

## **Design of a web – based online Contract Administrative System platform of an Engineering firm**

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### **Abstract**

This paper is aimed at designing a dynamic web – based Contract Bidding Information System that will be used to register details online to enable bidding for advertised contracts. It was motivated by the growing recognition of the need to modify bidding operation previously done manually. The Structured System Analysis and Design Methodology (SSADM) was used to develop a contract bidding system. A web – based application will be developed to enable bidders register and submit their biddings online.

**Keywords:** Design, Web – based, Software, E – Platform, Bidding and Contract.

### **1.0 Introduction**

A contract is a written or oral legally binding agreement between the parties identified in the agreement to fulfill the terms and condition outline in the agreement for the enforcement of contract among other things is the condition that the parties accept the terms of the claimed contract. Historically this was not commonly achieved through signature or performance, but in many jurisdictions – especially with the advance of electronic commerce the form of acceptance have expanded to include various forms of electronic signature. Contract management involves the administrative activities associated with handling of contract, such as invitation to bid evaluation, award of contract implementation, measurement of work completed and computation of payment. It also includes monitoring contract relationship.

Addressing relating problems, incorporating necessary changes or modification in the contract ensuring both parties to meet or exceed other expectations and actively interacting with the contractor to achieved the contracts objectives(s). Monitoring the performance of contract is key function of proper contract administration. The purpose is to ensure that the contractor is performing all duties in accordance the contract and for the agency to aware of the address any developing problems or issue. Small value or less complex contract normally requires little, or any, monitoring. However, that does not preclude the possibility of more detailed monitoring if deemed necessary by agency, conversely large

Contract may need little monitoring if the items or service purchased are not complex, with the contract or performance or level of risk associated with the contract (comptroller, 2016) common commercial contract include employment letters, sales invoices, purchased order and utility contracts complex contract are often necessary for the construction project, goods or services that highly regulated, goods or service with detailed technical specification, intellectual.

Property (IP), agreement and international trade most larger contracts requires the effective use of contract management software to aid administration between multiple parties (Aberdan Group, 2007).

### **1.1 Statement Of Problem**

It has become imperative for Engineering firms metamorphose from manual contract bidding to computerized/online operation as result of some inherent problems associated with manual operations as shown below:

1. Additional cost value to bidder's error: purchasing agency lots of money due to paper bid submission errors. Even a diligent bidder is apt to omit an occasional checkmark, make simple math errors, and fail to complete a required form or over look signing on a dotted line.

2. Travel cost /risk-Bidder incur travel and direct staff labor cost to pick up bid packages attends required the owner-agency meetings and returns sealed bid to an owner-agency. This can include gas, pay for employees, and fees for couriers.
3. Progress monitoring- this involves the monitoring of a contract already in existence. A lot of multimedia packages that enable sharing of pictures and videos are now used to avoid time wasted normally in supervision- in person. It also reduces the amount of labour/ work hour have been used to go personally check progress.

As a result of these afore mentioned problems a computer will be designed to handle all bid process on the electronic platform, enable bidders upload, edit and register their credentials online and also monitor work progress online while the project is being executed.

## 1.2 Aim And Objectives Of Study

The aim of this study is to develop and implement a contract administrative system (Web Based Project Management System WPMS) that will be used to automate the administrative processes involved in contract administration.

1. To develop an online website platform that will examine the flow of construction documents and establish new protocols if necessary.
2. To develop a system that will enable contractors to register their details and upload their credentials online.
3. To develop an online system that will possess an integrated bidding mechanism feature where the registered contractors can make bids for the contracts available.

## 2.0 Conceptual Framework

Exari (2016) introduces the Exari contracts software as the be – all and end – all of contracts life cycle management software. Managing and stream lining the entire life cycle from creation to archival with intuitive negotiation , creation and collaboration tools, customized reporting, risk scoring to speed up low risk deals and so much more. The software has strong APIS for connecting to upstream, mid stream, and downstream systems, including standards – based integration methods (web services etc) and story standard, support for data and document portability (XML, JSON etc). The software is robust, reliable and that scales to meet the needs of large enterprise with very large user communities (Exari, 2016).

