revenue and geographic operations of the company were collected. This will allow for those using the benchmark tool the opportunity to compare the results of both surveys in terms of demographics.

The style of the quality related questions were in the form of a self-assessment maturity model as outlined in ISO 9004. A self-assessment model can provide an overall perception of the performance, and degree of maturity, from a company's quality management system (ISO 9004). The research tool uses 5 prescribed maturity levels as the responses to each question in the survey. For each question in the survey the respondent starts at the first of the 5 responses, and if their companies QMS meets the criteria in the first response they move to the next response. This continues until the respondent reaches a response that is not reflective of their organizations QMS. A respondent selects a response to provide when they can no longer progress to a further applicable answer (ISO 9004). The format of the responses is such that the first response indicates a maturity level of a QMS that was created in an ad hoc manner. A greater level of QMS maturity is reflected as answers progress from one towards the fifth response, with the fifth response being reflective of a QMS that is generally conducted in a formal and systematic process. Within the context of this report and

based on ISO 9004:2011 'Quality Maturity' was defined as 'The level of quality implementation and effectiveness within an organisations quality program'.

### **Selecting a Sample**

The sampling method used for this research population followed a non-random sampling technique called judgmental or purposive sampling (Kumar 2011). Two critical factors of the research that must be considered when satisfying the criteria for purposive sampling include: the research objectives and, the 'best fit' population (Palys 2014).

- Research objectives: the sample population for the data collection must be tied to the research objectives. They must be able to provide answers to the questions in order to satisfy the objectives of the research (Palys 2014).
- 'Best fit' population: the researcher selects the respondents that are deemed the best fit to answer the survey and provide rich information i.e. relevant industry professionals (Palys 2014).

For the purpose of this research topic, the members of the WAQF were considered to be able to meet the criteria of a best fit population. WAQF members worked within the geographic area where the study was concerned with collecting data and also have the ability to answer questions related to quality processes at their companies. The survey focused on collected responses from individuals working for medium to large enterprises and did not include the perceptions of small enterprises due to the barriers and reluctance smaller organisations face when implementing quality management systems. Small enterprises often have insufficient extensive resources to implement such innovations as TQM or gain ISO compliance, whether it's financially uneconomical or lack employee resources (Mohrman 1995) which could impact the results and not provide a true reflection of where QMS stand within the medium to large firms.

### **Frequency Analysis**

Although the framework of the data analysis procedure is a continually evolving process, it should be broadly developed before the process is undertaken (Kumar 2011). The initial data analysis framework outlined the following:

- Summary of the frequencies to each of the surveyed questions
- Analysis of any trends determined by the response frequencies
- Analysis of the average quality weightings for each question
- An overall quality weighting across the entire set of quality questions (Kumar 2011)

The justification for using frequencies as a method of analysis was based on similar studies that used frequencies as well as the restrictive nature of just using descriptive research for this study. There are many other examples of quality and ISO certification studies that used frequencies as a means of statistical analysis. Two separate studies by Erel and Ghosh (1997) and Ng et al (2012), both used frequencies of ISO certification across businesses, and Erel and Ghosh (1997) used demographical questions as a means of cross tabulation analysis. Frequency analysis also aids the development of a benchmarking tool.

### **Findings**

Responses were collected from 53 members of the WAQF in total. Firms intending to use the results in order to see how they compare to others operating in Western Australia have the option of viewing the results from the QMS maturity questions by sorting them using the demographic information and then analyzing the results question by question. The aggregate results from each question can be viewed as well. Again, when answering quality related questions using a self-assessment model in the format of ISO 9004, respondents progress from answer to answer until they can no longer select an applicable answer. Stopping at the

first answer implies less mature QMS, while satisfying all answers up through number five implies a more mature quality system. This section will highlight the aggregate results from the 13 quality questions broken down by each of the areas of demographic collected. It should be noted though that a more detailed account of the answers to each quality question was provided to the participants, but that it would not be possible to report on each question individually within the space of a conference paper. The five demographical questions analysed were: (1) core business activity, (2) number of West Australian based employees, (3) geographical operations of the company, (4) annual revenue generation, and (5) number of quality management staff involved in QA/QC.

