Data Visualization in Business Intelligence

Abstract: Combining some examples with the recognized purpose of both data visualization and business intelligence the paper tries to emphasize: advantages, lacks, limits, actualities, and potential trends in this field. Most of the figures are the result of practical tests, except the last one which is a theoretical abstraction. The approach is somehow between descriptive and critical.

Key-Words: business reports, OLAP, metrics, data mining visualizations, 3D representations

1 Introduction

Technically speaking business intelligence [1] is a broad category of applications and technologies for gathering, storing, analyzing, and providing access to data to help clients make better business decisions.

The recognized functions of business intelligence technologies are: reporting, online analytical processing, analytics, data mining, business performance management, benchmarking, text mining, and predictive analytics.

Using illustration and graphic design tools, data can be visualized using static graphical content, animated movies and 3D models, and interactive visualization tools and presentations can be commissioned for web hosting or event displays [2]. Drawings of business processes, locations or trends can also be produced to illustrate concepts and enhance the presentation of information.

According to Friedman [3] the main purpose of data visualization is to communicate information clearly and effectively through graphical means. But that doesn't mean that data visualization needs to look boring to be functional or extremely sophisticated to look beautiful. The idea is to create both aesthetic and functional data visualizations in order to provide insights and intuitive ways of perceiving complex data.

2 Traditional visualizations in Business Intelligence and their limitations

First of all there is a constant need to make useful business reports usually based on reports templates that are created/defined for end-user use, best known as "point 'n click" reporting. These templates determine what fields are included in the report, the types of prompts users receive, and the look and feel of the report (see figure 1).

Many such templates are made with instruments that allow the exportation of reports in different other formats (rtf, html, xml, pdf).

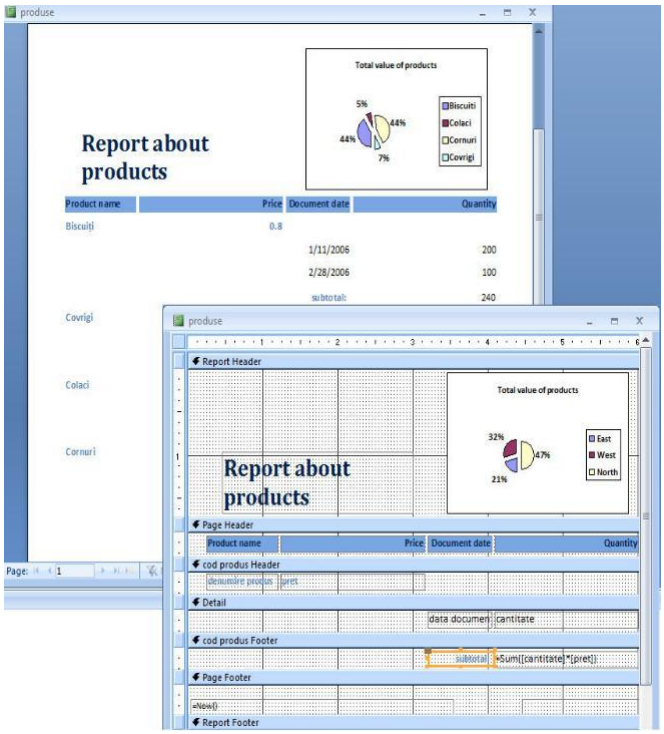

Fig. 1 Combined Access report (graphs and tabular data) exportable in various formats

In addition, data visualization in business intelligence means a lot of ad-hoc reports based-on OLAP (Online Analytical Processing) - a category of database software which provides an interface such that users can quickly and interactively examine the results in various dimensions of the data (see figure 2 - product and locations dimensions). OLAP primarily involves aggregating large amounts of diverse data, in fact millions of data items with complex relationships. Its

objective is to analyze these relationships and look for patterns, trends, and exceptions. A cube (hypercube) defined by its measures and dimensions [4] is in fact an OLAP tool [5].

