# The Audit of Business Intelligence Solutions

Bogdan GHILIC-MICU, Marinela MIRCEA, Marian STOICA
Department of Economy Informatics
Academy of Economic Studies Bucharest, Romania
ghilic@ase.ro, mmircea@ase.ro, marians@ase.ro

*Although in this period humanity passes through a relative economic crisis, we all agree that our environment is that of a society of information and knowledge, based on communication and teleactivity, one that is also called information society. Every new form of activity in the information society has an associated informational component consisting in a software program, an application, a system, etc. It is a certainty that in the new economic environment it is necessary to adjust quickly to the opportunities of the market, through Business Process Reengineering, adoption of Business Intelligence solutions, implementation of complex automation applications like Enterprise Resource Planning. But, more than this, in, the digital economy the stress is put on the "label", the "image", the "brand", and these features that are associated to organizations may be obtained by the information audit processes. The present study is focusing on the problem of information audit developed in one of the upper forms of manifestation of the information society in the field of changing the ways of doing business: Business Intelligence.*
**Keywords:** *Audit, Business Intelligence, Information and Communication Technology, Data & Metadata, Value Chain, Performance*

# 1 Introduction

The development of the information and communication technology, the larger and larger use of Internet, adjustment of legislation to the change in the nature of work in general, lead to the creation of new business models and decision support systems. In the new business environment, an increasing number of businesses integrate a certain form of Business Intelligence. In time, many of the Business Intelligence implementations have changed due to increasing demands and the desire to adapt to the newest technology, which entailed problems of adaptation to the strategic objectives of business.

Until recently, Business Intelligence solutions presented no real interest for auditors, as the audit process was concentrated mostly on the financial field and less on the operational information within the organization. But in the late period all changes rising in the business environment are generating big risks for the organization, and Business Intelligence may be considered a means for reducing the general risk and a means of audit. The main reason of change is that traditional methods of auditing financial data of a client, with the purpose of assessing the fidelity of financial information and the conformity level for the client are not satisfactory anymore [1].

Information audit may be considered a process that identifies the necessary information to reach the organizational objectives, checks the existing information and identifies gaps, incoherence and repetitions. In general, the inefficient aspects and the problems are identified, thus improving the information and the knowledge management practice, especially in the intranet of an organization. The goal of information audit [2] is to identify the need for management knowledge, to assess the present information resources, to map the information flow within and between administrative entities, to examine their activities and tasks.

Concerning the audit of the Business Intelligence solution, it represents the impartial examination, the analysis and assessment of the state, value and profitability of the Business Intelligence components from the entire organization. The Business Intelligence audit is based on the rigorous analysis of operational practices, methods, instruments, systems and products, of the profitability of investments. At the same time, there must equally be taken into account the structure and quality of the Business Intelligence investments. In other words, Business Intelligence elements are considered as a profit center, being made a complete analysis of costs, pointing out the structure of value and the benefits. Also, changes of value, costs and

benefits are assessed for a period of time [3].

Among the basic activities of the Business Intelligence solution, (reporting, analysis, statistics and exploitation, monitoring/alert and provision of relevant information), the most interesting activity for auditors is that of information delivery for the final user [1]. The need for audit of the Business Intelligence solution may have different reasons, among which are the following [4], [5]:

- assessment of the Business Intelligence solution in order to determine whether it is efficiently exploited;
- identifying the impact of the Business Intelligence solution implemented in the organization;
- problems in the real-time and accurate transmission of information;
- poor trust of the business environment in the efficient results of the Business Intelligence solution;
- identification and understanding of the changes that have to be made in order for the Business Intelligence solution to become available for a wider public;
- using the audit as a instrument in the strategy management of implementation of Business Intelligence solutions (audit recommendations may confirm the present course and identify new opportunities and specific initiatives of implementation).
- surpassing the limits of the traditional development methods by identifying the business risk associated with the investment in the Business Intelligence solution and putting forward of the best practices around the technical architecture, the data architecture and technology.

In order to reach maximum value, the Business Intelligence audit has to be objective and follow a series of strict recommendations. The best model is the one used in the financial-accounting field, which has rules applied to the information that must be assembled and reported objectively. With some small changes in the standard financial terminology, the generally accepted accounting principles might be applied to the Business Intelligence [3].

## 2 Audit Management of a Business Intelligence Solution

Efficient audit management is essential to any program of quality management. The audit management helps to ensure proactively the quality by the measurement and improvement of processes, procedures, and commercialized products. In addition, the products and services provided may be audited in order to ensure the quality during the value chain (the function by which an organization provides added value for the products/services for the customers) [6]. The audit management allows [6] the audit process to be monitored (visualization, change, cancellation / reactivation, deleting, saving and reopening / returning to the previous step) as well as monitoring of recorded events, which may be viewed, changed, deleted or cancelled at any moment, according to the level of access of the user.

