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SOFTWARE OUTLINES FOR DECISIONS MAKING SUPPORT IN OIL AND GAS ENGINEERING

Mykola CHESANOVSKYY[1*], Kostiantyn KRAVTSIV[2], Volodymyr PROTSIUK[3], Liudmyla POTERIAILO[4]

[1] Ivano-Frankivsk National University of Oil and Gas; nick.chesanovskyy@gmail.com, ORCID: 0000-0002-8687-0837
[2] Ivano-Frankivsk National University of Oil and Gas; kostya.kravtsiv@gmail.com, ORCID: 0000-0002-7916-3659
[3] Ivano-Frankivsk National University of Oil and Gas; v.v.protsiuk@gmail.com, ORCID:0000-0003-0055-2780
[4]Ivano-Frankivsk National University of Oil and Gas; milapoteriailo@gmail.com, ORCID: 0000-0002-0501-592
* Correspondence author

Purpose: The aim of this study is to develop an architecture of enterprise solutions that allow real-time (or simulated) extraction, storage and analysis of parameterized data from high-resolution sensors to more accurately predict the potential course of technological processes in the industry and solving of related logistics tasks.
Design/methodology/approach: The development of an integration architecture based on appropriate Web tools for viewing and collaborating on corporate information of the oil and gas industry will allow full operational decision-making on this basis, guided by the values of relevant controlled parameters and imposed on them and the process as a whole relevant constraints in general are the methodological grounds of the research from the theoretical and subject domain scope. The functionality of the artificial intelligence system should be reduced to sending signals to the controller in order to modify the controlled parameters through the appropriate instructions. At the theoretical level, measurement, interpretation and control will take place either on the surface, or on the bore, or in both places at the same time.
Findings: There were explored software outlines for making possible the creation of the desired findings for new and better business processes and technological innovations in the domestic gas and oil industries based on intelligent information solutions. As proposed in this study, optimal flexibility and forward performance will only be achieved through the use of the cloud as a platform for tomorrow's technological challenges in the oil and gas industry.
Originality/value: The newly developed focus on novel class of increasing domestic business efficiency will generally encourage oil and gas companies to develop their information architecture in the direction of knowledge-based systems and solutions, especially when controlling the drilling of oil and gas wells in terms of incomplete, inaccurate and poorly structured information from sensors.

Keywords: information technology, oil and gas engineering, corporate solution, data, data management, decision making support, knowledge-based technologies.

Category of the paper: research paper.

1. Introduction

The oil and gas industry is increasing the demand for IT architectural solutions. The reference architecture for oil and gas exploration and production must support and respond to the company's production activities and provide the opportunities necessary for efficient and effective management of the industry. Oil and gas exploration and production is a huge, complex business based on data, the number of which is growing exponentially (Rawat, 2014). These organizations work simultaneously with structured and unstructured data. Structured data is processed in applications related to the relevant domains used for geodetic data management, processing and visualization, exploration planning, reservoir modeling, production and other activities related to oil and gas production. At the same time, large amounts of information related to the same activities are formed in unstructured forms, such as e-mails or text messages, word processing of documents, spreadsheets, voice recordings and more (Singh, Pandey, Shankar, Dumka, 2015). Finally, oil and gas organizations also need the ability to connect and integrate large amounts of unstructured data obtained and used from non-domain specific sources, such as Word processing and electronic programs, unified communications, and application collaboration (Nicholson, 2012). This requirement means that much of the information needed to manage mining projects is actually located in non-domain applications and on both local environments and data clouds. This growing amount of data is now typically found in disparate source systems, from software to interpret seismic results to global corporate servers such as of BP, Chevron, Exxon Mobil, etc (Baaziz, Quoniam, 2013). This means that when a geologist studies seismic data for a particular site, and it needs to check the cores again, the information can usually only be accessed through an inconvenient and time-consuming search across different systems, rather than from a single common interface. If such integration exists, it usually works through a point-to-point connection or through intermediate database tables (Andrew, Henderson, Irani, Parker, Sternesky, 2008). These disposable connections add time and cost, and cannot be easily separated or reused in other applications. Various industry enterprises provide data integration frameworks or applications that create a common level of access to help solve the problem for integrating of large industrial data. To solve the industrial production problems of petrophysics, geology, field design, and others, there are usually exist their own systems of analytical modeling, but currently, there are very few solutions for connecting and interacting between these models. Thus, changes in the conclusions of one model are not always brought to others, which can lead to increased inaccuracies, errors and uncertainties in the data themselves and their structure, respectively (Baaziz, Quoniam, 2013). Given the existing IT infrastructure and architecture of industry enterprises, the organization of interaction is very difficult, because there is no convenient, common place where several internal and external software agents can access information stored in the corporate network. For example, an employee of a service company operating on the sites of several energy companies must have separate authorization data for each system of these joint partnerships (Hollingsworth, 2013). Cloud computing technologies refer to remote centers for storing and accessing data and applications using the Internet, which are designed to save money, in particular by reducing the need to design a large computing infrastructure. The cloud approach is ideal for complex oil and gas exploration and production operations, with a variety of software vendors, multi-parameters environments, and vast amounts of data that require a combination of rigorous security and easy communication with relevant partners (Ferguson, 2012). Cloud infrastructure solutions allow companies to rent only the functionality they need when they need it, and based on each user's individual profile. Cloud support for the latest data standards, for standard and industry data, combined with technologies such as web services, provide easy and secure integration between different instances of cloud hosting services, even those provided by different providers. With the proliferation of devices now available to consumers as well as businesses, especially tablets and smartphones, there is growing pressure on IT departments to maintain the flexibility that mobile devices can provide to end users. This is especially true when working with applications that connect to services and solutions that run in the public cloud. In addition, some hardware manufacturers for these oil and gas production capabilities provide tablet solutions in protected form factors to support long-term survival in harsh operating conditions at drilling sites with extremely high safety requirements. Today, industry enterprises need to consider information from data of any size and any type. In order to get the full value of big data, businesses need a modern data platform to manage data of any type, whether it is structured data such as drill sensor data or unstructured data such as raw seismic data, and of any size: from gigabytes to petabytes (Hems, Soofi, Prez, 2013). Big data solutions should also manage data at rest and on the go, as well as support state-of-the-art equipment such as Hadoop. Finally, whenever you need to access part of a dataset with analytics tools, this platform should have a way to temporarily store other data in an inexpensive, secure cloud storage, in order to reduce data center costs for these potentially vast arrays of data. In particular, source data such as seismic data interpretation data is hosted in the cloud infrastructure, which greatly simplifies full integration into web tools for viewing and collaborating on this information. For example, when a geologist studies seismic data, he can double-check the cores using a single common interface hosted in a web browser. When analytical modeling systems use theoretical disciplines such as petrophysics, geology and field development, all of this will be placed in the cloud in “software as a service” mode, and then full connectivity and interaction is possible, leading to much more accurate decision making in much shorter time (Guanghui, Feng, Hongxu, 2012).

