An Empirical Study of Big Data Based Information Strategy (BDBIS) for Resource Enterprises

Qiongwei Ye[1,2] Qian Zhang[3]

Nangai Yang[2], Peng Wang[2]

[1] Tsinghua University

Beijing, China

yeqiongwei@163.com

[2] Business School of Yunnan University of Finance and Economics

Kunming, China

[3] School of International Business Administration, Shanghai University of Finance and Economics

Shanghai, China

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Abstract. Now many businesses pay more attentions on upgrading their decision-makings and adjusting their organizational structures by making full use of big data and developing information strategy for business decision supports. For group enterprises, however, multi-layered organizational structures, diversified businesses, multi-regional locations along with the complexity and dynamics of strategic governance have shouldered the complexity in group information strategic planning and hence the difficulty in its implementations. In order to fetch a reasonable information strategy to enhance the business's ability in obtaining and integrating information and reducing risks and improve the success rate of the information strategy to achieve the ultimate goal of integrating the business information strategy with their development strategy, it is important that we approach the study from multiple aspects, multiple angles, and multiple levels to determine the information demands of the business and the strategic implementation strategy. In the first part, the paper presented an analysis of the situations within current information strategy in the context of the so-called "Internet +" environment as adopted by resource enterprises. Then using the tool of big data, the researchers formulated the big data based information strategy (BDBIS) aimed at improving work efficiency and group governance. An empirical study of the DY Coal Group was then conducted and an implementation framework and procedure for the information strategy were suggested. The research findings of the empirical study have significant implications for resource enterprises in formulating their business information strategy and implementing the information strategy.

Keywords: Big Data, Resource Enterprises, Big Data based Information Strategy (BDBIS), DY Coal Group Governance

1 Introduction

As of June 2015, internet users in China have reached 668 million and internet penetration rate has reached 48.8%. iResearch data shows that in 2015 global information has reached a volume of 8 trillion GB (huge data volume), 85% of which are unstructured data (variant data types), and data processing speed is reduced to 1s (processing speed fast). The value contained therein is immeasurable. Gartner predicts that globally it will produce 4.4 million big data related jobs while IDC predicts a big data market value of $23.8 billion for the year of 2016. With big data security and development in the "Internet+" era as its theme, the holding of the 2015 Guiyang International Big Data Industry Exposition (Data Exposition is bound to bring the building and use of China's big data into a new era thus presenting a great opportunity for the implementation and upgrading of business information strategy facilitated by the wise use of big data. Information management is a system project involving implementation is efficient, effective and economical (3E), is a systematic project involving such internal and external factors as the corporate culture, management model, and clients whose objective is efficiency, effectiveness and economy or 3E (Yushun Fan, 2008).

For China's resource enterprises, they are facing the double pressure of resource environment crisis and reform as state-owned enterprises (Xiulan Jia and Zhiyan Zhao, 2005). And the common path of development for resource enterprises worldwide is "economy of scale" (Jiaxin Zhang and Yifu Chen, 2008). However, in the post-

crisis and “Internet +” era, with the intensification of energy conservation and pollution reduction efforts and the increasing pace of industry transformation and upgrading, pressure on the numerous resource enterprises in the fields of oil, coal, metal mineral and natural bio-pharmaceutics in terms of organizational structure adjustment and information infrastructure construction has been mounting. Therefore, this paper intends to provide insights and suggestions for the implementation and upgrading of business information strategies to serve the purposes of resource integration and management efficiency by using big data as support.

