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## BUSINESS INTELLIGENCE PORTAL USING CONCEPT MAPS

### ABSTRACT

*The company's business intelligence (BI) environment today is a "patchwork" of technology that has accumulated for a variety of reasons over a long period: many kinds of general-purpose database (DBMS) software, a collection of different servers and end-user application relying on different database and communication standards. Users have approach to content and applications they need through role-based workspace created in BI portal. According to Eckerson& Howson, 2005, they find queries, reporting and analytical tools too complex or time-consuming to use. They spend too much time looking for the right report among hundreds, or get lost in endless series of drill-downs and dimension lists. They think that rather than empower users, BI portals overwhelm them.*

*Concept maps as knowledge visualization tools enable users to create one's own tailored individual workspace and provide the developers with useful information about the learning routes and performance of the knowledge workers. We investigate possibilities of applying concept mapping as a new approach to BI portal development.*

**Key words:** *business intelligence portal, concept map, visualization tools*

### Introduction

In the competitive world of business, the survival of companies depends on how fast they are able to recognize changing dynamics and challenges, and respond correctly and quickly. Companies have also other market "obligations" such as anticipating trends, identifying new opportunities for prosperity of a business, transforming their strategy, and reallocate resources to stay ahead of the competition. They collect significant volumes of data, and have access to even more data outside the boundaries of a business. There is increasing evidence that BI process automation deployed through BI Portal is a key capability for dealing with competitive and compliance challenges. It's an integrated solution that enables employees in a company to create and share important and filtered information for the interests of specific users, as well as to query and produce reports on enterprise-wide databases. BI portal consists of a variety of options such as reporting, analyzing, using dashboards, scorecarding, data integration and others, adjusted for the requirements of different users, relying on their position and importance in some business functions.

According to *TDWI Report* (Eckerson, W. W. & Howson, C., 2005) most users found that the original query, reporting and analytical tools are too complex or time-consuming to use. They spend too much time looking for the right report among hundreds, or

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get lost in endless series of drill-downs and dimension lists. They think that rather than empower users, BI portal overwhelmed them.

Organizations deploys web-based BI portal to provide employees and external users with personalized business user workspaces. Information workers using powerful collaborative contents management and BI capabilities need specific workgroup environment.

There is no doubt that to survive in a very competitive business environment, businesses will have to improve their capability to create and share new knowledge, elsewhere described as the need for continuous innovation. The capturing of any knowledge domain, in a format that employees can easily understand, is essential for the success of an organization and plays an important role in the implementation of strategy, communication, organizational learning and knowledge management. Relatively little research has been done on the use of concept maps and concept mapping tools in business (Fourie, 2005).

Since the focus in the past has mainly been on the educational use of concept maps and concept mapping software, the aim of this paper is to explore the possibilities of the concept maps usage in the business intelligence portal.

### **Business Intelligence Portal: State Of The Art**

Business portal is a workplace that gives users ability to access all of the business content needed to perform their daily tasks. The business content may consist of business processes and workflows, business applications and/or business information. In turn, the business information may come from operational systems, BI applications, CMS<sup>1</sup>'s or a collaborative environment. It allows a user to aggregate and share content: information, knowledge and applications, with customers, partners, employees and suppliers. Portals enable human users to surround themselves, in a few web-interfaces, with all kinds of information and applications. Applications include internal or external operational or analytic applications. Information includes structured data, business intelligence (reports, cubes, graphs, charts, etc.) and internal or external unstructured content (such as documents, digital media, Web feeds, etc.). Collaboration tools include Web-chat, net meetings, email, instant messaging, etc.

The main features and functionality of the portal are:

- *Presentation*: the portal illuminates business data and knowledge for better business decisions,
- *Dynamic Personalization*: The ability to dynamically personalize each user's work environment maximizes effective business processes and workflow.
- *Real-time Collaborations*: Co-workers can share information in real-time.
- *Application and integration*: the portal integrates information from multiple sources and applications.
- *Publishing and Distributions*: Portals users can share information by publishing content and subscribing to automatic delivery of relevant updated information.

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<sup>1</sup> Content Management System is a system used to manage the content of a Web site. A CMS facilitates the organization, control and publication of an industry-specific documentation such as news articles, operator's and technical manuals, sales guides, images, marketing brochures and multimedia resources. Typically, a CMS consists of two elements: the content management application (CMA) and the content delivery application (CDA).

