

## Integrating BI Tools in an Enterprise Portal for a better Enterprise Management

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*Access to information has always been a stringent necessity for any organization. This necessity has become more stringent in the actual economic context, as decisions must be taken in the shortest time. That is why, since the early sixties, Decision Support Systems emerged. They have evolved together with the client-server technology, during the eighties, towards today's Executive Support Systems. Nowadays, these systems tend to be replaced by Dashboards and Balanced Scorecards as individual BI tools or as integrated tools, which are part of more complex BI solutions, which fulfill the more and more sophisticated and growing information requirements from decision factors. In this paper, we shall present a partial integration solution of the BI tools in an enterprise portal created using Microsoft SharePoint Server technologies. Initially, the enterprise portal which we'll present in this paper was meant to be more a general solution for the informational integration of an organization and less than a portal with strong BI features. But, as we shall demonstrate by the means of this paper, the portal prototype, as it is now, can be rapidly expanded to an enterprise portal with full BI features.*

**Keywords:** Business Intelligence, Enterprise portal, Dashboard, KPI, Integrated reporting

### 1 Literature review

In specialized literature, there are a lot of synonyms for the enterprise portal term: corporate portal, corporate information portal, business portal or enterprise information portal [1]. In [2], beside a part of the already mentioned synonyms, there are others, like: employee portal, enterprise intranet portal, business-to-employee portal. In addition to these, Kim et al. [3] adds other terms, like data portal or collaborative portal.

Regardless of the chosen term, the broad definition signifies “a portal is a gate towards information, services, products etc. provide, with the help of the Internet, of the Intranet of an organization or of any other proprietary Intranet. A portal is a gate. It offers an access point towards a very broad area of resources and services, like: e-mail, forums, search engines or online shops” [4]. The strategic goal of an enterprise portal is to “provide a simple, usable interface to all who need to interact with the organization: employees,

customers, providers and business partners who need to access content, to use applications and to collaborate with each other”[5].

In the early 2000s, Gartner Group forecasted that by the end of 2001 more than half of all the important companies will use a portal as their main organizational and informational tool [6]. These assessments were also sustained by the numerous research studies which emphasized the importance of enterprise portals, considering them to be “the most important business information management project for the next 10 years” [7] or considered that it would become “the next generation of software for desktop applications” and “its impact on information management will be as important as the railroads were for the industrial revolution” [8]. It was natural to be so for the novelty, not so of the portals themselves, but especially for the novelty of the web technologies that barely had emerged. Nowadays, the interest in portal

technologies has dropped, which is partly due to the fact that web interfaces and web technologies have become very common, even for software applications which are used at transactional level in organizations. Specialized literature speaks very highly of portals, from the point of view of the numerous advantages they provide to enterprises. Beside the fact that an enterprise portal can provide advanced search functions for the users, by the means of integrating different information sources and of the easier access to the enterprise software applications, it can also provide employees with tools which can help them find information and sometimes even knowledge they need to complete their tasks [9], [10]. Unlike other systems, enterprise portals provide information taking into consideration the roles of the users within the organization [11], thus diminishing the „informational overload”, cutting down costs, improving their innovation capacities and providing Business Intelligence features [12]. A portal can also provide the following features: rationalizing business processes, increasing efficiency and productivity, and, thanks to the easy access to applications and relevant information, improving employee satisfaction. All this is possible thanks to the improved communication and collaboration between employees and workgroups across an organization [2], [6], [13], [14]. A portal can improve as well the external collaboration process with different business partners [6], [14]. Yet, all these advantages are still theoretical, as they weren't proven by any studies on real implementations, thus confirming or disproving them [14]. Although it's been a while since Dias has published his article, other empirical studies on these matters are very scarce. There are only the Detlor [9] and Detlor and Finn [15] studies [16]. Based on the experience gained while working on the portal referenced by this article, we consider that all the advantages above mentioned can be obtained if all the

portal features are fully employed by all users.

## **2. Introduction**

In tight connection with the BI field of activity, a more familiar term is “business intelligence portal”. However, these portals are much more restrictive than enterprise portals, because they provide only one unique, secure web interface, for integrated, personalized BI applications, like: reports, data hypercubes, dashboards, scorecards etc. Beside BI specific applications, some portals also provide unstructured content integration instruments, or collaboration tools. Because of these limitations, most times BI tools are integrated into one single enterprise portal, especially if several other BI applications or portals are already integrated. All these can be contained into one single enterprise portal which can provide, through a single access point, personalized interfaces for each particular user.

