Applicability of Six Sigma in Nigerian Fabrication Companies: Case of Aveon Offshore in Port Harcourt.

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Abstract
With the much of emphasis on quality among oil and gas construction companies, there is concern why ISO 9001 is still dominant in spite of Six Sigma's achievements. Literature was reviewed highlighting the various quality management systems in practice. Semi-structured set of questions were drawn for in-depth interviews of twenty participants who shared from their experiences why ISO is still in the main stay and the chances of Six Sigma. Thematic Network Analysis was used to analyse the findings; subsequently, discussions based on findings are presented with recommendations

The Research Problem

Six Sigma has been judged to be one continuous improvement programme; from its first known implementation at Motorola in the early 1980s, it has been adopted in many companies some of which are: General Electric, Honeywell, 3M, Polaroid, American Express, Dephi and Ford (Goffnett, 2004). While Motorola saved $15 billion in its first ten years of Six Sigma adoption, General Electric was reported to have gained $2 billion in 1999 and $2.4 billion in 2001 respectively to the bottom line. The main objective in Six Sigma has been the reduction of variation, increase in profits and customer satisfaction. Though the initial concepts of Six Sigma were developed in the manufacturing industry; other industries, from service to construction have begun benefitting from it.

Though Six Sigma has benefitted companies, many firms and industries are yet to adopt it as their quality improvement tool. This means they will keep doing business as usual, without realizing that things could be better. One such industry is the Nigerian Oil and Gas Construction Industry. The Industry is very important to the nation because more than ninety percent of Nigeria's gross income comes from petroleum resources.

As a matter of retrospect, Nigeria's petroleum industry has experienced changes since oil was discovered in economic quantity at Oloibiri in the Bayelsa State of Nigeria in 1956. Since then there has been lots of exploration and production activities within the land and waters of the country. One rippling effect of oil production is the growth of other relevant industries: design and construction, drilling, production, refining and marketing.

The global awareness of project management has put demand both on client and contracting companies to change their approaches from operations management to that of project management by establishing the Project Offices to minimize wastage, improve product quality and make every dollar spent produce its value.

The Research Question and the Purpose of the Study

The focus on existing research on Six Sigma is mainly towards the manufacturing industry with populations in excess of over 500 persons. The service sector, construction industry were later entrants into the realm of Six Sigma. These sectors had to do a lot of restructuring

to be able to adapt to Six Sigma. However, the oil and gas construction industry which is at the base of petroleum and gas production has not taken on Six Sigma. The research is therefore based on finding ways in which companies doing construction business in the energy sector can take advantage of this world-acclaimed process improvement tool. This research is therefore geared to know how close Aveon Offshore's quality management system is from Six Sigma and suggest ways in which the company can make changes to adopt Six Sigma.

The following research questions were formulated for this reason:

- Why have oil and gas construction companies not adopted Six Sigma?
- Are they just comfortable with the present ISO 9001 being practiced?
- Are they not aware of the place of Six Sigma in Quality Management?
- Is Company convinced that Six Sigma is not different from ISO 9001?

The Purpose of the Study

Given the above-stated research questions, this research attempted to answer questions of quality improvement processes going on in steel fabrication companies with vested interest in the petroleum and natural gas sector. Aveon Offshore Limited, Port Harcourt was investigated and findings got on the present quality management practice were compared with a Six Sigma process, the results of which were used to determine if this present practice can easily be modified into Six Sigma or a major change management process will be required to adopt Six Sigma.

Objectives of the Study

- Consider the present quality management and improvement practice being utilized Aveon Offshore Limited.
- Investigate to know if the company is aware of Six Sigma as a process improvement tool.
- Know company's disposition concerning Six Sigma i.e. what they think of it, whether or not it is the same with other process improvement tools.
- The readiness of the company in adopting another process management tool from ISO 9001 being used.
- Establish ways and how the company is close to or far from adopting Six Sigma.
- Make recommendations from findings.

Significance of the Study and the Justification of the Investigation

Ever since Motorola started Six Sigma, literature has covered many of its operations and improvements but these are mostly concentrated on the manufacturing industry. Other industries (Human Resources, Purchasing, and the service sector) later adopted it; however, the construction industry is yet to adopt Six Sigma wholly. Han et al (2008) identified that there is little work done on performance improvement and defect reduction rates in the construction industry. At the time of this work, little is known in literature concerning the place of Six Sigma in the Oil and Gas construction business, this work becomes relevant as one which looks into the possibility of companies in the energy business saving millions of dollars which would have been spent due to defects and rework, resources which would have been saved had the companies adopted Six Sigma.

Unit of Analysis

Our Unit of Analysis is Aveon Offshore Limited, a construction company whose business is the procurement and construction (fabrication) of steel structures for the Oil and Gas

industry. These facilities include offshore structures: jackets, decks, mudmats, piles, piping systems, bridges, etc; onshore facilities: pipes and piping systems, steel-constructed warehouses, canopies, etc.