Web based project management software platform (WPMS) have been designed to remedy many of the issues that affect the average construction project. Typically a large number of parties are normally involved in a project, the owner, engineer, general contractor, subcontractors, consultants etc (Lam and Chang, 2002). The project managers are continually moving issues from one entity to another as the industry is fragmented due to the multidisciplinary and organizational nature (Nitithamyong and Skibniewski, 2006). The availability of timely information is critical to maintain the construction schedule but the construction industry has suffered from difficult to access and incomplete information (Stewart and Mohamed, 2004). The implementation of IT in the construction industry is increasing and is now routinely used in some form during the management of a project. However WPMS have not been implemented until the late 1990s and most specifically until the last ten years. Engineering News Record in the United States reported that the number of construction related firms using web based management systems rose by 16% from the years 2002 to 2004. The report also estimated that the number of design teams or design build teams prepared to set up internet based management teams was doubling every six months (Hurtado, 2003). The general contractors do not have any control over which platform the design team uses. The system is already in by the design firm by the time the project is put out for bids and the general contractor and subsequent contractors and suppliers that will take part in the project will need to be familiar with the protocols needed for system implementation. The general contractor by virtue of position needs to ensure all of the information gets to the design team in the format that is applicable to the contract. The general contractors and suppliers may not be managed digitally during the bidding process. Some WPMS platforms being used allow email with attachments, while others offer a File Transfer Protocol (FTP) option enabling the user to upload large bundles of data.

**Submittal Review Process (SRP):** Submittals are an integral part of any contract/project with written specifications. The submittal review process ensures that the products, procedures and applications called out in the specifications and contract drawings are the same as being supplied and installed by the contractor

(Russo, 2006). The term submittal include shop drawings, product data, product samples, installation details, performance characteristics and anything that may be specified for by the design team in the specification. Multiple facets of the construction process will have shop drawings which lend themselves to adapting the original contract drawings in CAD format directly to a shop drawing. However designers do not want title blocks and drawings to be changed and submitted as a shop drawing (Thorburn, 2005). Submittals and shop drawings need to be drawn or provided with the designer's intent and dimensions, but it is the fabricator or supplier who will provide to most detailed and specific product data and drawing for review by the design team.

All submittals are important, whether the submittal is product specifications structural steel connections or the layout of the mechanical duct work; all submittals work together to ensure the project is built per the designer' intent and to ensure the structure is safe and all systems contained within is operated as intended. Complete and accurate implementation and construction of the design intent is critical for the project's success (Delapp, et al, 2004). New technology has already been integrated into the shop drawing process with the use of Computer Aided Design Files, allowing subcontractors and suppliers to more accurately detailed structural elements with three dimensional models, or overlaying contractor drawings over original design drawings. Some software alerts the fabricator or detailed of any areas that are not joining properly with the provided dimensions in the contract drawings. When issues arise during the shop drawing phase, issues can be corrected with Requests For Information (RFI) or clouded areas on the documents with express questions for the engineer when these issues are addressed at the earliest stages costly rework and schedule delays are avoided in the field. When addressing structural shop drawings, it is important to address liability. Engineering firms whether part of the design team or as a reviewing consultant will usually want or require the input from the general contractors in regards to the structural shop drawings (Elovitz, 20003). A question common to design firm s is whether the shop drawing should be reviewed if the general contractor has not made comments on the submitted documents. For financial and liability reasons, a good practice recommend by the consulting – specifying Engineer is to require the review and approval of structural drawings by the general contractor prior to the review of the design professionals ( Friedlander, 2000). Other design elements may not be as critical to occupant's safety, but just as important to the owner are equipment cut sheets and shop drawings.

Software platform integrating operations and/or estimating with accounting allow massive amounts of empirical data and estimating spreadsheets to be seamlessly integrated into a business's accounting software. Wireless technology and its use continue to increase with powerful applications on mobile devices and the ability for onsite superintendents to utilize the World Wide Web without the installation of a hard phone or cable line. As the onsite use of computers and internet increases so does the viability of web based project management software. Designers and owners are increasing their use of these platforms to have more control and visibility of the multitude of documents involved in a project (Nitithamyong & Skibainewski, 2006). Imaging software and hardware continue to increase their digital footprint. Management needs to be aware that the capital investment in hardware needed for imaging and documentation can be substantial. The use of a third party for such functions may be more viable. Solid documentation and accounting practices should provide the management staff with critical points of whether to make large capital purchases. There not only needs to be good fiscal policy prior to purchase and implementation, but a dedication to training. Training needs to be fully supported by the management team, if not the software will not get used as the investment will not reap the planned dividends.