Nowadays, thanks to the development of BI technologies, there are several ways to use BI tools in business processes among which we mention [17]:

1. Integrating BI tools in the operational applications already implemented in the organization;
2. Integrating analytical applications and BI tools in an enterprise portal;
3. Using Web Services in order to dynamically integrate BI tools both with internal operational applications and external applications from different business partners, thus supporting the collaborative commerce between organizations;
4. Implementing on-demand, event-driven processing for alerting systems, for real-time recommendation systems and for automating systems for different activities.

In this article, we shall approach the integration of BI tools in portals as an alternative to creating dedicated BI systems. We favor this approach as we

consider it to have a series of advantages, among which there are the speed and reduced costs of providing personalized BI tools to a great number of users. In addition to that, implementing an enterprise portal which is capable of offering tools like dashboards, scorecards or collaboration tools is much more appropriate for managers, decision factors and advanced users who need to analyze, evaluate and collaborate before making a decision.

### 3. Portal architecture

The solution we chose for implementing BI tools in an organization consists of a component of the enterprise portal we built as an organizational, integrating and collaborating, general-purpose solution. In order to build the portal, we used Microsoft Office SharePoint Server (MOSS) technologies, for several reasons: the modularity and reusability of the component technologies, the extensibility, scalability, and the service-oriented architecture (SOA) and, last, but not least, the complete and extremely complex enterprise architecture.

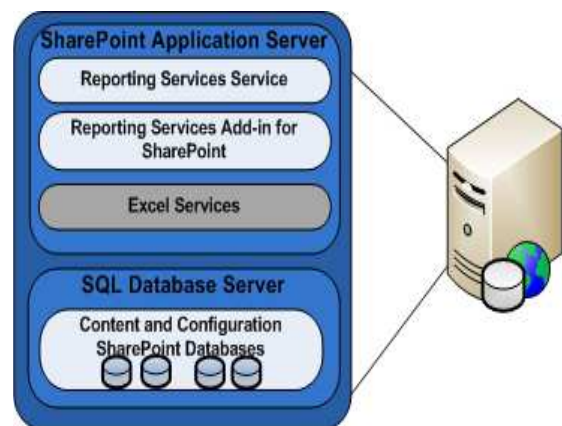
The general architecture of the solution, obtained by using MOSS consists of three levels, each with component servers, which have one of the three following roles: Web Server, Application Server and Database Server.

In order to build the portal and all its components, it was necessary to install, configure and implement several software components:

- Operating system - Windows Server 2003 SP2 or later;
- Web Server - IIS 6.0 or later and ASP.NET 2.0 or later;
- Database Server - SQL Server 2005 or later;
- E-mail Server – POP3 and SMTP;
- SharePoint Server - Microsoft Office SharePoint Server (MOSS) 2007, including Forms Services for creating sites;

- Report Server – SQL Server Reporting Services 2005 with SP2, including Reporting Services Add-in for SharePoint 2007, in order to integrate it with the SharePoint Server;
- Excel Calculation Services, Excel Web Access and Excel Web Services – which extend the portal functions in the direction of accessing external data sources in Excel files and integrating them in the portal. These, together with the SQL Server and the SQL Reporting Services, are the necessary components for building and implementing dashboards and scorecards.

Figure 1 depicts the architecture of the portal hosted on a single physical server.



**Fig. 1.** Portal architecture

The main advantage of this solution is that the three-level logical architecture can be implemented on a great variety of physical architectures, from a single server up to a great number of servers, depending on the organization's dimension and specifics.

Our solution combines all of these elements, being able this way to provide organizational features which help solve critical issues: efficient management of the business content and processes, easy, real-time access to information, thus contributing to better decisions.

