

Project Report

On

“3D VISUALIZATION OF WELL TRAJECTORY”

Submitted in partial fulfilment of the requirement for the degree of Bachelor of
Technology in Information and Technology

At

Exploration & Development Directorate
Oil & Natural Gas Corporation Limited, Dehradun



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Certificate of Completion

This is to certify that the project report entitled “**3D Visualization of Well Trajectory**” carried out by **Shubham Mathur** student of **VIT University, Vellore** pursuing Bachelor of Technology is hereby accepted and approved as a credible works, submitted in the partial fulfilment for the requirement of degree of Bachelor of technology. It is a bonafide record of the work done by them under my supervision during their stay as a project trainee at **OIL AND NATURAL GAS CORPORATION LTD.**



(V. K. SHARMA)

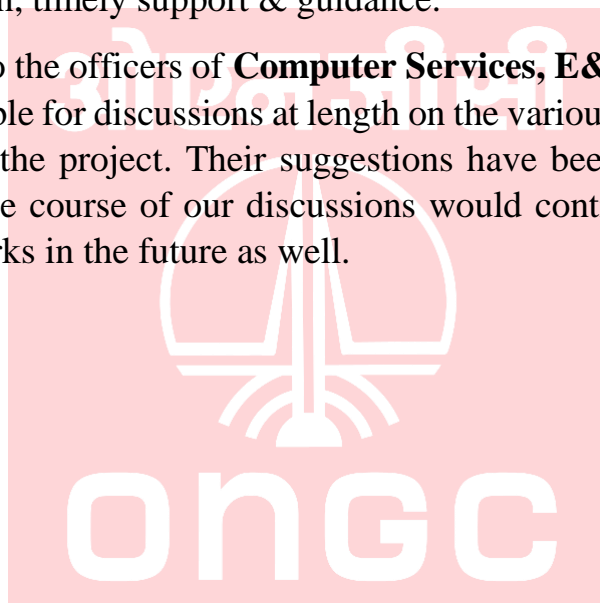
ACKNOWLEDGEMENT

The project bears the imprints of the efforts extended by many people to whom I am deeply indebted.

I am grateful to **Mr. V.K SHARMA**, GM (Prog.), E & D Directorate, ONGC, Dehradun for giving me the opportunity to work in E & D Directorate for the fulfilment of my project.

I would like to thank **Mr. Amit Kumar**, E & D Directorate, ONGC, Dehradun for their cooperation, timely support & guidance.

I am also grateful to the officers of **Computer Services, E&D Directorate**, who were always available for discussions at length on the various concepts that could be incorporated in the project. Their suggestions have been valuable and their teachings during the course of our discussions would continue to be a guiding principle in my works in the future as well.



DECLARATION

I hereby declare that the project work entitled “**3D Visualization of Well Trajectory**” is an authenticated work carried out by me at **OIL AND NATURAL GAS CORPORATION LTD.** under the guidance of **Mr. V.K SHARMA** for the partial fulfilment of the award of the degree of B.Tech. This work has not been submitted for similar purpose anywhere else except to our respective institutes.

Date: 29 - June -2016

Place: Dehradun



SHUBHAM MATHUR

INDEX

S.no	Content	Page No.
1.	Introduction to Project	6
2.	Introduction to ONGC	7
3.	Software Development Life Cycle	22
4.	Developing Environment	29
5.	Use Case Diagram	34
6.	Class Diagram	35
7.	Testing & Implementation	36
8.	Future Scope and Recommendations	39
9.	References	40
10.	Project Snapshots	41

Introduction to 3D Visualization of Well Trajectory

3D Visualization of Well's Trajectory is a software which is developed for three dimensional visualizations of the oil and gas wells. Any company in the drilling sector requires proper visualization of the drilling process based on the data provided by the geo-scientists. In this project user can enter the data file and the software will present the visualization of the corresponding drilling well.

The main objective of ONGC is to explore for oil and gas in tentative areas and a particular step up step procedure is followed to do so as the drilling of wells is a very expensive procedure and costs millions. One of the initial steps is by the Geologists along with the Geophysicist is to identify the area where oil and gas could be found and then imaging over those areas is done but the data that being obtained from such geological survey are not very structured and as we already know that the drilling procedure can cost millions so we have to be sure before going to further procedures. During the drilling process we have to maintain various casings in order to prevent well from collapsing. This project aims to develop a tool which helps to visualise the wells trajectory in 3-dimension which provides better and a more efficient and feasible methodology for the drilling of wells in the area. This provides a better study for the people involved and also improves the development of wells and even it is necessary for future reference as one can always go back and analyse if there had been any problem during the drilling or with the trajectory. Also, to identify whether there had been any dry patch i.e. where nothing was found. This also helps to get an idea of the surrounding area where further drilling could be done for the exploration of oil and gas wells.

We are grateful to the Exploration and Development Directorate department for providing us the opportunity and the environment to enhance our experience of industrial exposure in such short period of time.



Introduction To ONGC

“I would suggest ONGC to give world leadership in management of energy source, exploration of energy resources, diversification of energy sources, technology in Underground Coal Gasification, and above all, finding new ways of tapping energy wherever it is, to meet the ever growing demand of the country”

-HON'BLE EX-PRESIDENT DR. APJ ABDUL KALAM

Oil and Natural Gas Corporation Limited (ONGC) is an Indian multinational oil and gas company headquartered at Dehradun, India. It is one of the largest Asia-based oil and gas exploration and production companies, and produces around **77% of India's crude oil** (which is equivalent to around **30% of the country's total demand**) and around **81% of its natural gas**.

It is one of the largest publicly traded companies by market capitalization in India. According to a studies conducted by Platts Energy Business Technology, ONGC is among top 250 Global Energy Companies. Since its inception ONGC has produced more than **600 million metric tonnes of crude oil** and supplied more than **200 billion cubic meters of gas**.

Today, **ONGC is India's highest profit making corporate** and as per a survey conducted by the US-based magazine 'Global Finance' ONGC has been judged as **Asia's best Oil & Gas company**.

ONGC leads the list of Indian companies listed in Forbes 400 Global Corporates and Financial Times Global 500 by Market Capitalization. Its only fully-integrated petroleum company in India, operating along the entire hydrocarbon value chain.

VISION OF ONGC

“To be a World-Class Oil and Gas Company integrated in Energy Business with dominant Indian leadership and Global Presence.”

STRATEGIC VISION: 2001-2020

Focusing on core business of E&P, ONGC has set strategic objectives of:

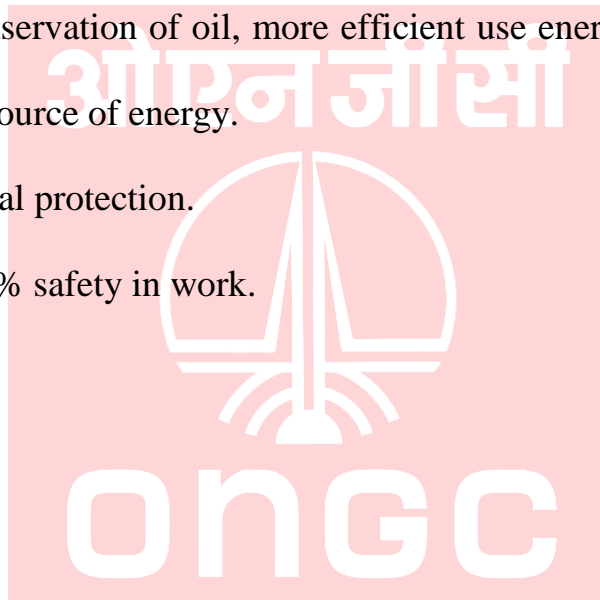
- ❖ Doubling reserves (i.e. accreting 6 billion tonnes of O+OEG) by 2020; out of this 4 billion tonnes are targeted from the Deep-waters.
- ❖ Improving average recovery from 28 per cent to 40 per cent.
- ❖ Tie-up 20 MMTPA of equity Hydrocarbon from abroad.
- ❖ The focus of management will be to monetise the assets as well as to assetise the money.