Literature Review

Project success is seen to depend on some critical factors: activity definition, schedule development, organizational planning, staff acquisition, communications planning, development of a project plan, etc (Zwikael & Globberson, 2006a). The authors stated that a more vigorous approach to the quality planning and communications planning processes will definitely bring an overall effectiveness of the project planning processes. Therefore giving quality time in conceptual concepts as quality and communications planning will have an overall positive impact in the project. Furthermore, Ika (2009) identifies that industry trend marks success of projects to their overall impact on the organization rather than that of the singular projects; hence project sponsors and owners have a lot to do in creating a success oriented culture in the entire organization rather than leave it in the hands of a project manager (Zwikael & Globberson, 2006b). One known criterion for project success is the quality standard of its delivery, which is monitored by the amount of rework or client's satisfaction (Munns & Bjeirmi, 1996).

Since its introduction at Motorola Corporation, Six Sigma, as a Quality Management System, has evolved in concept definition and implementation. In a general definition, it is a management attempt of reducing defects to 3.4 per million opportunities (Thomsett, 2005). To understand this first definition, one must be reminded of the basic statistical tool applicable: the sigma (σ), which is a lowercase Greek symbol for measurement of dispersion or variation about a mean and it denotes a population's standard deviation in basic statistics.

A second look at Six Sigma comes from the fact that organizations focus their policies around creative process improvement and customer satisfaction. Workers do not have to see the outside person or organization as the only customer but all persons involved in the production of goods and services (even those within the organization) are broadly referred to as customers (Thomsett, 2005). In a fabrication process for instance, the engineering team would recognize those involved in fitting, welding, scaffolding, lifting, etc as their customers because these individuals make use of engineering department's output. This second definition comes with strong organizational reorientation and the involvement of senior management, without which it becomes improbable of achieving success.

A third definition of Six Sigma comes from the observation that there are five steps in a regular Six Sigma implementation: these are Define, Measure, Analyze, Improve and Control (DMAIC). This brings in a strategic approach towards process improvement, and thus is a structured viewpoint for breakthrough thinking and product and process improvement meant not just for a whole organization but also for different segments: engineering, design, manufacturing, etc (Goffnett, 2004). There is though, another five-step Six Sigma methodology used which is known as DMADV (Define, Measure, Analyze, Design and Verify).

The construction industry is one of the first established industries from centuries past but its quality level with process improvement has not met those obtained in Six Sigma. Han et al (2008) state that little research exists in setting quantitative goals for project performance while taking defects rates into consideration and in the reduction of process variability

through evaluating quality level in the construction industry. Their research led to the conclusion that with Six Sigma, defects or quality variances in construction can be controlled in more practical ways in order to fit a desired range.

Stewart & Spencer (2006) remarked also that even though there is much literature on quality in the construction industry, less is available with regards the place of Six Sigma in quality improvement; their work took a case of a process improvement project which was performed on a railway station in London, UK using Six Sigma and concluded that there was improved productivity in beam construction, reduction in project schedules and delays, and an enhanced interaction among project team members.

In the construction of oil and gas facilities, there is no known literature that has an input. This research sought to fill such gap.

Research Methodology

In Twigg (1995), there is an outline of Yin's (1989) five research strategies in Social Sciences, which are experiment, archival analysis, survey, history, and case study. The decision on which strategy to adopt is based on the purpose of the study (exploratory, explanatory or descriptive); the type of research question asked; the extent of control the researcher has over the actual events studied and the degree of focus on historical versus contemporary events. Below is a table showing the various strategies.

S/No.	Strategy	Form of research question	Investigator's control over events	Focus on contemporary events
1	Experiment	how / what / why	yes	yes
2	Survey	who / what / where / how many / how much	no	yes
3	Archival analysis	who / what / where / how many / how much	no	yes/ no
4	History	how / what / why	no	no
5	Case study	how / what I why	no/ possible	yes

Table 1 Choice of research strategy for an exploratory investigation (adapted from Twigg, 1995)

This research project is basically exploratory in itself, investigating what are the processes of quality implementation and improvement at Aveon Offshore Limited. In this respect, any one of the five research strategies is appropriate. However, since the research has sought explanation into why Six Sigma has not been adopted into the Company and how Six Sigma can readily be adopted; the experiment, historical, and case study approaches appear appropriate. Thus, with the focus of research on contemporary events, and with little control over the events available to the investigator, Table 1 suggests that the case study is the most favourable strategy to pursue.

Research Design and Implementation

The sampling technique adopted in this investigation is therefore the non-probabilistic sampling technique because it is a selection of participants within a particular group making

it a Within Case type of a qualitative research (Higginbottom, 2004). The interview participants were drawn from managers, supervisors, engineers, document controllers, quality assurance and quality control (QA/QC) personnel, project planning and control personnel. Some participants referred the researcher to others whom they know will be able to offer their knowledge on the research as participants, a form of sampling known as snow ball sampling (Gibbs et al, 2007). A total of twenty participants were drawn from eleven departments of the company, giving it a wider coverage.

