The Mobile Business Intelligence Challenge

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While data creation, production, storage and availability have increased, everyone's ability to make sense out of that data has obviously decreased. That is why many enterprises are dealing with many difficulties when trying to consolidate decision-making data from multiple sources. That explains the born of Business Intelligence (BI). Although relatively new as concept, nowadays BI has got a great advance mainly because of the latest technologies which offer the power to pull-out the specific knowledge hide into the business environment. But beyond technology this advance resides in BI extensions due to its growing usage area. Such an extension is the Mobile BI that becomes more and more important as today businesses are often relying on Internet and mobile technologies for daily operations and not only. In fact, the boom in mobile business may be a real advantage when properly transmitted and absorbed by data warehousing and BI solutions that provide at least report and analyze support.
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1 Introduction

Many organizations are using computer based data management and analysis tools to reveal trends and patterns that would otherwise remain buried in their huge operational databases environment [1]. So, the need for a new generation of computational theories and tools to assist humans in extracting useful information from the rapidly growing volumes of digital data becomes pretty intense [2]. Such theories and tools are the subject of the emerging field of Knowledge Discovery in Databases (KDD) [3], part of the large field of Business Intelligence.

Moreover the mobile access to business data tends to become a rule rather than an exception. The idea of convergence between Business Intelligence (BI) and mobility is obvious within this context when more and more professionals start using smart phones and other mobile devices to keep up to date with business information [4].

As a segment of those professional contributing to the increase of need and demand for Mobile Business Intelligence (MBI), the executive management stuff are also adapting especially thru not being limited to their desks and office-based PCs. Together with the ubiquitous remote access, this reason makes the traditional executive workspace obsolete – now the whole world tends to becomes an office [5].

For example, retailers need to instantly access details about sales even when visiting stores in their territories. They also need to have access to Key Performance Indicators (KPIs) - comparing actual sales to their goals and plans, breaking down sales by product category, or monitoring the sales of add-on products and services. They can use remarkably light laptop computers still heavier than smart-phones and requiring mobile broadband service / Wi-Fi hotspots [6] to connect to the enterprise or smart-phones that let them connect instantly from anywhere, get critical information and take action immediately. Then, when they leave one store to go to the next, there's nothing left to finalize and no extra effort or data entry to worry about [7].

Beyond the access to many collections of KPIs about corporate performance regardless of geographic location, time of day, and content delivery platform, the big advantages of the MBI are the business agility, the

possibility to make dynamic and quality decisions based on real-time data [8] and the promised standardization. In fact as standardization has emerged and performance gaps have stabilized, the ease of use of mobile BI applications has increased in parallel, reducing learning curves for the executive audience of mobile BI devices. For power-users, reports have become customizable on all types of mobile devices. Now BI data can be consumed anywhere in the world on any wireless-enabled device including [5]:

- Cell phones
- Blackberry's
- I-Phones
- Various types of PDAs
- Pocket PCs.

2 MBI – Why and how?

The use of mobile technology in BI is not new. Since a few years ago there were BI results sent out to pagers, cell phones and PDAs, but they did not fit very well in BI environments because of:

▪ The broadcasting moment - established on schedule / trigger basis but not under any control of the recipient;

▪ The limited amount of sent data;

▪ The impossibility to do any kind of analysis (at least query if not drill up/down/around).

But many difficulties have been over passed, so, in order to complete the responses to the "Why?" question, apparently there are some more arguments:

- The remote devices overcame the limited bandwidth problem and many technical incompatibilities;

- The standardization and seamless integration of what were once disparate protocols, languages and hardware/infrastructure constraints [5];

- The mobile devices are a part of day-to-day life;

- The BI vendors deliver more sophisticated applications on smaller devices;

- The executives need to respond to critical issues faster [9];

- The possibilities for on-line, real-time decision support are now much broader than they were in 1982 and 2002 and the systems will certainly be more powerful, although the concept hasn't changed (Power) [10].

Nowadays the practical scope of MBI usually refers to three distinct usage models (Table 1.):

▪ Exceptions & alerts;
▪ Push reporting;
▪ Pull reporting.