An efficient audit management needs a combination of people, processes and technology, in order for the best results to be reached. But the technology-based audit programs are not sufficient. The best practice illustrated the essential demands for the audit management automated systems. Also, the necessary processes and the human resources demands are identified in order ensure that the regulations are met and the risks are diminished. [7]
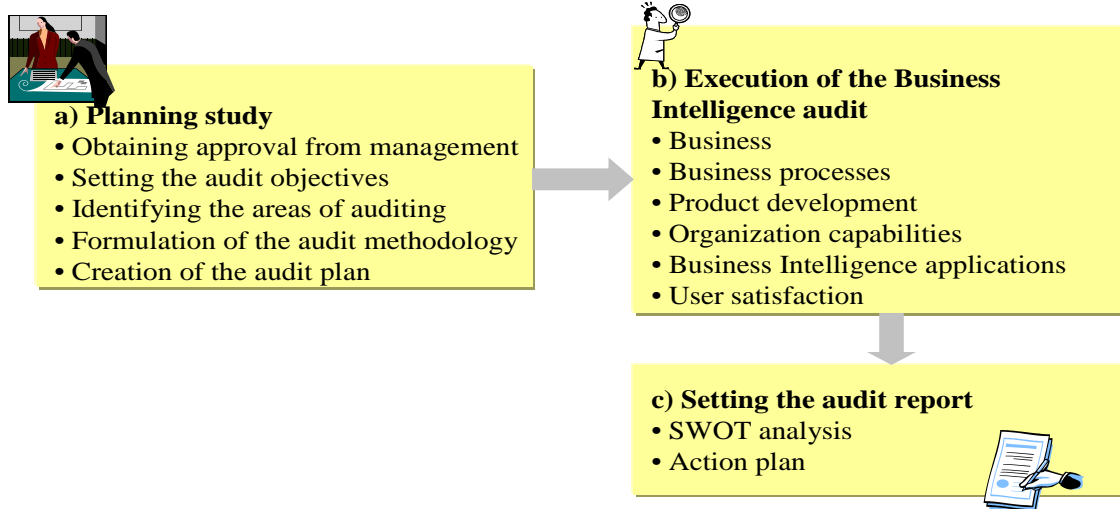


**Fig. 1.** Integrated Compliance Process Control [7]

An efficient management system must ensure the automation of the entire audit process and include the integration of the following elements [7]: corrective and preventive actions, change of control, management and checking of nonconformities, management of legal documents/content, reports, personalized analyses, training, appropriate intelligent dashboard (figure 1).

The audit process of a Business Intelligence

solution lasts between 15 and 30 days. It may be achieved through the following stages (with possible returns to previous stages): ❶ study

planning, ❷ auditing and ❸ issuing the audit report (figure 2).



**a) Planning study**
• Obtaining approval from management
• Setting the audit objectives
• Identifying the areas of auditing
• Formulation of the audit methodology
• Creation of the audit plan

**b) Execution of the Business Intelligence audit**
• Business
• Business processes
• Product development
• Organization capabilities
• Business Intelligence applications
• User satisfaction

**c) Setting the audit report**
• SWOT analysis
• Action plan

**Fig. 2.** Stages of the Business Intelligence audit process

*a.1. Obtaining approval from management.*
Having the support of the head management is one of the key factors for the success of the audit, which may be applied to the general process of creation and management of Business Intelligence components, or to the lowest target-level of Business Intelligence. The head management of the organization has to understand first what are Business Intelligence and what it means for the organization. At the same time, it needs to understand what are the products, principles, risks and realities and the advantages and costs [8]. The support of the head management means finding the means of a auditing the Business Intelligence solution for the organization of a line of reference in the permanent monitoring of management. For this purpose a program shall be set up for the improvement of the Business Intelligence solution within the organization [8].

The support of the head management is necessary because accomplishing the audit needs time, money and human resources. Gaining this support ensures that the audit process is treated as a corporative mandate and not as a departmental challenge [7], and that the necessary resources are identified for the success of the audit. Calculation of the ROI (Return Of Investment) index for the impact of the implementation of the Business Intelligence solution might be a good solution, but it is not a sufficient one (it entails establishing a real value on the development of Business Intelligence). Resources spent on Business Intelligence must be assessed both in

terms of costs and as value of return, both at the beginning and during the use of the solution. The impact must be assessed on the long term, considering both tangible and intangible factors at different organizational levels.

*a.2. Setting the audit objectives*
During this stage, the organization defines information related to objectives, goal and criteria of audit [6]. In general terms, the audit of a Business Intelligence solution helps in identifying the position of the organization in relation to the Business Intelligence solution, its target objectives in connections to the latter, and the means of reaching these objectives. Also, the audit may be used to tackle a specific problem of Business Intelligence or a problem faced by the organization. Therefore, the following main objectives of Business Intelligence audit to be formulated at the organization's level may be enumerated [4] [9]:

- identifying the difference between the actual and the desires situations for the purpose of setting the scalability of the Business Intelligence system;
- assessment of Business Intelligence processes and systems for complete adjustment to present and future business demands;
- revision of the community of users involved in the business in order to understand the present needs in the area of key performance indicators of the related business processes;
- verification of the use of the best practices to be consistently applied to the project making,

development and management of implementations and Business Intelligence environment;

- assessment of the opportunity of using Business Intelligence instruments, by creating a comprehensive image of the architecture and infrastructure;
- verification of the information used in order to identify any characteristics related to the users' information and satisfaction;
- revision of operational applications in order to assess the support granted by the organization to the Business Intelligence solution;
- analysis of top-level benefit in order to identify ways of transmission and protection of information flows towards the organizational management;
- assessment of the organizational management in relation to the best practice in the field;
- updating documentation on Business Intelligence solutions, processes, environment and practices in order to pass at the next level based on factual grounds;
- understanding the Business Intelligence investment and the effort needed for its upkeep;
- helping the development of a evolution plan of the Business Intelligence solution.