2 Literature Review

2.1 Overview of the Business Information Strategy for Resource Enterprises

Informatization refers to the use of information technology to promote changes in the targeted objects or fields such as business or society (Wikipedia, 2015). For example, Cooper demonstrated the benefits of informatization to business strategy at the organization level using FAC as an example (Cooper, 2000). Strategic management theories, on the other hand, have added more explanatory power as to the intuitive relationship between the two, namely, the implementation of informatization could increase the transparency of information or price hence reducing the information gap of the involved parties and providing decision support to the party in need of information (Soh, 2006). Further, the practical significance of an improved strategic information system lies in the use of information technology to enhance its business strategy (Lederer, 1988). Although the use of information technology strategy to enhance the competitiveness of enterprises is now common practice, correct understanding of the relationship between information technology and business strategy and its determinants is rare (Bakos, 1986). Bakos conducted a review of the impact factors of informatization on business strategy, and analyzed the respective relationship between informatization and internal business strategy, the relationship between competitive strategy and business portfolio strategy, and comprehensively expounded the important catalytic factor between the two (Bakos, 1986). To differ, Yang Li believes that the symbiotic inter-enterpreneurial business strategy is an important revenue for business profits thus validating the effectiveness of a cooperative and competitive strategy in the context of informatization (Li Yang, 2001; Wang Huimin, 2015). At the same time, Bakos expostulated the important guiding value of applying the validity of boundaries theory, the incomplete information for decision making theory and the entry barrier theory to informatization for strategic efficiency. Figure 1 is a comprehensive model demonstrating the business value of informatization emphasizing the key supporting role of external competitive macro environment to value realization and the impact of value production process inside the nuclear business on strategic efficiency (Melville, 2006). Using the X-Steel Group as an example, Gao analyzed the application characteristics of information in a resource enterprise and expostulated the promotional role of information strategy as a key venue to enhance its bio-economic circle emphasizing the key role of a supply chain based business platform in promoting informatization in businesses (Gao, 2011).

Information Strategy in general refers to such shared concepts guiding information investment, deployment, use and management. The emphasis is on consensus and attitudes regarding the consistent use of information resources for innovation (Ding Fang, 2012). Business information strategy allows businesses to avoid pitfalls ranging from unknown internal information to irregularities in production management and organizational procedure caused by messy operational information (Li Qi and Zhu Qinghua, 2011). From the perspective of group governance and talent development Lianming Zhao analyzed the planning of information strategy in coal businesses (Zhaolian Ming, 2011). Xiaobo Wu (2006) believes that the building of business information is more volatile at the beginning. But as the benefits of information strategy begin to emerge, businesses will be better motivated (Wu Xiaobo, 2006).Then Yawen Li conducted a study of business information strategies in the coal industry in a concentrated environment analyzing the principles of information strategy implementation, which are overall planning, step by step implementation, inventorying resources, connecting and sharing, uniform standards and management enhancement, differentiating the internal and external business information environment as based on effective and cooperative relations and presented the information strategy planning model in coal businesses (Wang Ya-wen, 2012; Wei Yong, 2013). After an analysis of the information strategy in power businesses, Xiaohui Zhu proposed the strategic alignment model and conducted a simulation study of the model using artificial neural network (Zhu Xiaohui, 2007).

2.2 Current Status of Big Data Research

Big data refers to the huge amount of information that is impossible for people to manually process so that we can intercept, manage, process and synthesize into usable information within a reasonable timeframe (5). The

birth of BI and BI analytics thus provide entrepreneurs and researchers with powerful support in decisions concerning data organization and business management (Chen, 2012). Today, companies are collecting and accumulating far more data that is needed for decision making. In order to transform these data into valuable information, companies need new skills and management models so that they can upgrade their "decision support culture" (McAfee, 2012). Erickson believes that the goal of strategic technology management is to enhance the competitiveness power of businesses so as to maintain and improve the cash flow necessary for the survival of businesses (Erickson, 2012). Meanwhile, Guoqing Chen and Zhiyan Feng etc. tried to define the concepts and characteristics of BI & A.BI & A 1.0, BI & A 2.0, and BI & A 3.0 emphasizing the importance of data management to businesses in the big data and "Internet +" era (Chen, 2012; Ping-zhi Yan et al., 2013).

In China, related major researches are the natural resource planning in strategic data planning as conducted by information service businesses since strategic data planning defines the standard or criteria upon which the entire database is built or modified. However, Zhang Jing Sheng stressed that if traditional businesses cannot take advantage of big data to get closer to consumers, understand their needs, efficiently analyze the information and make predictions, they will eventually become dependents of new e-commerce businesses who enjoy the monopoly of their end users (Zhang Jing Sheng, 2013 ; Wang Qian and Qian force , 2014). Bing Chen etc. believes that the operation mode has switched from “production of scale” to “customized production” and that decision making has evolved from business driven to data driven and the decision mechanism turning from the passive mode into the predictive mode. He also emphasizes that only by making full use of the big data can businesses plan ahead and regain control (Bing Chen etc., 2014).