### **QMS Maturity by Core Business Activity**

When completing the survey, respondents had the option of selecting from several different core business activities. The top three responses for core business activity were construction, mining, and Oil and Gas. Respondents had the option of selecting more than one core business activity for this question, which made it so that responses including engineering typically had more than one core business activity selected. This was problematic when attempting to compare engineering to other industries where only one core business activity was selected. The results showed that the highest average level of quality maturity with an average quality maturity response across all questions of 3.71 out of 5 was the oil and gas industry, followed by the construction industry with 3.43 and mining with a 2.91. Both mining and construction rated below the average of all respondents, which was an average maturity response of 3.57, which is shown in Figure 1.

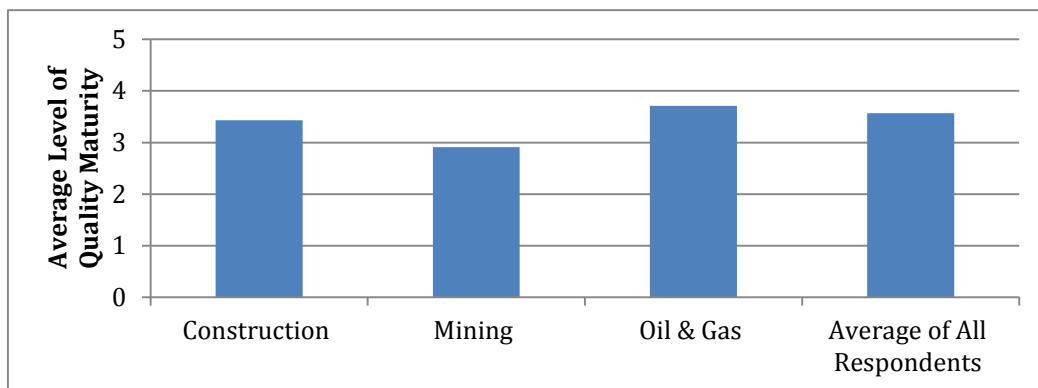


Figure 1. Average QMS Maturity Response by Core Business Activity

Due to the inherent dangers within the oil and gas industry, and the fact quality has a direct relationship with safety (Wanberg et al 2013), it is no surprise that oil and gas would have more mature QMS on average than other industries. The fact that construction companies had on average a more mature QMS than mining companies was a bit of surprise to the researchers, this is primarily due to the nature of one off projects within the construction industry and the fact processes are more repetitive in mining which provides more opportunities for refinement.

### **QMS Maturity by Annual Revenue Generation**

The members of the WAQF wanted to be able view results of the survey broken out by annual revenue generation in order to see if larger firms had a more mature QMS due the likelihood of having more resources to dedicate towards QMS implementation. In breaking the results down by firms with different annual revenue there was a surprise in that the largest firms, those with revenue greater than \$1B, had on average the least mature QMS. Figure 2 shows the average QMS maturity response by firms' annual revenue.