The development of the oil and gas industry has always relied on industrial data to conduct production activities. This industry is one of the few that first introduced the use of low-level data sensors. Oil and gas companies have long been collecting data from their oil and gas wells to monitor the progress of relevant technological operations and to model the life cycle of relevant industrial facilities (Chesanovskyy, Sheketa, Yurchyshyn, 2016). Today, oil and gas companies collect various types of data rapidly and in huge volumes. This includes data on drilling and extraction of raw materials, GPS and spatial data, seismic data, general industrial data, information on weather conditions (especially in offshore drilling), as well as logging data as histories of field explorations. Most of this data is unstructured or poorly structured, which raises relevant issues about storage, integration and access to such data using traditional and new technologies of databases, data banks, data warehouses, knowledge bases and knowledge-based technologies in general. The oil and gas industry now also covers social media capabilities (Romanyshyn, Sheketa, Poteriailo, Pikh, Pasieka, Kalambet, 2019), such as status updates and social media posts, instant messaging, blogs and wikis. As oil and gas professionals increasingly use these technologies to manage their personal connections, the industry is adapting to networking opportunities to strengthen intersectoral collaboration and to better understand and manage oil and gas exploration and production operations. Using the right combination and application of the technologies described in this study, oil and gas companies will be able to implement an IT infrastructure that will support and respond quickly to all the necessary analytical analysis, the work of individual units and the entire production process as a whole.

2. Page setup, formatting, notes – first level numbering

When using integrated global solutions to analyze data from a variety of sources, drilling anomalies can be identified in real time. This technology can be used to improve the environmental safety of oil rigs and drilling rigs by detecting patterns of emissions before they actually occur, with catastrophic consequences of possible incidents and other manifestations. Oil and gas companies must identify events and patterns that may indicate an imminent security threat or cyber-terrorist acts. Prognostic analysis reveals patterns that can help identify these threats in advance.

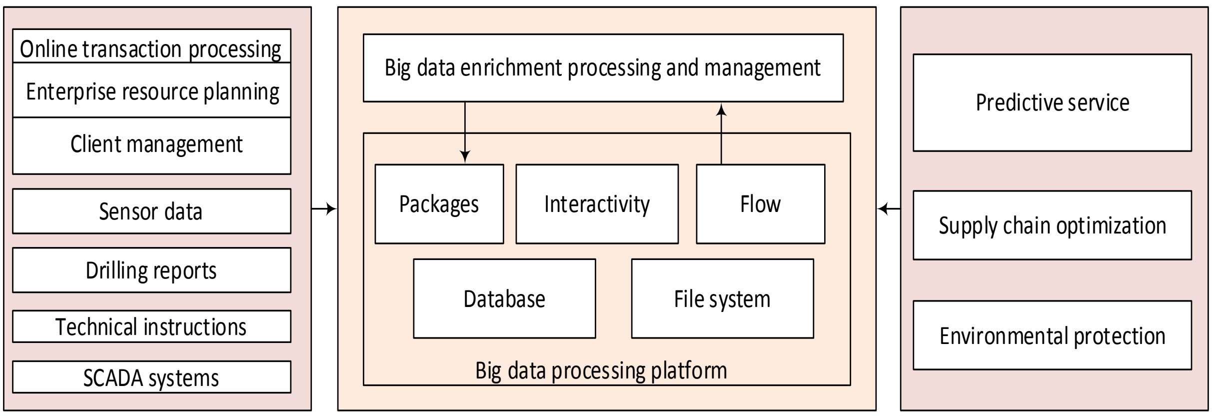

Figure 1. Basic data sources. Source: Author's own elaboration based on: (Ferguson, 2012).

Comprehensive solutions in this class can help identify threats in real time through machine learning and anomaly detection methods that can reduce the likelihood of such precedents (cases) from available sources.

In particular, analysis of seismic data and drilling and production data can help optimize oil production from existing wells. Big data methods can also be used to predict oil production. If the forecast does not correspond to a certain level of production, then a certain adjustment can be made. The proposed solutions can help engineers perform data integration and analysis to increase the bandwidth of data channels from existing wells.

The end user gets a proven, enterprise-class platform that deploys on-site, along with applications, and supports a wide range of mission-critical real-time applications. This system brings unprecedented reliability, ease of use and record speed for databases and streaming applications in a single distribution.

Sensors are increasingly used to monitor the state of exploration, production, transportation and processing of hydrocarbons as shown on figure 2. Real-time monitoring allows to take the precautions that is needed to be taken, which can significantly increase efficiency and reduce potential environmental and technological safety risks in general. Thus, the general method is to help ensure the success of the project and is accordingly performed in the rapid deployment of the project with the appropriate domain step in order to claim success at this stage and adjust the plan as needed. The complete information architecture of a software solution is never built at once, but is developed over many stages by further refinement.