### 4. The intelligent reporting solution implemented in the portal

The reporting process must become an intelligent one. An intelligent reporting

system is one which turns data into information and the information into knowledge, supporting users into taking the best decisions. The reporting system which our solution provides by integrating SharePoint Server with Microsoft SQL Reporting Services is such an intelligent system, because it successfully addresses the following problems:

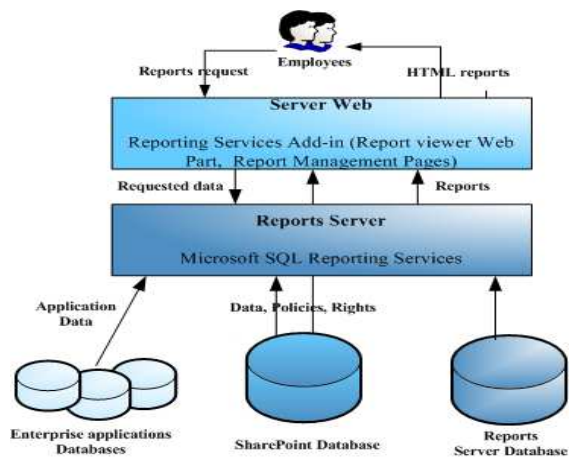
- *Integrating and consolidating different data sources* inside the enterprise and even outside the enterprise in order to be able to obtain relevant information and improve efficiency. This is done with the help of the integrated reporting solution;
- *Computing and reporting key performance indicators.* Integrating these indicators and presenting them in one single view makes them more suggestive and relevant in the decision-making process. For example, if one can see on one single display, in the form of a dashboard or of a scorecard, that the number of clients is dropping, while the number of employees is rising, the issue can be addressed more quickly;
- *Eliminating duplicate information.* Different applications in an organization mean that in fact the same data is stored in several places. Using our integrated solution, the organization can drastically decrease or even completely eliminate duplicate information.

So, the reporting functions of the portal address these problems and helps improve efficiency and the same time, provide better information features for the employees and decision factors.

SQL Server 2005 Reporting Services is a server reporting platform, which can be used to create and manage table-type reports, matrixes, diagrams or any other type, using data both from relational and multidimensional databases. If the Reporting Services server is integrated with the SharePoint server, the reports properties and elements are stored into the

SharePoint content databases, providing a better integration of the two server technologies. This integration determines the way the content is stored, secured and accessed.

Figure 2 illustrates how the two servers, the SharePoint Server and the Report Server, are integrated and are working together during a report generating process.



**Fig. 2.** The report generating process within the portal

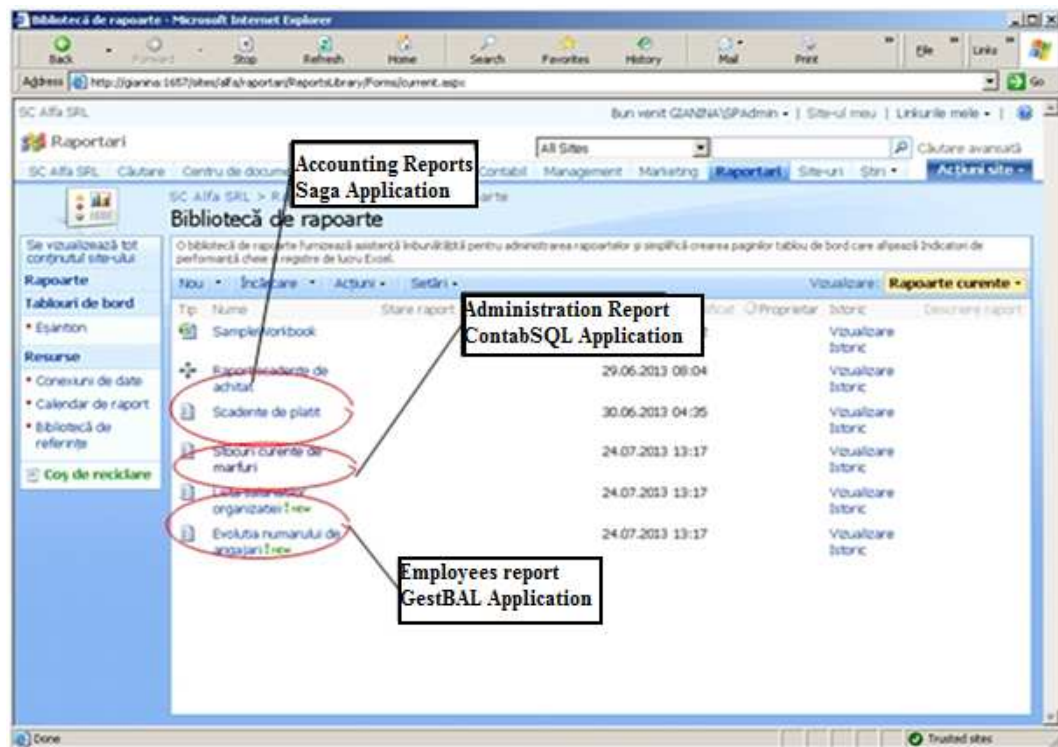
When a report is opened in the portal, the SharePoint server connects to the reporting server, creates a session, prepares the report for processing, takes over the data, configures the report according to the display properties and displays it in the portal, in a Web part which is called a Report Viewer. As long as the report is opened, it can be exported into different other formats, other data detail levels can be requested, filters can be added, or another report can be accessed by the means of some connections included into the opened report. The interaction with the report, like exporting, for example is also managed by the reports server.