Implementing Training: An effective training system is a set of processes designed to transform organizational inputs into output that meets organizational needs (Blanchard & Thacker, 2007). Training needs to compliment a company's strategic plan, address areas where a need for training has been identified and meet that need in a manner conducive to long term retention and implementation. A training process model as designed by Blanchard and Thacker breaks the training model into six phases, development phase; implementation phase and evaluation phase.

## 2.1 Bidding Softwares and Applications

1. **Coconstruct:** Coconstruct is a project, financial, and client management system for custom home builders and remodelers. It is the only single – entry estimating system that allows each user to enter a piece of information once, and have that data flow directly from the estimate, specifications, selections, bids, change orders, budgets and to and from quick books – with no double entry. Users can manage

their projects from their tablet or desktop, in the field with this mobile app. In addition to the fully integrated financial system, co-construct streamlines scheduling, communication, client and sub - contractor portals, files, photos, to-dos, time clock, job log, warranty and more.

## **2. Pipeline Suite Bid management software**

Pipeline suite is a web – based bid invitation software with an integrated online plan room for general contractors. The solution allows general contractors to email or fax bid invitations and agenda to subcontractors and vendors.

Pipeline suite comprise of three integrated – Pipeline RFQ is bid invitation software, pipeline OPR allows uploading plans and specs for subs and pipeline Pre Qual allows general contractors automate the subcontractor qualification process.

## **3. Smart – Bid Bid Management Software**

Smart Bid is an online construction bid software designed for general and prime contractors to manage sub-contractor data, pre – qualify subcontractors share project documents and send invitations to bid. As a web – based system, all communications, files, project and sub -contractor data are stored in a secure online portal. Approved users can access their data at any time, from any location via a web browser or the smart bid mobile app available for IOS, Andriod and windows mobile devices. Users can tap into their private sub – data base and filter for qualified subs or access the integrated smart insight construction network to select the most qualified subs to invited to bid on every project,

## **4. Building – connected software**

Building connected is an online bid management solution designed to serve general contractors and sub - contractors across the construction industry. The solution helps to streamline the building process, manage projects and build a network of professional contacts involved in the construction projects.

Building connected offers a basic version which helps users to manage the entire pre – construction process, from vendor qualification to sending or inviting bids.

## **5. iSqFt for General Contractors software**

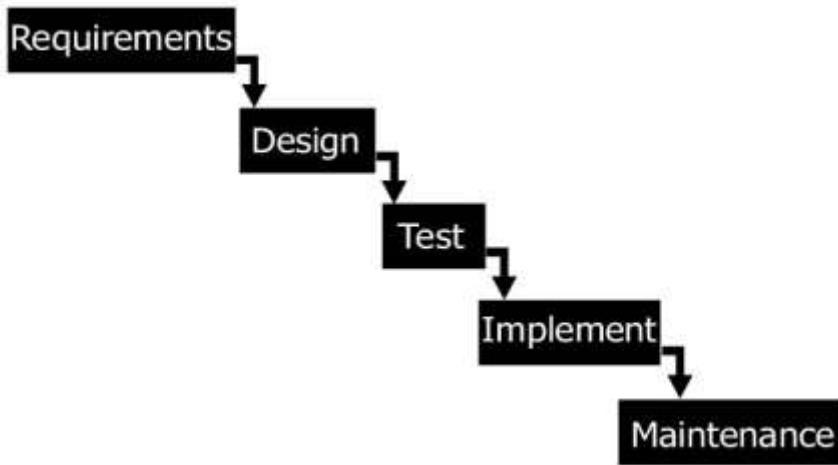
With iSqFt contractors of any size can streamline their entire pre – construction process and bid effectively. It is designed to address the unique challenges of general contractors, design – build firms and construction managers, iSqFt's customizable web – based system brings together every facet of a contractor's bid process into a single application.

### **3.0 Methodology**

The application development method used in this work is the SSADM (Structured systems analysis and design methodology). It uses a combination of text and diagrams throughout the whole life cycle of the design, from the initial design idea to the actual physical design of the application.

The software design will follow a top-down approach. This top-down approach which was proposed by Agarwal (2010) is said to be simple, efficient and effective. He further stated that the top-down approach starts from the highest level component of the hierarchy and proceeds through to lower levels.