3 Big Data Based Information Strategy Model for Resource Enterprises

3.1 Current Situations of Information and Status Use in Resource Enterprises

At present big data is mainly used in fields such as meeting customer needs, exercise and health management, smart city construction, business procedure optimization and the optimization or improvement of the performance of mechanic equipment. For resource enterprises, demand for big data is high in resource exploration, product quality control, and safe production management, optimization of refined business management process and decision support. But the actual use of big data is less than ideal due to the relative monopolistic market position of resource enterprises and their status as state-owned enterprises.

In resource enterprises, the use of big data is very limited and only in its infancy. Starting from the year of 2013, energy enterprises in the power industry and the oil industry who are leading the informatization efforts among resource enterprises gradually initiated their big data strategy trying to tap the value of big data by focusing on decision support, production and safety management. In the electric power industry, efforts are made to facilitate the full control of businesses by establishing data centers, expanding the depth of big data application and centering on data collection and analysis. As the resource reservation going down and the state monitoring strengths, resource enterprises in the chemical and mineral mining industries such as oil and coal are faced with increasing difficulties in exploration and development thus making the maturation level of informatization in the enterprises the most prominent factor impacting their growth rate. Meanwhile, big data problems can be addressed by cloud technology (Sahar, Julian and Nasseh, 2014).As the integration of industrialization and informatization deepens and accelerates, networking and cloud computing technology are propelling the oil industry into the intelligent information stage and ERP application integration and cloud- computing data centers have entered the implementation stage.

3.2 Study of the Information Strategy in Resource Enterprises Based on Big Data

For resource enterprises, the scarcity and indispensability of natural resources and the individual or unit differences in resource exploration present great difficulty for data collection. Because of the irregularity of the data collected, the corresponding value of such data is especially obvious in resource exploration. While large amount of data helps uncover trends and regularities, insufficient or limited data has virtually no practical value (Xuehui Jiang, 2015). Yet identifying and extracting valuable data from a huge pile of orderly or disorderly data can be very difficult. Given its characteristics, big data technology, however, could help (Li Yang and Junjie Zhang, 2015).

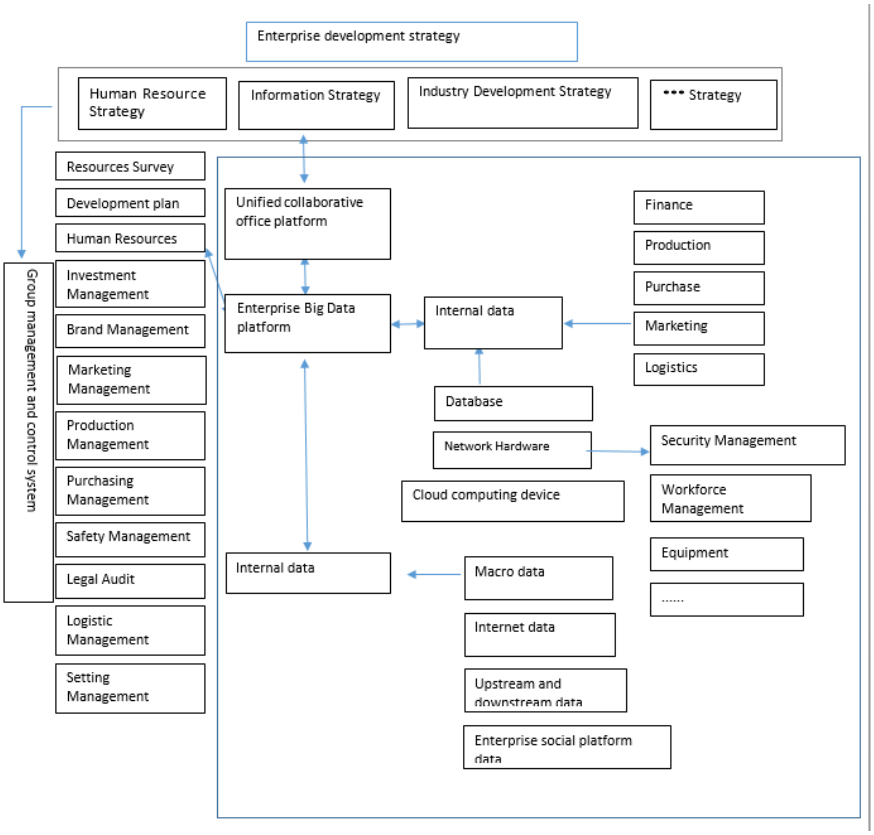

Fig. 1. Big Data Based Information Strategy Model for Resource Enterprises

On the one side, BDBIS requires seamless connection between Enterprise Big Data Platform (EBDP) and other departments, which not only can help to mine more useful information, process structured and unstructured data efficiently and monitor the operation of enterprise, but can also order the decision-making through the established management and control mode and coordinate both of information transmission and management work. Figure.1. shows the function of the big data based information strategy model for resource enterprises, which reveals the key role of big data and its unique characteristics within resource enterprise. Within the BDBIS, security management can be finished more easily and efficiently, for all the works are linked with EBDP seamlessly, Meanwhile, figure 2 reveals the internal framework of EBDP(a certain black box) and its connections with the whole product line that cover the production, management, control and coordination.