We also chose to implement a Reporting Center into the portal, as a solution for the integrated access to application data and for implementing dashboards and scorecards. A Reporting Center provides access to all users to the organization's data, by the means of reports, dashboards,

key performance indicators (KPIs) and data source libraries. The Reporting Center can also filter data before displaying it to the users. This allows customizing it, before displaying it to the users. For example, accountants can only see reports, key performance indicators and dashboards which deal with the financial and accountancy data, managers can only see synthesis information and reports etc. in the portal, data is filtered at the page-level and this is done by the means of Web part connections. The portal allows the employees to choose different data filtering conditions, like the calendar date, suppliers, clients or a certain category of reports.

The reports published in the reporting center are organized in report libraries. These reports can be created using data taken from any organizational application that supports an ODBC or OLEDB connection. The image in figure 3 presents a report library from the Reporting Center where there are published reports created using data from three different transactional applications:

- Saga – accounting application, Visual FoxPro database;
- ContabSQL – management application, Paradox database;
- GestBal – staff tracking and payroll application, MySQL database.



**Fig. 3.** Integrating reports from different applications into the portal

In spite of having different applications and data sources, the SQL Server Reporting Services can create reports from all of them and publish them in the portal, in only one library. Thus, employees are provided with access from a single point to data from all applications used in the organization. Once published in the reports library, the access to these reports is done in a controlled and secure manner. They

can be viewed only by users with proper permissions, directly in the web-browser, by simply clicking on them. They can also be exported into other formats (pdf, xls, html, tiff, csv) in order to be used and processed offline (outside the portal). The image in figure 4 shows the current inventories report generated using data from the ContabSQL management

application and displayed in html format in the portal.

Categorie	Cod	Denumire	UM	Stoc	Pret vanzare	Valoare stoc	Procent adaos	Valoare adaos pe produs	Valoare adaos stoc
Accesorii	01	Casti RPC-MV760	BUC	78	28.6	2230.8	0.31	6.77	527.9
	02	Mouse Optic OP-6200	BUC	126	31.5	3969	0.27	6.7	843.8
	03	Camera Web Logitech	BUC	82	73.2	6002.4	0.18	11.17	915.62
	04	Mouse Optic Asus120	BUC	45	39.8	1791	0.30	9.18	413.31
<b>Total</b>						<b>1.3993.2</b>	<b>0.26</b>	<b>8.46</b>	<b>2700.63</b>
Componente	05	HardDisk Samsung 160GB, 7200RPM, IDE	BUC	24	179	4296	0.15	23.35	560.35
	07	Hard Disk Seagate SATA 250GB, 7200RPM,	BUC	12	169	2028	0.15	22.04	264.52
	08	Procesor Intel Pentium Dual Core E5200, 2,5GHz	BUC	8	239	1912	0.20	39.83	318.67
	09	Procesor AMD Athlon64 X2 7750 Dual Core, socket AM2+, Box	BUC	11	239	2629	0.15	31.17	342.91
	010	Memorie	BUC	20	89	1780	0.20	14.83	296.67

**Fig. 4.** Report of current inventories

Any employee with proper permissions can see the inventory at any moment, even without access to the management application and, most of all, without having to wait for a report from the Sales Department.

Connecting to external data sources in Excel files or in databases is a necessity for an organization, as it needs to cover the lack of some functions in the already implemented applications. Together with the report, a connection to the database is also published in the portal, into the data connection library. These data connection libraries can be used to manage connections created both with Microsoft Office applications (.odc – office data connection files) and SQL Reporting

Services (.rds – report data source files). Once saved in the data connection libraries, other users can use these connections in order to create new .xls files or new reports, without having to possess the necessary knowledge required to connect to external databases. Also, by the means of libraries, access to these data sources can be monitored and controlled.