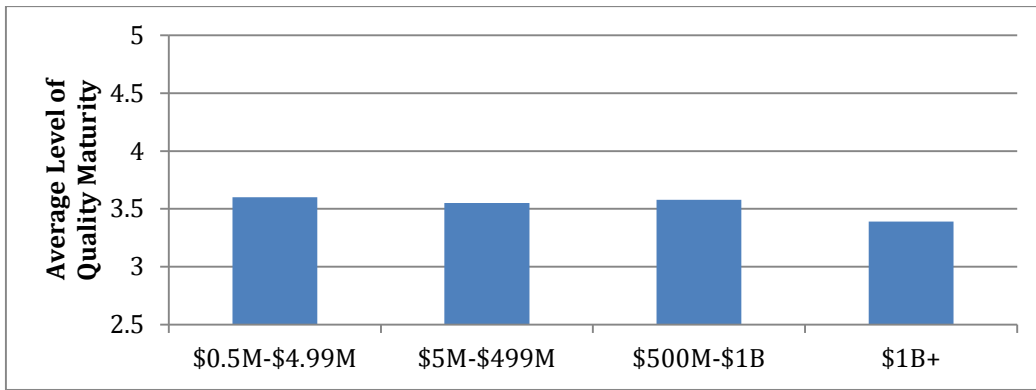


Figure 2. Average QMS Maturity Response by Annual Revenue

As shown in Figure 2, there was not much difference in average maturity response based on firm size. The smallest firms showed the most mature QMS and averaged a response of 3.6 out of 5, while the largest firms posted the least mature QMS responses with an average of 3.4. This could possibly indicate that smaller firms are more agile and able to better implement and refine QMS, though further research would be required to determine this.

### QMS Maturity by Number of Quality Staff

When examining quality management maturity based on the number of quality management individuals employed by each of the represented organisations the results do not lend themselves to any obvious conclusions. The responses shown in Figure 3 show that the highest average level of quality maturity is represented by the greatest amount of quality management staff employed (21+), which averaged a 3.90 out of five. This might indicate that firms with more quality management personnel have more mature QMS. However when looking at the average for the next largest number of quality management personnel, it reveals the lowest average maturity response of 2.85.

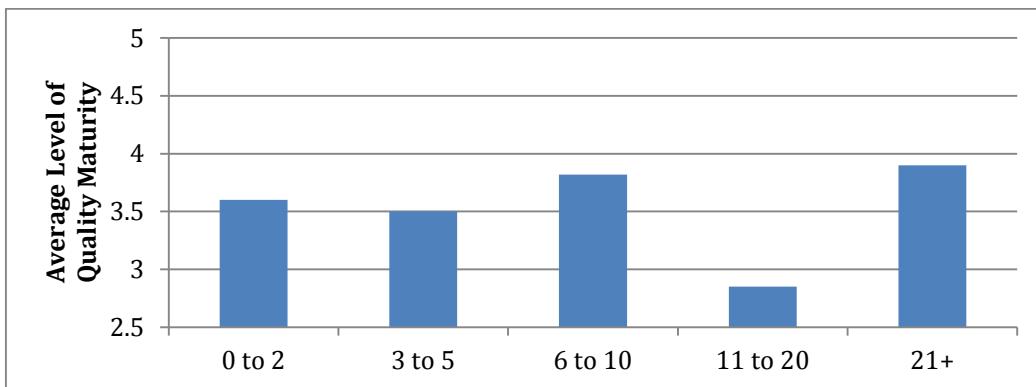


Figure 3. Average QMS Maturity Response by Number of Quality Staff

Due to the small sample size the statistical analysis of the responses does not allow any conclusions to be drawn as to whether or not the number of quality management personnel has an impact on the maturity of an organisations QMS maturity.

### QMS Maturity by Number of Regional Employees

Figure 4 breaks out the average maturity responses based on the number of regional employees (i.e. number of employees in Western Australia). Firms employing fewer WA employees posted higher average QMS maturity responses than those firms with larger numbers of employees. The most mature categories were those with 11 to 50 WA employees

which posted an average maturity response of 4.28, and was followed by firms with 1 to 10 WA employees which posted an average maturity response of 3.69.