MISSION OF ONGC

- ❖ Dedicated to excellence by leveraging competitive advantages in R&D and technology with involved people.
- ❖ Imbibe high standards of business ethics and organizational values.
- ❖ Abiding commitment to health, safety and environment to enrich quality of Community life.
- ❖ Foster a culture of trust, openness and mutual concern to make working a stimulating & challenging experience for our people.
- ❖ Strive for customer delight through quality products and services.
- ❖ Integrated in Energy Business.
- ❖ Focus on domestic and international oil & gas exploration and production business opportunities.
- ❖ Providing value linkages in other sectors of energy business.
- ❖ Creating growth opportunities and maximize shareholder value.
- ❖ Retain dominant position in Indian Petroleum sector and enhance India's energy availability.

OBJECTIVES OF ONGC

- ❖ To maximize production of hydrocarbon, self-reliance in technology, promoting indigenous efforts to achieve
- ❖ self-reliance in technology, promoting indigenous efforts to achieve in all related equipment, material and services.
- ❖ Assist in conservation of oil, more efficient use energy and development of alternate source of energy.
- ❖ Environmental protection.
- ❖ Observe 100% safety in work.



BRIEF HISTORY

ONGC was set up under the visionary leadership of **Pandit Jawahar Lal Nehru**, going against the wisdom of the then multinational oil companies operating in the country, who had almost written India off as a “Hydrocarbon Barren” country.

Pandit Nehru reposed faith in **Shri Keshav Dev Malviya** who laid the foundation of ONGC in the form of Oil and Gas division, under Geological Survey of India, in 1955. A few months later, it was converted into an Oil and Natural Gas Directorate.

The Directorate was converted into Commission and christened Oil & Natural Gas Commission on **14th August 1956**. In 1994, Oil and Natural Gas Commission was converted into a Corporation, and in 1997 it was recognized as one of the **NAVRATNAS** by the Government of India. Subsequently, it has been conferred with **MAHARATNAS** status in the year 2010.

Over 50 years of its existence ONGC has crossed many a milestone to realize the energy dreams of India. The journey of ONGC, over these years, has been a tale of conviction, courage and commitment. ONGCs’ superlative efforts have resulted in converting earlier frontier areas into new hydrocarbon provinces.

From a modest beginning, ONGC has grown to be one of the largest E&P companies in the world in terms of reserves and production. ONGC as an integrated Oil & Gas Corporate has developed in-house capability in all aspects of exploration and production business i.e., Acquisition, Processing & Interpretation (API) of Seismic data, drilling, work-over and well stimulation operations, engineering & construction, production, processing, refining, transportation, marketing, applied R&D and training, etc.

Today, Oil and Natural Gas Corporation Ltd. (ONGC) is, the leader in Exploration & Production (E&P) activities in India having 72% contribution to India's total production of crude oil and 48% of natural gas. ONGC has established more than 7 Billion Tonnes of in-place hydrocarbon reserves in the country.

In fact, six out of seven producing basins in India have been discovered by ONGC. **ONGC produces more than 1.27 million Barrels of Oil Equivalent (BOE) per day.** It also contributes over three million tonnes per annum of Value-Added-Products including LPG, C2 - C3, Naphtha, MS, HSD, Aviation Fuel, SKO etc.



PRODUCTS & SERVICES

- Crude Oil.
- Natural Gas.
- Liquefied petroleum Gas.
- Natural Gasoline.
- Ethane/Propane.
- Achromatic Naphtha.
- Superior Kerosene Oil

- 
- Chief Drilling Services, Mumbai
 - Chief Well Services, Mumbai
 - Chief Geo- Physical Services, Dehradun
 - Chief Logging Services, Baroda
 - Chief Engineering Services, Mumbai
 - Chief Offshore Logistics, Mumbai
 - Chief Technical Services, Mumbai
 - Chief Info-com Services, New Delhi
 - Chief Corporate Planning, New Delhi
 - Chief Human Resource Development, Dehradun
 - Chief Employee Relations, Dehradun
 - Chief Security, Dehradun
 - Company Secretary, New Delhi
 - Chief Marketing, New Delhi
 - Chief Corporate Affairs & Co-ordination, New Delhi
 - Chief Corporate Communication, New Delhi
 - Chief Material Management, Dehradun
 - Chief Technical Services, Dehradun
 - Chief Health, Safety & Environment, Mumbai
 - Chief Legal, New Delhi
 - Chief Medical, Dehradun
 - Chief Internal audit, New Delhi
 - Chief Commercial, New Delhi
 - Chief Exploration & Development, Dehradun

Some Impressive facts about ONGC

1. State owned

One of the biggest advantages & strength of the company is that it is state owned. This led the company have great infrastructure with the governments support. The policymaking also becomes easier due to the same reason. Moreover, any undue and sustained pressure creates due impact on the government as well.

2. Growing demographics

ONGC went to global fields through its subsidiary, ONGC Videsh Ltd. (OVL). ONGC has made major investments in Vietnam, Sakhalin and Sudan and earned its first hydrocarbon revenue from its investment in Vietnam.

3. Top Technology

ONGC is the technological advancements that were implemented over the last few years. The advancements were substantial and improved the company's ability to extract the greatest amount of oil and gas.

4. Hard Industry for Competitor to enter

The oil sector is an industry wherein not many competitors can enter owing to the scale and government intervention.