For resource group enterprises, to make the collected big data substantial and reliable so that its branch companies can increase their competitive edge, the key lies in the collection, integration and management of the data. Thus, in terms of business information strategy, how to incorporate business information needs into its information system planning, reduce the difficulty of data mining as well as increase the collected data volume for the purpose of improving data use efficiency and value are the first and most important consideration in implementing a business information strategy in the new era. Big data technology is the key to solving big data problems. These include hardware and software for data collection data platforms and diversified systems for data analysis. Therefore, in planning the information strategy for resource group enterprises, thinking ahead of big data technology and its application not only helps to control implementation failure rate, reduce duplication of investment in system construction and improve the efficiency in system use. Via big data technology, we could plan data standards, integrate existing systems, improve the operating efficiency of new systems make full use of the potential value of data and provide support management decision making.

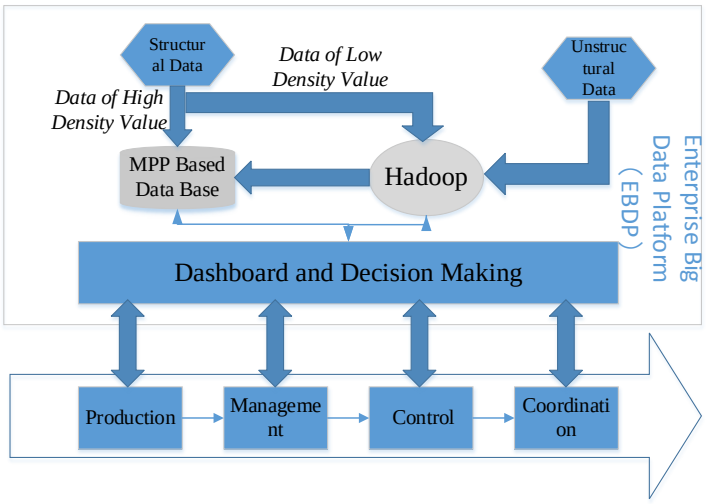

Fig. 1. The Framework of the EBDP within BDBIS

4 Implementation Framework and Empirical Study of BDBIS within DY Coal Group

4.1 Analysis of the Implementation of DY Coal Group's information strategy

DY Coal Group is a typical resource group company investing in coal resources and other diversified businesses. According to the twelfth five-year plan published by the DY Coal Group, the long-term goal of becoming the regional leading company in the coal industry has inspired the group to further invest in the continued improvement of its management performance and reach a management consensus of "internal strengthening of management and control and external creation of a successful image". In alignment with the group's overall management and control objective, the goal of the overall information strategy is to standardize the data collection system, establish a stable network and a complete control model of production, finance, procurement, marketing and decision-making that directly reaches the frontline of all the above-mentioned aspects. From the internal operation to its external environment, from the frontline of production to management, the complete coverage of information poses a challenge to the planning and implementation of the business's information strategy hence the prerequisite to ensure the efficiency in data collection and the provision of support to decision making.

4.2 A SWOT Analysis of the DY Coal Group's Information Environment

Although the DY Coal Group has finished the implementation of the finance system, human resources system, OA office system and gas monitoring system, their uses are very much confined with quite some distance away from such applications as decision support. Also the lack of information management professionals and the overall low level skills of the current IT staff have increased the resistance for businesses to move from extensive management processes to fine management processes. Given the lack of experience in implementing such a comprehensive system, the large sum of heterogeneous data and the evolving organizational structure in the business, even if personnel training and consistent investment funds are safeguarded, the choosing of a solid information strategy and its implementation can be a huge challenge for both the management and the staff implementing the strategy hence the unpredictability of the successful implementation of the information strategy. Table 1 reveals the results of SWOT analysis for the DY Coal Group.