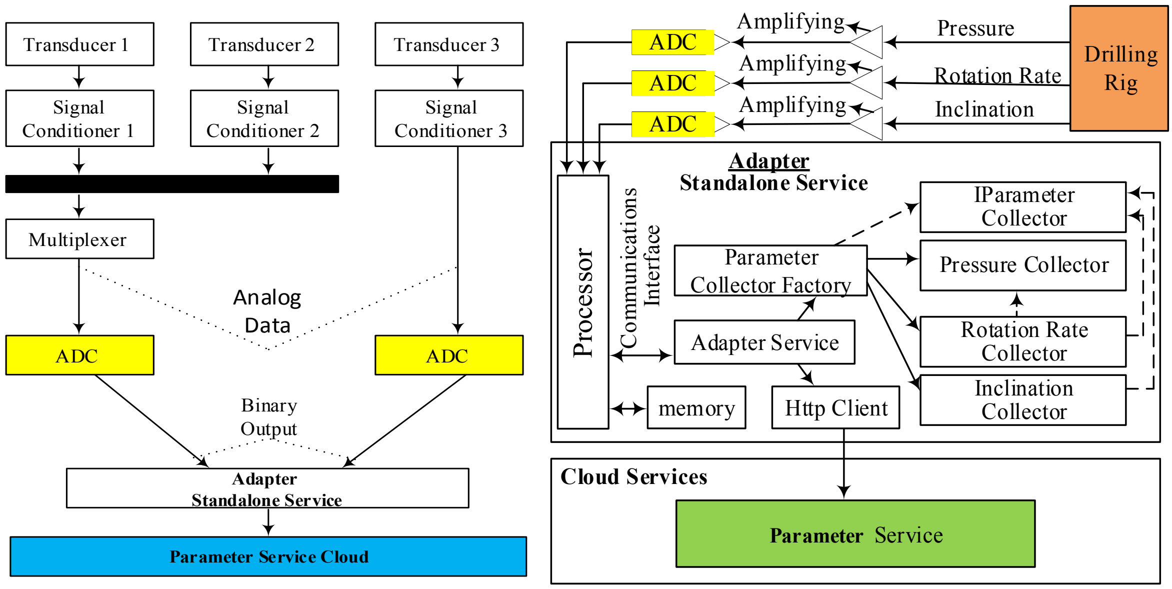

Figure 2. The proposed architectural outline for controlled parameters. Source: Author's own elaboration based on: (Chesanovskyy, Sheketa, Yurchyshyn, 2016).

The use of artificial intelligence techniques in well drilling allows to link aspects of automation with the level of sensors to monitor the progress of the well drilling process, as well as with the level of control systems to optimize the efficiency of the drilling process.

As the information architecture evolves rapidly, the ability to access, analyze, and manage vast amounts of data is becoming increasingly important for oil and gas exploration and production companies. Such companies, in an effort to increase production efficiency and productivity, face a number of challenges, including uncertain and volatile oil and gas prices, changing energy policies, environmental issues such as global warming, and competition, arising from new energy sources, as well as the current operating costs for management and inefficiency of the industry as a whole in Ukraine.

Faced with these problems, many see solutions in “big data” and sensors that can provide that data, which is an important source of information needed to optimize exploration, drilling, production and supply of oil and gas.

New data sources, such as social networks, can provide an important understanding of the mood of local communities in the context of their reform, affected by oil and gas facilities and pipelines. Well-managed real estate of industry companies is also important to maintain a positive reputation when faced with the assessment of financial assets and potential risks.

Thus, the technological process, which uses elements of artificial intelligence, must be able to operate without supervision by the operator.

Oil and gas companies exist in a rapidly changing market. New methods of obtaining energy and its alternative types can enter and are already successfully entering the market and creating excess supply. Political events can create a deficit. Understanding the direction of market pricing and demand in such conditions is crucial. For example, refineries may need to explore other markets (in new niches or other regions) when a local source outperforms demand.

Faced with this uncertainty, many experts continue to emphasize on more effective asset management and control. There is also a need to focus on effective and efficient oil and gas exploration. Maintaining favorable environmental cooperation and good public and state relations remain the priority of doing good business along with obtaining permits for new exploration and production in the event of confirmation of existing reserves.

The types of data used in these analyzes can vary widely, mostly from sensors and other streaming data sources. With the deployment of large scale data management systems, which include traditional data warehouses and new data reservoirs (based on structured and unstructured databases), broader data types can be analyzed to ensure that the business becomes more flexible.

The key challenge remains to transform this growing data avalanche into clear pathways that will affect the energy business as a whole. Oil and gas companies have long focused on improving the efficiency of exploration through advanced analysis tools applied to a variety of data.

Seismic topographic surveys tells where to drill. In today's challenging environment, the cost of new research should not increase, and the success rate needs to be improved to maintain profitability. Similarly, increasing reservoir capacity as part of improvement and development cost are key factors in maintaining profitability:

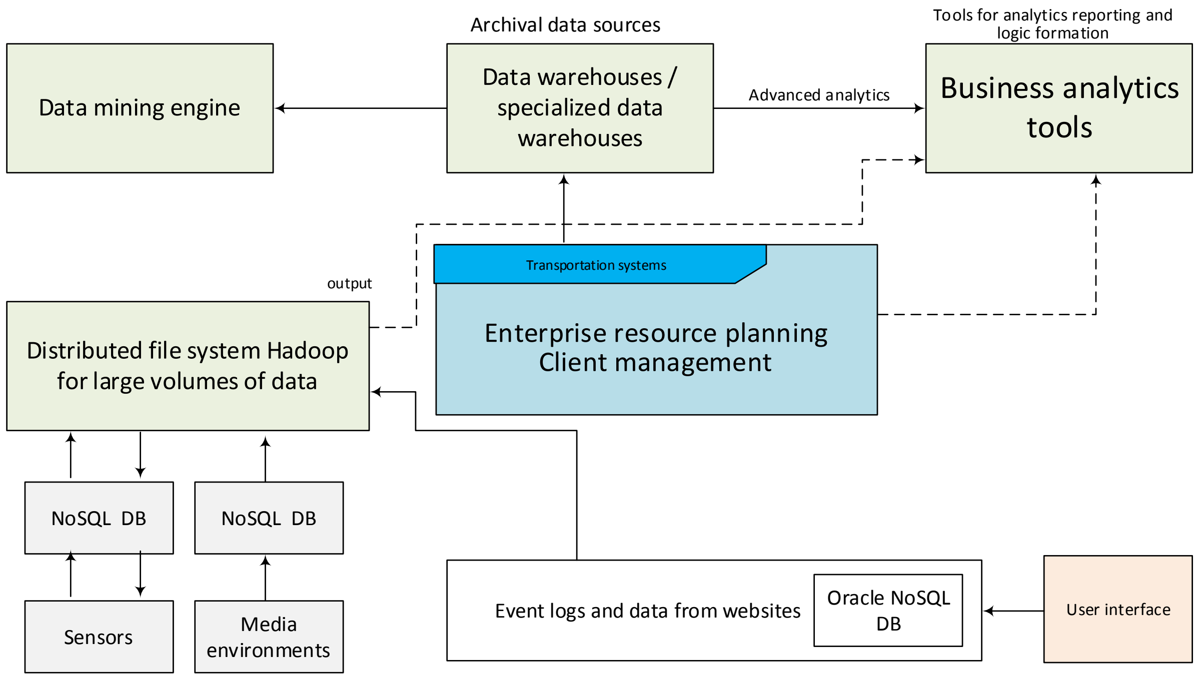

Figure 3. The initial data segregation outline. Source: Author's own elaboration based on: (Hollingsworth, 2013).