*a.3. Identifying the areas of auditing*
Identifying areas / processes / departments covered by the audit means understanding exactly the elements that are going to audited, the data spread, the Business Intelligence system's

infrastructure and construction. Among the most important area covered by Business Intelligence audit may be enumerated [9], [10]:

- adjustment between the present and future business objectives and the Business Intelligence solution;
- technological instruments and platforms related to Business Intelligence;
- Business Intelligence processes: analysis, project making, development, production, management of change, maintenance;
- people and their skills: structure of the organization' users and their demands; the way information produced corresponds to the tasks and responsibilities of the people that uses it (both the management and the executive); users' documentation concerning the Business Intelligence system;
- the way the system is supported by the organization;
- Business Intelligence architecture: data (the way data are extracted from the source systems) and data flows (source, stages, warehouses); quality of data and information (aspects of the business user); ETL processes (Extract, Transform, Load), data models (structure of cubes and aggregations), data schemes; presentation (the way information is visualized), interrogations, reporting and analysis (time of response in online analyses, as well as accuracy of the resulting data); metadata management.

Each of the areas / processes / departments under informational auditing must be analyzed according to different dimensions (figure 3).
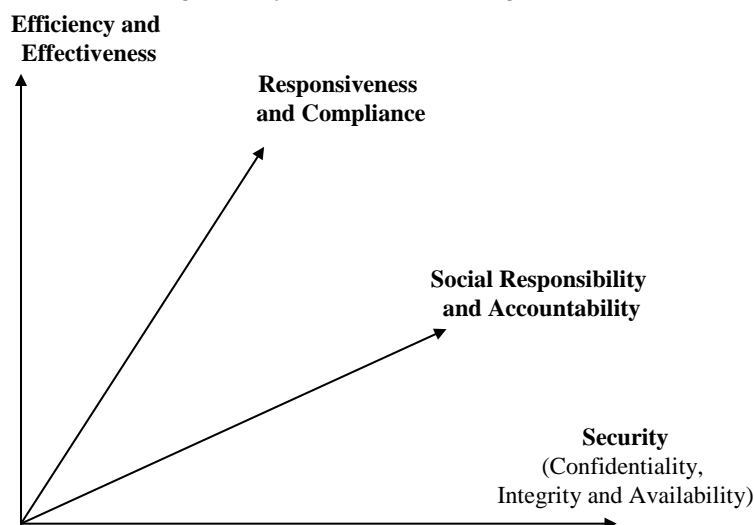


**Fig. 3.** Dimensions of System Audit [11]

*a.4. Formulation of the audit methodology*
This stage involves the description of the steps

and processes of audit, along with the audit guidelines and available instruments. The audit

methodology in Business Intelligence includes a well defined program for the use of the results of the Business Intelligence audit. This is an action program oriented on the improvement of the Business Intelligence areas of the organization [8]. Within this stage, ❶ clear policies, procedures and key performance indicators are set, which should be used in the assessment of the Business Intelligence solution (business drivers and essential aspects of Business Intelligence components), ❷ is identified the scale to be used for measurements (the industry guidelines and the best practices grouped in categories like a scale) and ❸ the questions to be asked in the assessment.

*a.5. Creation of the audit plan*
At this stage is created the audit team and the action plan based on the elements identified within the previous steps. The latter includes: specification and building of audit demands; establishing the cycle and frequency of audit; allocation of audit teams based on preset skills; setting the starting data and the periods of execution. The action plan and the verification lists are presented to the auditors, the audited and to the management of the organization for approval.

*b. Execution of the audit*
Another critical component of the Business Intelligence audit is the issuing of the written report on the maturity and quality operational activities of Business Intelligence. Assessment is made based on standards set forth at the level of the industry. The Business Intelligence audit includes assessment of components like: quality of basic data; information form; availability and delivery; infrastructure systems, instruments and software, as well as methods and practices of project making, development and control [3].
Taking into account the impact of the Business Intelligence solution in the entire organization, the audit must be executed at the level of the organization and not only at the level of the Business Intelligence application. Therefore, the execution of the Business Intelligence audit process entails: ❶ understanding the business; ❷ analysis of business processes; ❸ product development; ❹ assessment of organization's capabilities; ❺ assessment of Business Intelligence applications and ❻ measurement of user's satisfaction (figure 4).
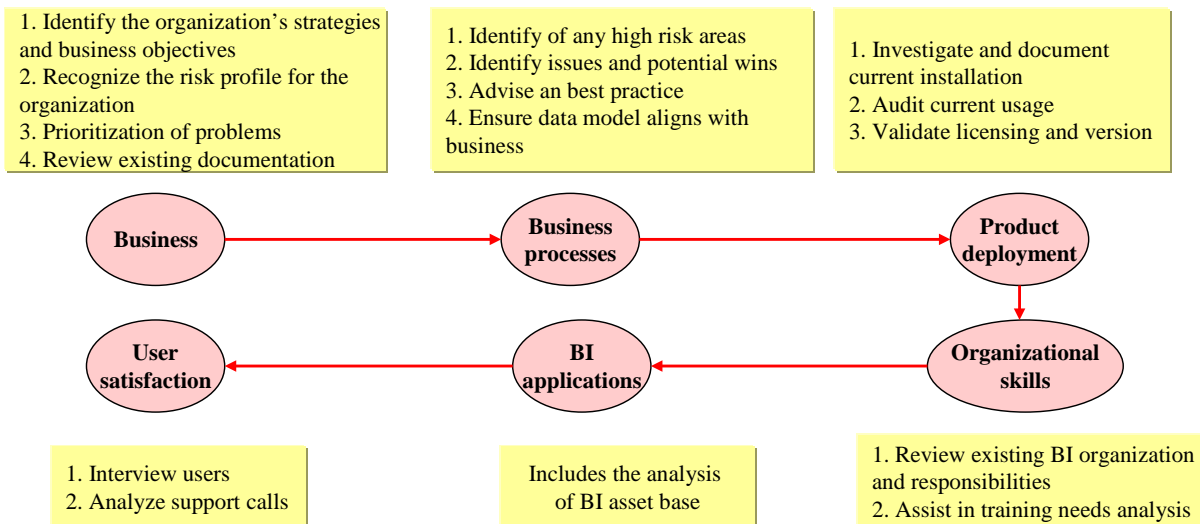