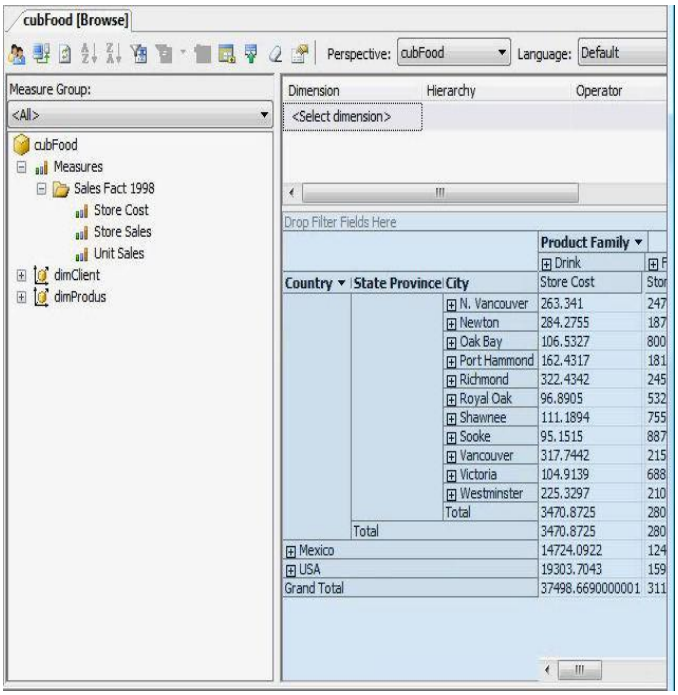

Fig. 2 OLAP cube browsing - SQL Server Business Intelligence Development Studio (BIDS)

Another case of ad-hoc visualization is that of the reports that use business metrics. These are measurements used to gauge some quantifiable components of a company's performance (see figure 3), such as return on investment, employee and student counts, revenues and expenses, etc.

	Nc	S1	S2	Growth (%)	Growth
3	1	80	85	6,25%	5
4	2	82	87	6,10%	5
5	3	35	45	28,57%	10
6	4	56	75	33,93%	19
7	5	23	34	47,83%	11
8	6	25	25	0,00%	0
9	7	90	97	7,78%	7
10	8	98	99	1,02%	1
11	9	13	14	7,69%	1
12	10	45	50	11,11%	5
13	11	24	23,5	-2,08%	-0,5
14	12	23,6	20	-15,25%	-3,6

Fig. 3 Microsoft Excel 2007 dashboard with business metrics

Moreover, data mining, also known as KDD (Knowledge Discovery in Databases) which is an important branch of business intelligence applications responsible with predictions and data pattern recognition, involve the use of trees, clusters, association rules etc., with their corresponding representations (see figure 4).

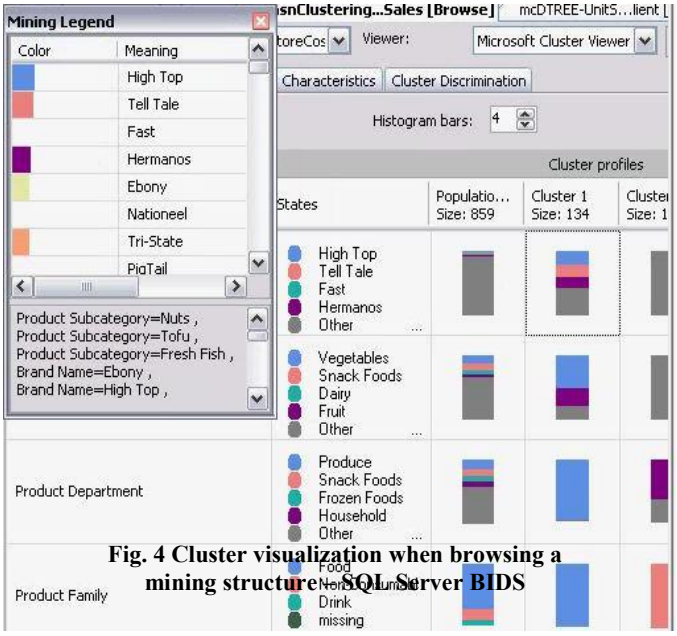

Fig. 4 Cluster visualization when browsing a mining structure in SQL Server BIDS

Beyond these forms, nowadays many graphical representations of business data have a three-dimensional orientation (see figure 5). In fact this is due to the need of easily comparing not only numerical values among them but entire series.

