Business Intelligence Technology, Applications, and Trends

Muhammad Obeidat, Max North, Ronny Richardson, and Vebol Rattanak
Management and Entrepreneurship Department
Information Systems Department
Coles College of Business
Kennesaw State University, Kennesaw, GA 30144, USA
Max@kennesaw.edu

Sarah North
Computer Science Department
College of Computing and Software Engineering
Kennesaw State University, Kennesaw, GA 30144, USA

[Abstract] Enterprises are considering substantial investment in Business Intelligence (BI) theories and technologies to maintain their competitive advantages. BI allows massive diverse data collected from virus sources to be transformed into useful information, allowing more effective and efficient production. This paper briefly and broadly explores the business intelligence technology, applications and trends while provides a few stimulating and innovate theories and practices. The authors also explore several contemporary studies related to the future of BI and surrounding fields.

[Keywords] Business Intelligence, Competitive Intelligence, Data Warehousing, Data Mining, Cloud Computing, Data Exploration and Visualization

Introduction

Data is growing at a rapid rate. Enterprises are turning to Business Intelligence (BI) theories and technologies in order to extract the maximum amount of information from this data in order to allow their employees to make better data-driven business decisions. BI transforms the raw, massive data collected by various sources into useful information. This information supports business operations, ultimately providing long-term stability for the firm (Rud, 2009). Additionally, as enterprises grow, there is an overwhelming need to analyze historical business data in order to predict future trends and improve business forecasting. A broader definition of BI is presented by Evelson (2008): "[BI] is a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information." Evalson builds on this, "[BI] allows business users to make informed business decisions with real-time data that can put a company ahead of its competitors."

In a recent article, Chaudhuri, Umeshwar, and Narasayya (2011) provided a broad overview of current BI technologies, and the manner in which they interact. The specific technologies addressed include extract transform load tools, complex event processing engines, relational database management systems, map-reduced paradigms, online analytic processing servers, reporting servers, enterprise search engines, data mining, and text analytic engines. The typical BI architecture is outlined as data moves through data sources, streaming engines, data warehouse servers, mid-tier servers, and front end applications. The article addresses the insights of reduced cost of data acquisition and storage as well as the resulting increased use by businesses acquiring large volumes of data to promote competitive advantages. Chaudhur et al. discuss new massively parallel data architectures and analytic tools, which are superior to traditional parallel SQL data warehouses and OLAP engines, and the need to shorten lag between data acquisition and decision making.

The general goal of this paper is briefly and broadly to explore the BI technology, applications and trends while provides stimulating and innovate theories and practices. We explore several contemporary studies related to the future of BI and surrounding fields.

Competitive Intelligence

It is important to understand that Competitive Intelligence (CI) is a term sometimes used as a synonym for business intelligence; however, CI is more accurately a sub-discipline of BI widely used for larger business clusters, focusing on textual reports prepared from public resources to help decision makers understand competitive environments. Consequently, Nemrava, Ralbovsky, Kliegr, Splichal, Svatek, and Vejlupek (2008) describe business clusters as geographic concentrations of interconnected businesses, suppliers, and any other companies in an associated field. The goal is to use semantic structures and business maps to enhance CI reports for easier retrieval of information and lucid presentation of complex information to support decision-makers' strategies. Nemrava et al. conducted a study with a group of three hundred students who were trained to collect information for CI reports to address 3 fields: packaging, glass, and information industries. They designed core CI ontology and used Porter's Five Forces as the underlying CI model. They also used two software tools, *Ontopoly* and *Tovek Topic Matter (TTM)*, to better display and edit the ontology. Since this project was likely the first attempt to link CI reports with semantic technologies, specifically in large business clusters, the researchers suggest additional future work is needed.

Diverse Business Intelligence Applications

Business Intelligence applications are sporadically used in a majority of search-based applications within a variety of fields, such as Business, Security, Finance, Marketing, Law, Education, Visualization, Science, Engineering, Medicine, Bioinformatics, Health Informatics, Humanities, Retailing, and Telecommunications, just to list a few. While BI is widely used in Enterprises (private or public entities) for both standard business and e-business, BI applications are growing in many diverse fields. For instance, in the areas of Mobile Device Fraud Detection, Health Care Informatics, and even in Chronic Disease Management, studies are beginning to describe the advantages of BI applications.