**Fig. 4.** Areas analyzed within the audit process (according to [4] and [12])

Business Intelligence Audit may be achieved on three levels. The zero level presents all areas of Business Intelligence, the first level (figure 5) points out all the main components of Business Intelligence, and the second level of audit (figure 6) entails defining the key assessment features for each main component. The primary objectives of the audit of Business Intelligence elements are the key assessment features, which can be visualized on the second level [13].
Within the first level, the business informational component has been decomposed in data and metadata components. Also, the infrastructures of the platform have been extracted and presented separately, as technical infrastructures and as non-technical infrastructures, so as to allow the attentive assessment of each part, as separate entities.
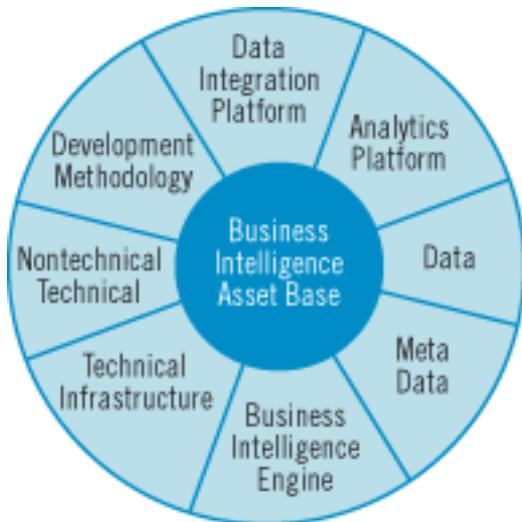
**Fig. 5.** Business Intelligence component basis [13]

The main components that can be analyzed in the Business Intelligence application are [13]:
• *The analysis platform*, which supports the entire interface with the user (interrogations, analyses, reports and online analytical processing).
• *Business Intelligence Engine*, which collects data from the multiple source systems, transforms and interrogates the data in a single easy accessible information library.
• *Data*. The Business Intelligence application involves a complex assessment, starting with the data source, passing through a series of transition stages and finally including data into an information library that is considered the "sole source of truth" for the organization.
*The data integration* supports data gathering and integration from the operational systems and from other sources. Data are refined, translated and integrated into a central information library.

•   *Development methodology* includes the direction and the way in which information is gathered, transformed and integrated, plus the development strategies and the processes used in the creation of analytic applications, being a critical element for the success of Business Intelligence in an organization.
• *Metadata*. Metadata may be combined with the primary data in order to be transformed in an information product. Also, metadata must be precise, accessible, and closely related to data.
• *Non-technical infrastructure*. The non-technical infrastructure is composed of all buildings and features that are not tangible (contrary to hardware), but that provide a framework of consistency, integration and efficient operations in the interior and within the entire Business Intelligence components basis. This non-technical infrastructure includes, for example, all standards, guidelines, and governing lines, at the level of service.
•   *Technical infrastructure*. This technical infrastructure is the first layer of Business Intelligence architecture and represents the technical support on which all the rest of the Business Intelligence system is built. This technical infrastructure includes hardware, middleware, operation systems, networks, database administration systems and so forth.
In the case in which the performance of the data warehouse and of the Business Intelligence subsystems presents a problem then the system is assessed in order for data processing time to be reduced, without performing major changes in it.
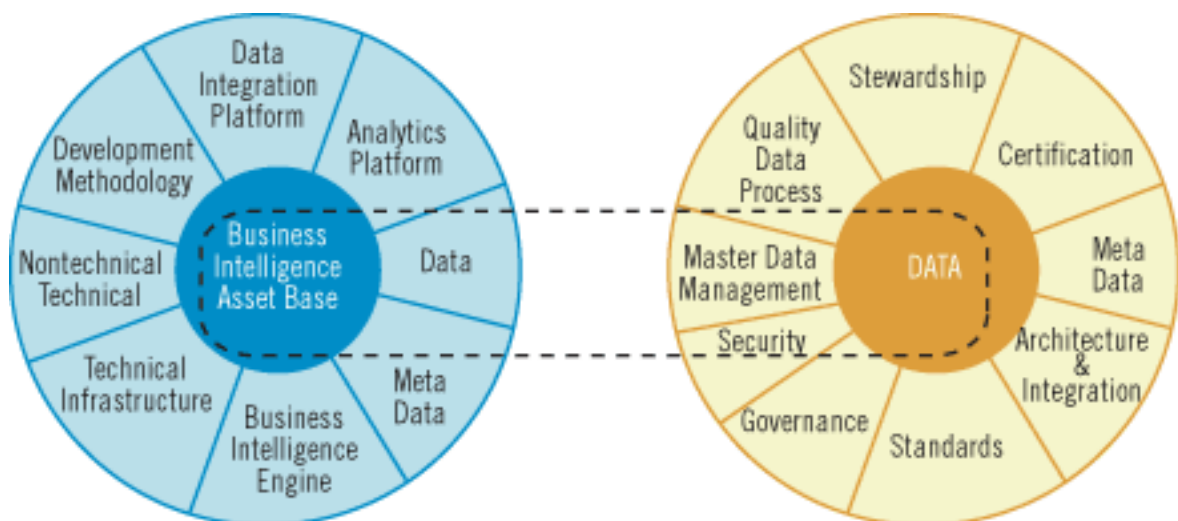