A top-down design approach starts by identifying the major components of the system, decomposing them into their lower-level components, and iterating until the desired level of detail is achieved.



**Fig 1: Top Down Approach**  
(Source: B. B. Agarwal, S. P. Tayal, M. Gupta, 2010)

**3.1.1 Requirements:** This is the process of gathering the software requirements from clients, analyzing and documenting them. The goal is to develop and maintain sophisticated and descriptive ‘System Requirements Specification’ document.

The data used in this research work were obtained by interviewing of contractors and sales executives, observation and examination of manual contract records. During the interview, questions were asked the client and end-users to know their ideas on what the software should provide and which features they want the software to include.

**3.1.2 Design:** Here, the software graphical user interface was first designed after the requirement gathering. Graphical User Interface provides the user graphical means to interact with the system. GUI can be combination of both hardware and software. Using GUI, the user interprets the software. The program code was then written in preparation for testing.

**3.1.3 Testing:** The software tester prepares test cases for different sections and levels of the code, executes the tests and takes appropriate reaction. However, the manual testing was performed (without taking help of automated testing tools). Manual testing is time and resource consuming.

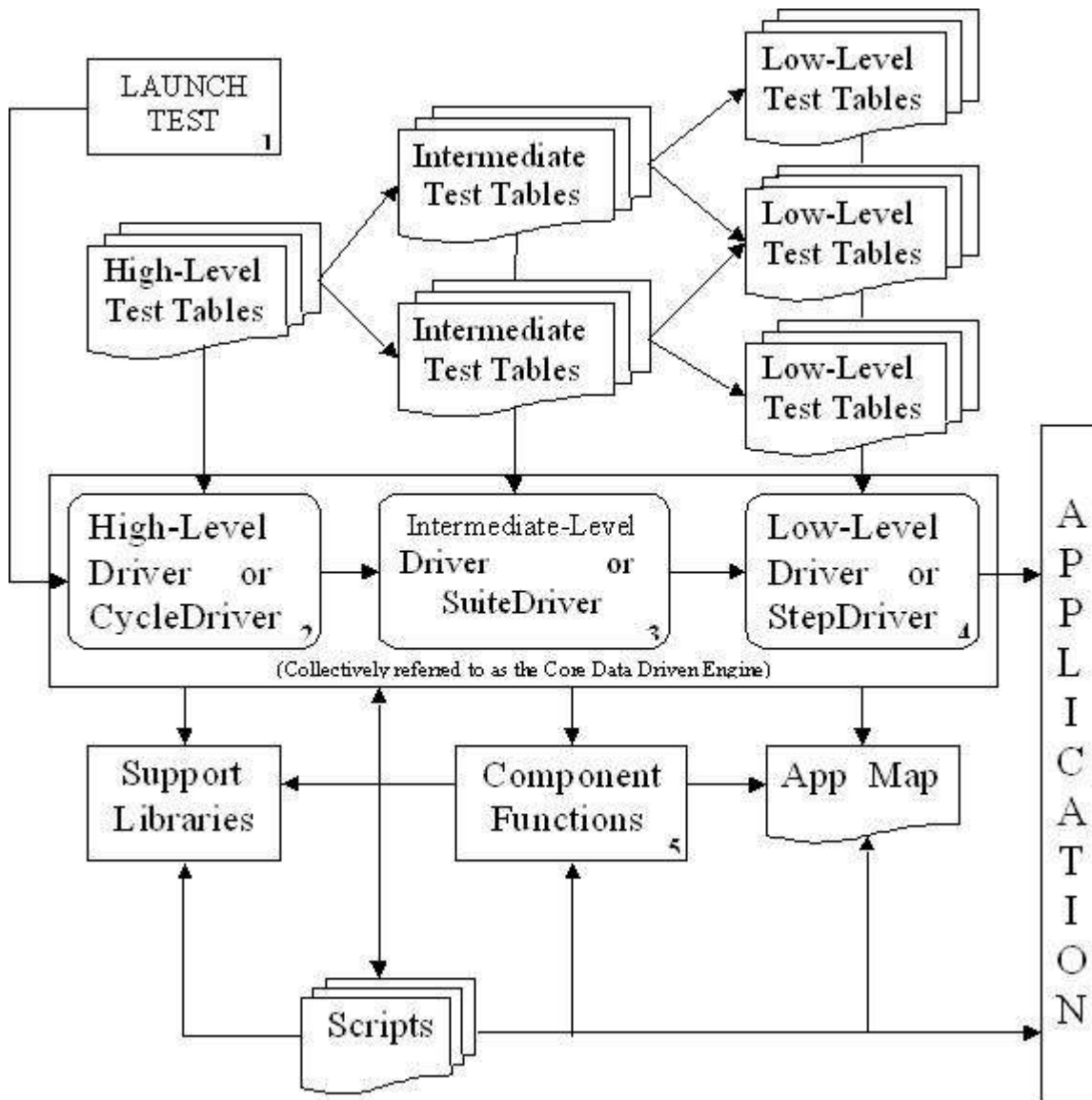
**3.1.4 Implementation:** These steps involve installation and use of the software after all agreements are met. The software development methodology that will be used to develop the contract bidding system will be the Structured System Analysis and Design Methodology (SSADM). The expected outcome of this study will be a developed software application that contractor’s will use to enable bidders register and perform biddings on the E – platform. This software will tackle most of the issues associated with the paper model.