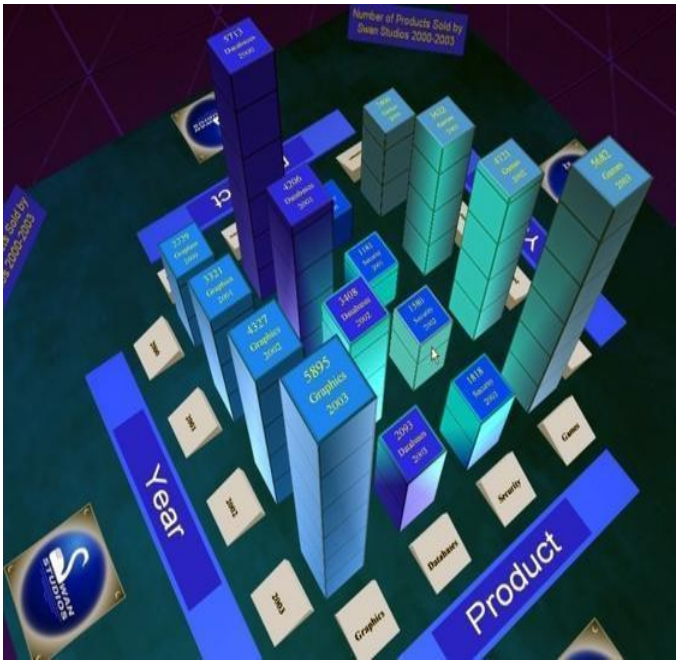

Fig. 5 Simultaneous 3D visualization of many data series [6]

Visualizations like that above are now easy to make with spreadsheet software products. As example, Excel 2003 and 2007 offer this possibility the last one also being able to preview the 3D result (see figure 6).

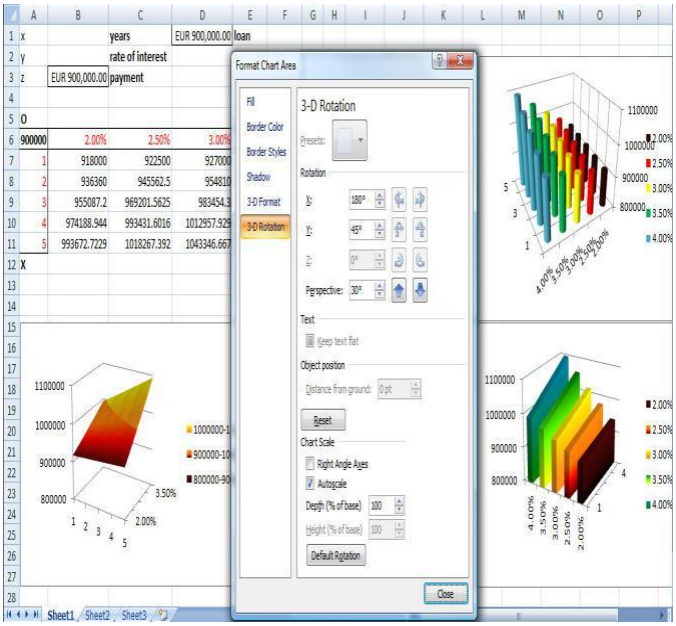

Fig. 6 Mixed 3D data visualization with Excel 2007 based on simulation and preview

Most of the 2D graphical representations used today in business intelligence applications have a geographical dimension. In this case we are dealing with maps - cartograms (see figure 7A) and cartodiagrams (figure 7B).

