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The need for quality assurance scheme in the Nigerian manufacturing sector

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Abstract
Defined as a proactive approach of scrutinizing a company's products and services to ensure that products and services consistently keeps up to high quality, the concept of Quality Assurance Scheme's (QAS) best practices focus on the prevention of mistakes or defects during the manufacturing process. The paper examined in detail the concept of QAS, the application of its tools and techniques which is a vital component of any successful improvement process, and noted that the tools and techniques can only be beneficial for the manufacturing sector after the proper training of the employees to enable them to understand and appreciate them effectively. The QAS implementation steps were discussed in detail, before the appraisal of the Nigeria's parlous manufacturing sector, where it was highlighted that the major challenges facing the sector include: insufficient access to credit facilities, lack of infrastructure, and insufficient demand for local products as a result of the manufacturing of low quality and defective products. It was observed that the sector contributed only 4.2% to the nation's GDP and 4.19% in 2010, which are abysmally low when compared with agriculture contribution of 42.1%, 41.7%, and 41.4% respectively. On the need for the application of QAS in the Nigeria's manufacturing sector, the paper concluded that it will go a long way in reviving the sector's fortunes, minimize business risks, ensure timely release of high quality products that exceeds the customers' expectations, generate massive employment, fight poverty, create wealth, improve the GDP, and also enhance profitability and the exportation of quality products, which will consequently improve the much desired foreign exchange earnings.

Keywords: quality assurance scheme, quality assurance, quality control, Nigerian manufacturing sector, kaizen, continuous improvement, Poka yoke

1. Introduction

Although the concept of quality has been in existence for time immemorial, the study and classification of quality attained prominence just in the last century. It is defined as the standard of something as measured against other things of a similar kind; the degree of excellence; and a distinctive attribute or characteristic possessed by someone or something.

Also, defined as fitness for purpose; conformance to specifications; and the pursuit of excellence, quality in manufacturing according to Business Dictionary (2017), "is a state of being free from defects, deficiencies, and significant variations, which is brought about by strict and consistent commitment to certain standards that achieve uniformity of a product in order to satisfy specific customer or user requirements."

Initiatives, such as Quality Assurance (QA) is becoming increasingly prevalent as leaders in manufacturing industry recognize the need to compete in a rapidly changing world. Quality assurance comprises administrative and procedural activities implemented in a quality system so that requirements and goals for a product, service or activity will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention, and can be contrasted with quality control, which is focused on process output.

According to Eriksson (2013) [5], Quality Assurance (QA) aims at preventing defects by focusing on improving the processes used to manufacture products. It is therefore a proactive process that provides the means for creating a lasting quality. Assurance program, ensuring that everything from raw materials to inspection procedures are of the highest quality, as issues and defects from poor quality materials or third-party components are all reduced or possibly eliminated.

Also, Russell (2018) [15], explained that Quality Assurance is "all the planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality." QA streamlines production and helps to ensure that the final products meet the company's quality criteria. As the maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of delivery or production, QA ensures that the processes used to design, test, and manufacture products are performed correctly.

Quality assurance includes two principles: "Fit for purpose" (the product should be suitable for the intended purpose); and "right first time" (mistakes should be eliminated). QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes. The two principles also manifest before the background of developing (engineering) a novel technical product: The task of engineering is to make it work once, while the task of quality assurance is to make it work all the time.

As shown in figure 1, Quality Assurance in manufacturing incorporates planning, material requirements, design, product development, quality control, product validation, and implementation.

Fig 1: Quality Assurance Activities

2. The state of the Nigerian manufacturing sector

Regarded as those industries which are involved in the manufacturing and processing of items and indulge in either creation of new commodities or in value addition, the manufacturing sector is the engine of growth of any economy, as they account for a significant share of the industrial sector in developed countries. As the key variable in an economy and motivates the conversion of raw material into finished goods, manufacturing industries create employment, which helps to boost agriculture and diversify the economy, thereby assisting in the increase of foreign exchange earnings.