- *Search and Retrieval Access Multiple Sources:* Users can quickly pinpoint the needed information.

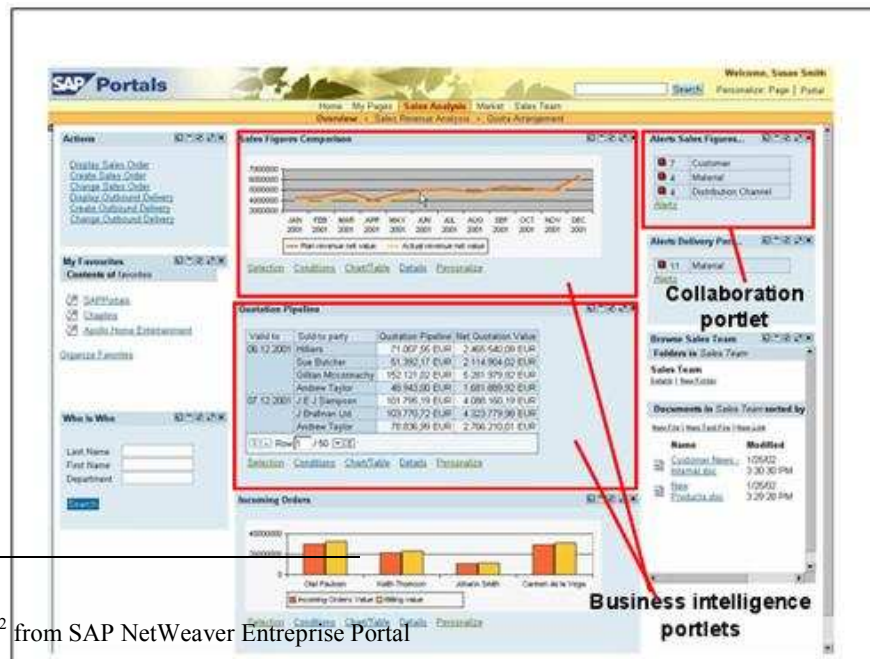
The role of business portals is to give users access to the business services and content needed for their jobs. These services and content are managed and provided by five main types of applications, as well as their underlying data stores:

1. *Collaborative applications* that provide e-mail, instant messaging, discussion groups and bulletin boards, web conferencing and online presentations, online white boards and screen sharing and remote learning.
2. *Workgroup applications* that support search document sharing and workflows, the management of workgroup documents, web pages, digital media and local offline data.
3. *Enterprise content management applications* that provide similar capabilities to workgroup applications, but at the enterprise level.
4. *Business intelligence applications* that report on, analyze and deliver business information about strategic, tactical and daily business initiatives and operations.
5. *Business transaction applications* that run day-to-day business operations.

A portal offers user interface integration. It is not attempting to integrate business processes or applications. This is simply integration at the screen. Portals render content from different underlying systems onto the screen as a set of "portlets" to make it look like it is all one system. Portlets are simply parts of the screen that give the user access to application functionality, business intelligence, collaboration tools, and unstructured content. There can be several portal pages, each consisting of a set of portlets rendering content from different systems. Also, these portal pages can be designed so that they are not only personalized to a role but also task specific (i.e., the portlets on a portal page could, for example, be associated with particular tasks of a business process performed by a person in a specific role. Fig.1. shows screenshots of a personalized role-based sales manager portal with sales BI portlets integrated into the user interface<sup>2</sup>. Furthermore, portals are device independent; thus, they can cope with users accessing business intelligence and other applications on mobile devices.

**Figure. 1.**

**Example of enterprise portal screenshot for Sales Manager**



<sup>2</sup> from SAP NetWeaver Enterprise Portal

In technological sense, BI portal encompasses data warehousing technologies and processes on the back end, and query, reporting, analysis, and information delivery tools and processes on the front end. Data warehouse extracts data from multiple transaction or operational systems and integrates and stores the data in a dedicated database. For example, a data warehouse might match and merge customer records from five operational systems (e.g. orders, service, sales, shipments, and loyalty programs) into a single file. Then, users equipped with analytical tools (e.g. query, reporting, OLAP, and data mining tools) access, analyze and identify trends, patterns, and exceptions. They can then create rules from the trends and patterns they've discovered. These rules can be simple (e.g., "Order 50 new units whenever inventory falls below 25 units.") Or, they can be forecasts or "what if" projections based on past trends and working assumptions. Or the rules can be highly complex, generated by statistical algorithms or models. For example, statistically-generated rules can dynamically configure prices in response to changing market conditions or determine the best cross-sell opportunities using customer response models.