Table 1. SWOT analysis of the Information Environment for the DY Coal Group

Advantage (S):	Opportunities (O):
1. basic foundation of informatization 2. attention from top management because of the management and control objectives 3. basic foundation for the use of big data	1. vigorous state support and the golden period for the big data based information system in enterprises 2. a maturing proprietary information system for the coal industry
Weaknesses (W):	Threats (T):

1. seriously isolated, overall level of application is difficult to sustain big data application 2. structural imbalance in information technology investment, shortage of professionals 3. insufficient coordination in building the information system and meeting the group's management and control needs	1. the deterioration in market conditions and the decline in business efficiency decline will negatively impact continued investment in information technology 2. the implementation strategy of the information system will have a significant impact on the success of the project

Based on the objectives of the corporate strategic plan, the strengths and weaknesses of the existing corporate information environment, the only way for DY Coal Group to achieve its operational management and control objectives is to take full advantage of the opportunities, strenuously rule out the threats, take advantage of the informatization strategy and use the big data based information strategy for resource enterprises for support.

4.3 BDBIS Implementation Framework

Based on the above analysis, the paper presented the Big-data Based Information Strategy, BDBIS. Specifically, BDBIS is a big data application model based on cloud-computing. From the perspective of decision support needs, BDBIS generally involve five layers of structures, namely, the analysis and decision-making layer (Aaas), the business application layer (Paas), the management platform layer (Paas), the data collection and management layer (Daas) and the infrastructure layer (IaaS).

Inspired by the idea of big data, the DY Coal Group information system framework uses group management control as its goal, business-driven as the path and heterogeneous data in safety, production, operation and management and on-site production monitoring from both the group and its branch businesses in the fields of coal, electric power and aluminum as the major parts of the management system. This system contains a multi-level system platform that consists of relevant public and professional data warehouses and a business operating platform under which such information as production, supply, sale, personnel, finance, commodity, safe production management, comprehensive information services, business knowledge management, data mining and business tables and forms are housed. This system provides multi-level services to business operators, the middle management and senior decision-makers to continuously promote enterprise reform and management and improve the economic and social benefits of the enterprise that is needed for big data. Figure.3. presents the DY Group's implementation framework of its information strategy, which services the application of big data. Thus, we can assert BDBIS does be able to solve the big data problems and help resource enterprise operation more safely and efficiently (Sahar, Julian and Nasseh, 2014).