**Fig. 6.** The characteristics of the data component [13]

The objectives followed during this audit are [14] (figure 7): improving performance of the data warehouse; improving time of response on interrogation with data aggregation; a more rapid loading of the database and data warehouse; accelerating Business Intelligence applications; reducing the time of analysis; hardware use and optimization.
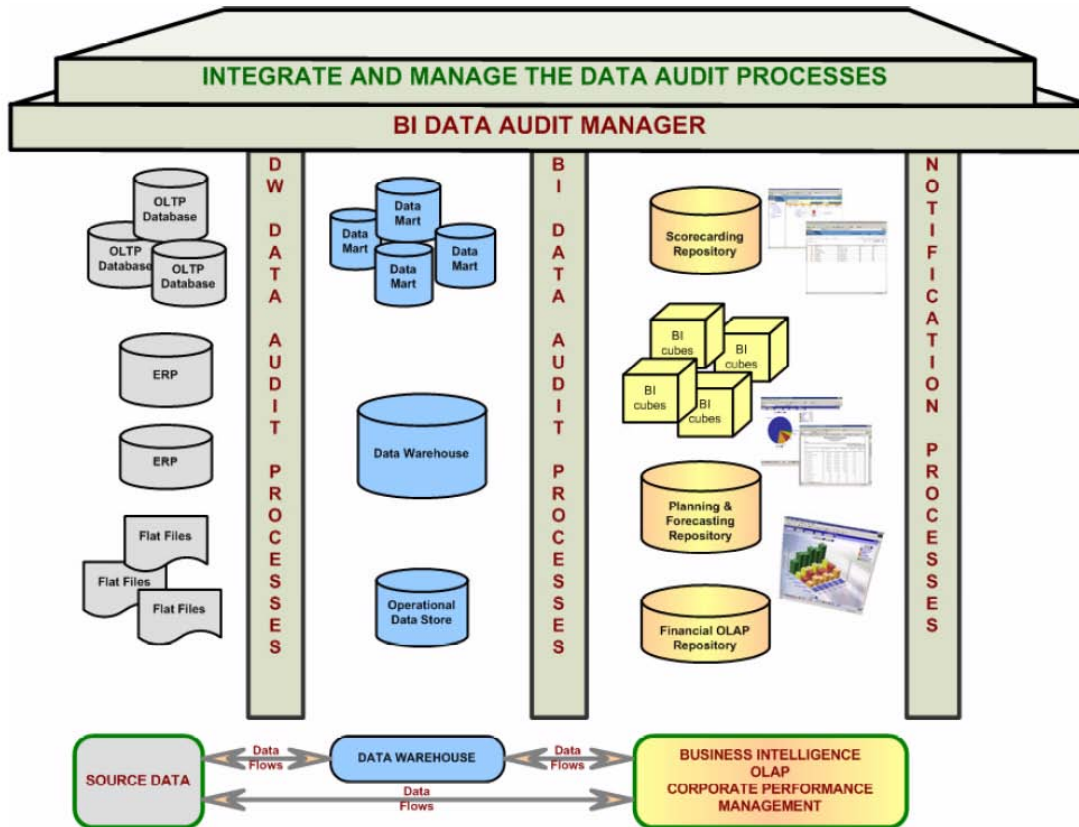


**Fig. 7.** Management Business Intelligence data audit [15]

In order to meet these goals, the following actions are recommended [15]:

- monitoring correctness of critical data;
- monitoring data accuracy between all objectives of the Data Warehouse and Business Intelligence;
- workflow approach in identifying and solving data accuracy problems;
- establishing data ownership and accountability;
- monitoring business rules accuracy;
- setting up of statistics related to data accuracy problems;
- data update control.

*c. Setting the audit report*

After the execution of the audit, the audit team shall issue a complete report containing a revision of the present processes and of Business Intelligence practice, SWOT analysis, information for all parties concerned and the action plan (practical recommendations on the short term and improvements on the long term). The action plan shall also contain the necessary resources, effort, processes, and instruments to reach the recommended levels. For a clearer presentation of the gaps, the report may contain diagrams presenting the present stage and the target levels (figure 8).
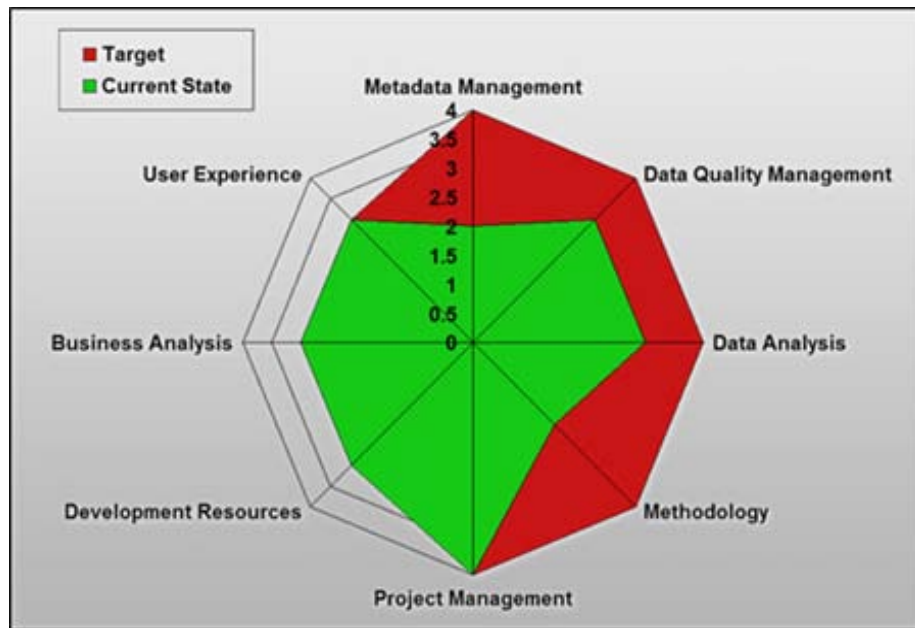
**Fig. 8.** Assess**.** Determine maturity and readiness [16]

