A framework to implement business intelligence tool to optimize output from oil drilling operation

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Abstract -*The main aim of the article is to show the growing importance of business intelligence and their influence in the companies. As companies having direct connection with large number of customers, a growing number channel-oriented applications (e.g.: e-commerce, call center) create new data management challenge that is effective way of integrating application in real time. To learn from past and overcome the future problems many companies have started adopting business intelligence tools and system. We mainly explore the role and benefits of the business intelligence system to grow income and reduce costs and maintain the complexity of business `environment. We are going to implement the BI tool which will be a sub system for VuMaxDR Drilling Optimization system and it is a requirement of the company named with ConocoPhillips Canada.*

Keywords:*Business Intelligence*, *Data mining, Data warehouse, Data Analysis, OLAP, Dashboard.*

I.   INTRODUCTION

The Business Intelligence tool performs analysis on raw data and generates meaningful information for the organization in graphical as well as numeric format reports. The Easy BI tool will provide functionalities to analyze the data from multiple data sources and generate analytical reports easily. There is number of BI tools available in the market and most of them require lot of efforts to design and generate the reports but it creates dependency on technical staff to make the reports in the BI tools for the end users. This solution will be used directly by the end users who will be able to design and generate analytical reports quickly without going through any kind of coding process.The tool will provide functionalities to generate basic analytical reports in graphical and tabular formats.There are 5 styles of business intelligence applications as shown in Figure-1.
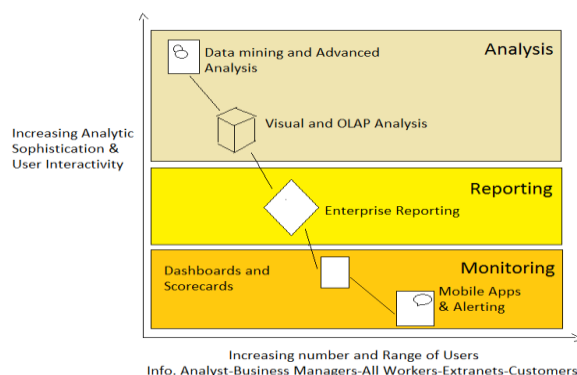

Figure-1

The major goal of the BI Tool is that it is extremely simple and intuitive to use. The application is geared towards the higher management in the enterprise that requires meaningful information generated easily from the data present in the multiple datasets. The roles of this BI Tool are taking quick decision, Using business intelligence solution,

helps in growing income and reduces the cost,also helps to manage complexity of business environment, and cuts IT cost.

II.PREVIOUS WORK

Many Companies are using leading BI tools like spot fire,Microsoft BI etc. and it requires lot of efforts to generate analytic from the drilling data. It has different functionalities available as Slice and Dice Data, Multiple data sources, multi-level granular analysis of the data, Graphical and numerical outputs, Complex output with user-defined layouts

III. PROPOSED WORK

As mentioned in the previous work BI tool required lot of time and efforts to generate analytic from the drilling data so to overcome that problem we are going to create a tool that provides functionalities to generate analytics of data from different data sources.The business intelligence tool is not just simple reporting system but is an analytical platform that provides powerful functionalities to generate intelligence from the data.We are going to generate BI Tool for the dataset of the oil well drilling industry namedas ConocoPhillips Canada. This company has various datasets describing information about wellformation, wellphasing information, drilling trip information, casing design, well trajectory data , optimization Road map and processed sensor data with rig states that we have mentioned in the dataset.The main aim of generating this BI Tool is to take quick decision by looking at the graphical analysis generated by this tool in many form at a time. It will save much time of the analyzer to get to the perfect decision.Below mentioned are the features of our BI Tool:

- Complete web interface to design analytics
  Most products provides desktop clients to design analytics and that requires installation on each machine
- Built-in functions for industry specific analysis
  Rate of penetration, footage drilled etc
- Ability to process and visualize large volume of data using down-sampling methods
  Other products requires preprocessing of data outside of the application
- Ability to write complex custom algorithms that run on data subsets to produce the results.The BI tool provides functionality to write c# .net code that run dynamically.Other products provides built-in math and statistical function only
- Ability to provide custom visualizations

A. *Work Flow:*

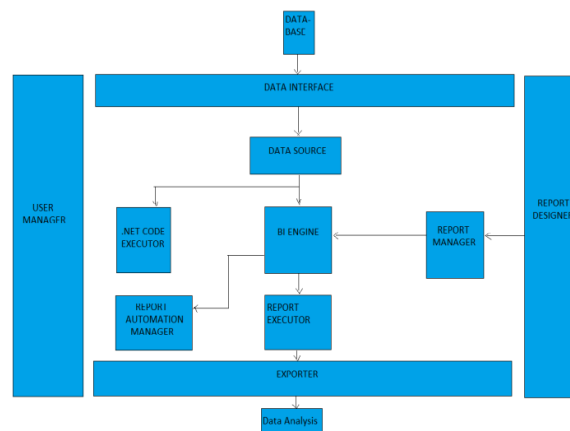The system will be divided into following components that are shown in figure-2.