Such data have traditionally been analyzed in data warehouses consisting of relational databases. Today, the focus is shifting to data clusters, partly because of their relatively low cost and partly because of the schema-less file system, which is ideal for predictive workload analysis.

The need for operational efficiency at drilling rigs, pipelines and refineries is well understood by industry experts. Data on the status of operations is collected from sensors in real time, which allows to better understand when a particular service should be provided, as well as, by monitoring changes in the status of key components, provide even greater service efficiency and savings. Predictive analytical solutions deployed on large scale data management systems are likely to become common practice to increase overall security, reliability, and reduce the cost of implementing typical industry projects. Such an analysis may also indicate potential safety concerns or the identification of environmental risk factors for accidents and abnormal situations.

Today, predictive analytics programs can also be deployed in data warehouse solutions, such as optimizing the routing of vehicles, process personnel, hydrocarbon exploration and production materials. Such routing is fundamental to ensure the lowest possible cost of delivery while maintaining profitability. It is also important for the timely delivery of spare parts, thus avoiding serious problems with the maintenance and safety of logistics in general.

Oil and gas prices can be very volatile, but their value during the life cycle of the project can determine whether the exploration, production and refining of oil or gas makes financial sense. Forecasting analysts can play a crucial role in gaining an understanding of the likely directions of pricing, determining the right exploration and choosing the level of industrial production. Such data can also provide guidance on the right investment in relevant projects.

Many of the existing business opportunities can be expanded as more diverse data becomes part of the information architecture. IT departments in oil and gas companies typically work with their business lines to create solutions when identifying large scale data projects that provide the following:

1. Improved subsoil exploration pays off faster: oil and gas exploration requires extensive seismic, environmental, and cost analysis of production to determine whether expected returns can be profitable and achievable. Understanding changes in market conditions is also an important factor for project success.
2. Improving production efficiency. Production efficiency is ensured by constant analysis of drilling operations and timely maintenance of equipment. Remote monitoring and analysis are also important to determine the condition of pipelines and refineries. Also, the analysis plays an important role in providing assistance to avoid safety problems, environmental pollution, which may be a by-product of sub-optimal management of technological operations.
3. Cost-effective and timely supply chains and logistics management: delivery of spare parts, consumables, equipment and personnel on time are key while maintaining optimal production capacity and ensuring minimum downtime. Effective logistics management can also provide more cost-effective supply chains.
4. Better market analysis for investment: analysis of current prices and market trends is crucial in determining when to conduct subsoil research, when to start production, when to buy and sell assets, and when to change investment strategies.
5. Improved public relations: understanding public opinion and being able to respond quickly to requests from public and state bodies is extremely important in building trust with the wider community.
6. IT operational efficiency is not something unique for oil and gas companies and is rarely conducted from the standpoint of a pure IT business, but there are possible reasons for use on advanced architectures and it is the need to move data and turn it into "schema-less" – a platform for more efficient processing and involvement of IT resources. Operational efficiency is often difficult to prove, but sometimes this is the initial rationale for which IT companies actually seek to deploy these new and innovative types of solutions in some of the stage of drilling data lifecycle. Improved geological analysis through information and computer modeling of equipment failures and seismic analysis, leads to greater findings and with a more predictable result, as well as improves the planning of industrial drilling wells. Remote operational control and monitoring of pipelines and equipment for lower cost, reduces environmental risk and increases overall safety. Tracking environmental regulations in the area and understanding the potential costs of cleaning the ecosystem is the main directions to move. Sensors on wells that indicate incorrect readings help to anticipate and avoid the risk of accidental failure. Better energy management reduces drilling costs.

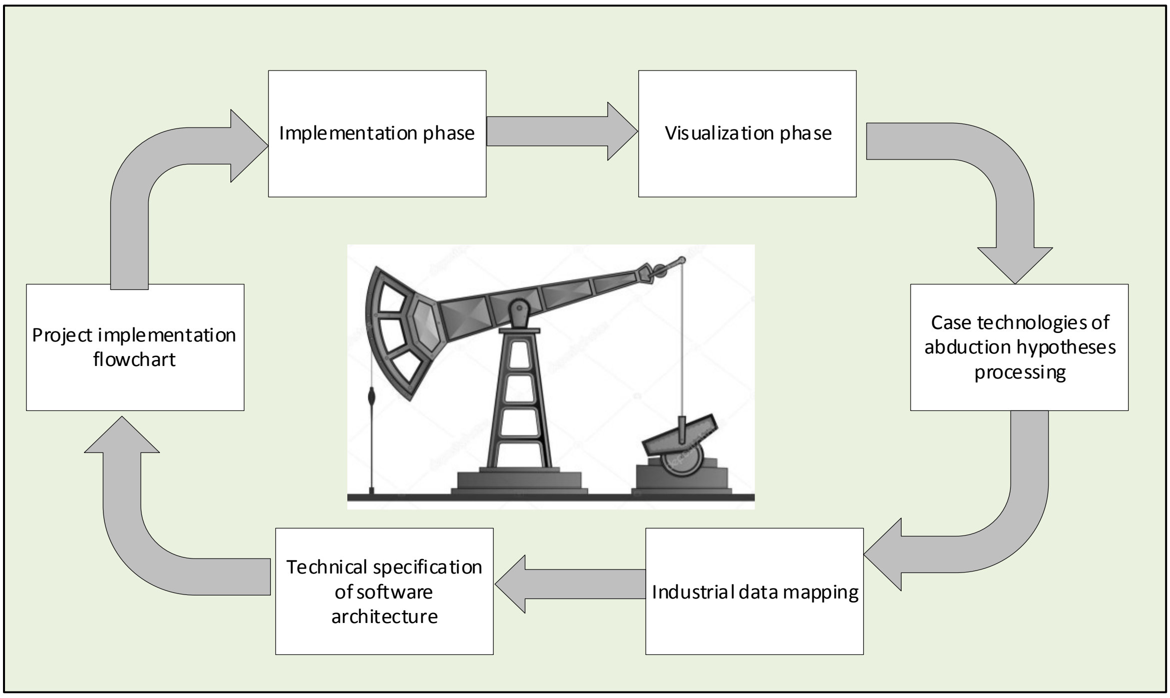

Figure 4. Typical data cycle in the subject domain. Source: Author's own elaboration based on: (Hems, Soofi, Prez, 2013).