Mobile Device Fraud Detection

Nguyen, Schiefer, and Tjoa (2005) reported on the use of real-time analytics to detect fraud of business process and operation. By providing real-time monitoring of processes, businesses were able to capitalize quickly on time-sensitive business opportunities. The sample of mobile phone fraud detection was used to gather events and was analyzed to detect usage patterns for normal or fraudulent behavior.

Health Care Informatics

Zheeng, Zhang, and Li (2014) addressed the lack of BI applications in Healthcare Informatics. They described BI and healthcare analytics as emerging technologies that can improve industry service quality, reduce cost, and manage risks. They note, however, that analytics healthcare data processing is mostly missing from current healthcare information technology (HIT) programs. Their paper conducted an analysis of how BI technologies can be incorporated into an HIT program. A general framework and several strategies were presented; the authors conclude by stating they will expand their investigation onto a national level to improve the framework. It is their hope that more HIT programs will recognize the importance of healthcare BI.

Chronic Disease Management

Wickramasinghe, Alahakoon, Georgeff, Schattner, De Silva, Alahakoon, Adaji, Jones, and Piterman (2011) investigated BI use for chronic disease management. They identified chronic disease management as one area of healthcare in which health knowledge management can have a positive effect. Their research presented a new BI module that will analyze, visualize, and extract knowledge from the chronic disease management network (cdmNet). Their aim was to facilitate short- and long-term decision making and improve the ability to understand care models, policy models, and economic models which are part of chronic disease management. Their paper contained results which obtained by applying this model to the data. The module consisted of three sub-modules: pre-processing, dashboard, and data mining. Pre-processing converts cdmNet data to a suitable form, the dashboard provides an interface, and data mining extracts patterns which can potentially provide solutions to questions concerning chronic disease management.

Assorted Features of Business Intelligence

Although a good number of features of BI theory and practice exist, we will discuss here the most prominent and well-researched. There are several research thrusts related to assorted aspects of BI worthy of exploration: Data Integration, Real-Time Analytics, Balanced Efficiency and Effectiveness, and Collaboration and Teamwork.

Data Integration

Dayal, Castellanos, Simitsis, and Wilkinson (2009) analyzed and described the requirements necessary for data integration flows in the "next generation" of operational BI systems, the limitations of current technologies, challenges, and a framework to address these challenges. Their goal was to facilitate the design and use of optimal flows to meet new and evolving business requirements. Their paper investigated the traditional BI architecture and compared it to next generation architecture. Their solution was a layered methodology for data integration flow life cycles. Metrics and tradeoffs were discussed, and the pros were shown to outweigh the cons. They concluded that with the more complex integration flow designs, it is important to create automated or semi-automated techniques to help practitioners deal with the complexity.

Real-Time Analytics

Nguyen, Schiefer, and Tjoa (2005) proposed an event-driven information technology infrastructure for operating BI applications to enable real-time analytics over business processes and operations. A "sense and response service architecture" called SARESA provided real-time monitoring of processes and allowed businesses to quickly capitalize on time-sensitive business opportunities. The real-time analysis requirements of a BI system, which are not a part of the traditional BI system, included data freshness, continuous data integration, analysis and active decision engines, high availability, and scalability. As mentioned earlier, the sample of mobile phone fraud detection was used to walk through the architecture's approach. Call Detail Records (CDRs) are gathered as events and analyzed to detect usage patterns for normal or fraudulent behavior. This was a prototype of the SARESA system, and it will continue to be developed to support time-sensitive BI platforms.