Oyayi (2012) [13], noted that manufacturing sector not only plays but also represents an important criterion in assessing a nation's development, as most developed countries have strong manufacturing base. She pointed out that growth in manufacturing has significant positive effects on employment creation, sustained increases in per capita income, technological innovation and adoption, competitiveness and economic growth of any country.

Also, according to Oburota and Okoi (2017) [8], the "manufacturing sector is the major determinant of the level of industrialization and real growth of any economy, as it plays a vital role in providing intermediate inputs, finished goods, increasing foreign exchange earnings, positive spillover effects and employment opportunities.

There has been a growing concern on the role of fiscal policy on the output and input of manufacturing sector in Nigeria, despite the fact that the government had embarked on several policies aimed at improving the growth of Nigerian economy through the contribution of manufacturing industry to the economy and capacity utilization of the sector.

Adenikinju and Chete (2002) [2], performed an empirical analysis of the performance of the Nigerian manufacturing sector over a 30-year period, and observed that the sector was performing with satisfactory growth levels from 1970 to 1980. However, they observed that after that phase, that there was a sharp decline in the growth and profitability of the Nigerian manufacturing sector, especially after 1983, the negative effects of the oil price collapse in the international oil market can be clearly seen on the sector's performance. Due to that global oil crisis, the revenues of the Nigerian government sharply declined which resulted in reduction in foreign exchange earnings, which forced the government to take several initiatives with the intention of strictly controlling its trade.

Unfortunately, the Nigerian manufacturing sector which is bedeviled by numerous problems and challenges among whom are power, policy summersaults, high lending rate, lack of infrastructures and capital, and manufacturing of low quality and defective products is yet to recover its lost glory.

Ayeni (2003) [3], pointed out that the Nigerian manufacturing sector is lagging behind in attaining sustainable growth because most of the time, their operators and the Nigerian authorities reacted to market situation by formulating short-term policies and strategies. He noted an important flaw in the economic policies of the country by arguing that there is less attention given to satisfying the needs of the domestic consumers due to low quality products, thereby making the demand for locally manufacturing products to remain low.

Commenting on the current state of the Nigerian manufacturing sector Ojo and Ololade (2013) [19], opined that manufacturing sector in Nigeria could literally be assumed to have a vast potential for a spot for economic development due to abundant labour force coupled with the agrarian nature of the economy. However, they explained that the absorptive capacity for labour expected from agriculture and other spillover effects were soon proved mysterious, as sooner or later do import substitution industrialization and other incentives to attract foreign entrepreneurs failed, resulting in a weak and infantry manufacturing sector.

According to Abolo (2017) [1], Nigeria's manufacturing sector contributes on the average a mere 4.19% to the national GDP, as it contributed only 4 per cent to GDP in 2011. He insisted that for Nigeria to be one of the twenty biggest economies in the world in 2020, the sector must be contributing a minimum of 15% yearly to its GDP and grow it steadily to a minimum of 30% by 2020.

The sector has been operating under very unfavourable environment, as more than 270 firms closed shop in 2016 due to lack of patronage of their products both in Nigeria and beyond, while others reduced production and retrenched workers.

Abolo (2017) [1], while quoting the Manufacturing Association of Nigeria (MAN), explained that the major problems facing the Nigerian manufacturing sector are insufficient demand for local products, insufficient access to credit, and lack of infrastructure. On the effects of the challenges, he noted that "MAN has officially declared that of its 2000 members, 30 percent mostly small and medium scale industries (SMEs) have closed down, 60 percent of them ailing while just 10 percent of them, notably the multinationals currently operate at sustainable level, and that between 2000 and 2016, over 900 manufacturing companies closed down or temporarily suspended production."

Other effects of the major challenges facing the country's manufacturing sector include: operating below installed capacity: at 47% in 2009 and 45% in 2010; losing business opportunities, incurring losses and closing shops; as shown in Table 1, in 2008 and 2009, the sector contributed only 4.2% to the nation's GDP and 4.19% in 2010, which are abysmally low when compared with agriculture contribution of 42.1%, 41.7%, and 41.4% respectively; inability to provide/create employment opportunities in a country where the rate of unemployment (particularly graduate unemployment) is very high; high debt burden to financial institutions both in Nigeria and abroad; relocation of

industries to neighbouring countries, unplanned inventories of both raw materials and finished products, inability to compete globally and earn foreign exchange for both themselves and the economy, etc.