The image in figure 5 shows a dashboard built with the help of the integrated reporting solution, which gives decision factors the possibility to watch in real-time the organization's capacity to deal with overdue payments during a 10 days period. The dashboard has four components, all linked to the accounting application database through an ODBC connection.

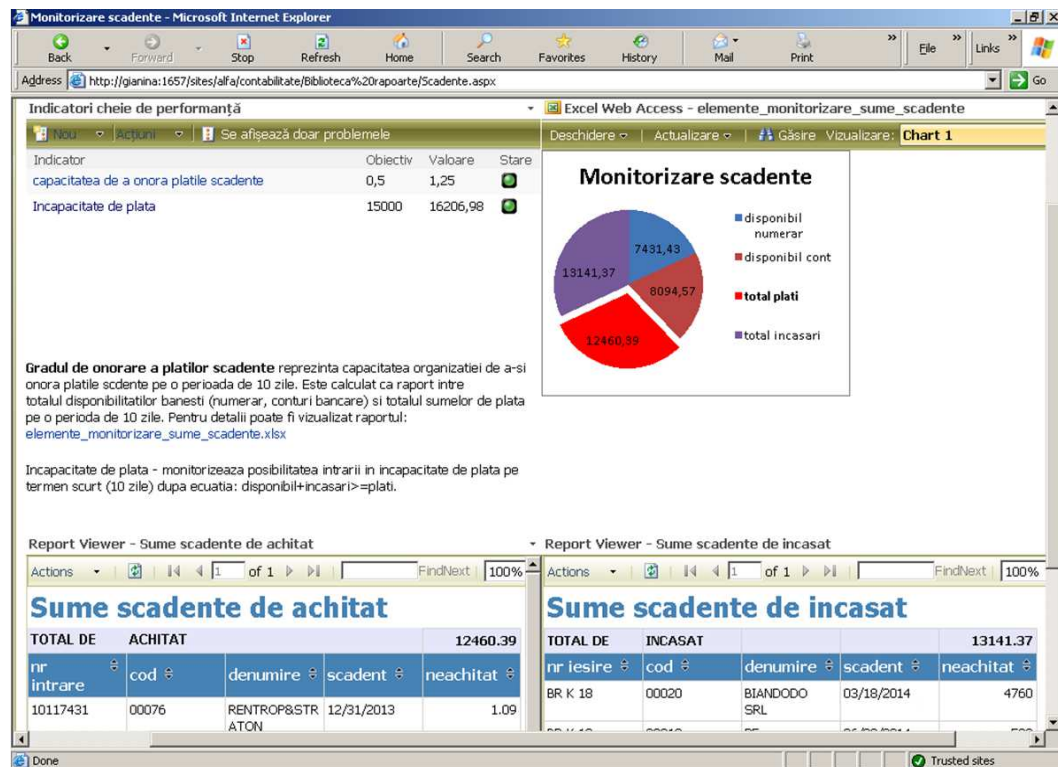


Fig. 5. Overdue payments monitoring dashboard

The four components of the dashboard are:

1. *Key performance indicators*. The dashboard computes and monitors two performance indicators:

- *The capacity to deal with overdue payments*, calculated using the formula:

$$\frac{(\text{Available Cash} + \text{Available Bank})}{\text{Total Amount to be Paid}}$$

The indicator is considered to be good if the available cash can cover 50% of the total amount to be paid for the next 10 days. If the available cash drops to 30% from the total sum to be paid, the user will be notified by a yellow indicator (in the form of a traffic light).

- *Insolvency*. This indicator shows the organization is on the edge of insolvency, by adding to the available cash, the collections for the next period. The indicator is monitored using the inequality:

$$\text{Available Cash} + \text{Available Bank} + \text{Collections} - \text{Payments} \geq \text{nr}$$

Analyzing cash collections and payments during a 10 day period,

there can be established an optimal level for this indicator.

2. *Overdue payments monitoring diagram* – shows in a graphical manner the total available cash in the cash register, in the bank account, the collections and the payments for the next 10 days.
3. *Reports* created using data took directly from the accounting application, which provide details on the collections' origin and the payments' beneficiaries for the next 10 days.

The *Overdue payments monitoring dashboard*, by its components, allows decision factors to watch collections and payments continuously, so that they can avoid penalties for the overdue payments or even the insolvency of the organization. Such a dashboard can improve the efficiency and acuity of the decision factors, providing them access to relevant and accurate data they need to successfully

complete their tasks. The most important thing is that any of the dashboard's components can be connected to the

database of any of the organizational applications by the means of an ODBC or OLEDB connection. This way, dashboards can integrate data from several applications, with decision factors being able to get exact, meaningful, real-time information for their activities, regardless of the application the data comes from.