**3 Performance Assessment of the Business Intelligence Solution Audit**
In the good practice of audit processes the finalization of the audit involves issuing a chart for the assessment of the audit performance (table 1) and obtaining its confirmation by the audited structure. Concerning the audit of Business Intelligence applications, assessment of the audit performance must allow identification of deficiencies, initiation of the necessary improvements for a good development of the future audit missions and planning of the professional training actions for the human

resources involved in the use of the applications. Also, based on this assessment, it shall be determined the efficiency of the audit in the key areas covered by Business Intelligence, the feedback during the audit, the length of the audit, accuracy of observation, the value of recommendations of the audit report, the added value created by the Business Intelligence audit process.

This audit performance assessment chart has to be filled by the employees of the organization who are involved in the activity of the audited administrative structure.

**Table 1.** Audit performance assessment chart (excerpt)

| No. | Assessment | Agree completely | Agree | Disagree | Disagree completely | No comment |
|---|---|---|---|---|---|---|
| | **THE AUDIT PROCESS** | | | | | |
| 1 | The audit process was clearly notified and explained at the beginning of the audit mission | | | | | |
| 2 | The objectives and area of audit have been discussed with the management of the audited structure before the start of the audit mission | | | | | |
| 3 | The suggestions and concerns of the management have been marked and taken into account during the audit | | | | | |
| 4 | The management was informed on the stage of the audit and the possible problems in the audit | | | | | |
| | .................. | | | | | |
| | **DEVELOPMENT OF THE AUDIT MISSION** | | | | | |

| No. | Assessment | Agree completely | Agree | Disagree | Disagree completely | No comment |
|---|---|---|---|---|---|---|
| 1 | The audit observations have been relevant for the activity of the audited structure | | | | | |
| 2 | Observations and recommendations from the audit report help you improve your system of management and control | | | | | |
| | ..................... | | | | | |
| | **INTERNAL AUDITORS** | | | | | |
| 1 | The auditors had the necessary knowledge on the policies and demands that affect the activity of the audited structure | | | | | |
| 2 | The internal auditors acted in a professional and open manner | | | | | |

Such assessment shall be executed also for the audit team in order to be measured the professional competence of the auditors in a specific case. In order to ensure the success of the audit, intelligent dashboards may be used that would allow identification of problems, detection and analysis of the causes that determined the gaps, and visualizing the actions that may be taken for the purpose of reaching the target levels (figure 9).
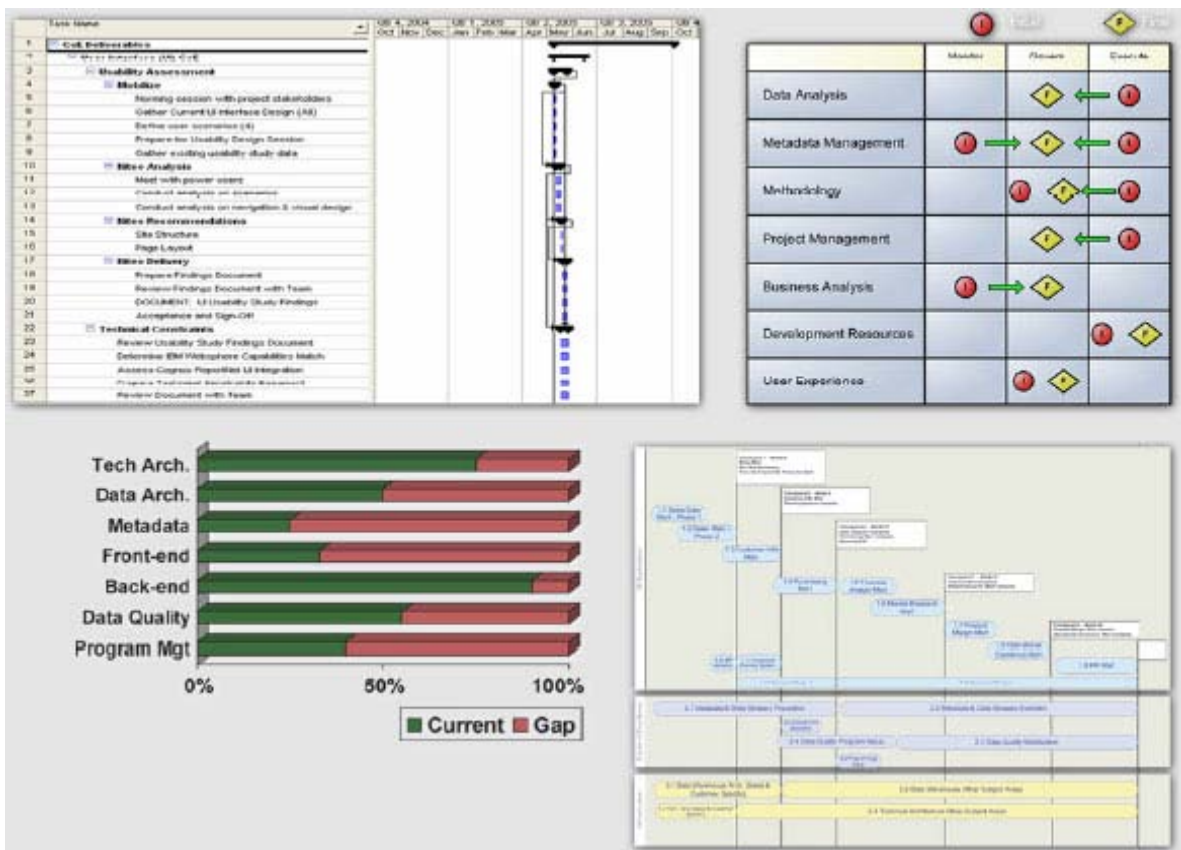


**Fig. 9.** Audit. Define your current state, CoE focus, and a roadmap to get there [16]

Measurement of audit performance would lead to better communication of the contribution audit has to the development of the organization. For this measurement technological instruments may be used and may be made data analyses (figure 10) to calculate indicators regarding the environment, results, quality, efficiency and the impact of audit on the organization [17].