Balanced Efficiency and Effectiveness

Finneran and Russell (2011) presented an article on Balanced Business Intelligence arguing that companies may be better served by concentrating on capability instead of maturity. The article was broken down in sections that would help with the balance, starting with Managed BI growth, Evaluating BI capacity, scope of delivery, information delivery capability curve, and levels of BI. Managed BI growth can be linked with BI capability, meaning that at any stage it is significant to operational, tactical or strategic perspective. For example, if a good is going to be made for one vendor, they may ask, "What is the most cost-effective way to manage our people and process to produce a product for our customer?" Next, they moved on to describing identifying and building capability, optimizing the architecture, and controlling the flow of information, focusing on areas defining organizational BI needs. For each category, authors identified needs to conceive and compose. The identification and building of capacity requires performance business-sustaining processes and generation of operational and managerial reporting capability.

To optimize, businesses need to measure and manage through the creation of standard measures and tracking history to perform trend analysis for lines of business. Lastly, controlling the flow of information was segmented into govern and protect, meaning a continued framework for data governance to enable stewardship and improve corporate data confidence across the enterprise and the protection of information delivered internally to the enterprise. The scope of delivery was described as the importance of getting information to the people that need it, when they need it. Using this helps BI to be effective by defining the audience and the manner for delivery as well as the method of access across the organization. Lastly, the levels of BI, which are described as stepping stones to success are described: Operational reporting, Tactical reporting, Strategic Reporting (History and Trending), Performance and Improvement, Highly Available and Highly Trusted, Highly Focused, and Highly Administered. To conclude the article they state, "The balance of both efficiency and effectiveness enables a well-rounded intelligence program in any organization."

Collaboration and Teamwork

Berthold, Wortmann, Carenini, Campbell, Bisson, Strohmaier, and Zollep (2010) strived to create a system which would be highly scalable and flexible for gaining collaborative, ad hoc BI. The common shortcomings with organizations are the lack of business context information for analytical data, with too little emphasis on data from strong collaboration and a lack of integrating external or unstructured information in an effective and timely way. The BI platform proposed allows business users to shape their strategies in a collaborative manner, putting information acquisition back into the business user's hands. It is accomplished with a flexible data model, scalable data store, a business configuration methodology, an information self-service environment, and an integrated collaboration environment (for instance, "Collaboration Rooms"). By using these methods, business users have the architecture for ad hoc and collaborative decision making.

Furthermore, Lovell at el. (2014) stated that plenty of vendors promise to solve all business users' or technical teams' problems with their tool sets and methodologies. With the mounting pressure on BI teams (whether embedded in organizations or those of consultancies) to deliver on time and meet expectations, it is no wonder that the allure of agile BI has cast its net on unsuspecting teams desperate for success. It is possible to learn from an execution and delivery methodology crafted around the concept of the "team" rather than the "individual." This article looked at how teams can implement the agile mindset in building data output applications. It explained the concepts and how they relate to BI projects, rather than the typical data input applications managed through the software delivery life cycles commonly associated with the term "agile."

Data Storage and Technology

As computer technology advances, larger volume of data are acquired and stored at much lower cost. Any classification of transaction in business, including e-business, RFID tags, Web sites, emails, blogs, and many more produces new data to be tracked. Authors briefly provide most important aspects of data storage and technology below, beginning with Data Type (Structured and Unstructured), Data Warehousing, Data Mining, and Data in Clouds.

Data Type (Structured and Unstructured)

In a broad context, there are two types of data—structured and unstructured—to be incorporated in BI phases. Park and Song (2011) introduced structured and unstructured data by stating that as the amount of data grows very fast inside and outside of an enterprise, it becomes important to seamlessly analyze both of categories to establish robust BI. Particularly as most valuable business information is encoded in the unstructured text documents, including Internet web pages, specialized Text OLAP solutions are needed to perform multi-dimensional analysis on text documents in the same way as on structured relational data. Since text mining and information retrieval are major technologies for handling text data, authors first review the representative works selected for demonstrating how they can be applied for Text OLAP. Then authors conduct a survey of the representative works selected for demonstrating how analysts can associate and consolidate both unstructured text documents and structured relation data for obtaining total BI. Finally, the authors present the architecture for a total BI platform incorporating structured and unstructured data. It is expected that the proposed architecture, which integrates information retrieval, text mining, and information extraction technologies alongside relational OLAP technologies, would make an effective platform toward total BI.