Better assets and personnel management can reduce the cost of technological processes in general. To construct a correct economic assessment, it should be assumed that all the values considered in the study, represent the actual cost of well development. Based on these considerations, it is necessary to take into account not only the potential savings from the use of each artificial intelligence system, but also the cost of the well that will be obtained from the use of such systems.

Hadoop-based data reservoirs are usually the most efficient when storing datasets of unknown structure. Characteristics of data, which include how the data was obtained, how it should be formatted, what refresh rate and quality of this data - will help us put in the right place the right technology that is best suited to a particular situation. We need to understand which type of data processing will be most appropriate: real-time or batch processing. Initially, such projects are often considered experimental in terms of implementation, and therefore they can be independent, separate from traditional environments.

The main focus of the proposed study is on analytics and management related to reporting data and parts of the information architecture in general. Where oil and gas companies control and use data from sensors, the discussion of architecture expands to the level of relevant services. This advanced architecture for data collection, security and communication with other parts of the information architecture may require additional consideration in terms of the implementation of its components. The figure shows the main components of a typical information architecture. Data is collected and organized as needed and then analyzed to make meaningful business decisions. The variety of basic platforms provides a crucial role. Management, safety and control are crucial in everything and always come first in oil and gas companies.

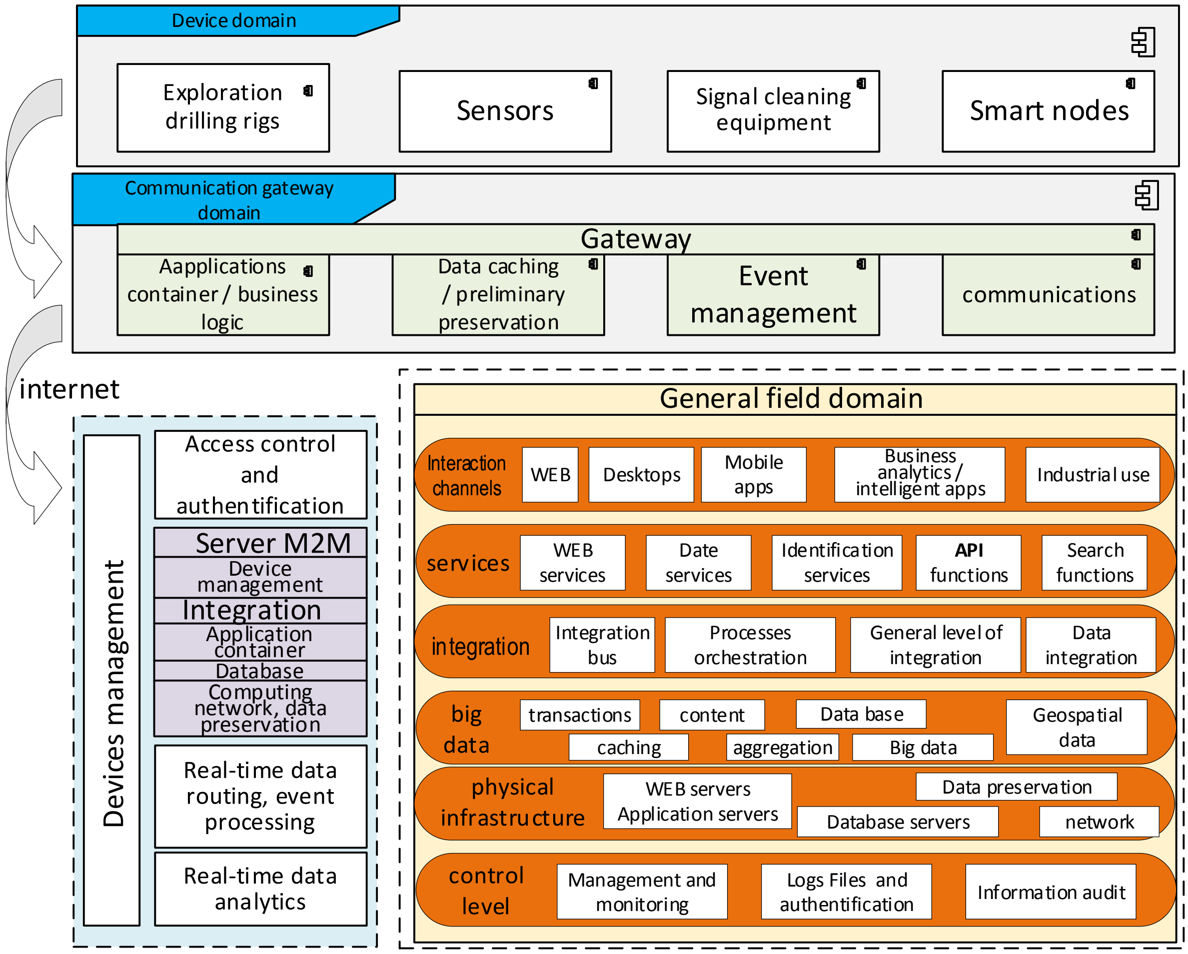

Figure 5. General structure of the data aggregation routines. Source: Author's own elaboration based on: (Baaziz, Quoniam, Vasilak, 2013).

On the figure there conceptualised the levels of detail that can be considered around the delivery of information and its presentation in the system.

The security of the solution is extremely important, as most companies do not want unrecognized third parties to intercept data provided by sensors. Applications that are close to the sensors themselves are often written using event handling engines to take urgent action based on predefined rules. There are also issues with message routing, resource allocation, and aspects of managing such solutions. The level of automation of oil and gas drilling processes is expanding and improving every year. However, the degree of automation and its components are different. Therefore, the application of automation processes to some extent is considered in the control systems of drilling mud, embedding of the casing, as well as other types of drilling operations. Such automation tools are based on a number of measurements performed in modern drilling technologies, which allow to determine the properties of drilling mud, drilling process parameters, to conduct casing research, to measure wells (including measurements during drilling), direct measurements and others.