**3.1.5 Maintenance:** It stands for all the modifications and updating done after the delivery of software product.

Furthermore, using the top-down method, a complex problem is separated into simpler parts, which can be programmed easily. At each stage, the instructions or steps can be checked for errors in logic, corrected or modified without any effect on the other subprograms. The result will be a truly modular program that satisfies the requirement, which says “a good program can be modified easily”, University of Dar es salaam; MT 512 Lecture Manual, (2014).

### 3.2 High Level Model Of The Proposed Software

The diagram below shows the high level model of the proposed system. The application interface is clearly specified, with the test tables and support libraries.



**Fig 2 High Level Model of the Proposed System**  
(Source: Field Work, 2018)

### 3.3 Feasibility

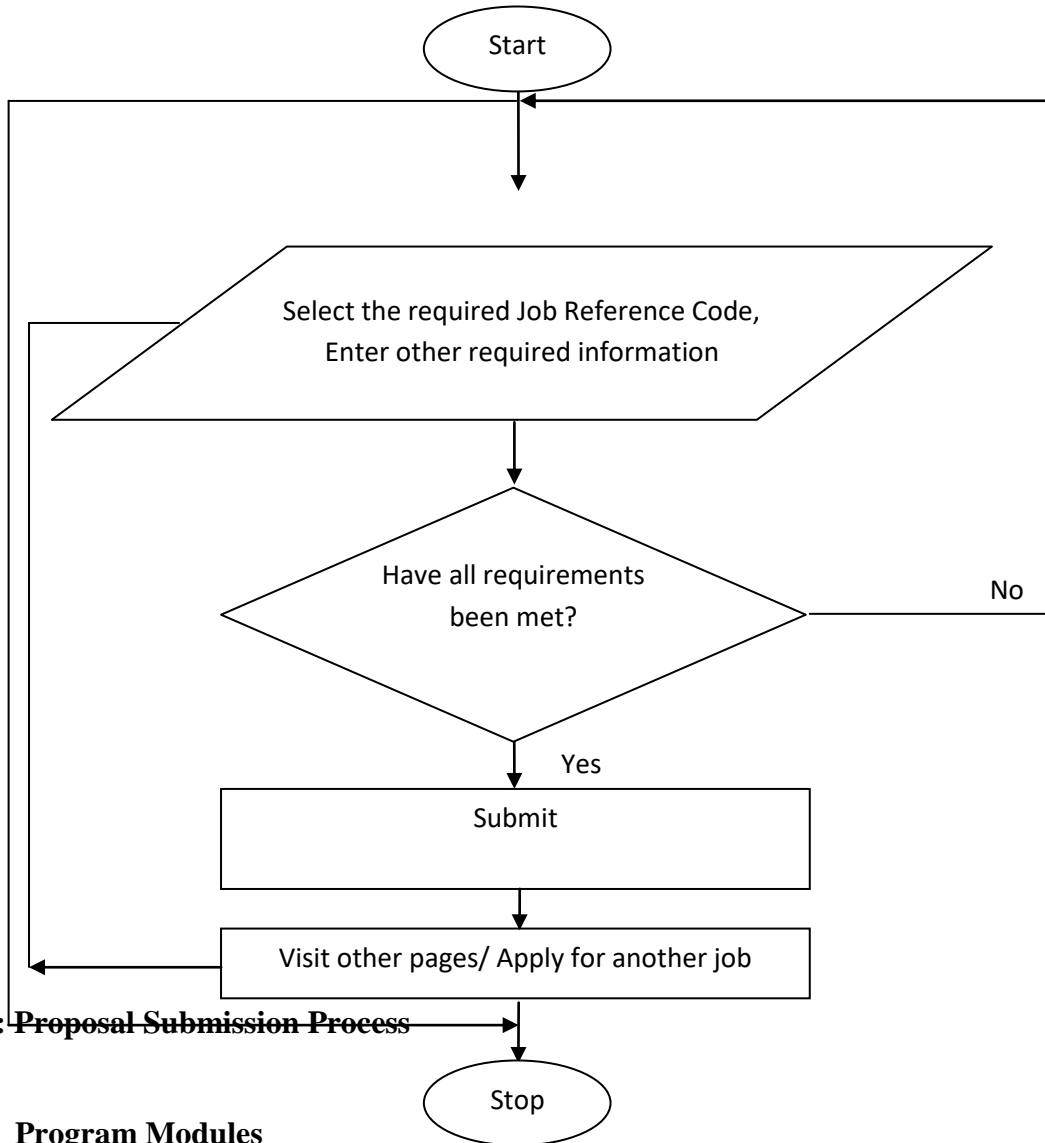
A feasibility study is important because it drives the development of the project proposal, which can be presented to senior management to gain their commitment to the project and to obtain project funding. Furthermore, during the creation of the feasibility study, risks associated with the project are identified, providing valuable input into the risk management efforts. Feasibility should be reviewed throughout the project, Whitten et-al (2004). The feasibility study indicates: Operational Feasibility, Technical feasibility and financial feasibility.