Data Warehousing

One of the main sources of data provided for BI applications is collected from data warehouses. Data acquisition is becoming cheaper and easier, while the size of the data are getting larger, within range of tens to hundreds of terabytes. Farooq and Sarwar (2010) examine real-time data warehousing (RTDW) and highlight the advantages of using semi- structured multidimensional modeling (DMM), such as XML, in RTDW versus traditional DMM, such as relational. The two are compared on four characteristics, including heterogeneous data integration, types of measures supported, aggregate query processing, and incremental maintenance. The authors also provide explanations as to why semi-structured DMM is better than structured DMM. In their article, they used the RTDW framework as an example for a telecommunication company. Their experiment showed that if a delay is caused in incremental maintenance of DMM, there is no ETL technology that can help in real-time BI. They conclude that semi-structured XML-DMM is more capable for incorporating real-time data updates from operation sources. Not only does it reduces query response time, but also increases real-time BI.

In an article, Goeke and Faley (2007) wrote how data warehouse flexibility affects its use. In the beginning, background knowledge is given before the research is done. A data warehouse enables the collection and storage of vast amounts of data extracted and analyzed by end users. Now the research, which was done in a form of a survey including the original TAM items adapted to fit a data warehousing environment, was sent to managerial-level data warehouse users in a number of major Midwest U.S. Corporations. The survey also obtained other information, including the industry and size of the user's company, position and department, the amount and type of system-related training the user had, what system support was most useful to the user, and the amount of experience the user had with the data warehouse. The research used various scales to get to the results. The results that they achieved were well in line with previous studies conducted. In conclusion, they made recommendations for increasing data warehouse usage by leveraging its flexibility. The extent to which the data warehouse is perceived to enhance job performance is the most important determinant of its usage. Flexibility is not a major determinant of usage, and users will not use a data warehouse because it is flexible. Lastly, system flexibility is embedded within the features of the data warehouse, meaning that sophisticated users are more likely to leverage system flexibility, because they are savvy enough to know where the flexibility exists in the data warehouse.

Data Mining

In simple terms, data mining provides extensive and complex analysis of historical and current data, allowing the building of predictive models. An article by Grossman, Hornick, and Meyer (2002) described Data Mining in great detail, starting with established and emerging standards that address various aspects of data mining, including Models, Attributes, Interfaces, Settings, Process, and Remote and Distributed Data. After a brief description of the aspects of data mining, authors move into the different standards of data mining and break them up into three major categories XML Standards, Standard API's, and other standard efforts. In XML standard there was a group known as the Data Mining Group that developed PMML (Predictive Model Makeup Language) that represented and described data mining and statistical models, as well as some of the operations required for cleaning and transforming data prior to modeling. PMML consists of the following components: Data dictionary, Mining schema, Transformation dictionary, Model statistics, and models. The consensus among Data Mining Group members is that the transformation dictionary is powerful enough for capturing the process of preparing data for statistical and data mining models. Next, authors move into Standard APIs that facilitate integration of data mining with application software. After a brief description they illustrate the software that was developed for SQL, Java, and Microsoft. Knowing these few standards, they proceed to introduce other standard efforts, which define software objectives in data mining. These include Data mining metadata, process standards, and web standards. In conclusion, they state that the main reason so many different data representations and data communication standards exist today is that data mining is used in so many different ways and in combination with so many different systems and services, many requiring their own separate and often incompatible standards. Authors summarize two major challenges to data mining: agreeing on a common standard for cleaning, transforming, and preparing data for data mining; and agreeing on a common set of Web services for working with remote and distributed data.

Cloud Data services

Cloud virtualization allows virtual servers to be hosted in the cloud, ultimately providing much lower cost of hardware and software, while providing better utilization of resources. For instance, in a study undertaken by Juan-Verdejo and Baars (2013), researchers illustrated the possibility of a cloud migration framework that would be an information technology based decision support system with four sets of BI scenarios. As companies are moving toward cloud based offerings for increased scalability and flexibility with lower costs, this seems like a great strategy. However, with BI applications, businesses sometimes have sensitive data that cannot be completely outsourced to a cloud environment. The four scenarios gradually show how more specialized data or the movement of a BI application can trigger events in other systems indicating targeted applications should be moved by following a local and cloud deployment model rather than an all-or-nothing with cloud infrastructures only.

