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Customized Software Development & Testing in Nigeria: Challenges and Way Forward

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Abstract:
In past and recent times, Nigeria which is known for high development and delivery of software face major challenges that affect the quality of software products being delivered to the customers. Software developers in Nigeria are facing the "trust challenge" from clients because of their inadequacies to produce quality software that meets the expectations of the clients in its operational environment. Hence, the need to identify the problems facing the software development industry and proffer solutions to them as this may go a long way in improving the quality of software being produced to meet the demands clients. The methods used to gather information for this paper are Literature searches/reviews, personal experiences and one-on-one interview from few software developers. It was found out that improper planning and standards, quick delivery schedules and drive for immediate profits are some of the major challenges facing the Nigeria software development industry. However, proper planning and standards, conducting thorough software testing and developers/testers putting their selves in place of customers are some of the way forward for the industry to meet its quality expectations.

Keywords: Software Development Process, Software Development Industry, Software Testing, Challenges and Way forward, Nigeria

1. Introduction
The advent of software has evolved to become very significant in our daily activities. It has become a important aspect of the world, with its application in mobile devices, home appliances, telecommunications, automobiles, airplanes, business, web, entertainment, education to mention a few. Therefore, there has been a high demand for improved quality (reliability, usability, dependability and maintainability) from users [1]. The software development industry is a very significant part of any nation because of its importance in developing software that meets individual and organizational needs. Everybody uses software one way or the other ranging from small systems such as applications running on mobile devices, laptops to large systems like security systems, the airplanes and traffic control systems. According to [2] "Software can generate 10 billion dollars annually if harnessed" [2].

The development process of any software is very crucial in producing high quality of that software as the activities involved should be carried out in order and as it is required either following traditional approaches or agile/extreme approaches. These approaches have emerged to help the developers and clients to improve the standard and quality of software in meeting specified requirements. One of the most important activity of the development process is software testing as it helps to detect faults before they are being delivered in order to assure the users to a large extent that the software would be operational for a specified or long period of time. Improper software testing can cost more than it can generate. Therefore, software should be tested to improve the quality of software and deliver a failed free system to the clients.

In Nigeria today, there are challenges facing the software development industry in producing high quality software and there is a need to address these challenges in order to meet the expectations of clients and improve the nation's economy. The objectives of this study are to identify the challenges facing Nigeria's software development industry with regard to software testing. The methods used in getting the information are through literature searches and reviews, personal experiences and interview with few software developers.

In order to grasp the content of this paper, it is important to first understand the basic concepts of software development process and software testing which are presented in section 2. The Challenges faced by the Nigeria software industry, the way forward (possible solutions) and conclusion are presented in sections 2.3, 3 and 5 respectively.

2. Theoretical Background

2.1. Software Development Process
This section presents the basic concept of software development process and the main activities involved in the development of software.

[3] defined the software development process as a structure imposed on the development of a software product. The structure can also be regarded as a software development model which should be incorporated by the software engineer(s) to simplify the process, methods and tools for the software development [3]. The software development process is a framework of the activities required to develop high quality software [4] and can also be referred to as Software Development Life Cycle (SDLC). According to [5] "software processes are complex and rely on people to creatively make decisions" [5]. The major software development activities include; requirements analysis, design, Implementation, Testing and Evolution (Operation and Maintenance) and a phase has to be completed before the next phase starts [6]. Brief descriptions of the activities are given as follows:

- **Requirement Analysis**
  In this phase, the functionality and constraints of the software to be developed must be defined by users appropriately [5].
- **Design**
  In this phase, the software to be developed has to be planned from the requirement specification   [6].
- **Implementation**
  In this phase, the designed software would be translated into a programming language [4]. The actual coding of the designed software takes place in this phase.
- **Testing**
  In this phase, the implemented software would be tested to find errors and defects and validated to check that it meets the requirements [5], though current approaches to software development have introduced testing throughout the SDLC.
- **Evolution**
  After the software has been tested, corrected and delivered, the software should be maintained to include updates and new patches [6].

2.2. Software Testing
In order to understand the subject of this study, it is important to know the basic concepts of software testing. This section presents review of some literatures on the definitions and the importance of software testing.
The testing phase is a very important phase of the software development process as it is used to assure the quality of software before it is being delivered. [7] stated that the "testing phase is a critical part of the quest for a high reliability in software and can take up to 60% of the entire development budget" [7]. Testing is still the most cost effective approach to building confidence within most software systems [8]. By testing, the level of risk can be identified, reduced or eliminated and decisions can be made [9].
Software testing is very vital to the development of software products, because it engages fully 40-50% of development efforts and as the level of quality increases, the development efforts increases. Software testing is a very broad area, which involves many areas, such as specification, design, implementation, maintenance, process and management issues in software development process [10].
Software Testing has been defined by various authors as follows:

- **Myers:** Testing is the process of executing a program with the intent of finding errors [11].
- **Bertolino:** Software testing consists of the dynamic verification of the behavior of a finite set of test cases, suitably selected from the usually infinite execution domains against the specified expected behavior [12].
- **Kaner:** Software testing is an investigation conducted to provide stakeholders with information about the quality of the product or service under test [13].
- **Luo:** The testing of software is an important means of assessing the software to determine its quality [10].
- **Bentley:** Software testing is a process of verifying and validating that a software application or program meets the business and technical requirements that guided its design and development, and works as expected [14].
- **Kapfhammer:** Software testing is the process of assessing the functionality and correctness of a program through execution or analysis [15].
- **IEEE:** Testing is the process of exercising or evaluating a system or system component by manual or automated means to verify that it satisfies specified requirements, or to identify differences between expected and actual results [16].