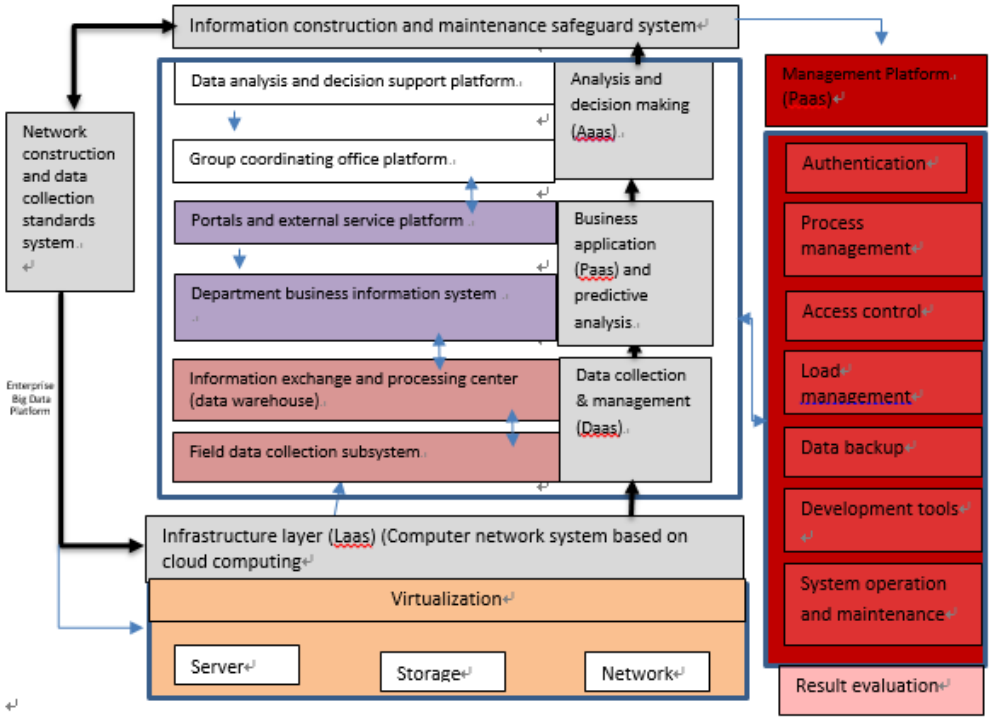

Fig. 1. BDBIS Implementation Framework for Resource Enterprises

4.4 BDBIS Software Platform Framework for the DY Coal Group

Currently, UF NC5.0's financial management module and human resource management module are used in the DY Coal Group's operating business systems, but data from the two modules are not linked nor to be shared. The only function of the OA system that is now in use is the electronic processing of documents, namely, the sending and receiving of documents. More functions like flagging, reminding, document processing progress tracking by flow node staff and follow-up of document decision implementation are yet to be implemented. Gas monitoring and controlling systems down in the mine are interconnected but complete data collection every 30 seconds and data analysis of historical data are not achieved. Horizontal mapping of the mining progress is also done first on stand-alone computers, then printed and stored for checking and control. Online checking and command over connected computers is not possible. Automatic control equipment and industrial TV monitoring data in power plants and the aluminum industry are used and undertaken for on-site management with no additional storage of data and electronic analysis. Subsystems like logistics management, laboratory analysis of coal quality and materials management are not established yet.

Therefore, based on the decision needs of the DY Coal Group, its BDBIS model should be a closed-loop business integration system for decision making supported by big data. This system should have a unified group management platform to manage all types of business subsystems and provide different kinds of services both internally and externally. This includes safe production management, material supply management, capital management, equipment management, human resource management, marketing management, planning and scheduling, project management, and information exchange with government departments. All this base data in the business subsystems come from on-site data collection infrastructure and all business subsystems adopt uniform data collection and storage standards. Stored in a data storage repository for central management, these data will be managed through big data technology for data mining to provide decision support services. Fig.4. shows the DY Coal Group's BDBIS software platform structure.

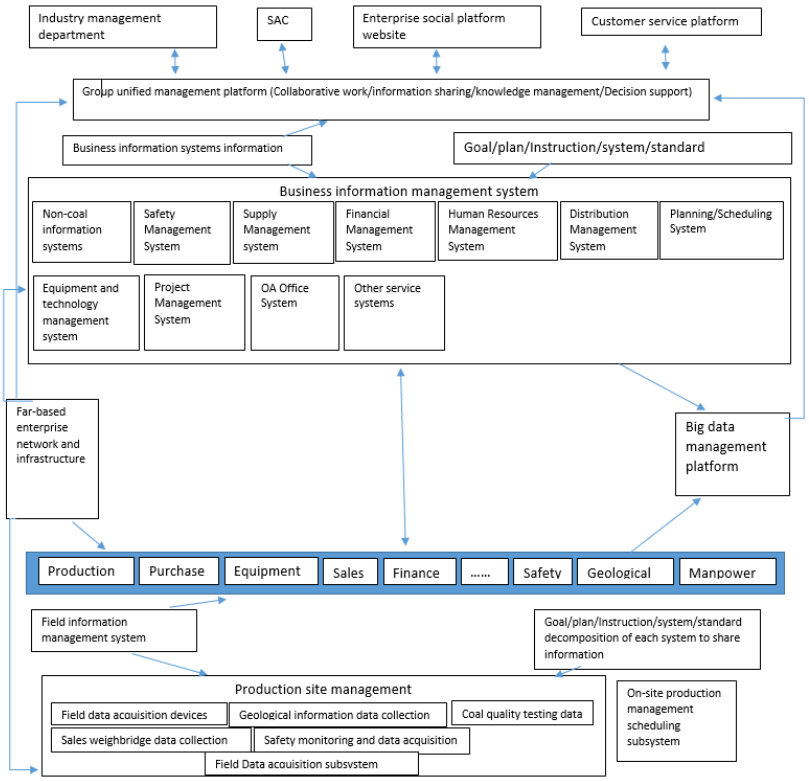

Fig. 1. The DY Coal Group's BDBIS Software Platform Structure

4.5 Construction of the Standards System and the Safeguard System

Construction under the Standard System BDBIS. The standardization of network construction and the standardization of data collection not only help to reduce the difficulty of system implementation but help to standardize data management, reduce the difficulty in data extraction and use in big data mining, improve system stability and security to better facilitate data sharing and business coordination. All these constitute the foundational work information system construction. The DY Coal Group's information standards system should be jointly made and published by the group's information management department and software providers by referring to the industry standards, national standards and combining them with current group standards. Table 4 provides a summative contrast of the main aspects.