Business Analytic

According to Davenport (Henschen, 2010), BI is comprised of Querying, Reporting, OLAP, “alerts” tools, and business analytics. He further suggested that business analytics is the subset of BI that incorporates statistics, prediction, and optimization. Generally, there are several major technological components that collectively contribute to the process of the business analytics: relational databases, online analytic processing (OLAP), and distributed systems using map-reduced paradigms, just list a few. Relational databases (RDBMS) serve as the backend of data warehouses and enables complex SQL to be efficiently executed on massive databases while the OLAP provides filtering, aggregation, pivoting, and other operations on the data (Chaudhuri, Umeshwar, and Narasayya, 2011). The authors have provided only a brief important description of business analytic here, as a detailed and comprehensive report is not within the scope of this paper.

The broad direction for future research of business analytic is addressed in an article by Lim, Chen, and Chen (2013). According to these researchers, BI and analytics refers to the technologies, systems, practices, and applications that analyze business data to help an Enterprise better understand its business and market. They stated that the new insights of this field can be used to improve products and services, to achieve better operational efficiency, and to foster customer relationships. The three broad research directions addressed in the article are big data analytics, text analytics, and network analytics. In the respective categories, the three research directions focus on Hadoop, natural language processing, and link mining. They conclude that there is much room for further research and development due to the emergence of new computing paradigms, data genres, and mobile technologies.

User Interactions and Interfaces

Successful use of BI systems within Enterprise environments ultimately correlates with user acceptance and continued user supports through a variety of interfaces and interactions using advanced techniques (such as visualization and mobile). A few recent research studies are provided below to demonstrate a few examples of the range of research undertaken in user interaction and interfaces.

Survey of BI Users, Suppliers, and Academics

Molensky, Ketter, Collins, Bloemhof, and Van de Koppel (2010) examined BI users, suppliers, and academics through a survey to reveal the BI focus of academics, vendor-neutral consultants and vendor-specific consultants. The survey examined the experiences and expectations of BI users and suppliers by asking questions about BI goals, monitoring, analysis, and management. The survey results showed that

BI users and suppliers have about the same focus on BI issues and that, while any non-matching BI issues between the groups were deemed a gap, these were mostly covered by consultants. The study concluded that consultants are playing a major role between users and suppliers and will continue to focus on improving information sharing between the groups to make users more profitable and suppliers more competitive.

Usability Evaluation and Guidelines

Jooste, Biljon, and Mentz (2013) studied the usability evaluation of BI applications in the context of a coal mining organization. Through a study which included user observation, heuristic evaluation and survey means, the researchers were able to determine what criteria should be used to evaluate the usability of BI applications. A log of usability issues was compiled, and the criteria extracted from the log were then evaluated against general usability criteria from literature to synthesize a set of BI usability evaluation criteria. The BI usability criteria included visibility, flexibility, learnability, application behavior, error/control/help, and decision support. The study confirmed the importance of Efficiency, Affect, Control, Helpfulness, and Learnability, with a focus on reporting format and data quality as well.

Restricted Domain Question and Answer Systems

Vila and Ferrandez (2011) present a model-driven development in order to automatically adapt patterns of restricted domain question answering (RDQA) systems in lieu of the traditional, manual effort used for BI scenarios. RDQA systems are good, as BI applications have expanded to needing to retrieve information from the web, and QA systems allow users to get concise answers to their questions on the web. By integrating Knowledge Organization Systems (KOS) in a nine-step model consisting of Restricted domain meta-model, Question pattern meta-model, Answer pattern meta-model, Obtaining a restricted domain model, Enriching the restricted domain model, Obtaining expected answer type taxonomies from the restricted domain model, Obtaining QA pattern models, Adapting questions answering pattern models, and Generating new QA pattern code, they achieved an automatically adapting QA system for restricted domains.