### 5. Limits and further development

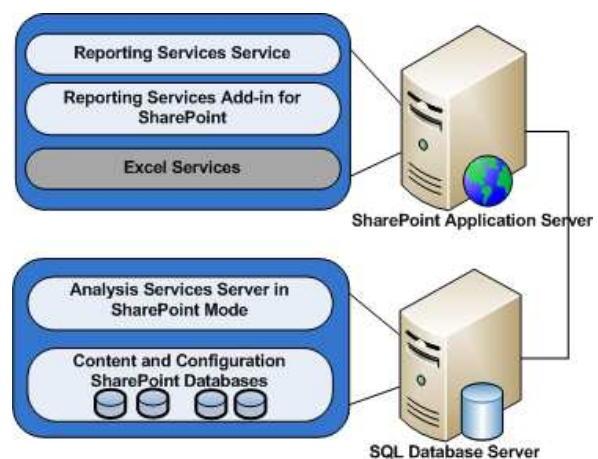
According to the MicroStrategy company, one of the biggest BI solution producers and integrators in the IT field, a complete BI solution should provide a set of instruments that are capable of offering reports and also monitoring and analyzing features using data from the organizational data storage to a very broad category of users, both internal and external. In order to be able to do that, the portal should integrate five categories of BI tools [18]:

1. *Dashboards and scorecards* – these BI tools cover all monitoring requirements for an organization, from management and decision factors level, down to simple employees and even providers (external users);
2. *Reporting tools* – used to create operational and financial reports in standard formats (.pdf, .xls, .txt etc.) and in Web format and distribute them to both users and decision factors in the organization and external users;
3. *Multidimensional data analysis tools* – these tools are good for analysis which can be forecasted. They include mainly OLAP cubes, which allow ad-hoc data interrogation on multiple dimensions and different data subsets, obtained by specific slice and dice operations and also by data drill down from the highest aggregation level to the lowest detail level (transactional level);
4. *Predictive data analysis and advanced data analysis tools* – they can discover unexpected data behavior and can make forecasts, using set theory techniques and mathematic and statistic functions. These tools, also

known as data mining tools, can perform advanced analysis, predictive analysis, hypothesis and forecast testing;

5. *Proactive warning and notification tools* – they are used for automated distributing of great number of reports, scorecards or warnings to a great number of users, in a pro-active, centralized manner, according to a previously established schedule; they can also send predefined or on-demand triggers based on a subscription system.

As one can see, the prototype portal we built has only reporting tools, dashboards and scorecards implemented and also a few warning and automation features for distributing reports throughout an organization. In order to implement the other BI tools, multi-dimensional analysis and data mining tools, we shall have to install and integrate the Microsoft Analysis Services component in SharePoint Mode; we shall also have to install and configure the Excel Services Application Data Model in order to integrate it with the Analysis Services Server and integrate it in the portal. The future, three level architecture of the portal will look like the image in figure 6.



**Fig. 6.** The future three-level architecture of the portal

By adding an analysis server, but especially for building practical solutions which can imply even creating a data



warehouse in the organization in order to be able to completely benefit from the power of OLAP and data mining tools, the one single server architecture (see figure 1), will not be appropriate anymore, even for small organizations.

## 6. Conclusions

While organizations are more and more dependent on information, collaboration and integrating multiple, both internal and external, data sources, decision factors must face a growing challenge: to manage information provided by lots of carriers: events, digits, documents, reports etc. In a more and more dynamic working environment, our solution provides the necessary tools it takes to manage, organize, share and provide efficiently all this content to both decision factors and simple users in an organization.

Created using SharePoint technologies, the solution we presented in this paper provides an intelligent organizational reporting process and also creating dynamic, interactive dashboards, which can combine and integrate data from multiple sources and can provide meaningful information to the users, taking into account their roles in the organization and, consequently, their particular informational needs. By combining Web Parts, filters, key performance indicators (KPIs), diagrams, reports and other elements, these dashboards are capable of offering ideal combinations of information, formatted and presented according to the particular requirements of each user.

Extending the portal's functions by implementing the Microsoft Analysis Services in SharePoint Mode component will lead to obtaining a complete BI solution integrated into the enterprise portal.

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