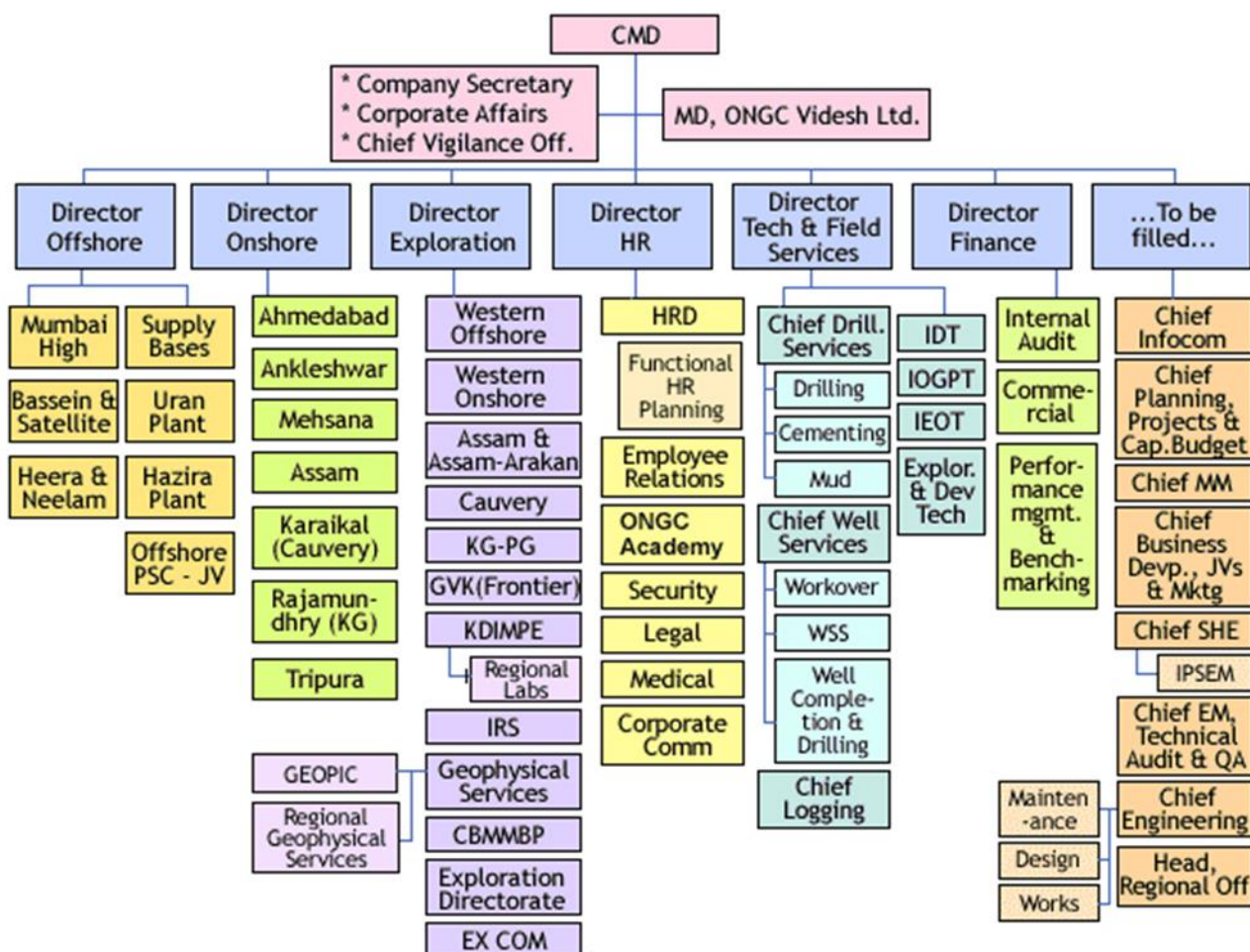
5. Strive to be environmentally friendly

The Company has in its guiding principles to cut down emission and become nature friendly in due course of time.

6. Strong Infrastructure

The company implemented some well needed improvements to the infrastructure and created a strength for the company.

ORGANIZATIONAL STRUCTURE



“The structure is a strictly hierarchical organization with strictly defined roles and there is a unity of command which it makes it one of the most efficient companies of the country and best MAHARATNA PSU.”

EMPLOYEES & ENVIRONMENT

“To adopt and continuously innovate best-in-class HR practices to support business leaders through engaged, empowered and enthused employees.”

This shows that the ONGC nurtures best practices within the company environment and promotes innovation and the management is able to motivate the employees to perform their best.

ONGC has 33,000 employees on its rolls. Of this number, 24,000 work across the company's various offices, while 9,000 are employed on rigs.

Employee management “Treating Employees like Customers”

Companies should have a similar approach to employees and customers. A company should strive to retain an employee in the same way it tries to retain a customer.

ONGC is an organization which is a pride for the nation, the reason being its excellence in its performance. The reason behind this is its strategies outside as well as inside the organization. ONGC is a firm which knows how to deal with the internal as well as the external environment of its functioning.

If we deeply look into its smooth running work environment, then we would find the initiatives this giant corporation has taken for the well-being of its people. ONGC is committed to its value and promise of creating a healthy work environment for its employees, which facilitates their growth, builds up their confidence, and fosters in its employees a sense of belonging as well as job satisfaction.

A lot has already been done here at ONGC, many are in process and much more is planned, for the valuable employees of the renowned ONGC.

ONGC is a firm which believes that the non-financial benefits are as much important as the financial ones, and hence has thoughtfully kept a balance between both, as both are great motivating factors.

PERFORMANCE APPRAISAL SYSTEM AT ONGC:

Performance appraisal report is an index of an employee's work performance over a given period of time. It is crucial for his or her career growth as it indicates the strengths, weaknesses, training needs, nature of job being performed and problems faced in work situation. The objectives of the performance appraisal are:

- To set norms and targets of work performance, as well as, to monitor the work progress of employees.
- To facilitate placement of employees in accordance with their suitability for different types of assignments.
- To provide an objective basis for determination of merit, efficiency and suitability for the purpose of promotion.
- To identify areas requiring exposure for training and development.

The performance appraisal system seeks to evaluate:

- The work performance of an employee on the present job in relation to the expected levels of performance, both qualitative and quantitative.
- The extent of development achieved by the employee during the period under review.
- Evaluation of behavioural attributes, attitudes and abilities.
- Evaluation of potentials for assuming higher responsibility. The appraisal covers:
 - Performance during the period from 1st April to 31st March of every year.
 - All regular employees of the company a) Non Executives b) Executives

CORPORATE SOCIAL RESPONSIBILITY

The mission of ONGC stated that the company would have an "abiding commitment to health, safety, and environment to enrich quality of community life." And this mission was reflected in its CSR activities. CSR at ONGC began as a philanthropic activity where the company contributed to several socio-economic developmental programs like building schools and hospitals, developing agriculture and cottage industry, building infrastructure facilities, etc., around its areas of operation on an ad hoc basis.

- ONGC is spearheading the United Nations Global Compact - World's biggest corporate citizenship initiative to bring Industry, UN bodies, NGOs, Civil societies and corporate on the same platform.

- During the year, your Company has undertaken various CSR projects at its work centres and corporate level.

- ONGC's CSR programs at the corporate level focused on disaster relief management and water management projects.

- ONGC and the Global Compact Program

The concept of 'global compact' was initiated by UN Secretary-General Kofi Annan in July 2000. The idea was to form an international corporate citizenship network for the advancement of universal social and environmental principles.

ONGC IN INDIA



- 1.ONGC Videsh Limited (OVL)
- 2.Mangalore Refinery and Petrochemicals Limited (MRPL)
- 3.ONGC Nile Ganga BV (ONG BV)
- 4.ONGC Mittal Energy Limited (OMEL)
- 5.ONGC Mittal Energy Services Limited (OMESL)
- 6.ONGC Tripura Power Company Pvt. Ltd. (OTPCL)
7. Kakinada Refinery & Petrochemicals Limited (KRPL)
- 8.Kakinada SEZ Limited
- 9.Mangalore SEZ Limited
- 10.Dahej SEZ Limited
- 11.Rajasthan Refinery Limited (RRL)

ONGC VIDESH



ONGC Videsh Ltd.

ONGC Videsh Limited (OVL) is the international arm of ONGC. It was rechristened on 15 June 1989. It currently has 14 oil and projects across 15 countries. It's share of oil and gas production was 8.753 MMT of O+OEG in 2011-12 as against 0.253 MMT of O+OEG in 2002-03. OVL's overseas cumulative investment has crossed USD 14 billion.

OVL currently has presence in 33 E&P projects in 15 countries, namely: Vietnam, Iraq, Libya, Syria, Sudan, South Sudan, Iran, Cuba, Brazil, Venezuela, Russia, Myanmar, Colombia, Nigeria and Kazakhstan.

Some of the leading alliance partners of OVL are BP, CNPC, Ecopetrol, ENI, Exxon, Statoil Hydro, PDVSA, Petrobras, Petronas, Petrovietnam, Repsol, Rosneft, Shell, Sinopec, Total and TPOC.