Selected Trends, Future Challenges and Issues of BI

As many research challenges remain in all aspects of BI, several new open research challenges appear on horizon for recent technologies, such as Cloud Computing, Near Real-Time BI, Enterprise Search, Data Mining, and more (Chaudhuri, Umeshwar, & Narasayya, 2011). In this section, we review selected trends, issues, and future challenges of BI, such as Data Exploration and Visualization, Cloud Computing leap in BI, Self-Service BI, Improving and BI Computing Issues.

Data Exploration and Visualization

The traditional BI perspective is focused on Extract, Transform, and Load (ETL), and reporting, while the new generation of BI seems to be more focused on data exploration and visualization (Anadiotis, 2013). As databases expand in size and complexity, the traditional navigating techniques become inefficient and ineffective, while data exploration and visualization techniques assist in a much higher understanding of big data. In addition, authors stress the importance of providing environments to support users in increasingly demanding tasks. In general, data exploration and visualization techniques provide an important nexus for the various business entities to explore, comprehend and gain valuable insights to operate and compete globally. It seems clear that such a mingling of minds will lead to many new innovations.

Cloud Computing Leap in BI

Chaudhuri, Umeshwar, and Narasayya (2011) conclude that the landscape of BI is growing exponentially as a result of the new technologies and concepts in the industry. It is their opinion that cloud computing will be the cause of the next leap forward. Muriithi and Kotza (2013) delivered a conceptual framework for a cost-effective BI solution as a service. They start by giving a brief explanation of what BI accomplishes and then noting especially that use of BI systems within smaller companies with resource constraints is low. They attribute this fact to the high cost barriers and complexity of in-house expertise. Their proposed framework combines attributes of information technology outsourcing, traditional BI, cloud computing, and decision theory to present consolidated views of cloud BI. Their framework was presented with South African Higher Education as the test target. Their conclusion is that the adoption of cloud computing will improve extreme low rates of conventional BI adoption. Cloud computing lowers the cost, complexity, and need for expertise.

Self-Service BI

Weber (2013) illustrates how to sustain self-service BI. It starts off with the definition of self-service reporting, describing the methods for business executives, managers, operational decision makers, analysts, and knowledge workers to access data required to support decisions and actions to promote business success. BI software vendors and industry experts recognize self-service as a key component to eliminate problems to timely insight, decision making, as well as lowering the cost of reporting, analysis, and metrics-driven management by putting data in the proper hands. Weber proceeds to discuss the steps required for providing proper self-service. These include unified design, targeted outputs, sound development practices, and active governance. Next, he goes into in detail on how exactly to implement the proper procedures to help self-service succeed. Successful strategy, road maps, governance, and the best practices are all briefly explained and contrasted with the costs that of a poorly ran self-service system. In conclusion, Weber provides valuable advice in helping companies to identify a starting point or interesting event.

Improving BI

As a unique and specific improvement of BI, Middelfart (2007) introduced the Observation Orientation Decision Action (OODA) concept as a means to improve BI speed and quality in decision making. The OODA loop concept was originally pioneered by Top Gun pilot John Boyd. He states that the OODA concept can be applied to groups and categorizes available BI technologies according to their role in the OODA loop. Middelfart states that any organization and its goals can be described as a number of OODA loops which are cycled over and over. The faster users can cycle through an OODA loop, the more competitive the organization can be when it comes to correcting problems and improving performance. Three examples are used to exemplify the power of the OODA concept. The conclusion is that the combination of OODA loops with Key Performance Indicators (KPI) can render an organization agile and competitive when using BI.

Open Source Product Software for BI

Gameiro (2011) addresses the choice of product software for BI use with project size, budget, and risks in mind. He states that the right choice depends on organizational needs and ambitions. Gameiro outlines the use of decision support systems and then poses open source software as a solution for ETL. The two he describes are Jaspersoft ETL and Pentaho Kettle. He compares the two products in terms of total costs of ownership, risk, ease of use, and deployment. His conclusion is that Pentaho Kettle is more than capable and has a very user friendly user interface. He does, however, state that the right tool will depend on project specifics.