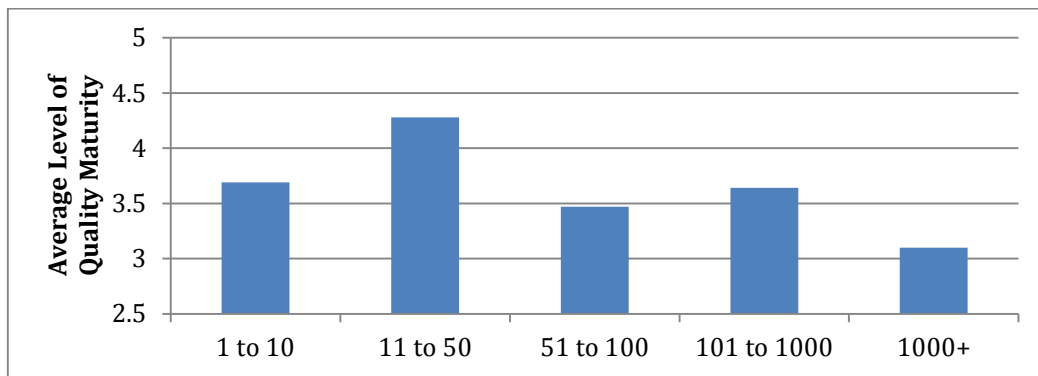


Figure 4. Average QMS Maturity Response by Number of Regional Employees

The companies with the most regional employees, those with more than 1000 in WA, returned the lowest average maturity responses with an average of 3.1. Figure 4 indicated that larger firms may not be as flexible and therefore have more difficulty developing and implementing a QMS.

#### QMS Maturity by Geographical Range of Operations

When looking at QMS maturity based on geographical range of operations (Figure 5), the results are in line with might be anticipated in that firms with international operations provided the highest average maturity response with an average of 3.74. This potentially stands in contrast with the results from other demographic questions (i.e. annual revenue and number of employees) which showed larger firms returning lower average QMS maturity responses. Typically one might assume international firms to have more employees and higher annual revenue.

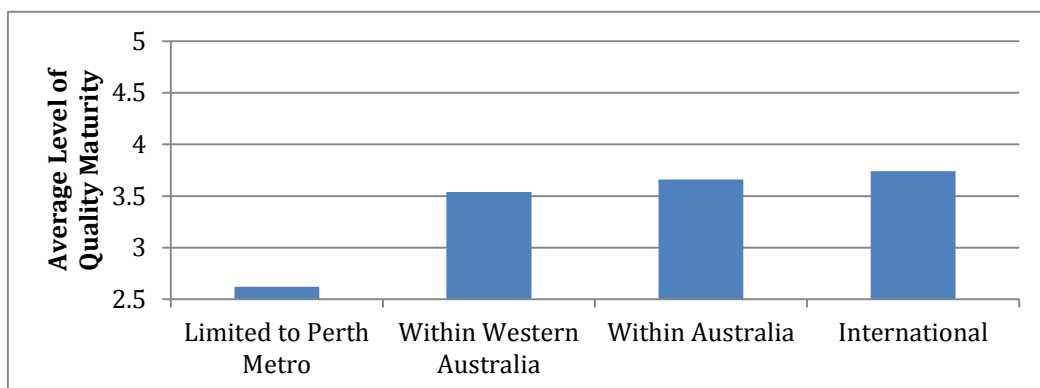


Figure 5. Average QMS Maturity Response by Geographical Range of Operations

Figure 5 shows that as you progress from firms with a presence only in the Perth metropolitan area towards firms with larger areas of geographical operations, the average of the QMS responses go up. Firms operating only in Perth provided and average response of 2.62, those operating in WA provided an average response of 3.54, and those operating Australia wide provided an average response of 3.66.



## Limitations & Further Research

The study was limited to the membership of the WAQF resulting in a narrow sample. Increasing the geographic coverage and sectors covered would provide a larger sample size and facilitate improved analysis of the results. Further research, in the form of obtaining feedback on how it was used in the participating organisations will allow the tool to be refined and provide further insight into the effectiveness of using a benchmarking tool to improve Quality System Implementation maturity.

## Conclusion

The study used established benchmarking theory and practice to develop a tool that can be used by companies to improve their quality management systems on an ongoing basis. The survey tool was based on the ISO 9004 self-assessment QMS maturity framework. The tool can be used to compare organization with others in their peer group operating in Western Australia. Firms using the tool can identify their areas of weakness and use feedback from the survey to inform the creation of new goals and plans.

The results of the survey showed that Oil and Gas companies on average had more mature QMS when compared to construction and mining companies. The results also showed that companies that conducted business in larger geographical areas (i.e. internationally) typically had more mature QMS when compared to companies operating only regionally (i.e. Perth or Western Australia). Other results that require further investigation include the fact that there was no evidence that companies with greater revenues have more mature QMS. In future iterations of this research a larger pool of respondents will be sought so that meaningful statistical analysis can be used to confirm trends in the results of the survey.

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