SDLC

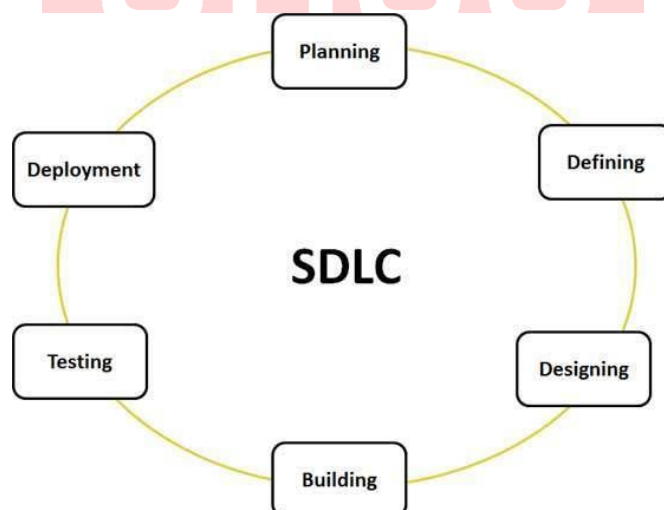
SDLC, Software Development Life Cycle is a process used by software industry to design, develop and test high quality software. The SDLC aims to produce a high quality software that meets or exceeds customer expectations, reaches completion within times and cost estimates.

- SDLC is the acronym of Software Development Life Cycle.
- It is also called as Software development process.
- The software development life cycle (SDLC) is a framework defining tasks performed at each step in the software development process.
- ISO/IEC 12207 is an international standard for software life-cycle processes. It aims to be the standard that defines all the tasks required for developing and maintaining software.

What is SDLC?

SDLC is a process followed for a software project, within a software organization. It consists of a detailed plan describing how to develop, maintain, replace and alter or enhance specific software. The life cycle defines a methodology for improving the quality of software and the overall development process.

The following figure is a graphical representation of the various stages of a typical SDLC.



Stage 1: Planning and Requirement Analysis

Requirement analysis is the most important and fundamental stage in SDLC. It is performed by the senior members of the team with inputs from the customer, the sales department, market surveys and domain experts in the industry. This information is then used to plan the basic project approach and to conduct product feasibility study in the economical, operational, and technical areas.

Planning for the quality assurance requirements and identification of the risks associated with the project is also done in the planning stage. The outcome of the technical feasibility study is to define the various technical approaches that can be followed to implement the project successfully with minimum risks.

Stage 2: Defining Requirements

Once the requirement analysis is done the next step is to clearly define and document the product requirements and get them approved from the customer or the market analysts. This is done through SRS (Software Requirement Specification) document which consists of all the product requirements to be designed and developed during the project life cycle.

Stage 3: Designing the product architecture

SRS is the reference for product architects to come out with the best architecture for the product to be developed. Based on the requirements specified in SRS, usually more than one design approach for the product architecture is proposed and documented in a DDS - Design Document Specification.

This DDS is reviewed by all the important stakeholders and based on various parameters as risk assessment, product robustness, design modularity, budget and time constraints, the best design approach is selected for the product.

A design approach clearly defines all the architectural modules of the product along with its communication and data flow representation with the external and

third party modules (if any). The internal design of all the modules of the proposed architecture should be clearly defined with the minutest of the details in DDS.

Stage 4: Building or Developing the Product

In this stage of SDLC the actual development starts and the product is built. The programming code is generated as per DDS during this stage. If the design is performed in a detailed and organized manner, code generation can be accomplished without much hassle.

Developers have to follow the coding guidelines defined by their organization and programming tools like compilers, interpreters, debuggers etc. are used to generate the code. Different high level programming languages such as C, C++, Pascal, Java, and PHP are used for coding. The programming language is chosen with respect to the type of software being developed.

Stage 5: Testing the Product

This stage is usually a subset of all the stages as in the modern SDLC models, the testing activities are mostly involved in all the stages of SDLC. However, this stage refers to the testing only stage of the product where products defects are reported, tracked, fixed and retested, until the product reaches the quality standards defined in the SRS.

Stage 6: Deployment in the Market and Maintenance

Once the product is tested and ready to be deployed it is released formally in the appropriate market. Sometime product deployment happens in stages as per the organizations. business strategy. The product may first be released in a limited segment and tested in the real business environment (UAT- User acceptance testing).

Then based on the feedback, the product may be released as it is or with suggested enhancements in the targeting market segment. After the product is released in the market, its maintenance is done for the existing customer base.

Our Approach: SPIRAL Model

The spiral model combines the idea of iterative development with the systematic, controlled aspects of the waterfall model.

Spiral model is a combination of iterative development process model and sequential linear development model i.e. waterfall model with very high emphasis on risk analysis.

It allows for incremental releases of the product, or incremental refinement through each iteration around the spiral.

Spiral Model design

The spiral model has four phases. A software project repeatedly passes through these phases in iterations called Spirals.

- **Identification**: This phase starts with gathering the business requirements in the baseline spiral. In the subsequent spirals as the product matures, identification of system requirements, subsystem requirements and unit requirements are all done in this phase.

This also includes understanding the system requirements by continuous communication between the customer and the system analyst. At the end of the spiral the product is deployed in the identified market.

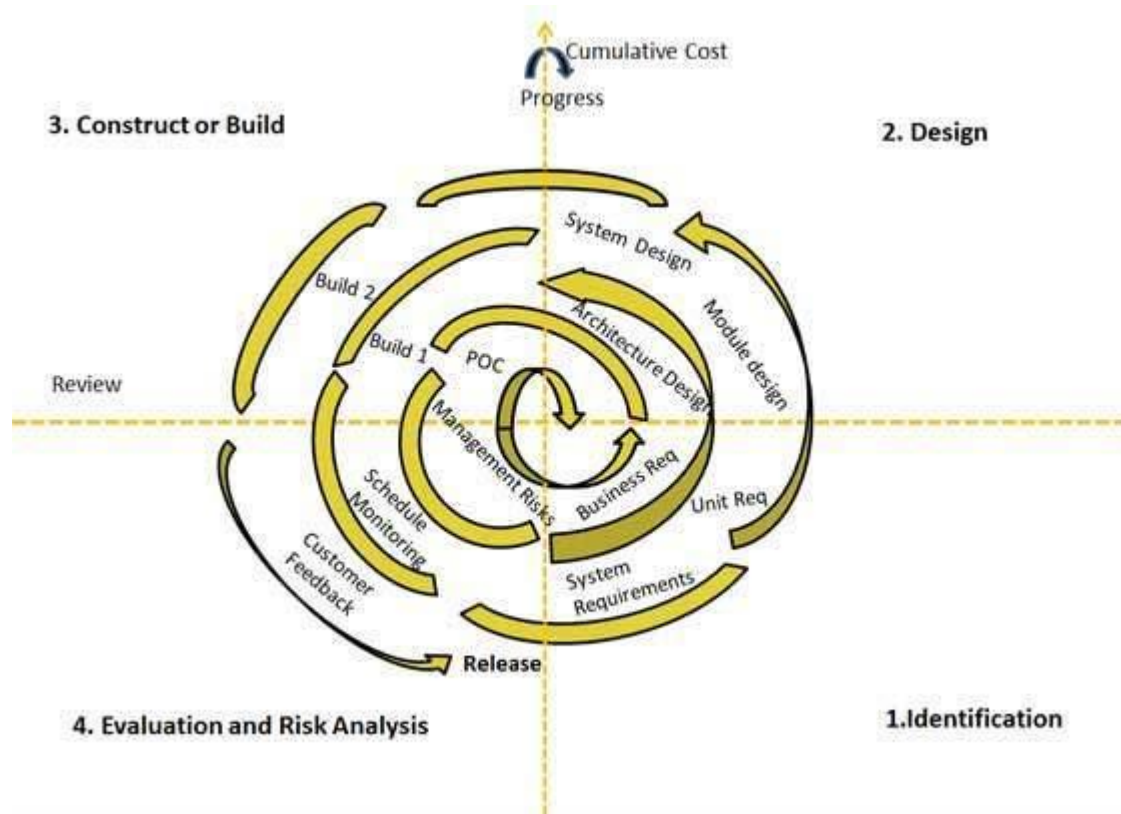
- **Design**: Design phase starts with the conceptual design in the baseline spiral and involves architectural design, logical design of modules, physical product design and final design in the subsequent spirals.
- **Construct or Build**: Construct phase refers to production of the actual software product at every spiral. In the baseline spiral when the product is just thought of and the design is being developed a POC (Proof of Concept) is developed in this phase to get customer feedback.