Figure-2

1 Database Interface
   The database interface component will provide following functionalities
      i.   Connectivity to any database.

Right now it will be limited to following databases.
- a. SQL Server
- b. Oracle
- c. MySQL

ii. Read the information of database objects like tables and views.

iii. Read the data and run aggregate functions like sum, count, average,trend etc. and perform grouping at multiple level.

2 BI Report

The BI report will contain the design of the report. The BI report will be divided into two parts
i) Report View
    ii) Composite report.

The report view will contain the graphical or numerical output and the composite report will be collection of multiple report views, arranged into grid format.

3   Report Designer

The Report Designer component will provide interface to design the BI report. It will allow users to create report template by taking the user through simple steps. The report template will be stored into the BI database and will be available to the users at the time of running the report.

4   Report Manager

The Report Manager component will provide interface to manage reports stored in the database e.g. browsing or searching the reports in the BI database, removing it from the database, assign the permissions to run the report to the users etc.

5   BI Engine

The BI Engine will perform following task:

    5.1 Read the report template.
    5.2 Read the data from one or multiple databases and generate the output report.
    5.3 Display the report output in the browser.
    5.4 Export the report in various output formats like pdf, excel etc.

6   User Manager

The User Manager component will provide functionalities to manage system user e.g. creating/removing users and assigning permissions etc.

7   Automated Delivery System

The automated delivery system will provide functionalities to generate the report automatically at specified time and deliver it through email. It will allow setting up jobs to send the report through email to specified recipients.

IV.   TECHNIQUES

- Predictive modeling: Predict value for specific data item attribute.
- Characterization and descriptive data mining: Data distribution, dispersion and exception.
- Association, correlation, causality analysis: Identify relationships between attributes.
- Classification: Determine to which class a data item belongs.
- Clustering and outliers analysis: Partition a set into classes, whereby items with similar characteristics are grouped together.
- Temporal and sequential patterns analysis: Trend and deviation, sequential patterns, periodicity.
- OLAP (Online Analytical Processing): OLAP tools enable users to analyze different dimensions of multidimensional data. For example, it provides time series and trend analysis views.
- Model Visualization: Making discovered knowledge easily understood using charts, plots, histograms and other visual means.
- Exploratory Data Analysis(EDA): Explores a data set without a strong dependence on assumptions or models; goal is to identify patterns in an exploratory manner.

V.   DATA SET

The total gross capacity of the company for the first two phases is expected to reach 150,000 barrels per day.The required data for the results are mentioned below:

1. Real time raw sensor data from drilling rig. This includes data anywhere from 150 to 500 sensors. Refer to table-1 for more information.
2. Bottom hole assembly data: It includes bottom hole assembly information.A bottom hole assembly (BHA) is a component of a drilling rig. It is the lowest part of the drill string, extending from the bit to the drill pipe. The assembly can consist of drill collars, subs such as stabilizers, reamers, shocks, hole-openers, and the bit sub and bit.The characteristics of the BHA help to determine the borehole shape, direction and other geometric characteristics. Refer to table-2 for more information.
3. Casing design data: Pressure loads are produced by fluids within the casing, cement and fluids outside the casing,pressure imposed at the surface by drilling. It contain the information of top depth,bottom depth and casing size. Refer to table-3 for more information.
4. Trajectory data: This includes information like depth, true vertical depth, inclination, azimuth etc.
5. Formation Tops: This data provides geological information about formation underground.In petroleum exploration and development, formation evaluation is used to determine the ability of a borehole to produce petroleum. In this dataset it contain the information of top Id ,top name , depth of the top and when it was created and modified last. Refer to table-4 for more information.
6. Drilling phase information: Phase is the process where currently drilling is taking place at which level. Refer to table-5 for more information.
7. Rig state information generated by processing raw sensor data. Refer to table-6 for more information.

VI.   CONCLUSION

BI is a promising application to retrieve knowledge from the underlying information which cannot be seen or derived from the tradition ways of information processing. Here, in this research article we have proposed a BI tool framework which will be helpful to process information of oil drilling wells, resultant knowledge would be helpful to take astute business decisions which will stimulate growth of the organization.

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Table-1

WELL_ID	TOP_ID	TOP_NAME	DEPTH	COLOR	CREATED_BY	CREATED_DATE	MODIFIED_BY	MODIFIED_DATE
369-336-510-881-315	158-616-736-889-484	Notikewin	2782.5	0	Nitin-PC\Nitin	24:40.0	Nitin-PC\Nitin	24:40.0
369-336-510-881-315	207-460-466-224-509	Bad Heart	1830	0	Nitin-PC\Nitin	22:50.0	Nitin-PC\Nitin	22:50.0
369-336-510-881-315	270-397-676-666-841	Dunvegan	2441	0	Nitin-PC\Nitin	23:57.0	Nitin-PC\Nitin	23:57.0
369-336-510-881-315	287-400-152-568-233	Base of Fish Scale	2623	0	Nitin-PC\Nitin	24:12.0	Nitin-PC\Nitin	24:12.0
369-336-510-881-315	308-809-342-636-974	Muskiki	1858.5	0	Nitin-PC\Nitin	22:56.0	Nitin-PC\Nitin	22:56.0