BI Computing Issues

Saha (2007) writes the article Business Intelligence Computing Issues by introducing BI and many different practices that are associated with it. Saha defines BI as a term which means a technology that incorporates the application of statistical techniques in conjunction with mathematical formulae that attempt to identify significant relationships between variables in historical data, which can then be used to forecast, perform sensitivity analysis, or just identify significant relationships that exist in the data at hand. After the introduction, the article is broken up into six parts that go into detail explaining the Computing Issues, starting with BI computing implementation Issues, Critical Factors to BI Computing Success, BI

Computing Implementation Problems, BI Computing based on Seasonally Adjusted Regression Model, and Business Intelligence Computing Benefits. In conclusion, he states that in order to stay competitive, companies must meet or exceed the expectations of consumers.

Concluding Inference

The main goal of this paper was to briefly and broadly explore the Business Intelligence domain by providing a variety of components involved in theories and practice within Enterprises. In addition, we have dedicated sections to distinct and diverse BI applications, assorted features of BI, foremost technologies utilized, and selected trends, future challenges and issues of BI. The BI theories, technologies, and practices are very complex and extensive; thus, we have focused and provided very selective BI aspects in this paper. As a final concluding inference, BI is becoming more prominent in diverse fields; in general, Enterprises need to consider several main factors when acquiring and implementing BI, such as BI empowerment through organization, flexibility, and integration.

Acknowledgment

This current exertion is an adaptation and derivative of work based on distributed article in Universal Journal of Industrial and Business Management by Horizon Research Publishing, with full permission granted to authors for reproduction.

References

Anadiotis, G. (2003). Agile Business Intelligence: reshaping the landscape (http://www.tableausoftware.com/sites/default/files/media/gigaom-research-agile-business-intelligence.pdf?signin=89ae07dd32727354922f756f98e40144)

Berthold, H., Wortmann, F., Carenini, A., Campbell, S., Bisson, P., Strohmaier, F. & Zollep, R.P. (2010). An architecture for ad-hoc and collaborative Business Intelligence. *Proceedings of the 2010 EDBT/ICDT Workshops* (EDBT '10). ACM, New York, NY, USA, Article No. 13.

Chaudhuri, S., Dayal, U. & Narasayya, V. (2011). An overview of Business Intelligence technology. *Commun. ACM* 54, 8 (August 2011), 88-98.

Dayal, U., Castellanos, M., Simitsis, A. & Wilkinson, K. (2009). Data integration flows for Business Intelligence. *Proceedings of the 12th International Conference on Extending Database Technology: Advances in Database Technology* (EDBT '09), Martin Kersten, Boris Novikov, Jens Teubner, Vladimir Polutin, and Stefan Manegold (Eds.). ACM, New York, NY, USA, 1-11.

Evelson, Borris. (http://www.forrester.com/Topic+Overview+Business+Intelligence/-/ERES39218?objectid=RES39218)

Farooq, F., & Sarwar, S. M. (2010). Real-time data warehousing for Business Intelligence. *Proceedings of the 8th International Conference on Frontiers of Information Technology* (FIT '10). ACM, New York, NY, USA, Article No. 38.

Finneran, T., & Russell, B. (2011). Balanced Business Intelligence. *Information Management*, *21*(1), 20-23.

Gameiro, C. (2011). Implementation of Business Intelligence tools using open source approach. *Proceedings of the 2011 Workshop on Open Source and Design of Communication* (OSDOC '11). ACM, New York, NY, USA, 27-32.

Goeke, R. J., & Faley, R. H. (2007). Leveraging the flexibility of your data warehouse. *Communications of the ACM, 50*(10), 107-111.

Grossman, R. L., Hornick, M. F., & Meyer, G. (2002). Data Mining Standards Initiatives. *Communications of the ACM*, *45*(8), 59-62.

Henschen, Doug. (4 January 2010). Analytics at Work: Q&A with Tom Davenport (http://www.infomationweek.com/news/software/bi/222200096). (Interview).

Jooste, C., Biljon, J.V., & Mentz, J. (2013). Usability evaluation guidelines for Business Intelligence applications. *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference* (SAICSIT '13), Philip Machanick and Mosiuoa Tsietsi (Eds.). ACM, New York, NY, USA, 331-340.