Then in the subsequent spirals with higher clarity on requirements and design details a working model of the software called build is produced with a version number. These builds are sent to customer for feedback.

- **Evaluation and Risk Analysis**: Risk Analysis includes identifying, estimating, and monitoring technical feasibility and management risks, such as schedule slippage and cost overrun. After testing the build, at the

end of first iteration, the customer evaluates the software and provides feedback.

Following is a diagrammatic representation of spiral model listing the activities in each phase:



Based on the customer evaluation, software development process enters into the next iteration and subsequently follows the linear approach to implement the feedback suggested by the customer. The process of iterations along the spiral continues throughout the life of the software.

Spiral Model Application

Spiral Model is very widely used in the software industry as it is in synch with the natural development process of any product i.e. learning with maturity and also involves minimum risk for the customer as well as the development firms. Following are the typical uses of Spiral model:

- When costs there is a budget constraint and risk evaluation is important.
- For medium to high-risk projects.
- Long-term project commitment because of potential changes to economic priorities as the requirements change with time.
- Customer is not sure of their requirements which is usually the case.
- Requirements are complex and need evaluation to get clarity.

- New product line which should be released in phases to get enough customer feedback.
- Significant changes are expected in the product during the development cycle.

Spiral Model Pros and Cons

The advantage of spiral lifecycle model is that it allows for elements of the product to be added in when they become available or known. This assures that there is no conflict with previous requirements and design.

This method is consistent with approaches that have multiple software builds and releases and allows for making an orderly transition to a maintenance activity. Another positive aspect is that the spiral model forces early user involvement in the system development effort.

On the other side, it takes very strict management to complete such products and there is a risk of running the spiral in indefinite loop. So the discipline of change and the extent of taking change requests is very important to develop and deploy the product successfully.

The following table lists out the pros and cons of Spiral SDLC Model:

Pros

- Changing requirements can be accommodated.
- Allows for extensive use of prototypes
- Requirements can be captured more accurately.
- Users see the system early.
- Development can be divided into smaller parts and riskier parts can be developed earlier which helps better risk management.

Cons

- Management is more complex.
- End of project may not be known early.
- Not suitable for small or low risk projects and could be expensive for small projects.
- Process is complex
- Spiral may go indefinitely.
- Large number of intermediate stages requires excessive documentation.

DEVELOPING ENVIRONMENT

C++

C++ is a general-purpose programming language. It has imperative, object-oriented and generic programming features, while also providing facilities for low-level memory manipulation.

It was designed with a bias toward system programming and embedded, resource-constrained and large systems, with performance, efficiency and flexibility of use as its design highlights.

C++ has also been found useful in many other contexts, with key strengths being software infrastructure and resource-constrained applications, including desktop applications, servers (e.g. e-commerce, web search or SQL servers), and performance-critical applications (e.g. telephone switches or space probes).

C++ is a compiled language, with implementations of it available on many platforms and provided by various organizations, including the Free Software Foundation (FSF's GCC), LLVM, Microsoft, Intel and IBM.

C++ introduces object-oriented programming (OOP) features to C. It offers classes, which provide the four features commonly present in OOP (and some non-OOP) languages:

- Abstraction
- Encapsulation
- Inheritance
- Polymorphism

One distinguishing feature of C++ classes compared to classes in other programming languages is support for deterministic destructors, which in turn provide support for the Resource Acquisition is Initialization (RAII) concept.

OPENGL

Open Graphics Library (OpenGL) is a cross-language, cross-platform application programming interface (API) for rendering 2D and 3D vector graphics. The API is typically used to interact with a graphics processing unit (GPU), to achieve hardware-accelerated rendering.

Silicon Graphics Inc., (SGI) started developing OpenGL in 1991 and released it in January 1992; applications use it extensively in the fields of computer-aided design (CAD), virtual reality, scientific visualization, information visualization, flight simulation, and video games.

OpenGL is managed by the non-profit technology consortium Khronos Group.

The OpenGL specification describes an abstract API for drawing 2D and 3D graphics. Although it is possible for the API to be implemented entirely in software, it is designed to be implemented mostly or entirely in hardware.

The API is defined as a set of functions which may be called by the client program, alongside a set of named integer constants (for example, the constant `GL_TEXTURE_2D`, which corresponds to the decimal number 3553).

Although the function definitions are superficially similar to those of the programming language C, they are language-independent. As such, OpenGL has many language bindings, some of the most noteworthy being the JavaScript binding WebGL (API, based on OpenGL ES 2.0, for 3D rendering from within a web browser).

The C bindings WGL, GLX and CGL; the C binding provided by iOS; and the Java and C bindings provided by Android.

In addition to being language-independent, OpenGL is also cross-platform. The specification says nothing on the subject of obtaining, and managing, an OpenGL context, leaving this as a detail of the underlying windowing system.

For the same reason, OpenGL is purely concerned with rendering, providing no APIs related to input, audio, or windowing.

The first version of OpenGL, version 1.0, was released in January 1992 by Mark Segal and Kurt Akeley. Since then, OpenGL has occasionally been extended by releasing a new version of the specification. Currently OpenGL 4.5 is being used.

OPEN INVENTOR

Open Inventor, originally IRIS Inventor, is a C++ object oriented retained mode 3D graphics toolkit designed by SGI to provide a higher layer of programming for OpenGL. Its main goals are better programmer convenience and efficiency. Open Inventor is free and open-source software, subject to the requirements of the GNU Lesser General Public License (LGPL), version 2.1.

OpenGL (OGL) is a low level Application programming interface that takes lists of simple polygons and renders them as quickly as possible. To do something more practical like “draw a house”, the programmer must break down the object into a series of simple OGL instructions and send them into the engine for rendering.

One problem is that OGL performance is highly sensitive to the way these instructions are sent into the system, requiring the user to know which instructions to send and in which order, and forcing them to carefully cull the data to avoid sending in objects that aren't even visible in the resulting image.

For simple programs a tremendous amount of programming has to be done just to get started.

Open Inventor (OI) was written to address this issue, and provide a common base layer to start working with. Objects could be sub classed from a number of pre-rolled shapes like cubes and polygons, and then easily modified into new shapes. The “world” to be drawn was placed in a scene graph run by OI, with the system applying occlusion culling on objects in the graph automatically.

OI also included a number of controller objects and systems for applying them to the scene, making common interaction tasks easier. Finally, OI also supplied a common file format for storing “worlds”, and the code to automatically save or load a world from these files.

Basic 3D applications could then be written in a few hundred lines under OI, by tying together portions of the toolkit with “glue” code.

On the downside OI tended to be slower than hand-written code, as 3D tasks are notoriously difficult to make perform well without shuffling the data in the scene graph by hand. Another practical problem was that OI could only be used with its own file format, forcing developers to write converters to and from the internal system.

COIN3D

Coin3D is a free and open-source implementation (library) of the Open Inventor API. Coin3D was originally developed and maintained as commercial software by the Norwegian company Kongsberg Oil & Gas Technologies (formerly Kongsberg SIM).