Today, oil and gas companies analyze data from various sources. These data sources may include:

- Data from low-level sensors during exploration, drilling, production, transportation or refining of oil and gas.
- Traditional corporate data from operating systems.
- Social networks used by company employees.
- Web browsing templates (on corporate information websites).
- Data on announced vacancies of specialists.
- Archival data on exploration, logistics, oil and gas prices.

These measurements generally help process operators in monitoring the progress of the well drilling process. A next figure illustrates a typical map of the capabilities of the proposed architecture for oil and gas companies:

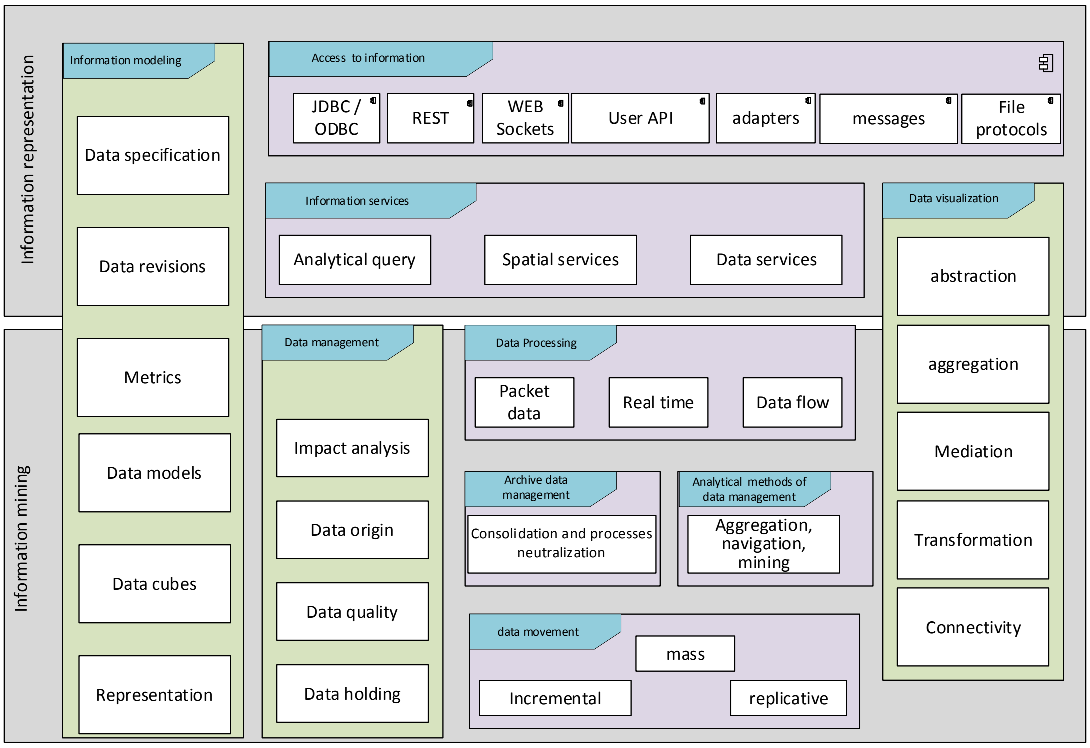

Figure 6. The generalized architecture outlines Source: Author's own elaboration based on: (Baaziz, Quoniam, 2013).

Thus, oil and gas companies need to purchase software from leading software vendors, in the form of modern cloud solutions, to reduce inefficient costs and increase the flexibility of doing business as a whole. Although the term "enterprise software architecture" is widely used, there is no generally accepted definition. However, this essence is crucial for managing the complexity of technological processes in the industry and reducing the time relative to the cost of the proposed solutions, as software becomes increasingly intertwined with business and with the daily work and leisure of people around the world. The corporate architecture framework serves as an important transport information tool for the classification, organization and structuring of knowledge repositories and related maintenance processes of production processes. They serve to divide a complex production system into interconnected, managed and understood in the future. Information obtained from various sources can be analyzed for specific production purposes, which gives an idea of the work of the production system as a whole.

Thus, the proposed corporate architectures and related systems justify their potential value due to the efficiency and continuous benefits they provide to industry enterprises.

The use of modern cloud solutions for joint work of all departments of the enterprise, increases the speed and ease of cooperation for employees within the organization, as well as authorized external partners, and ultimately allows safe access to general information, and only for the required time. Key performance indicators are used to understand and assess the current and general state of the industry, always readily available when placed in modern cloud applications. The data used to support these key metrics can be processed using the massive computing power available in cloud infrastructures, and thus, system responses will be available quickly and in a timely manner. The basic principles of ascending architecture do not indicate that they do not set out the specifics of the structure and function of the bit structures to achieve the future state described initially. Rather, the ascendancy of architecture describes a set of guiding elements, or principles, that govern it. This descriptive approach not only provides a coherent set of principles for consistent performance, but also provides companies and enterprises with the flexibility to innovate and create competitive differences.

Today, powerful reasons are forcing oil and gas companies to look for a new and more efficient architecture of cloud-based IT infrastructure. Companies are trying to reduce the cost of implementing and maintaining new solutions at all means. This can only be done by making the most of existing investments when purchasing new technology solutions from suppliers. However, so far there have been few indications of how investing in such solutions can take full advantage of existing investment in technology that is already used by relevant IT departments in their organizations. For example, it would be beneficial for a company to know that a vendor's solution uses legacy management solutions from other industry enterprises to facilitate deployment or use of single technology input from already deployed solutions to manage production facility identification and decisions making in general. In addition, due to the widespread use of cloud solutions, capital investment in data centers can be reduced by increasing business flexibility and thus reducing the cost of information support in general.

In today's business and operational environment, companies need to provide more bandwidth for data with fewer resources and strictly time-limited expert working groups. In order to deliver better results faster, geologists and geophysicists and engineers should be able to spend more time on subject-oriented work and spend less time searching for and preparing the data needed for that work. Workflows, managed data events, and automated analysis of such data should help identify potential risks and manage the exploration of the relevant resource or production operations in general.