Juan-Verdejo, A., & Baars, H. (2013). Decision support for partially moving applications to the cloud: the example of Business Intelligence. *Proceedings of the 2013 international workshop on hot topics in cloud services* (HotTopiCS '13). ACM, New York, NY, USA, 35-42.

Lim, E.P., Chen, H., & Chen, G. (2013). Business Intelligence and Analytics: Research Directions. *ACM Transaction on Management. Information Systems, 3*(4).

Lovell, J. (2014). Agile business intelligence: A practical approach. *Business Intelligence*, *19*(1), 15-21.

Middelfart, M. (2007). Improving business intelligence speed and quality through the OODA concept. *Proceedings of the ACM tenth international workshop on Data warehousing and OLAP* (DOLAP '07). ACM, New York, NY, USA, 97-98.

Molensky, L., Ketter, W., Collins, J., Bloemhof, J., & DeKoppel, H.V. (2010). Business intelligence gap analysis: A user, supplier and academic perspective. *Proceedings of the 12th International Conference on Electronic Commerce: Roadmap for the Future of Electronic Business* (ICEC '10). ACM, New York, NY, USA, 119-128.

Muriithi, G. M., & Kotzé, J. E. (2013). A conceptual framework for delivering cost effective Business Intelligence solutions as a service. *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference* (SAICSIT '13), Philip Machanick and Mosiuoa Tsietsi (Eds.). ACM, New York, NY, USA, 96-100.

Nguyen, T.M., Schiefer, J., & Tjoa, A.M. (2005). Sense \& response service architecture (SARESA): an approach towards a real-time Business Intelligence solution and its use for a fraud detection application. In *Proceedings of the 8th ACM international workshop on Data warehousing and OLAP* (DOLAP '05). ACM, New York, NY, USA, 77-86.

Nemrava, J., Kliegr, T., Svatek, V., Ralbovsky, M., Splichal, J., & Vejlupek, T. (2008). Semantic annotation and linking of competitive intelligence reports for business clusters. *Proceedings of the first international workshop on Ontology-supported Business Intelligence* (OBI '08). ACM, New York, NY, USA, Article No. 9.

Park, B. K., & Song, I.Y. (2011). Toward Total Business Intelligence Incorporating Structured and Unstructured Data. *BEWEB '11 Proceedings of the 2nd International Workshop on Business Intelligence and the WEB,* 12-19.

Rud, O. (2009). *Business Intelligence success factors: Tools for aligning your business in the global economy.* Hoboken, N.J: Wiley & Sons.

Saha, G. K. (2007). Business intelligence computing issues. *Magazine Ubiquity, 25*(8).

Vila, K., & Ferrández, A. (2011). Model-driven restricted-domain adaptation of question answering systems for Business Intelligence. *Proceedings of the 2nd International Workshop on Business Intelligence and the WEB* (BEWEB '11), Jose-Norberto Mazón, Irene Garrigós, Florian Daniel, Malu Castellanos, Kjell Orsborn, and Silvia Stefanova (Eds.). ACM, New York, NY, USA, 36-43.

Wickramasinghe, L.K., Alahakoon, D., Georgeff, M., Schattner, P., DeSilva, D., Alahakoon, O., Adaji, A., Jones, K. & Piterman, A.L. (2011). Chronic disease management: a Business Intelligence perspective. *Proceedings of the Fourth Australasian Workshop on Health Informatics and Knowledge Management - Volume 120* (HIKM '11), Kerryn Butler-Henderson and Tony Sahama (Eds.), Vol. 120. Australian Computer Society, Inc., Darlinghurst, Australia, Australia, 55-62.

Weber, M. (2013). Keys to sustainable self- service business intelligence. *Business Intelligence, 18*(1), 18-24.

Zheeng, G., Zhang, C., & Li, L. (2014). Bringing business intelligence to healthcare informatics curriculum: a preliminary investigation. *Proceedings of the 45th ACM technical symposium on Computer science education* (SIGCSE '14). ACM, New York, NY, USA, 205-210.