Table 1: Manufacturing and Agricultural Percentage Contributions to the Nigerian GDP

Year	Manufacturing Contribution (%)	Agriculture Contribution (%)
1999	3.5	43.5
2000	3.5	42.7
2001	4.1	42.3
2002	3.7	42.1
2003	3.6	41.0
2004	3.7	41.0
2005	3.8	41.2
2006	4.0	41.7
2007	4.0	42.0
2008	4.2	42.1
2009	4.2	41.7
2010	4.19	41.40
2011	4.2	40.19
2012	4.2	39.2

3. The need for quality assurance scheme in the Nigerian manufacturing sector

As stated earlier, Abolo (2017) [1], quoting the Manufacturing Association of Nigeria (MAN), pointed out that apart from insufficient access to credit facilities, lack of infrastructure which includes electricity, roads, etc., that another major problem that faces the Nigerian manufacturing sector is insufficient demand for local products. This is mainly hinged on the manufacturing of low quality or defective products which cannot compete favourably with imported products.

In the ever dynamic manufacturing sector where emphasis has already shifted from achieving customers' satisfaction to exceeding his expectations, Nigerian manufacturing companies that aim to remain competitive in the twenty first century market must embrace Quality Assurance Scheme (QAS) due to its numerous benefits. This will enable them to win back the confidence of customers in locally manufactured products.

Gardner (2018) [6], pointed out that Quality Assurance Scheme helps manufacturing firms to meet their clients' demands and expectations. He insisted that the manufacturing of high quality products guarantees the customers trust and confidence, which in turn, assures competitive advantage, saves costs, and leads to improved profitability.

Some of the benefits of QAS which will reposition the ailing Nigerian Manufacturing Sector when applied include the following:

4. Quality consciousness

The most important advantage derived by introducing quality control is that it develops and encourages quality consciousness among the workers in the factory, which is greatly helpful in achieving desired level of quality in the product.

Cost and waste Reduction

Having quality assurance in place is especially helpful to manufacturing companies, as it enables them to reduce extra costs that accrue from re-testing, replacing, and re-selling of defective products. By checking the production of inferior products and wastages, QAS leads to considerable reduction of production cost.

Customers' satisfaction

Achieving maximum customer satisfaction through the production of quality products guarantees repeat purchases, which enables a company to increase its market share. When customers are not satisfied with a company's products, the backlash can damage the company's reputation; negatively affect future products and even an entire company's goodwill.

Effective Resource utilization

QAS ensures maximum utilisation of available resources which minimizes wastage and all forms of inefficiency.

Enhanced goodwill

By producing better quality products and satisfying customer's needs, QAS raises the goodwill of the concern in the minds of people. A reputed concern can easily raise finances from the market.

Higher morale of employees

An effective system of Quality Assurance is greatly helpful in increasing the morale of employees, and they feel that they are working in the concern producing better and higher quality products.

Improved employer-employee relations

QAS develops a better industrial atmosphere by increasing morale of employees which ensures cordial employer-employee relations, thereby leading to better understanding.

Improved sales and profitability

QAS ensures production of quality products which is immensely helpful in attracting more customers for the product thereby increasing sales and profitability. It is greatly helpful in maintaining existing demand and creating new demand for the product.

5. Quality Assurance Scheme

Quality Assurance Scheme (QAS) is therefore a manufacturing initiative of preventing mistakes and defects in manufactured products, and avoiding problems when delivering solutions or services to customers, thereby providing confidence that quality requirements will be fulfilled. Rather than focusing on inspection which adds no value to an already manufactured product, QAS emphasizes on attainment of quality right from the conception or design phase of a product up to manufacturing and delivery phases.

In manufacturing, QAS approaches help to manage and improve many processes like: raw materials acquisition, purchasing of third-party components and sub-assemblies, design and use of inspection procedures, complying with production processes, and responding to defects.