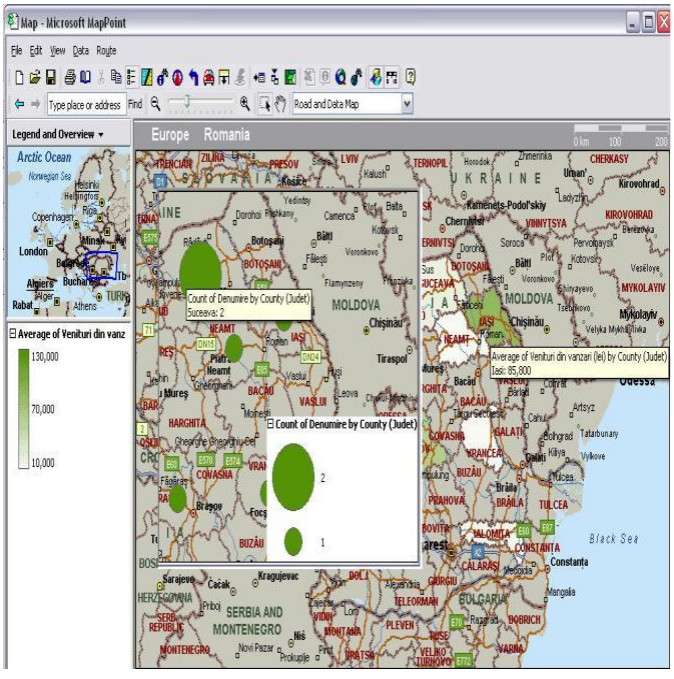

Fig. 7A 2D data visualization with MapPoint 2009 – cartograms with intensity and volume representation on counties

Fig. 7B 2D data visualization with MapPoint 2009 – cartodiagram with structure representation on counties

There are even 3D forms of those maps intended to show the spatial distribution on Earth for any phenomenon and for any associated indicator (see figure 8).

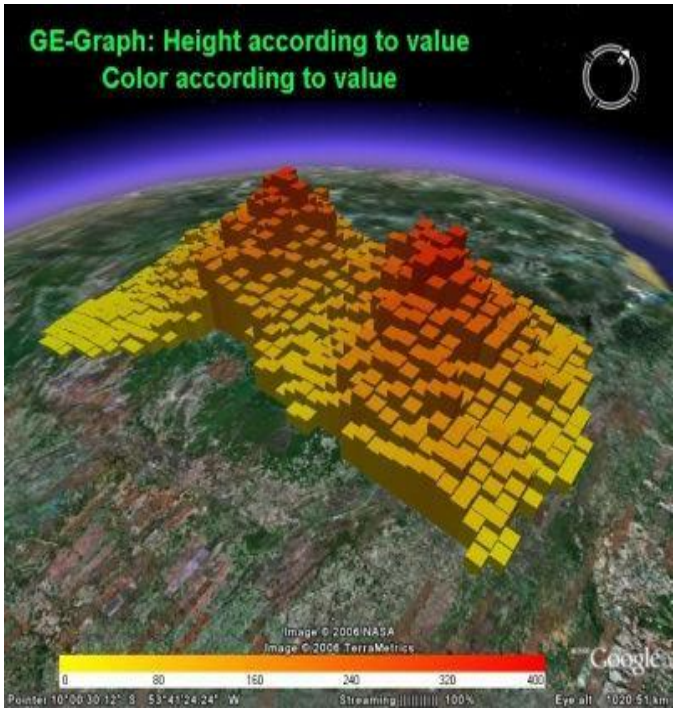

Fig. 8 3D bar data visualization with geo-mapping [7]

Every data visualization example mentioned above is currently used by most of the software developers of business intelligence solutions. The main problem is still the limited interface or the fact that one perspective (the third one) continues to remain insufficiently exploited by those products.

3 Solutions in further developments

There are a lot of possible solutions for the dimensional representation problem starting even with the realistic stereoscopic user interface [8] (see figure 9).