BI applications as a part of an enterprise portal are used from business users to query, report, analyze, mine, visualize, and, most importantly, act on the data in the data warehouse. They can be grouped in five different types of analytical tools<sup>3</sup>:

1. *Enterprise reporting* used to distribute standard operational reports or financial reports to all stakeholders in the organization in the form of printed and Web reports or multi- report scorecards and dashboards;
2. *Cube analysis* is ideal for basic analysis that can be anticipated in advance. It can include OLAP functionality on data subset and so called slice and dice analysis;
3. *Ad Hoc query and analysis* enable investigative analysis of enterprise data, down to the transaction level of detail.
4. *Statistics and data mining* uncover subtle relationships and forecast projections using set theory techniques, statistical and mathematical functions. They can include advanced analysis, hypotheses testing or predictive analysis;
5. Report delivery and alerting engine allows enterprises to distribute vast numbers of reports or messages on a proactive and centralized basis, as well as allowing users to self-subscribe to report distributions.

It is accepted today that every employee of successful organizations analyzes business data to some degree and in some fashion. Their analyses may be deliberate and exploratory, they may be triggered automatically by threshold conditions or they may be even so embedded in everyday systems that their existence as BI per se may not even be recognized.

Integrating BI into portals as an option to create a closed-loop intelligent business environment has strengths and weaknesses. The strengths of this approach are that it is a fast and economical way to deliver personalized role-based BI to a mass user base. In addition, implementing portals with scorecards<sup>4</sup>, dashboards<sup>5</sup> and collaboration tools<sup>6</sup> seems

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<sup>3</sup> from MicroStrategy Inc., vendor white paper, 2003

<sup>4</sup> Scorecard helps teams and tactics of a company with strategy, communicate goals effectively and monitor performance against targets.

<sup>5</sup> Dashboard provides decision makers with practical metrics to characterize and communicate security effectiveness; enables BI and integrate technologies. Different dashboards are personalized and suited for each employee in a company. The dashboard offers instant snapshots of key performance indicators (ex. sales orders, commissions, support cases, accounts receivable).

particularly well suited to executives, managers and power users who need to strategize, evaluate and collaborate before making a decision. The main weakness of this approach is that the user must find the right application, create a report and still has to interpret the complex results before taking any kind of action. Most users find the original query, reporting and analytical tools too complex or time-consuming to use. They spend too much time looking for the right report among hundreds, or get lost in endless series of drill-downs and dimension lists. They think that rather than empower users, BI tools overwhelm them.

The investigation results on concept maps (Cañas, at all, 2001) indicated that the concept map-interface provides a new method for organizing and browsing through applications and information that leads to less frustration and confusion among users. Our hypothesis is that concept maps based BI interface can serve as a common information workers' workspace.

## **Concept Maps**

Concept maps are graphical representations of knowledge that are comprised of concepts and the relationships between them. Concepts can be defined as a perceived regularity in events or objects, or a record of events or objects, designed by a label (Novak & Cañas, 2006). Concept maps are a graphical two-dimensional display of concepts (usually represented within boxes or circles), connected by directed arcs encoding brief relationships between pairs of concepts forming propositions. Each concept map is an original creation, but is embedded in the prior knowledge of the designer. Some relevant characteristics of concept maps (Fig. 2) are described in a few ways: first, general concepts are at the top of the map, and the less general concepts are arranged below; second, inclusion of "cross-links" re-establishes relationships between different domains of knowledge, shown on a single concept map. Concept maps in electronic form provide an understandable representation of an expert's domain knowledge in a browsable, sharable form for all users of one organization.