Table-2

WELL_I	WELLBOI	LOG_I	ROADMA	ENTRY_I	FROM_D	TO_DEPT	MIN_VAL	MAX_VA	CREATE	CREATE	MODIFIE	MODIFIE
us_13956	us_139567	us_1395	382-899-	0	0	1000	0	20	Nitin-PC\N	53:28.	Nitin-	53:28.
us_13956	us_139567	us_1395	382-899-	1	1000	1200	0	20	Nitin-PC\N	53:28.	Nitin-	53:28.
us_13956	us_139567	us_1395	382-899-	2	1200	1200	0	20	Nitin-PC\N	53:28.	Nitin-	53:28.
us_13956	us_139567	us_1395	872-862-	0	0	50	10	40	Nitin-PC\N	53:06.	Nitin-	53:06.
us_13956	us_139567	us_1395	872-862-	1	50	1000	10	40	Nitin-PC\N	53:06.	Nitin-	53:06.
us_13956	us_139567	us_1395	872-862-	2	1000	1200	1	4	Nitin-PC\N	53:06.	Nitin-	53:06.

Table-3

PROFILE_ID	SR_NO	TOP_DEPTH	BOTTOM_DEPTH	CASING_SIZE	CREATED_BY	CREATED_DATE	MODIFIED_BY	MODIFIED_DATE
344-996-956-120-402	1	0	3000	1	vmx_vumaxadmin	07:08.0	vmx_vumaxadmin	07:08.0
344-996-956-120-402	2	3000	5000	1.2	vmx_vumaxadmin	07:08.0	vmx_vumaxadmin	07:08.0
344-996-956-120-402	3	5000	6000	1.3	vmx_vumaxadmin	07:08.0	vmx_vumaxadmin	07:08.0
344-996-956-120-402	4	6000	7000	1.4	vmx_vumaxadmin	07:08.0	vmx_vumaxadmin	07:08.0
555-317-298-710-942	1	0	3000	2	vmx_vumaxadmin	42:27.0	vmx_vumaxadmin	42:27.0

Table-4

WELL_ID	TOP_ID	TOP_NAME	DEPTH	COLOR	CREATED_BY	CREATED_DATE	MODIFIED_BY	MODIFIED_DATE
369-336-510-881-315	158-616-736-889-484	Notikewin	2782.5	0	Nitin-PC\Nitin	24:40.0	Nitin-PC\Nitin	24:40.0
369-336-510-881-315	207-460-466-224-509	Bad Heart	1830	0	Nitin-PC\Nitin	22:50.0	Nitin-PC\Nitin	22:50.0
369-336-510-881-315	270-397-676-666-841	Dunvegan	2441	0	Nitin-PC\Nitin	23:57.0	Nitin-PC\Nitin	23:57.0
369-336-510-881-315	287-400-152-568-233	Base of Fish Scale	2623	0	Nitin-PC\Nitin	24:12.0	Nitin-PC\Nitin	24:12.0
369-336-510-881-315	308-809-342-636-974	Muskiki	1858.5	0	Nitin-PC\Nitin	22:56.0	Nitin-PC\Nitin	22:56.0

Table-5

PHASE	STEP	EMPH	TOTAL	TIME_C	OFF_T	OFF_T	SPEED	SPEED	TARGE	DELTA	AVG_C	AVG_D	AVG_N	CONN	DELTA	DELTA
Product	Trip	Run #4	1	0	0	0	135	155	0	-		1.7		93	-	-
Product	Trip	Run #3		0	0	0	35	134	0		2.6			76	-	-
Product	Trip	Run #2		0	0	0	14	151	0		1.8	1.8	0	39	-	-
Product	Trip	Run #1			0	0	53	169	0	0	0	0	0	0	-	-
Product	Trip	Run #4	1		0	0	54	153	0	-		0		80	-	-

Table-6

D	DATE	R	S	DE	DI	RP	ST	HK	HD	SP	BP	CI	AIR	FO	HT	MIS	M	NEX	NEX	RE	RH	RI	RIG_S	TV	WE	GT	NE	GAM	MT	G	S
9	05:3	0	0	0	-	-	-	-	0	-	1	0	NU	0	NU	NU	NU	05:4	-	NU	NU	1	-	NU	NU	NU	3	-	NU	-	0
	05:4	0	0	0	-	-	-	-	0	-	1	0	NU	0	NU	NU	NU	05:5	0	NU	NU	2	-	NU	NU	NU	3	-	NU	-	0
	05:5	0	0	0	-	-	-	-	0	-	1	0	NU	0	NU	NU	NU	06:0	0	NU	NU	2	-	NU	NU	NU	3	-	NU	-	0
	06:0	0	0	0	-	-	-	-	0	-	1	0	NU	0	NU	NU	NU	06:1	0	NU	NU	2	-	NU	NU	NU	3	-	NU	-	0
	06:1	0	0	0	-	-	-	-	0	-	1	0	NU	0	NU	NU	NU	06:2	0	NU	NU	2	-	NU	NU	NU	3	-	NU	-	0