Coin3D, like Open Inventor, is a C++ object oriented retained mode 3D graphics API used to provide a higher layer of programming for OpenGL.

The API provides a number of common graphics rendering constructs to developers such as scene graphs to accomplish this.

Coin3D is fully compatible with the Open Inventor API version 2.1.

Coin3D is being used by many small and large companies to drive advanced visualization solution in a wide range of application domains such as geo-modelling, CAD, medical visualization, robotics and presentation.

According to Kongsberg Oil & Gas Technologies, the software is used in a number of commercial and open-source, scientific visualization or 3D modelling projects such as

OpenRAVE. Apple, for example, uses Coin for 3D rendering in iWork '08 and later.

FreeCAD adopted Coin3D to an interface for developing Open Inventor programs.

Kongsberg Oil & Gas Technologies also develops software development libraries designed to integrate Coin3D with GUI development environments.

For developers targeting multi-platform - 'Quarter' provides a seamless integration with the Qt framework.

For developers targeting Windows - 'SoWin' integrates with the Win32 API, and 'Nickel' provides integration with WinForms/.Net (prototype implementation, not officially supported yet).

For developers targeting Mac OS X - Sc21 provides integration with Apple's Cocoa framework

Legacy GUI bindings are Qt (SoQt), Win32 API (SoWin) and Motif (SoXt) are also maintained.

Programming Language and Development Tools used

- Platform Used: Microsoft Visual Studio
- Language Used: C++
- Libraries used: SoWin, Coin3d