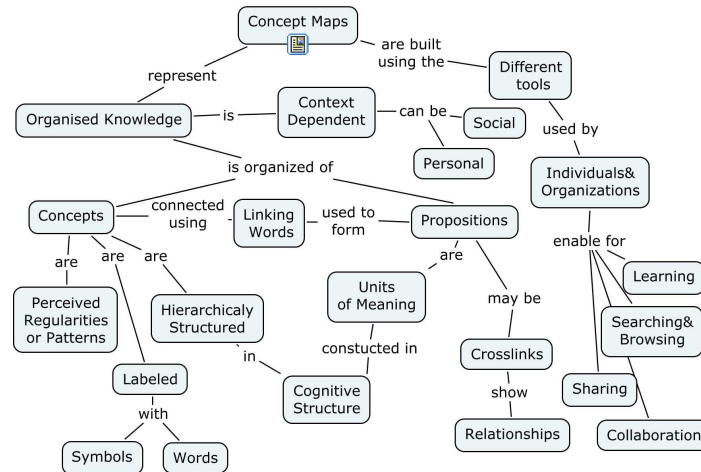
Concept maps have been demonstrated to be an effective means of representing and communicating knowledge and concept mapping has been shown to help learners learn, researchers create new knowledge, administrators to better structure and manage organizations (Novak & Cañas , 2006).

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<sup>6</sup> Collaboration tools represent knowledge management tools which help enterprise users to share ideas, create content and make decisions. They often include: online whiteboards, Web-based file and document sharing, discussion groups and Bulletin Boards, Internet presentations, document collaboration, distance learning, chat and instant messaging.

Figure 2.

### A concept map showing the key features of concept maps



Concept Maps proved efficient for companies in the business area in many different ways. Concept maps facilitate discussions among different groups within a company; creation of collaborative concept maps by experts has been used to preserve organizational knowledge; utilization as a collaborative mapping technique and managerial decision making; concept maps are often profitable as a graphical information visualization and navigation tool. Knowledge of a company can be personalized if it resides on people, or it can be codified through capture and representation in a form that can be shared and so the capture of conceptual knowledge using concept maps provides partial answers to questions of leveraging day-to-day/critical knowledge. They also allow collaboration in problem solving by people from different backgrounds or situations and shorten the time to conceptualize new products and services (Fourie, 2005).

According to the same author, conceptual mapping tools users intend to improve the web interface in an environment where input is received from many different disciplines, often making it difficult to track the mission of the site. The use of concept mapping tools would not only allow collaboration on this mission, but also provide an evolving roadmap for the site. The BI portal is environment such like this. In an organization whose needs for a personalized visualization tool are known, digital interactive concept maps are suggested as visual interfaces for navigating in digital information repositories, organizing and managing information and for providing interactive access.

### BI Portal Using Concept Map

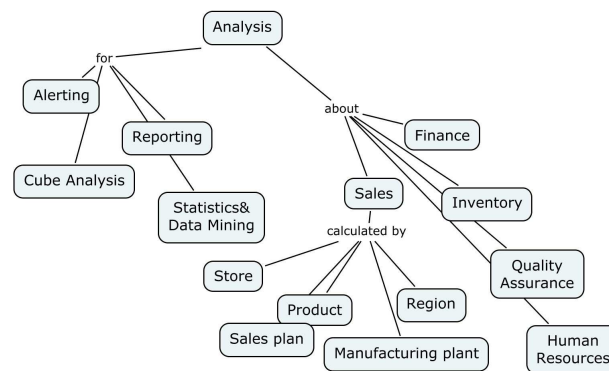
Traditional BI environment involves sorting, summarizing and "drilling down" from summary level to detail level information and "rolling over" in the opposite direction. It involves lots of flexibilities to tailor specific requirement of each user and common ability to access multiple databases. The resulting screenshot is limited to the information in the data mart or data warehouse and defined by the pathways established by the developers, not by the user. With a concept map in BI portal it will be possible to apply a heuristic approach for

tailoring each user according not only to their needs, but according to their previous knowledge and experience. Concept map can mimic the linking metaphor of Web with enabling cross-domain contextual data analysis in which freeing users from static, predetermined or linear paths of analysis. The information and knowledge of users are not limited only to the data within a given report, but to the topics and concepts that are logically related according to their needs. It is an effective way of representing and organizing a person's understanding of a domain knowledge. With use of concept map in BI portal it is possible to track the development of a user's understandings of business situation or to compare different user's concept maps in the collaboration process. It will be very useful for training and education of novices in a specific field. Also information system designers can use user's concept maps as a starting point for user's requirement analysis.

For the purpose of this work we used concept mapping tools CmapTools<sup>7</sup>, which is presently widely used for knowledge modeling. This tool has a number of features intended to support the development and publication of interlinked concepts maps and associated resources. It is easy to link concept maps through simple drag-and-drop operations, to establish links to all types of resources and then publish the resulting map anywhere on the Internet or to export into the portal. We made an example of BI portal screenshots for Sales manager in Fig.3..