The new system, after development, will implement a contract Administrative System (Web-based Project Management System WPMS) that will be used to automate the administrative processes involved in contract administration.

### 4.0 Objectives Of The Design

The objectives for design of this application software “Contract Bidding System” (CBS) are to:

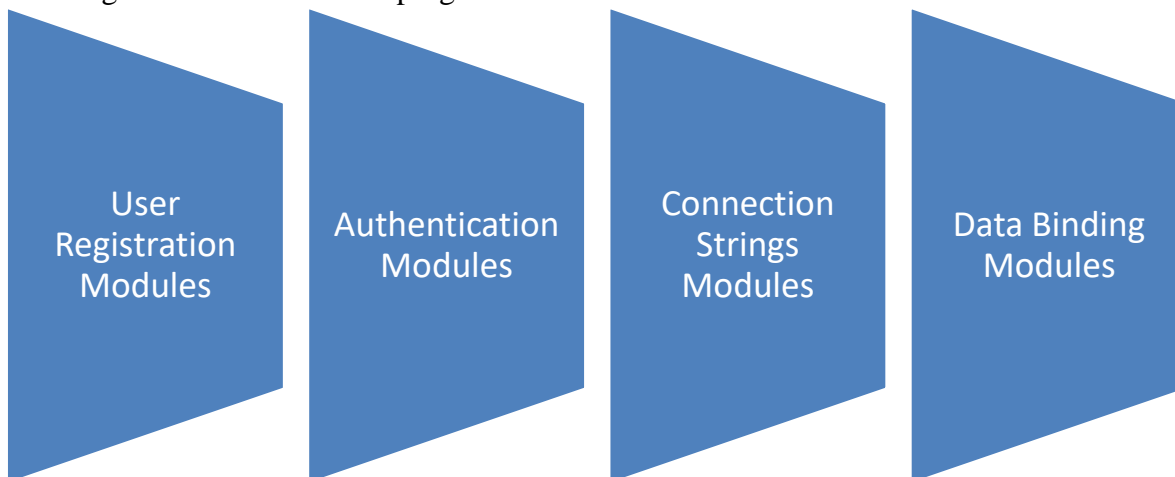
- i. Develop an application with simple user friendly interface for its users.
- ii. Integrate a feature which will help administrators to collect relevant information from contractors, this will help to identify hit-and-run contractors.
- iii. Ensure that reliable storage and database design is provided for managing user information.
- iv. Reduce paper applications for contract applications and proposals.