5.1 Quality assurance scheme methods

QAS methods entail activities such as development, design, production, servicing, and production, it also covers aspects of management of production, inspection, materials, assembly, services and other areas related to the quality of the product or service. QAS methods document what functions a product or system must fulfill, and what characteristics it must possess. They specify the required resources and ensure

that these resources are available.
For production, they specify the characteristics of incoming material and supplies, the qualifications of the people carrying out the work, and the tests required to verify actual versus specified qualities. For other systems, quality assurance methods specify performance levels and output parameters.

The quality assurance process is depicted in figure 2.

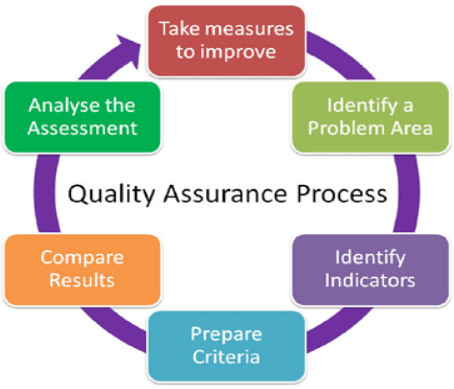

Fig 2: Quality Assurance Process

Although sometimes used interchangeably, Quality Assurance (QA) is different from Quality Control (QC), as QA is a process-oriented method that avoids defects from happening before a product is manufactured, while QC is a product-oriented method that checks for defects after the product has been manufactured. For instance, final inspection and testing are some quality control methods. In the manufacturing process, quality assurance happens before quality control.

5.2 Tools and techniques of QAS

According to Singh and Grover (2012) [16], the application of tools and techniques of QAS is a vital component of any successful improvement process. However, they observed that these tools and techniques can only be beneficial for any manufacturing industry after the proper training of their employees to enable them to understand and appreciate these tools effectively.

The tools and techniques include the following

Kaizen: Also known as continuous improvement, Kaizen refers to activities that continuously improve all functions and involve all employees from the CEO to the assembly line workers. Vorne (2018) [17], explained that Kaizen (Continuous Improvement) is a strategy where employees at all levels of a company work together proactively to achieve regular, incremental improvements to the manufacturing process. He pointed out that in a sense; it combines the collective talents within a company to create a powerful engine for improvement.

Poka Yoke: this is any process that can stop mistakes from being created, thereby ensuring that there are no defects within the production process. When a machine is designed to stop or at least sound a warning signal if it is not aligned correctly then 'Poka Yoke' is in action. Okpala, Anozie and Ezeanyim (2018) [10], explained that Poka yoke uses a wide variety of ingenious devices to prevent mistakes, and that one example is an automotive gasoline tank cap that has an attachment that prevents the cap from being lost.
The operator will be alerted to the fact that the machine has not been correctly aligned and instead of faulty goods being created, or the machine continuing and then perhaps break down, the operator will take the necessary steps to ensure that the problem is resolved before the faulty goods are created or before it leads to machine break down.

Benchmarking: Benchmarking is a self-improvement tool for organisations, it allows them to compare themselves with others, to identify their comparative strengths and weaknesses in order to adopt best practices for process improvements.

Design of Experiments: DOE is a systematic approach to investigation of a system or process. Here a series of structured tests are designed in which planned changes are made to the input variables of a process or system. The effects of these changes on a pre-defined output are then accessed.

Failure Mode Effect Analysis: FMEA is a systematic, proactive method for evaluating a process to identify where and how it might fail and to assess the relative impact of different failures, in order to identify the parts of the process that are most in need of change.

Problem Solving Methodology: This is a process of working through details of a problem to achieve a solution. Problem solving may include mathematical or systematic operations and can be a gauge of an individual's critical thinking skills.

Quality Function Deployment: QFD is a systematic approach to design based on a close awareness of customer desires, coupled with the integration of corporate functional groups. According to Rosenthal (1992) [14], QFD consists of translating customer desires (for example, the ease of writing for a pen) into design characteristics (pen ink viscosity, pressure on ball-point) for each stage of the product development.