Figure 3.

**BI portal screenshots for Sales manager using Cmap tool**



For example, a sales manager could create a summary report that lists the total sales by region, or by office, sales by rep and so forth. He could also submit queries to analyze the data based on any variable within a predefined data set, for example from different department as a Quality assurance, Production Scheduling or Product defect, according to the way the data has been linked. Concepts are linked by user and according to their specific requirement. A concept map in BI portal serves as an individual web page with specific content, contextual explanation and history, created by the user himself. It can be a matter of changes anytime and anywhere without help from an information system specialist. Each concept can have associated different resources as a product of BI web services and from the technical point of view it is feasible to integrate concept mapping tools like every other portlet in BI/enterprise portal (Fig. 4.).

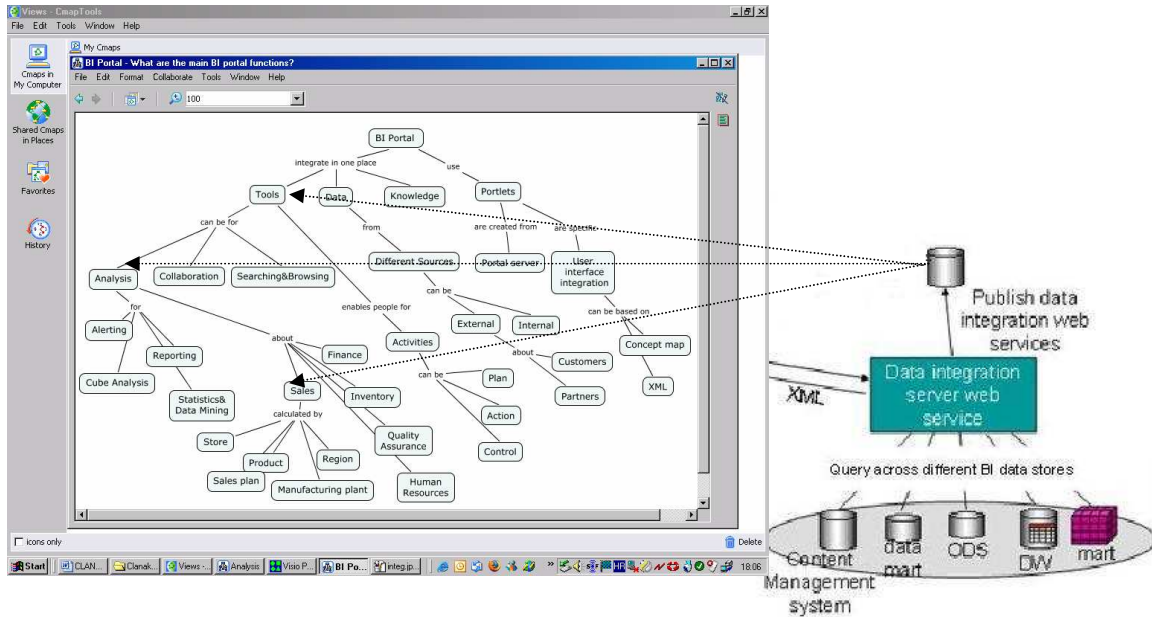
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<sup>7</sup> software available at <http://cmap.ihmc.us/>



Figure 4.

### Solution for concept maps integration into BI platform



Web services supporting concept map tools, make it fairly easy to integrate concept map based BI portals into portal products. Mostly all BI vendors provide services support in their product to allow different objects and tools to be published as web services. In our case, creating user's concept map will look like creating web services interface to integrate data on demand. If BI portal use data from several data marts, databases or data warehouses that need to be integrated, it can be done using data integration tools. Those tools can be called via web services to pass the integrated data back to the requesting portal in XML form. Each data integration query can be a web service such that BI can be presented on demand in different concept maps alongside other content from other systems.

### Conclusion

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The enterprise portal with BI tools is becoming the standard approach for providing users with a role-based workspace for accessing, sharing and communicating about business content. A portal offers user interface integration. It is not attempting to integrate business processes or applications. This is simply integration at the screen. Because these portals could provide "everything that each user in the organization requires", they became too sophisticated, complex and impersonalized. In this situation users need extra effort and time to explain and understand the shown results. The results of different tools application are shown on one screen (statistical, OLAP and Data mining tools). Results are determined by BI system design processes and not made with the goal to facilitate the user's context understandings.