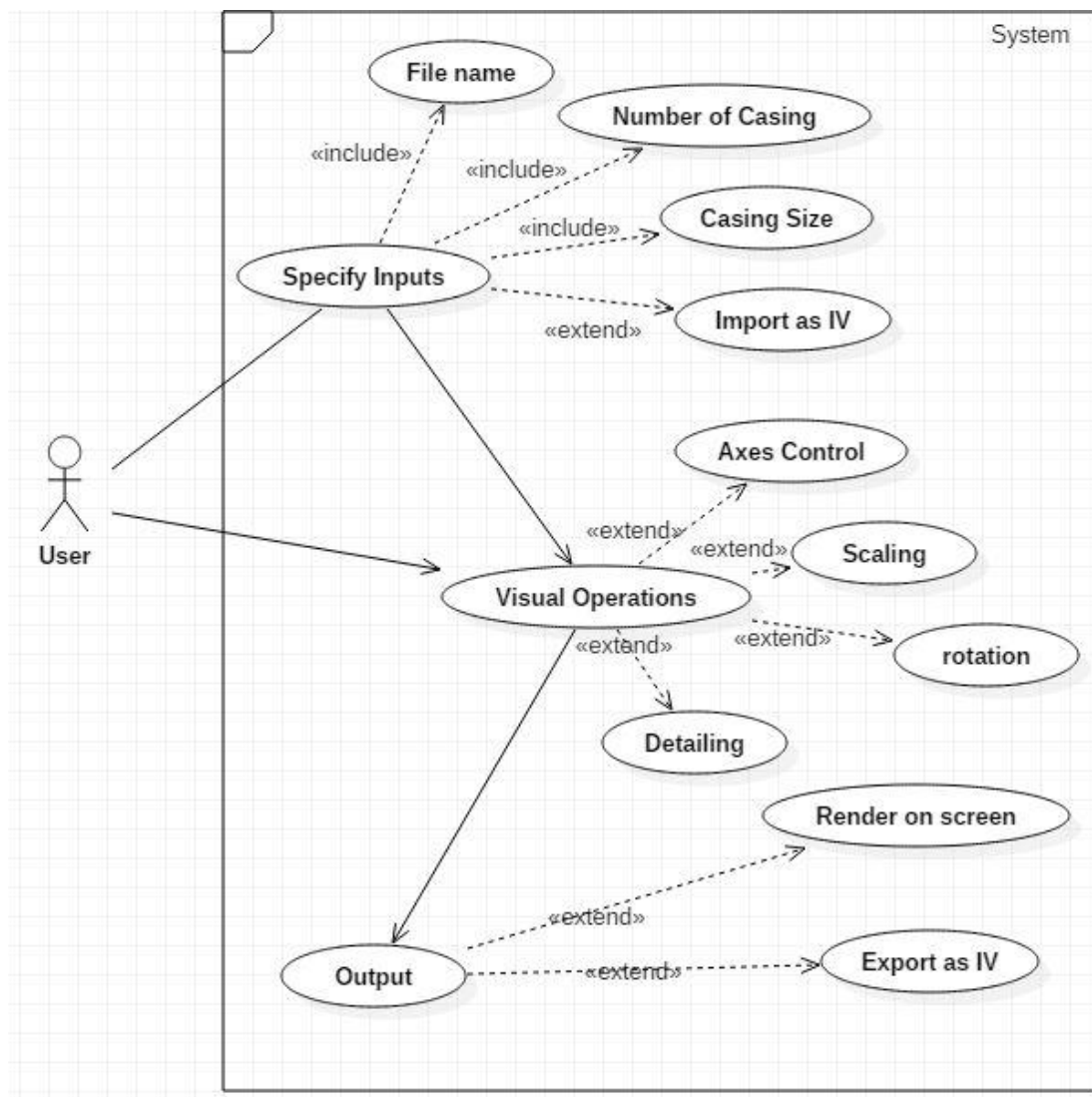
Development Tools Used are

- Visual Studio, Notepad++



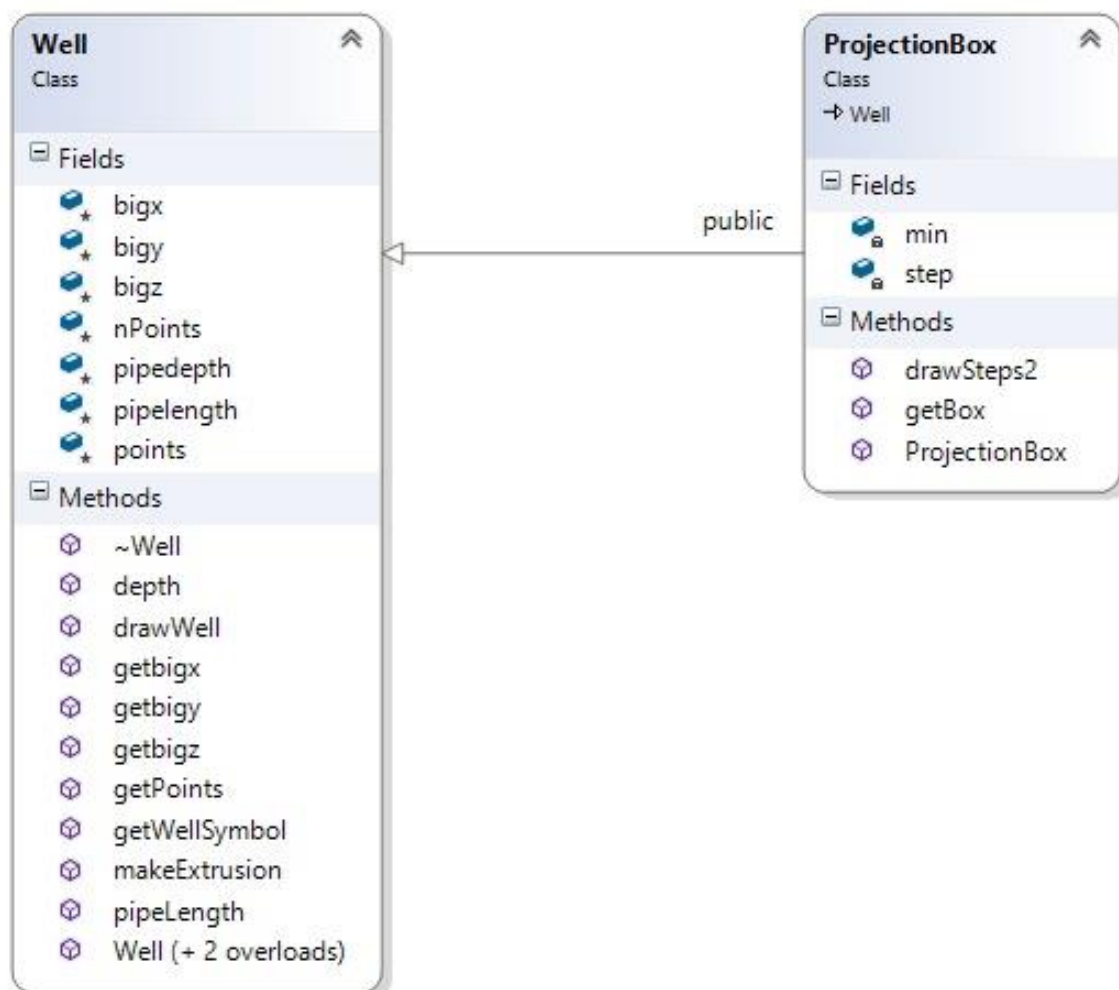
USE CASE DIAGRAM

The purpose of use case diagram is to capture the dynamic aspect of a system. But this definition is too generic to describe the purpose. Use case diagrams are used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements. So when a system is analysed to gather its functionalities use cases are prepared and actors are identified.



CLASS DIAGRAM

The purpose of the class diagram is to model the static view of an application. The class diagrams are the only diagrams which can be directly mapped with object oriented languages and thus widely used at the time of construction. Class diagram is basically a graphical representation of the static view of the system and represents different aspects of the application. So a collection of class diagrams represents the whole system.



TESTING PHASE

The testing phase requires organizations to complete various tests to ensure the accuracy of programmed code, the inclusion of expected functionality, and the interoperability of applications and other network components. Thorough testing is critical to ensuring systems meet organizational and end-user requirements. If organizations use effective project management techniques, they will complete test plans while developing applications, prior to entering the testing phase. Weak project management techniques or demands to complete projects quickly may pressure organizations to develop test plans at the start of the testing phase. Test plans created during initial project phases enhance an organization's ability to create detailed tests. The use of detailed test plans significantly increases the likelihood that testers will identify weaknesses before products are implemented.

Software Testing is done to:

- check that a program conforms to its specification
- uncover software defects
- ensure it functions correctly & does not produce unexpected results
- check robustness -how far can it be pushed before it fails badly

In any endeavour, testing is always important before the actual implementation. SDLC is no different, in fact testing in SDLC is so important these days that developers have to work in testing longer than most stages in SDLC.

Types of Testing:

Testing by developers: Developers will have to test the software themselves extensively. Even though they are also the one who have developed the software, they still have to run it extensively. These are the usual steps developers follow in testing their software:

1. Checking of Syntax: The software is checked as it is. Developers just run software and look for possible errors. A very basic checking to know if there are major functions and errors that will occur.

2. Code inspection: After the execution, developers review their codes to look for possible bugs or errors in coding technique. Even though it has worked in

initial checking, the language has to be checked extensively to predict possible problems in some executions.

3. Desk Checking: In this part of the testing, developers check the code and the software at the same time. Each line of command is tested if the desired output is met. This is done manually as each line is expected to work and one way of making sure it will work is to manually check each line so that developers will know what output the line has created.

4. Walkthrough: After checking the software themselves, it's time to present the software to the experts. Not the upper management but possibly experts on the coding language or other developers of this type of software. The developer will present their work to the pool of professionals who will scrutinize their work. It is also important for the developer to present not only the coding technique but also program itself. Using simple case studies, the software will somehow provide answers faster or with a better result.

5. Module Testing: After the walk through, developers will again check the software in terms of individual modules. Each module will be tested extensively for possible errors.

6. Integration Testing: Once the module has been tested, it is time to test them as being integrated to other modules.

7. System Testing: After the integration, the whole program will again be tested. Case studies will again be applied with integrated software.

Testing by Users: Once the developers have finished their own testing with the help of other professional developers, the software is ready for release to the public or to the intended users.

The stages usually followed are:

Alpha Testing: Developers usually choose the users who will try out the program. For the general public, it is often tested on known users or even technology bloggers who can honestly give their opinion of the software.

Beta Testing: This type of testing is more open to the public. Developers or software companies can accept users sometimes by invitation or openly accepting users. Beta testing will no longer be limited to the data set by developers; instead it will now be tested in a real environment where there is a bigger possibility of hacks, lack of performance or bugs. The main reason the software is given to the public for testing is to open it for possible hacks. If something wrong is found, developers can just go back to the software easily.

IMPLEMENTATION PHASE

The implementation phase involves installing approved applications into production environments. Primary tasks include announcing the implementation schedule, training end users, and installing the product. Additionally, organizations should input and verify data, configure and test system and security parameters, and conduct post-implementation reviews. Management should circulate implementation schedules to all affected parties and should notify users of any implementation responsibilities. After organizations install a product, pre-existing data is manually input or electronically transferred to a new system. Verifying the accuracy of the input data and security configurations is a critical part of the implementation process. Organizations often run a new system in parallel with an old system until they verify the accuracy and reliability of the new system.

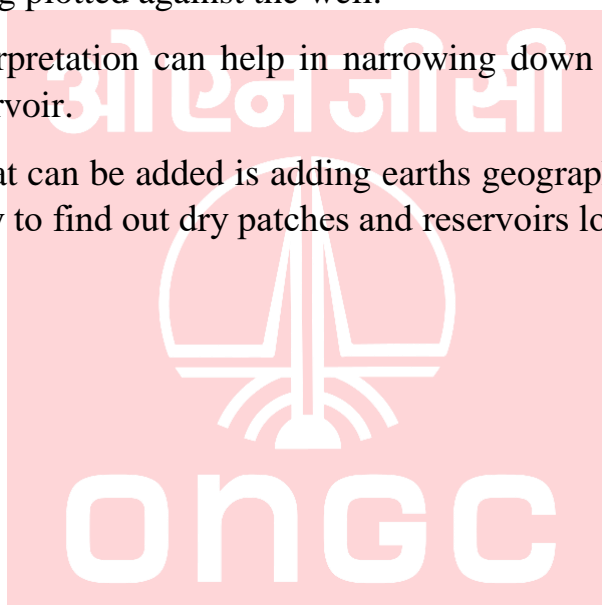


FUTURE SCOPE & RECOMMENDATIONS

As any other software that we create their will be always scope for further enhancement. This project covers the basic functionalities of the visualization from rendering 3D modelling of the objects and their required functions such as rotation, scaling, axis manipulations and selections. However, this project can be extended to the further boundaries. Since the geologist and data scientists need to work together for such operations on well drilling and data interpretation. Its required to put a good visualization of the data along with the well's trajectory. We can add a curve that follow the same path as the well's trajectory where the seismic data is being plotted against the well.

This real time interpretation can help in narrowing down the approach in the location of the reservoir.

Another module that can be added is adding earths geographical layer data with the well's trajectory to find out dry patches and reservoirs location as we drill.