Fig. 9 Stereoscopic user interface (Avatar 3D movie) [9]

Another one (see figure 10) could be the extended desktop technique (physical and artificial solution) using many monitors plugged into the same graphical adaptor.

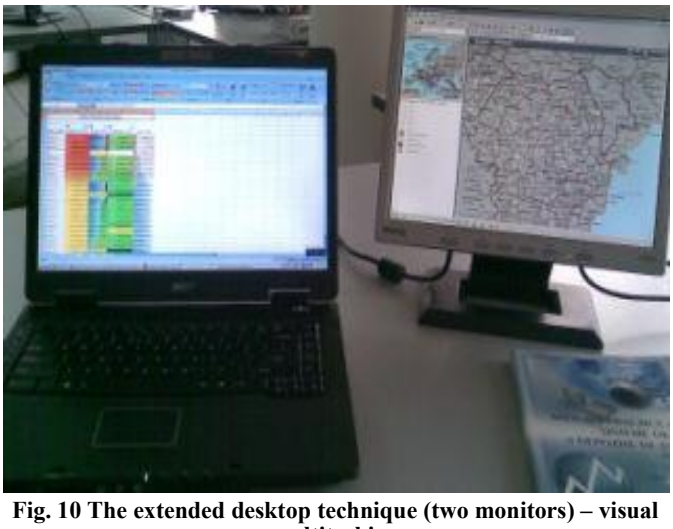

Fig. 10 The extended desktop technique (two monitors) – visual multitasking

Another solution could be a software product inspired by some 3D desktop techniques: switching planes (similar to Windows Vista Aero), rotary cubes and planes within a cube (see figure 11).

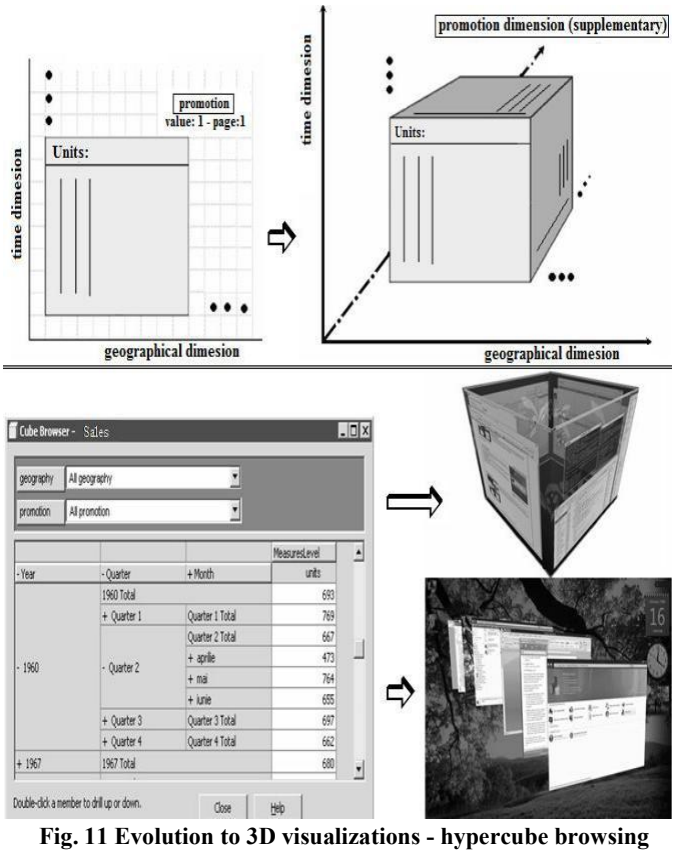

Fig. 11 Evolution to 3D visualizations - hypercube browsing

In the example above the gain could be the possibility to navigate (drill-down, roll-up, pivot operations) thru the "real" data cube using a browsing interface that exploits the all three spatial dimensions.

4 Conclusions

There are many ways to conceive business graphics and data visualizations for business intelligence. The point is not to confound between these two categories because the last one is much more concerned about insights and consequently its techniques and instruments are more sophisticated and up-to-date.