The business uses of concept maps are still very limited when comparing it to the usage in the area of education, learning, knowledge representation, sharing and collaboration.



In this article, we investigate the possibilities of their application into BI portal in order to enable users for the creation of one's own tailored individual workspace. Existing computer-based concept mapping tools like Cmap, can enhance this creation and sharing by overcoming the traditional linear method of content presentation. Concept mapping tools integration to an existing portal solution is possible and realizable with existing technological solutions. We have shown that concept maps can serve as personal tools for creating workspace in an enterprise or BI portal according to each employees needs and tailored to their business situation understandings.

## REFERENCES

Cañas, A.J. (2003): A summary of Literature Pertaining to the Use of Concept Mapping Techniques for Education and Performance Support, The Institute for Human and Machine Cognition, Pensacola, at <http://www.ihmc.us/users/acanas/Publications/ConceptMapLitReview/IHMC%20Literature%20Review%20on%20Concept%20Mapping.pdf>, [Accessed: 23.11.2006.]

Collenen, T. A., Trochim, W.M.K.: Concept Mapping: Merging "art" and "science" in Community Strategic Planning, Cornell University, at <http://www.cardi.cornell.edu/images/CM%20paper%20July2006.pdf>, [Accessed: 07.12.2006.]

Eckerson, W. W. & Howson, C. (2005): Enterprise BI: Strategies and Technologies for Deploying BI on an Enterprise Scale", TDWI Report Series, The Data Warehouse Institute, <http://www.tdwi.org> [Accessed: 20.02.2006.].

Fourie, L. C. H. (2005): Computer-based concept mapping tools in business, at [http://sisc.sdsu.edu/archive2005/Business\\_Intelligence/Fourie.pdf](http://sisc.sdsu.edu/archive2005/Business_Intelligence/Fourie.pdf), [Accessed: 11.12.2006.]

Freeman, L. A. (2004): The power and benefits of concept mapping: measuring use, usefulness, ease of use and satisfaction, University of Michigan, Dearborn, at <http://cmc.ihmc.us/papers/cmc2004-164.pdf>, [Accessed: 27.11.2006.]

Novak, J. D. & Cañas, A.J. (2006), revised version: The Theory Underlying Concept Maps and How to Construct Them, Technical Report IHMC CmapTools 2006-01, Florida Institute for Human and Machine Cognition, 2006, available at: <http://cmap.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>

White, C. (2005): Business Intelligence Network – The Vision for BI and Beyond, at <http://b-eye-network.com>, [Accessed: 24.11.2006.]

Goebel, A. & Ritthaler, D. (2005): *SAP Enterprise Portal: Technology and Programming*, SAP Press.

Tatnall, A. (2005): *Web Portals: The New Gateways to Internet Information and Services*, Idea Group Publishing.

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## PORTAL POSLOVNE INTELIGENCIJE KOJI KORISTI KONCEPTUALNE MAPE

### SAŽETAK

Suvremena okolina poslovne inteligencije organizacije predstavlja šarenilo tehnoloških rješenja koja su iz različitih razloga, akumulirana dugi vremenski period: sustava upravljanja bazama podataka, poslužitelja, aplikacija utemeljenih na različitim bazama podataka i komunikacijskim standardima. Potrebnim sadržajima i aplikacijama korisnici mogu pristupati preko, njihovoj ulozi prilagođenog radnog prostora, odnosno putem integriranog sučelja. Prema njihovom mišljenju, a prema istraživanju Eckerson& Howson, 2005, kreiranje upita, izvješća, kao i uporaba analitičkih alata je komplicirana i vremenski zahtjevna. Korisnik previše vremena provodi u traganju za potrebnim izvješćima ili biva izgubljen u serijama svrdlanja kroz baze i skladišta podataka. Portal poslovne inteligencije im više odmaže nego pomaže u obavljanju svakodnevnih aktivnosti.

Alati konceptualnog mapiranja, kao vizualizacijski alat, omogućuju samostalno, brzo i jednostavno kreiranje individualno skrojenog radnog prostora (sučelja), kao i praćenje načina učenja i izvođenja poslovnih aktivnosti za potrebe razvoja sustava. U radu su istražene mogućnosti primjene konceptualnih mapa kao novog pristupa razvoja portala poslovne inteligencije.

**Ključne riječi:** Portal poslovne inteligencije, konceptualne mape, alati vizualizacije