Among the categories of measurement of audit performance, the impact indicators are

considered the most difficult to quantify. Their purpose is that of measuring the final results in the organization in terms of budget, risks, money recovered from projects. The most used indicators are: the number of reported problems, identified losses, income from capitalized benefits, audit cycle, audit cost, achieved percentage of the audit plan, number of issued recommendations, and number of implemented recommendations, reaching the long term quality objectives and so on.
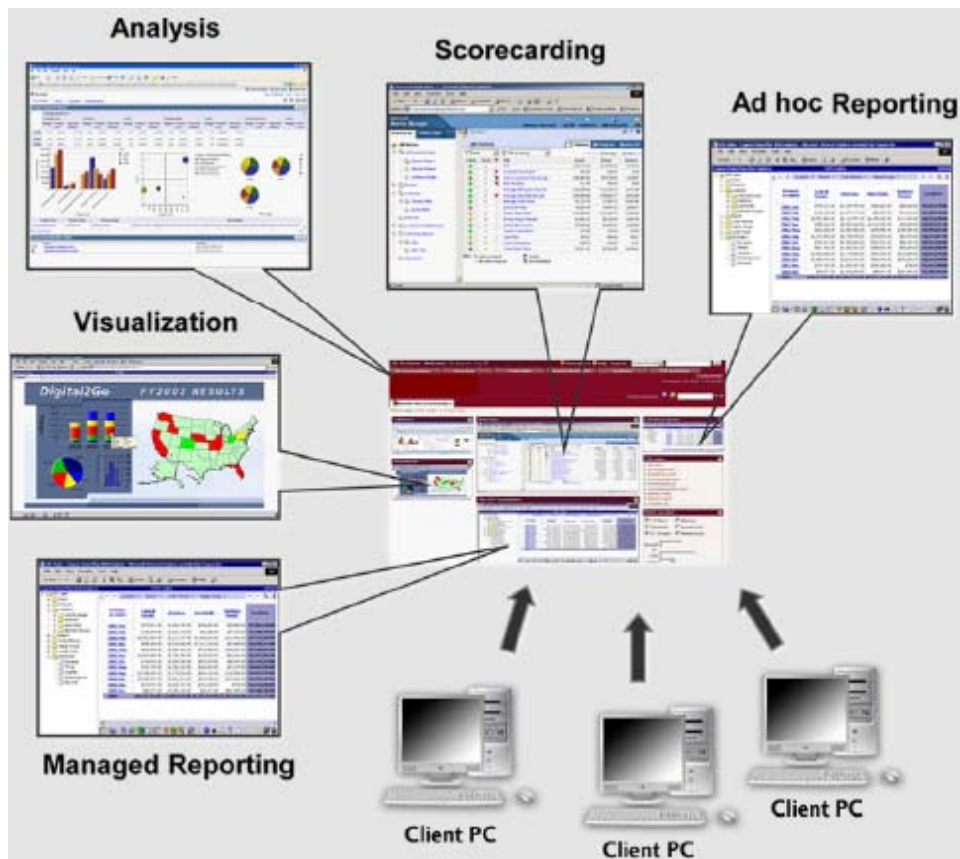


**Fig. 10.** Enable. Evolve your organization from disparate and disconnected to Business Intelligence competence, then to Business Intelligence excellence [16]

Taking into account the above considerations, we may say that the efficiency of Business Intelligence audit is generally dependent on two main factors: ❶ the presence of a mechanism for the examination of audit, having the purpose of improving the efficiency of the latter and ❷ quality of observations and their perceived quality by the audited area / organization.

**4 Conclusions**
At the end of the first decade of the third millennium the mankind is going through powerful transformations concerning the way of working, communicating, having fun, and of living in general. We are witnessing a genuine revolution of the way business is done, a revolution that started 20 years ago and which represents a new era, in which the computer networks and the communication systems have become a common feature of the daily life for the majority of people. The possibility of enlargement of Internet use is stimulated by the substantial development of various applications like electronic commerce, distance education, electronic mail, digital libraries and virtual communities. The development of these applications favors speculating on the social changes generated by the use of internet on a large scale.

Business Intelligence audit proves its importance and usefulness in relation with ensuring the quality of economic activities and processes within organizations. Through audit processes we can discover relatively easy the weaker points and the problems in the parameterization of Business Intelligence solutions in relation to the essence of the activity that is the object of implementation. In this way we can find the

answers to questions on the time of reaction of the Business Intelligence solution to data or information interrogations, the quality of data and information, the way data are extracted from the system, the means of visualization, the structure of the rings of users and of the content trees, structure of data cubes and of interrogations of the type aggregation-desegregation or synthesizing-desynthesizing in the processes of compatibility of information, etc.