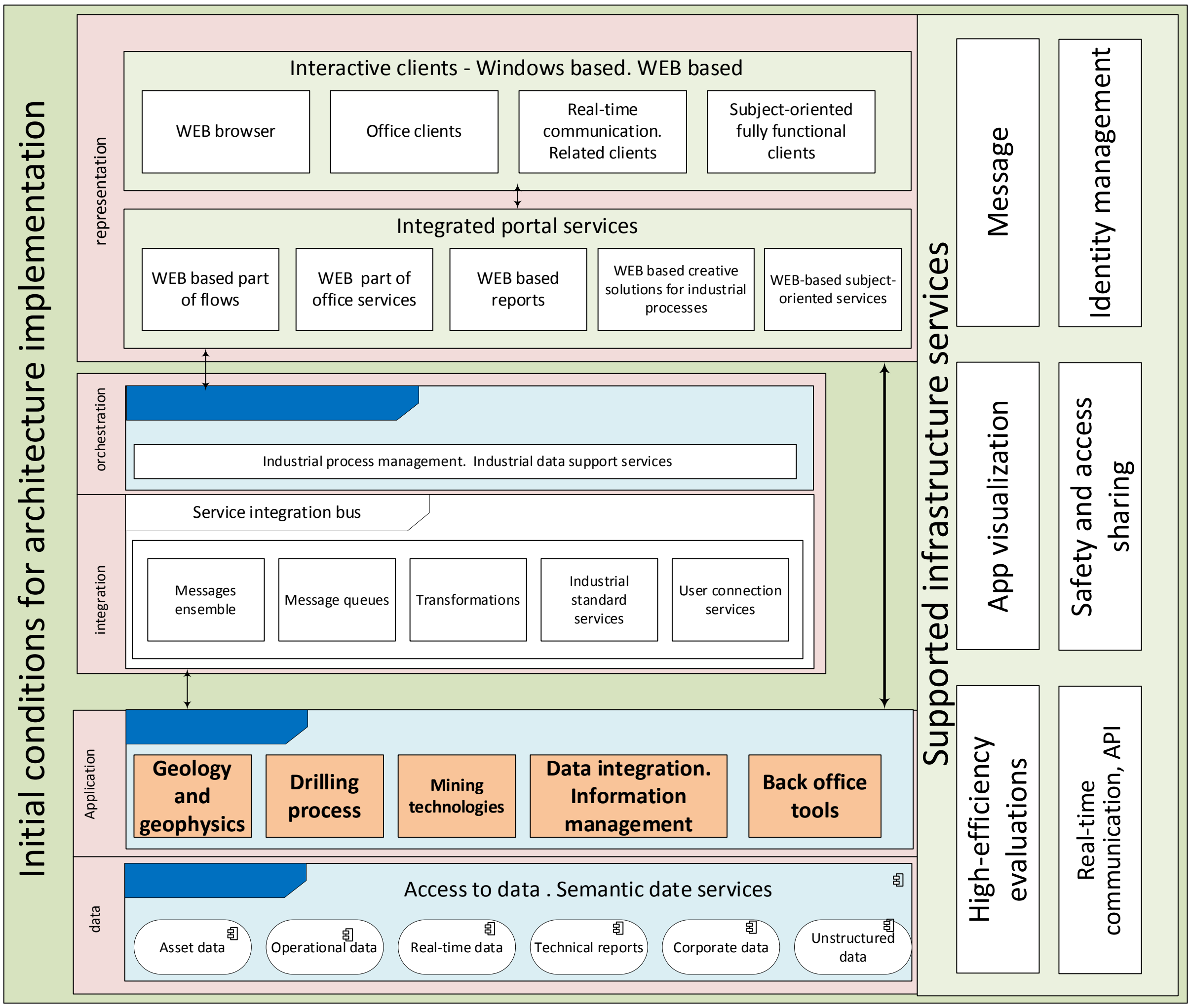

Figure 7. Architectual levels for solution implementation Source: Author's own elaboration based on: (Rawat, 2014).

Specific performers should also have a holistic view that will disclose all relevant data, both structured and unstructured, for a given situation.

Management needs to have refined key performance indicators in order to fully understand the current state and general state of the organization. For example, ideally, managers should be able to see on one screen a portfolio of current opportunities, and see which of the rigs, for example, are ready and which are planned for the coming weeks. With the appropriate details, managers can focus their time on the assessments of teams of performance experts to quickly take action to remedy the situation and return them to the expected level of performance. The oil and gas industry needs an architectural approach that will allow organizations to use more flexible and cost-effective cloud technology that will work in Plug-and-play mode. If a technology vendor designs the best web seismic translator, for example, the architecture must assume that the new solution will be quickly and cost-effectively deployed on other cloud solutions that could use it. This approach lowers the constraints on IT, gives companies access to the best solutions, and can reduce the time it takes to deploy new solutions from a year or months to one month or even days. The integration of structured and unstructured data is a major challenge. As already mentioned, some new industry standards and technologies now allow for more flexible, prerequisite integration or also cloud architectural solutions needed in the oil and gas industry as a matter of time. On the figure 7, in particular, it is shown a service-oriented computing environment when it includes the integration of domain applications, business performance tools, and inverse applications. All of them are placed in the traditional formal format. There is shown the state of the architecture when it is deployed on a cloud. Using a service-oriented architecture (SOA) approach to the interoperability of components at different levels of the architecture, subordinate enterprises, technology vendors, system integrators, and other partners can be realized all the benefits of this environment. Some key aspects of the designed architecture should be considered and the possible interactions that will occur between the components after their implementation in both local or cloud, and as a hybrid solution (partly local, partly cloudy) should be discussed. The scenarios serve as an example and show how solutions can be delivered using the various components of this architecture. Windows and WEB interactive clients form a presentation layer for the business user architecture, which for the device can use a workstation PC, laptop, touch tablet, smartphone, or a combination of some or all of them at different times, as dictated by user needs and/or location. Integrated portal is presented as a common platform in which geo inspectors, engineers and managers can access all types of IT-based domain processing technologies. The portal establishes a single place where authorized personnel can find and use a wide range of data, including key performance indicators on the control panel, technical programs such as those used to interpret seismic data, log files, field research, exploration reports, and systems business analysis. This Web portal also provides mechanisms that support blogs, wikis, and corporate social networks, such as Yammer, that are used to install and maintain cross-domain shared systems. Instead of logging in to a specific system (such as SAP to access a work order), users simply log in to an integrated portal to access work orders, analytics, and other research or production-related systems. This portal-oriented approach allows experts and managers to focus on drilling resources, technical resources, and redundancy ratios, rather than working on placing data in multiple programs. For example, if there is a problem with drilling rigs, the drilling engineer or operating personnel will be able to quickly and easily use the tools available through the portal to deploy and view all relevant data related to this rig to analyze the problem and create a timely operational solution. Data integration and business process management components are largely the foundation of a more efficient IT architecture, providing a central mechanism for moving data between systems, equipment and other elements of the IT infrastructure using most advanced technologies.