Table 2. Scope of the DY Coal Group's Information Standards System

1. Data standards	2. Information system construction standards	3. Infrastructure specifications	4. Information security specifications	5. General basic standards
Data classification and coding standards	Overall system construction specifications	Intranet construction technology standards	Physical security technical specifications	Information standardization specifications
Data dictionary	Information system interface standards	Technical standards for designated net connection and construction	Network security technical specifications	Information terminology dictionary
Common data elements	Technical standards for system development	Technical standards for internet connection and construction	Information Security Technical Specifications	……
Data element description standards	Software engineering specifications	System hardware technical specifications	……	
Data analysis indicators	……	System support software technical specifications		

Funds, Regulations and Organizational Safeguard System Construction. Given the special industry background of the DY Coal Group and in order for the BDBIS model to be smoothly and successfully implemented, the first order of business is to come up with a solid rule design for the information system construction itself. Second, there should be an organization led by senior group executives, joined by heads of all business departments and information professionals from group headquarters and branch businesses responsible for the implementation of specific projects to ensure that the implementation is carried out and monitored during the process. Finally, a special informatization construction fund needs to be set up to provide for the purchase of hardware and software, personnel training and bonuses so that the implementation would abort due to lack of funds. The money will come from a certain percentage of annual business revenue.

5 Approach to the Successful Implementation of the BDBIS Model in Resource Enterprises

In the above SWOT analysis for the DY Coal Group, the paper offered some suggestions regarding the implementation strategy. However, based on the group's management and control needs and a comprehensive analysis of the information environment and the actual status of informatization, the group should start from the basic environment, the implementation approach and an effective control mechanism to ensure the smooth and successful implementation of the group's information strategy.

5.1 Basic Environment Construction for BDBIS

As is betrayed by the DY Coal Group's information infrastructure, great leap within resource enterprises in informatization construction needs to start from the basic environment to lay a solid foundation. Only until then will it merge with the group's overall business strategy and start to lead the way right to a successful construction of the information system.

Strengthening Network Construction under the Cloud-computing Framework. As a cross-regional enterprise, resource enterprises should start from the internal network of its second-tier or even third-tier branch businesses to provide needed equipment and optimize the network so that a good hardware environment is in place for system application and a complete overhaul of the single mode business information model to provide support for both cloud-computing and big data applications by using Hadoop methods more deepen (Ma et al, 2014).

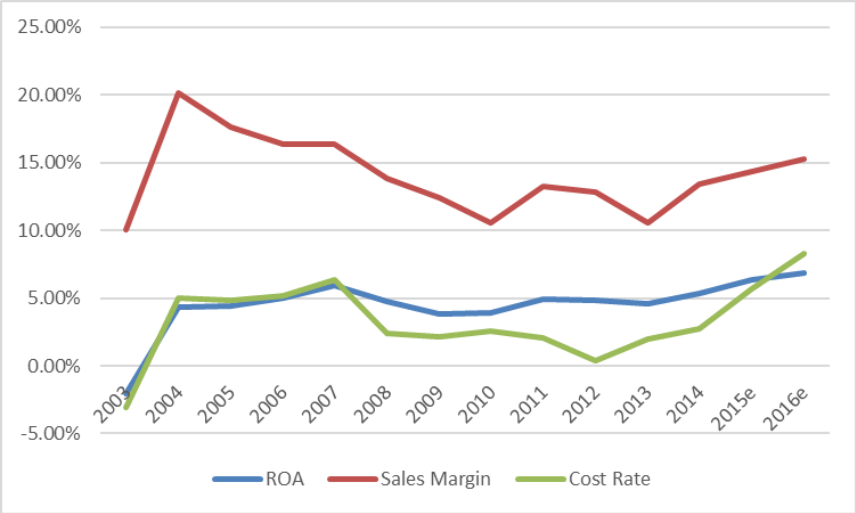

Fig. 5. A comparison of the DY Group's finance before and after the implementation or optimization of its information strategy based on big data