In the end we may state that the enlargement of audit processes to the level of the new forms of work and activity that are specific to the information society – E-Education, E-Commerce, E-Government, E-Everything – and that involve an Information Technology solution must represent a priority for the organizations that practice such activities. Quality stays one of the most important dimensions of human activity, and the audit of information systems specific to every form of modern activity may be one of the efficient means of promoting quality.

## Acknowledgment

## References

[1] C. Steven, „Business Intelligence and audit reports," *Financial Services Industry*, 2007, Available at: http://findarticles.com/p/articles/mi_qa5377/is_200711/ai_n21298951/

[2] G. Ptacek, „An Information Audit of a Business Intelligence Portal," *School of Information and Library Science of the University of North Carolina at Chapel Hill,* 2008, Chapel Hill, North Carolina, Available at: http://etd.ils.unc.edu/dspace/bitstream/1901/554/1/GretchenPtacek.pdf

[3] D. Miller, "Have We Lost Control of the Business Intelligence Investment?", *Itbusinessedge*, 2009, Available at: http://www.itbusinessedge.com/cm/community/features/guestopinions/blog/have-we-lost-control-of-the-business-intelligence-investment/?cs=37281

[4] SOPRA, „Business Intelligence - Business Re-Discovery (A Business Intelligence Audit)", *Sopra Group*, 2007, Available at: http://www.sopragroup.co.uk/resources/biauditemail.pdf

[5] XTIVIA, "Business Intelligence & DW Readiness Audit," , 2008, Available at: http://www.virtualappserveradmin.com/pdfs/BIDW_ReadinessAudit_2008.pdf

[6] SoftExpert, „Audit Management", *Software for Business Excellence*, Available at: http://www.softexpert.com /audit-management.php

[7] Decimal, *Audit Management Best Practices*, Available at: http://www.decimal.ca/en/practices/audit-management.htm

[8] D. Miller, „Business Intelligence: Key Performance Indicators", *Business Intelligence Review Online*, 2007, Available at: http://sixsigmabi.com/ dmreview%2010-26-07%20BI%20 Key%20performance%20indicators.pdf

[9] InfoBlueprint, „Business Intelligence Audit (Business Intelligence Healthcheck)", *InfoBlueprint*, 2007, Available at: http://www.infoblueprint.co.za/bi_audit.html#

[10] Business Intelligence, "Business Intelligence Audit," *Passionned Group 2003-2010*, Available at: http://www.passionned.com/products/business_intelligence_audit/

[11] S. Kanhere and V. Kanhere, „IS Audit and Security Professionals: An Emerging Role in a Changing World Order," *ISACA Journal*, Vol. 5, 2009, pp. 50-53.

[12] M. Ackerman, B. Rucker, A. Wells, J. Wilson and R. Wittmann, „IT Strategic Audit Plan," *Journal of Technology Research*, Vol. 1, 2009, Available at: http://www.aabri.com/manuscripts/09163.pdf

[13] D. Miller, „Defining the Business Intelligence Asset Base, Mesuring Business Intelligence," *Information Management Online*, 2008, Available at: http://www.information-management.com/news/10000770-1.html

[14] XTIVIA, „Business Intelligence & DW Performance Audit", *Xtivia Inc.*, 2008, Available at: http://www.xtivia.com/pdfs/BIDW_PerformAudit_2008.pdf

[15] G. Shiller, „Business Intelligence data audit manager", *Sky Solutions*, 2006, Available at: http://www.skysolutions.com/

[16] Niteo Partners, Business Intelligence of Excellence, 2009, Available at: http://www.niteo.com/BICenterExcellence.html

[17] K. Hill, S. Driver, M. Garner, S. Goodson, D. MacCabe and H. Young, "Performance Measures for Internal Audit Functions: A

Research Projet," *The Institute of Internal Auditors*, 2009, Available at: www.theiia.org/download. cfm?file=36268

**Bogdan GHILIC-MICU** received his degree on Informatics in Economy from the Academy of Economic Studies Bucharest in 1984 and his doctoral degree in economics in 1996. Between 1984 and 1990 he worked in Computer Technology Institute from Bucharest as a researcher. Since 1990 he teaches in Academy of Economic Studies from Bucharest, at Informatics in Economy Department. His research activity, started in 1984 includes many themes, like computers programming, software integration and hardware testing. The main domain of his last research activity is the new economy – digital economy in information and knowledge society. Since 1998 he managed over 25 research projects like System methodology of distance learning and permanent education, The change and modernize of the economy and society in Romania, E-Romania – an information society for all, Social and environmental impact of new forms of work and activities in information society.

**Marinela MIRCEA** is professor assistant in Economic Informatics Department, Academy of Economic Studies of Bucharest. She published over 35 articles in journals and magazines in computer science, informatics and business management fields, over 15 papers presented at national and international conferences, symposiums and workshops and she was member over fifteen research projects. She is the author of one book and she is coauthor of three books. In February 2009, she finished the doctoral stage, and her PhD thesis has the title *Business management in digital economy*. Her work focuses on the programming, information system, business management and Business Intelligence.

**Marian STOICA** received his degree on Informatics in Economy from the Academy of Economic Studies, Bucharest in 1997 and his doctoral degree in economics in 2002. Since 1998 he is teaching in Academy of Economic Studies from Bucharest, at Informatics in Economy Department. His research activity, started in 1996 and includes many themes, focused on management information systems, computer programming and information society. The main domains of research activity are Information Society, E-Activities, E-Working, and Computer Science. The finality of research activity still today is represented by over 50 articles published, 9 books and over 20 scientific papers presented at national and international conferences. Since 1998, he is member of the research teams in over 15 research contracts with Romanian National Education Ministry and project manager in 5 national research projects.