The interview protocol was planned with the general direction of the questions based on the literature review and findings from the pilot study. The questions below were planned to investigate the level of knowledge of Six Sigma among staff members of Aveon Offshore and to know how readily they would adopt Six Sigma. Thus the following main questions were designed to guide the exploration:

1. In your opinion, what is the relevance of your ISO 9001:2008 certification status to your company?
2. How satisfied are you with company's current quality delivery?
3. What are your clients' opinions about the quality of your work?
4. Do you feel that there are improvements needed by company regarding the quality of its projects?
5. What is your opinion about your company's experience with defects?
6. What is your opinion on rework due to correction of defects?
7. Will you be willing to propose or adopt a new quality management strategy if it can guarantee gross reduction in the number of defects to 3.4 parts per million opportunities?
8. What do you know of Six Sigma, a quality improvement strategic tool used to reduce defects to 3.4 defects per million opportunities?
9. Do you think Six Sigma is the same with ISO9001 or you think there is a difference?
10. If Six Sigma is to be adopted, what are your concerns about productivity since it would require comprehensive company-wide (or department-wide) training?

A pilot study was conducted at the engineering and planning departments of the Company on four participants to ensure that the interview design was adequate for the research. The essence of the pilot session was to know the limitations of the interviews and make modifications where necessary before embarking on the main investigation with other participants.

Like in other qualitative researches, this research does not seek for generalisations as is common with quantitative findings. In qualitative researches, validity relates to the degree to which a finding is determined to have been interpreted in an acceptable way (omni.org, n.d.).

Reliability of this research like other qualitative researches is said to be enhanced by standardizing data collection procedures and practices while documenting the time, day and place of observations (Cohen and Crabtree, 2008).

This project took into consideration the following:

i. Respect for individual participants
ii. Bias reduction to promote attention to validity
iii. Informed consent from participants was properly requested.
iv. Confidentiality of responses
v. Participants were informed about the benefits of participating in this study and were provided with the results of the study upon request.

vi. Ethical clearance was obtained from the University of Liverpool Research Ethics Committee.

Data was analyzed using Attride-Stirling's (2001) proposed Thematic Network Analysis, a development of other tools for the analysis of qualitative researches. The thematic network is a web-like instruction which summarizes the main theme in a given text. Thematic networks do not seek to reconcile definitions of a problem; rather they aim to explore the understanding of an issue or the meaning of an idea. It is a simple way of analyzing qualitative data; from basic themes found in statements it organizes these themes into global positions.

Findings

Findings from the participants show different views which were organised into several global themes. Identified global themes are shown below from the above-given interview questions:

- Overall positive image
- Satisfaction with quality delivery
- Satisfied clients
- Company is thriving to improve on their existing records
- Displeasure over defects
- Loss of production in time, money, materials and reputation
- Workability of the new QMS
- No useful information
- Highly efficient quality management system
- Training, at last gives production boost

Discussion and Conclusion

This research shows that because Aveon Offshore is satisfied with the fact that it is meeting its clients' quality requirements through its present quality system there is little or no desire in searching for and introducing Six Sigma which can be of immense benefit to it. The research therefore agrees with the work of Stewart & Spencer (2006) which acknowledges that though quality is a recurrent word in the construction industry's literature, there is a low place given for Six Sigma in quality improvement. This in itself is intriguing because although Six Sigma grew within the manufacturing sector other industries have since started adopting and benefitting from it but the age-old construction industry is still far from adopting it.

In addition, the current global financial situation seems not to have had its toll on the Oil and Gas industry. This is not a guarantee that the situation will remain the same; it is the time for wise companies to begin preparing themselves for future possibilities. Given the fact that Boldrin & Peralta-Alva (2009) stated that American companies were almost put out of their once, untouchable global market when the Japanese companies began their quality improvement initiative; there is the tendency that non-Six Sigma construction companies may be put out of business if other construction companies in the industry become Six Sigma compliant and get the clients to buy into Six Sigma. This is because the clients too want to be guaranteed a better job at reduced cost; this is where Six Sigma has an edge over other quality management programmes. Then companies like Aveon Offshore would be coming in late, to be found where Motorola was before Six Sigma.

The research also acknowledged the gross lack of awareness of Six Sigma. This should not be taken lightly if company desires to adopt Six Sigma. Getting workers' motivation was

identified as a key requirement for the introduction of Six Sigma (Baird, 2009, pp. 38 – 39). In addition, Aveon Offshore is a multicultural company with workers from Europe, North America, Asia and Africa so more challenges can be anticipated than if only a native culture were present as remarked by Treichler, & Carmichael (2004, p. 193).

Finally, the fact that a company is known today for good quality does not mean that it should rest on its oars; Toyota's (Ohnsman et al., 2010) recent experience should remind everyone that improving on today's benchmark is a key to retaining customer loyalty.

Recommendations

Having observed and realized the research objectives, the following recommendations are presented:

- Research is required among the client companies to know their opinion of Six Sigma and the possibility of them adopting it in their projects.
- Further research is needed to know why other construction companies have not adopted Six Sigma in quality improvement in spite of their well-known interest in project quality.
- Another research is needed to ascertain the efforts of Six Sigma professionals and trainers in taking their idea to newer frontiers, especially in industries submerged in ISO standards.

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