Quality Improvement Teams: Quality improvement teams provide a means of participation for employees in quality decision – making. They aid in employee development, leadership, problem solving skills and lead to quality awareness which is essential for organizational change.

Statistical Process Control: SPC is a scientific visual method used to monitor, control and improve processes by eliminating special cause variation from manufacturing, service and financial processes. It is a key continuous improvement tool.

5.3 Other quality improvement techniques

The key to a company's performance lies in the achievement of targets that match the overall goals. QAS methods deliver output that satisfies quality goals, but they don't address efficiency. The application of the lean principles enable companies to maintain the level of quality they need while becoming more efficient. Six sigma principles complement quality assurance and lean principles by introducing statistical measurement into the operations. Companies that embrace quality assurance together with lean six sigma principles can reduce costs, improve performance and

produce higher quality output.

Lean

Companies apply lean principles to increase efficiency. They do this by continuously monitoring processes to reduce waste and unnecessary effort. This is especially important for small businesses, whose resources are limited. Lean principles identify and eliminate process steps that don't add value, repeated mistakes that take time to fix, and movement of people and materials without a productive purpose. According to Okpala (2013) [11], Lean is a manufacturing approach that is applied to achieve continuous improvement through the identification and elimination of wastes that are inherent in manufacturing approaches.

The seven wastes are transportation, excess inventory, unnecessary movement, waiting, over-production, over-processing, and defects.

Six Sigma

Six sigma principles focus on reducing defects. The term refers to a statistical value for almost zero defects. Measuring such defects is a key part of the system. A defect is an output that doesn't correspond to user expectations. Companies design processes simple enough to allow the production of low-defect outputs. Simple processes in production are especially valuable for small business because it frees up personnel for other business functions.

An overview of the principles gives the five functions of Define, Measure, Analyze, Improve and Control (DMAIC). Companies apply these functions to simplify their processes and determine how successful they have been in achieving zero defects in their output

6. QAS Implementation and Best Practices

6.1 Implementation of QAS

A QAS implementation plan generally include two basic areas: how to address errors (quality-related events), and how to improve practice before an error occurs (continuous quality improvement). QAS are mostly designed and implemented with customer satisfaction in mind.

Landerville (2015) [7], observed that the QAS "techniques lead to higher levels of customer satisfaction because organizations have developed products, services and programs that not only please customers, but also ensured the consistent delivery of what it promised." He listed the following as the QAS implementation steps: identify organizational goals, identify critical success factors, identify internal and external customers, develop a customer feedback mechanism, implement continuous improvement, select quality management software, and measure results.

However, Oregon (2016) [11], identified the following as QAS implementation steps:

A. Secure management's approval and support
   - The management's approval and support is a key to the successful implementation of QAS

B. Embark on a comprehensive staff training
   - Provide a detailed training of QAS to the entire staff, both at the onset and at regular intervals
   - Design a means to effectively document quality-related events (QREs) and educate staff appropriately
   - Collect all relevant details of the event, identify the root cause(s), and make a plan to avoid the same error in the future

C. Set up Quality Assurance teams

D. Identify one or two quality related parameters for measurement and improvement
   - Monitor to track successful improvements

E. Design a method to measure the identified area
   - Focus on quantitative measures that can show clear results
   - Use random samples where appropriate
   - Consider a simple method that can be accomplished in a reasonable amount of time by appropriate staff
   - Determine how often the measurement will be repeated, and make plans to ensure it is not forgotten

F. Set appropriate goals
   - Determine what is acceptable for practice, as perfection is not realistic target
   - Set an attainable goal and be prepared to update the goal when it is achieved
   - Include instructions on what the person taking the measurement should do if the goal is not met (e.g. who to contact)

G. Make new plans when goals are not met
   - Set a deadline for addressing of unmet goals
   - Be prepared to change policies or procedures in order to improve areas of deficiency

H. Quality Assurance is a Continuous Process that never ends
   - Continue to update your plan as necessary.
   - Over time, the entire process will be internalized and continuously improved upon.

The limitations of QAS implementation include the following

Too much theory: Manufacturing firms that are striving for perfection often go overboard. In an attempt to implement the "perfect" QAS, they often focus more on theory than on putting theory into practice.