Components of data integration and production processes provides a centralized input data repository with log analysis, work management, spatial, production and control systems. Using defined business rules, this components organizes the movement of data between different systems, including the seismic data warehouse, the operational data store and peer review programs used for information modeling of technological processes in oil and gas engineering.

3. Results

This study presents a thorough analysis of big data functionality and analytical capabilities within a new generation of architecture that can meet the needs of a dynamic market for information software products for the oil and gas industry. It is shown that the speed with which the data describing the technological processes of the industry is generated is constantly increasing, which leads to an increase in the level of need for such data by experts in the field. This increase in data rates and sources, of course, leads to an increase in total data. Industry experts and business analysts want to absorb more and more data at high speeds, store it longer, and want to analyze it as quickly and in depth as possible. The large scale data solutions proposed in this study help oil and gas companies meet these requirements. The introduction of the reference architecture is also presented. The approach and the proposed methodology are the result of the development of customer projects and as a result offer solutions that customers face in the process of planning the architecture and implementation of software applications for the life cycle of oil and gas fields. Creating an integrated information architecture that can handle datasets with a known structure as well as an unknown structure allows to increase the capabilities of existing oil and gas data warehouses to much better, knowledge-oriented industrial data centers. The flow of oil and gas industrial data is increasing exponentially every day. As a result, market operators require software solutions that allow them to operate more efficiently and take advantage of new technologies, including cloud services, cloud applications, mobility, social networks, and platforms that fully unleash the potential of big data. A number of global software vendors are at the heart of, or even ahead of, these technological advances. The proposed study forms a new vision of the problem, which is to form packages for the supply of technologies of this class in the energy sector of Ukraine. It is an indisputable fact that cloud services today are the next generation in information technology and the next step in the industrial pursuit of efficiency and globalization of the energy sector of the state. Oil and gas engineers, industry managers feel a real need to use cloud services in the future, and a significant part is already using private or public data cloud services. Industry customers expect that their computing environments will provide easier access to the large amounts of data needed for rapid decision-making in the oil and gas industry. The proposed architectural framework leads the oil and gas industry to cloud solutions, and from there, will provide a solid foundation for the next generation of oil and gas solutions focused on expertise to a greater extent than on the clouds of big industrial data. Comprehensive solutions help to cost-effectively integrate and analyze a wide range of unstructured data to increase drilling efficiency and overall production productivity while preventing environmental problems and ensuring the safety of technological operations in general. High-availability software tools help you perform remote operations reliably, making them especially valuable. And the features of multi-platforms provide the necessary flexibility to run multiple applications on a single cluster, within a single unified data space. Data from equipment sensors and geological data can be analyzed to predict equipment failure and to understand which equipment is best for what operating conditions and where it should be installed.

4. Discussion

Convenience and simplicity of information needs are important for many subject matter decisions. Business intelligence is likely to have different business requirements and has different types of analysis and technical skills. They may require a solution ranging from a simple representation for the temporal possibility of queries to predictive analysis. One dimension is usually not suitable for all cases of architecture implementation. While new capabilities in the data management platform can provide more flexibility, the placement of data for such solutions, data types, volumes, and usage of it typically determines the most optimal technology for deploying an application. The best common practice is to eliminate as many data transactions as possible to reduce latency at the application end-user level.

Data security and control issue are also key factors. Oil and gas companies want data to remain closed unless they specifically agree to open it, which is unlikely. Thus, providing access to data is crucial and does not depend on the data management platform, the means and methods of data transmission in use. Data management needs related to the value of data, as well as their accuracy and quality often require close coordination between several lines of IT solutions. Finally, implementation time is important for the success of any oil and gas initiative. There can be used reference architectures, data models, and standard configuration devices. They can accelerate system development and deployment and reduce the risk of incomplete solutions and serious integration issues.

Many of the individual components that make bit control intelligent already exist in some form, and others can be created using existing technology. For example, surface sensors already exist to monitor many important drilling parameters. Accordingly, downhole sensors implemented in modern systems for measuring drilling processes can measure and transmit to the surface data related to the control of the inclination of the wellbore and the parameters of rock formation.

5. Summary

The presented research is aimed to provide an approach to the application of the methods of the latest information architectures for oil and gas companies of Ukraine. These methods demonstrate the expansion of existing software architecture models to meet new and diverse data sources that become part of the information landscape of a typical industry enterprise on the example of regional drilling company. A thorough analysis of the information architecture leads to the consideration of where to host and how to analyze the data. Most oil and gas companies choose to place data where the data will initially minimize data traffic on the network, while data protection will be done in dynamic and static modes. Once data is saved, reporting and predictive analysis are often stored in the same data management system. So far, where part of the data is stored in the cloud there should be a careful consideration of the impact of network bandwidth on the performance of the analysis in places where data from all sources are required. An additional consideration in this paper is the availability of skills required for business analysts and IT organizations in the oil and gas business. However, there is always a requirement to integrate previous solutions that work locally, or between cloud-based, freely distributable solutions, or a combination of both. Therefore, this should be an important factor for companies planning to have a future in the global energy economy, which are technologically based every year much more and more on the means of information intelligent technologies, and knowledge-oriented technologies in general. Future assessment of the state of the software architecture of industry enterprises should include an understanding of the degree of complexity that may be created in the future, as well as the ability of the proposed architecture to overcome it. Competition from oil and gas companies will ensure that using the benefits of these new sources of data and knowledge to increase what is known about this type of business will continue their market leadership and provide significant competitive advantages.

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