**Fig. 3: Proposal Submission Process**

#### 4.1 Program Modules

The diagram below shows the program modules used:



**Fig. 4**

#### 4.2 Hardware and Software Requirements

##### 4.2.1 Hardware Requirements

The following hardware components should be made available for full operation and performance:

1. A hard disk drive of about 80 (GB) and above.

2. A Pentium M (2.0 GHz) processor.
3. A flat screen monitor.
4. A RAM of at least 1.0 GB and above.
5. An enhanced keyboard.
6. A printer.
7. A UPS.
8. Flash drives for backup files.

#### 4.2.2 Software Requirements

This refers to all programs, which the computer needs to execute a complete process. For this software to run without any hitch, the following have to be installed;

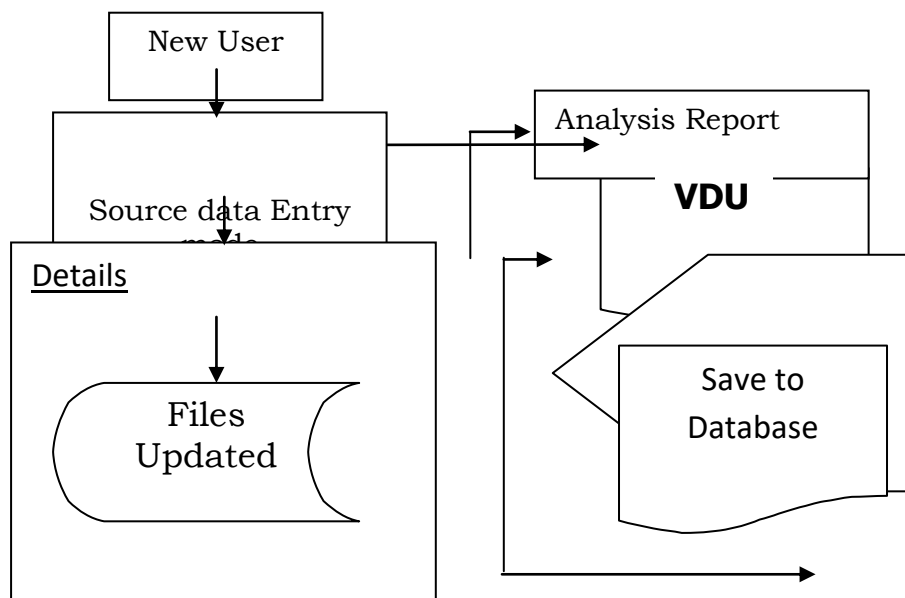
- (i) An Operation system, Microsoft Windows (XP, 7 or 8)
- (ii) Dot Net framework 3.0, 3.5, 4.0 or 4.5.
- (iii) Reliable antivirus software.
- (iv) MySQL Database program

#### 4.2.3 Input /Output Design

The aim of design in any system development is to make data entry easy, and logical flow-charts free from errors. There is need for the operator to know the following during the entry:

- i) The space allocated to each field.
- ii) Field sequence, which must correspond to that in the source document.
- iii) The format in which the data are entered.

The validity of the input determines the accuracy of the output. The input presented must be as accurate as possible. This should be monitored so that illegal/wrong data would not be entered.



**Fig 5:** Overall Data Flow Diagram of the New System

#### 5.0 Conclusions

The design of the contract administrative system for to automation of administrative processes involved in contract administration has been done to improve the old system. This new system, unlike the existing one has features that make it unique, effective and more reliable. The features include:

- i) It is user friendly and simple to use.
- ii) There are reduced error occurrences to the barest minimum.
- iii) Time taken for the operation will now be faster because a secure database has been introduced.
- iv) It ensures that contractors are duly registered, with the genuine credentials, to minimize “hit and run” contractors.



- v) The high level of operating efficiency, which has been incorporated into the new system, has helped immensely to enhance quick decision-making.
- vi) There is improved confidence among contractors and business executives.

## 5.1 Recommendations

Contract may need little monitoring if the items or service purchased are not complex, with the contract or performance or level of risk associated with the contract (comptroller, 2016) common commercial contract include employment letters, sales invoices, purchased order and utility contracts complex contract are often necessary for the construction project, goods or services that highly regulated, goods or service with detailed technical specification, intellectual. This work is recommended for business executives, contractors, sales executives, and other numerous professions.

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