From the above definitions, it is important to note that software testing is a process that is intended to find faults in software, assess its functionality, verify that the software meets its requirements and expected behavior to determine its quality. Software testing is not to show correctness but to reveal faults is a fact agreed upon by most researchers in the field. Researchers are of the opinion that testing for bugs is more successful than testing for correctness.
It is also important to note that total testing of software is infeasible as all paths in a program cannot be tested effectively especially in a large systems. However, the remaining defects should be such that they are trivial and would still allow the software to operate without failing.
The importance of software testing in the software development cycle as stated in [6] include; Identification of Bugs and Defects, Information to stakeholders and reputation of company, Improvement in Product Quality, To Get ahead of any Competitive Developers, Keep Away any Hazards, Verification and validation, Reliability Estimation, Prove Usability and Operability, Prevent Defect Migration and Economic importance.
2.3. Challenges Facing the Development of Quality Software in Nigeria
This section enumerates and describes major challenges facing the Nigerian software development industry in producing quality software as determined from literatures, experiences and relation with few software developers. [17] stated that "there are no established agencies to monitor issues pertaining to software development as it affects quality in Nigeria" [17]. [18] also stated that "improper software project cost (effort and money) estimation is one of the major reasons why software projects fail" [18].

Furthermore, Dr. Evans Woherem (Former Executive Director of Operations & Services, Unity Bank, Nigeria) in 2004 as stated in [19], enumerated some challenges facing the software development industry in Nigeria. The points enumerated are given as follows:

- Poor development practices and project management.
- No dependability on Software i.e. safety, reliability, security.
- Poor software quality, does not meet necessary level of ISO compliance
- Drive for immediate profit. Therefore, normal software development cycle is not
- completed.
- Lack of software quality assurance.
- Most of the software lack scalability and cannot meet future demands of the
- users.
- Software design in most cases, solve short term requirements only.

[19] also highlighted some of the problems (using the banking system in Nigeria as a case study) facing the Nigerian software development industry as; low adoption rate of technology, poor implementation of software, enormous losses from failed implementations and compliance penalties, poor planning resulting in high level of stress and quick improvisation [19].

The findings from personal experiences and observations shows that software testing in Nigeria has not been very encouraging, as there are very few "professional software testers" in the software development industry (recall software testing is a major factor of software quality) and software developers do not think it is necessary to adopt any software development model or test software before it is delivered to the customer because they think it is time and money consuming. Their concern is to get the software delivered and get payments for the work done quickly. Even in rapid approaches to software development where software is delivered due to quick delivery schedules, the proper standards are not taken into consideration. Furthermore, software development and the need for proper testing are not being taught effectively in most Nigerian universities hence, the few professional software testers and researchers in the industry. Finally, most software developing companies confuse testing as a correctness check instead if its major intent of finding faults.

The consequences of these challenges described above are the facts that customers would not be satisfied and subsequent projects would not be given to the developer or development team. Also, for safety critical systems and business systems, there could be loss of life, properties or financial instability which would turn out to worsen the economy of the country.

3. Research Methodology

3.1. Way Forward

Many of the challenges facing the Nigerian software development industry in producing quality software have been discussed in the previous section and the question now is "what is the way forward"? This question would be answered if:

- A standard agency governing/overseeing the quality of software products is established.
- The agency does its work with all discipline.
- Developers and testers are not money driven.
- Developers see themselves as the customers to be able to critically asses the project at hand.
- Individuals or teams are trained to become professional testers.
- Software developing companies begin to see quality assurance as a major part of software development.
- Software companies do proper feasibility studies on the costs of software projects given to them.
- Software companies should incorporate independent testing teams [17].
- Customers and developers agree on the methodology to use for carrying out projects.
- Customers, developers and testers work cooperatively.
- Developers and software testing teams know and are up-to-date about techniques and tools used in practice.
- Software Testers are involved in all phases of development [19].

4. Research Findings and Result

This study has been able to identify major challenges facing the software development industry in Nigeria and has also proffered possible solutions (with regards to software testing) to the challenges.

5. Conclusion

This study will help to greatly open the mind set of individuals (software developers, stakeholders, customers and users) and organizations involved in the development and quality assurance of software on the best practices for the improvement of software quality. If the solutions proffered are put in place, the software development industry in Nigeria would be second to none and would improve the economy greatly.

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