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PROJECT SCREENSHOTS



Fig.1 Home Screen

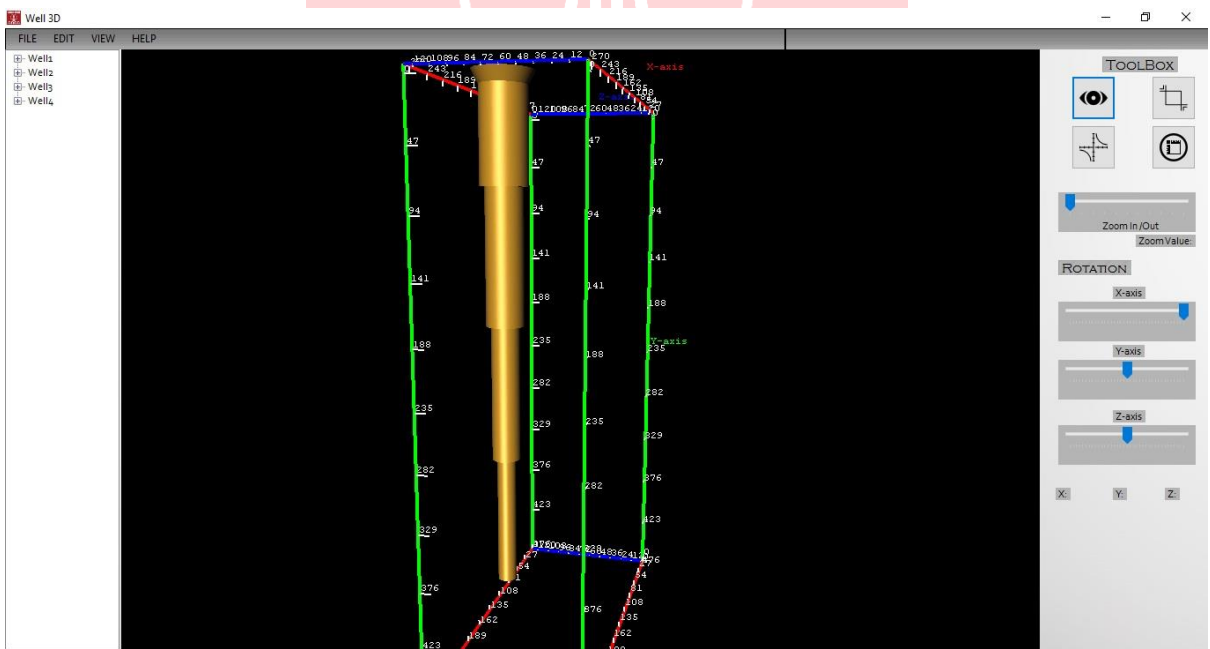


Fig.2 Oil Well

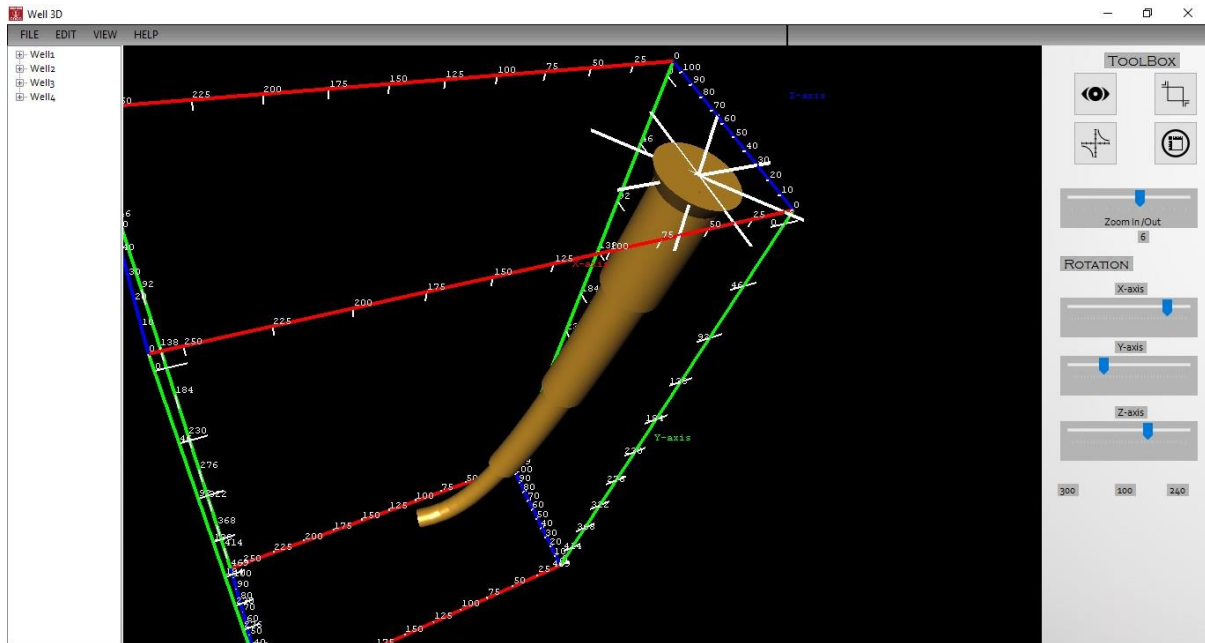


Fig.3 Directional Gas Well

ओएनजीसी

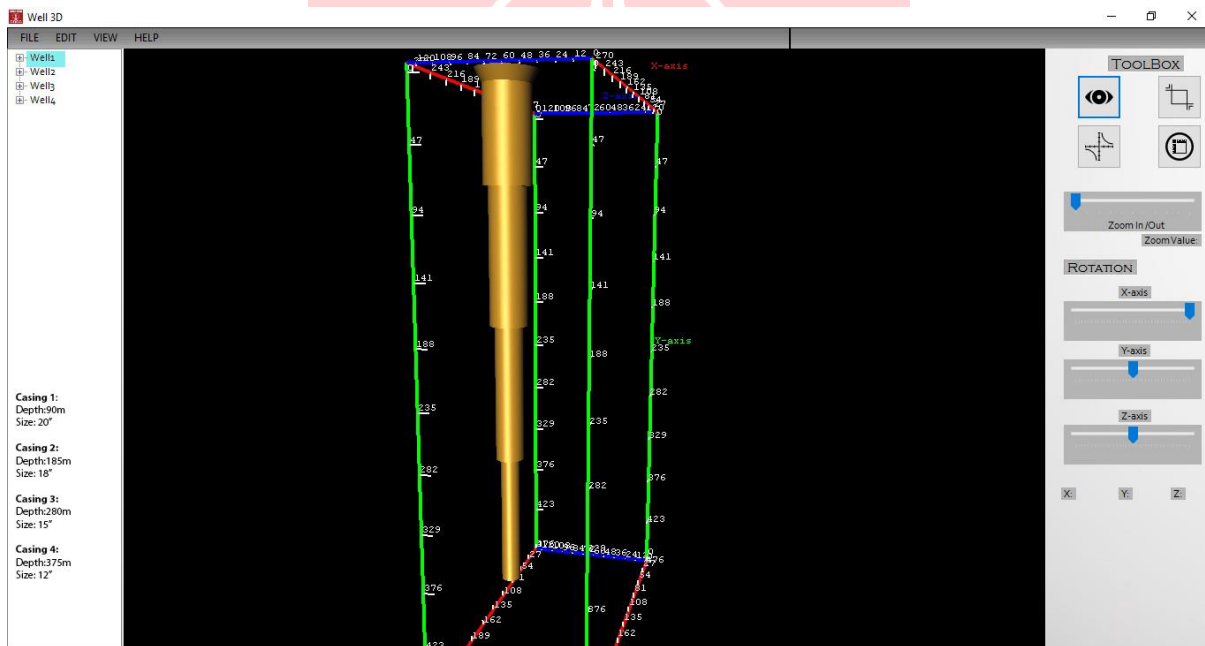


Fig.4 Well Details



Fig.5 Well Details