Too many details: Companies often want their documentation to include as many details as possible. Evidently, this takes time and resources, and will result in a more difficult application of the documentation'

Too much rigidity: If a company's QAS is too rigid and inflexible, it will be difficult to improve when necessary. As a result, it may not guarantee the best results for the future.

Inadequate motivation - When organizations implement QAS because of external factors only it will be difficult to get the best results.

Less attention to customers: Manufacturing companies often pay more attention to quality to the detriment of customer satisfaction.

6.2 QAS Best Practices

Best practices in a company's QAS program all contribute to a host of benefits, including reduced costs, dramatically increased efficiencies and, ultimately, greatly enhanced customer satisfaction.

The five key best practices include the following

1. **Integration of a Robust ERP with QAS Capabilities Delivers the Highest Quality:** While many manufacturers are yet to adopt a fully automated system to ensure the quality of their product, gradually, more and more are transitioning into Enterprise Resource Planning

(ERP) with robust QA functionality to achieve these objectives. These solutions provide the tools needed to effectively manage quality assurance objectives at every point in the supply chain – from initial evaluation to finished product to distribution.

ERP systems also enable QA teams to monitor all of the systems and sub-systems in the production cycle for errors or defects so that the finished products are consistently of the highest quality, as well as safe and effective.

2. **Quality Assurance Scheme Yields Higher Customer Satisfaction:** Quality Assurance Scheme and customer satisfaction are inextricably interconnected. That's why manufacturers who rely on QAS during the production process are much more likely to deliver higher-quality products that will attract more loyal customers for the long term. A robust QAS capability is able to gather critical, real-time intelligence from within and without – from the manufacturing plant, distribution centers, human resources, etc., as well as from every link in the supply chain. Armed with all of this intelligence, manufacturers are not only able to produce higher-quality products; they can also deliver higher levels of customer service.
3. **Improved workflows mean reduced expenses and better decision-making:** Another by-product of an integrated QAS functionality is the ability to generate accurate forecasts that can anticipate future events in the supply chain and help to make workflows more efficient. Worthy solutions provide a broad range of business analytics that can shed light on the effectiveness of assorted workflows, including production planning, inventory and distribution. Studies indicate that use of QAS systems helps businesses make more informed decisions and significantly reduces costs.
4. **Quality products breed loyal customers:** If a manufacturer takes all the steps necessary to produce a first-rate product and deliver to its customers on time, the odds are very good that not only will they be repeat customers, but they will recommend their products to others. In other words, the benefits (and the profits) will continue to accrue over time. One additional way to earn customers' trust is to provide them with up-to-date quality assurance testing information on products they purchase, which reinforces the perception that the company is totally committed to quality and transparency.
5. **Compliance:** Compliance is a critical issue for all manufacturers and QAS capabilities will instill confidence that all regulations and standards are met across the board. To this end, the right QAS solution is able to collect all applicable data from integrated systems to monitor workplace safety and to prevent any potential workplace hazards. A QAS solution also facilitates generation of weekly or monthly safety reports. The system should also enable manufacturers to design their own testing procedures of incoming materials to make sure that they meet all the requirements, starting with the quality of raw materials and spreading throughout the entire manufacturing process.

7. Conclusion

Investing in quality assurance is indispensable for manufacturing industries today. It is most effective when it is put in place from the onset. This is because when quality assurance is done right, it provides confidence, tests the product, and enables companies to market their products with few worries.

Adherence to QAS principles helps to streamline production and ensure that a company's exacting standards are met throughout the design, development, manufacturing and delivery processes. It also helps to safeguard the quality of all raw materials, components, assemblies and finished products and to prevent any issues arising as a result of defective third-party components.

The application of QAS by the Nigerian manufacturing companies will go a long way in reviving their fortunes, minimize business risks, ensure timely release of high quality products that exceeds the customers' expectations, generate massive employment, fight poverty, create wealth, improve the GDP, and also enhance the exportation of quality products, which will consequently enhance the much desired foreign exchange earnings.

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