5.2 Organizational Safeguard, Regulation Safeguard and Funding Safeguard

Set up the project implementation work group consisted of senior resource enterprises executives, backbone individuals of all business departments in the headquarters, administrative leaders of branch businesses and vendor(s) and clarify their respective responsibilities in accordance with safeguard system construction norms. In the specific implementation process, senior group executives take responsibility for the final decision and by a group of executives responsible for the final decision and coordination of the entire informatization construction project. Vendor(s) charged with the responsibility of system implementation need to customize system modules and functions as required by the enterprise. Then business departments of finance, marketing and production in the headquarters need to come up with accurate and standard descriptions of the actual business flowchart and a concrete plan after some training. Of course, these departments could also use the completed business flowchart module published in the internal business management manual for the preliminary construction of flowcharts. The enterprise IT department will be in charge of the maintenance of the database, the entire system and the training tasks serving also as the communication channel between business departments and the vendor(s). The enterprise should have a very detailed implementation plan and work guide to clarify the rights and responsibilities of departments and individuals and to ensure the implementation by specific departments and individuals to avoid the implementation projects falling by the wayside. All levels of enterprises under the resource enterprises should set up the corresponding governing bodies and implementation team for informatization construction with clear specification of their respective rights and responsibilities. Informatization construction involves large amounts of funds and is not a visible investment. Therefore, sufficient funds are needed to guarantee the completion of information system project.

Establish the Level of Information Evaluation and Performance Appraisal System. Although there is not a perfect level of information evaluation and appraisal model, but inside the enterprise, the CIO should purposefully collect some comparable data in advance before and after the informatization construction so that an assessment in relation to the current status can be made to facilitate a comprehensive review of the business benefits and implementation benefits to inspire more faith in informatization on the part of the senior management and general staff.

System Selection based on the Enterprise's Cloud Computing Structure. Currently IT vendor(s) all offer their own solutions for individual industries. Yet there is not a single vendor that is able to offer a resource enterprise with an information system that can be applied to multiple industries, especially an ERP solution.

5.3 The Resource Enterprises Performance Appraisal under BDBIS

In economics, relative to corporate performance, the RBV (resource-based value) theory is often applied to explaining the contribution of informatization although there is also the "contingency theory." It is generally believed that in evaluating the value of informatization, many variants or components are rather hidden, hard to measure in quantity and easily subjected to the influence of other factors. Because of the increased complexity in appraising the performances of informatization in comparison to other physical investments, it is suggested that a comprehensive approach be adopted for the job. Globally current evaluation models such as COBIT, Benchmark, ISO9000, CSF, ITIL, ABC, IT BSC, KPI, etc. are often applied by the IT industry to evaluate and quantify the performance of the information strategy. Yet because of the different perspectives and where they stand, the results differ too.

From the view point of information departments, the performance appraisal of informatization depends on the information system construction model. For enterprises, particularly coal enterprises, because of their comparatively weak information foundation, the notion that information is service should be accepted and the information department itself should be independently reviewed and included as part of the information system vendor's performance review. Then the results could be used for a reversed calculation of information investment and performances.

6 Conclusion

Finally the paper elaborates the mechanism within resource enterprises faced with the dilemma of sustainable growth by taking the BDBIS, which reveals further meanings in the current days. As the pace of economic globalization gradually speeds up, coupled with increased competition in the market and great challenge from the information society, the development model of related diversification has become the base upon which enterprises counteract the risks of the market and grow bigger and stronger. But the expansion across industries and the inertia in transforming the traditional management tools have brought growing difficulty for the enterprises in terms of their current management tool packet and the racing strategic goal of their development. How should the enterprises take full advantage of informatization to renovate the management ideas and how should they reduce the production costs, optimize their business processes, satisfy customer needs, optimize their decision making process and improve their management skills so that eventually they could lead the transformation of the traditional management model into the modern e-commerce model with the help of big data? This is no less an issue of focus for this research and exploration paper than it is a much needed issue of practice. Within which big data has brought the information strategy many new difficulties and challenges. Thus the paper insists that relevant plans must take full consideration of all the information that can be used adequately.

Using the DY Coal Group as a representative and after an analysis of the enterprise's resource characteristics, current status of management and informatization construction, and this paper has come up with a set of strategic suggestions of decision making by big data regarding the enterprise's information strategy by presenting the big data based information strategy framework for resource enterprises. It is our hope that as the big data application movement develops resource enterprises could step out of the traditional management and rid themselves of the current market and management difficulties by upgrading to an intelligent enterprise and transforming the enterprise into a modern e-commerce enterprise.

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