Table 1. The MBI usage models [25]

Exceptions & Alerts	Some proactive alerts about events that fall outside predefined norms are received by users. As example, a purchasing agent could be alerted when the inventory of a critical part fell to a level that threatened to interrupt the assembly line; a sales executive would be alerted about a delayed shipment, so he or she could intervene to expedite the process or proactively contact the customer about the delay.
Push Reporting	Some role specific predefined reports, such as key performance indicators (KPIs), are pushed to executives (regardless of their location or their device) on a regular schedule. As example, each Friday afternoon, a report on the week's sales could be distributed to sales and marketing executives, while the chief financial officer might receive a report on critical financial metrics.
Pull Reporting	Workers specify the information they want, using what input method is appropriate for the available device. The user could access almost any type of information available from a centralized server-based system. As example, a salesman could ask the application to identify the current top 10 customers, or to provide detailed background about a specific client. The model supports advanced data visualization with interactive charts, graphs, and maps.

In fact, many MBI applications developers have learned that in a changing world not so many users can easily and precisely identify what data they will need and when. So the developers have created many set of key performance indicators and various types of reports, dashboards, tables, or charts for the wireless devices and for their small screens. Consequently, nowadays the business intelligence applications running on mobile devices use different kinds of dashboards usually depending on the provider.

As a general structure (Fig. 1.) of such dashboards we must mention: tables, metrics, alerts, trend graphs, charts and even mini-maps. Their main feature is the dynamics – they support some operations well-known in OLAP applications as drill-down or roll-up.

Fig. 1. Mobile dashboard components [26]

Compared to the general structure above, a dashboard used on a device at the border between a smart-phone and a laptop (IPad –

Fig. 2.) fits well the pattern (apparently there are only differences in size and resolution).

Fig. 2. Example of IPad BI data visualizations – Apple [27]

Another obvious difference between proprietary types of MBI dashboards is about how they combine different kinds of components on a single screen (for example table and alerts – center of the Fig. 3., or trends and alerts – bottom-left of the Fig. 4.).
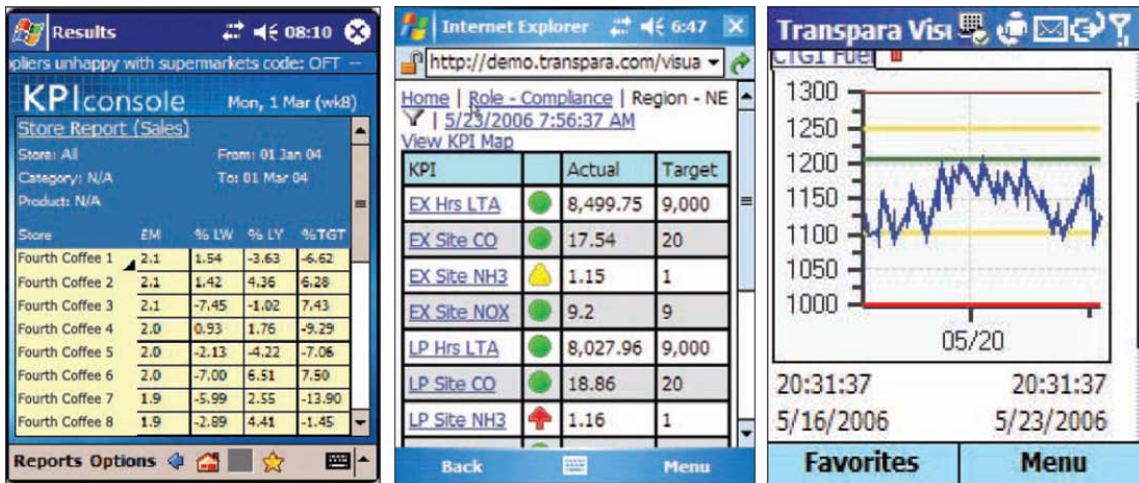

Fig. 3. Mobile interface with tables, KPIs and graphs – Windows Mobile [28]

Fig. 4. Mobile interface with ad-hoc graphs, KPIs and reports – AT&T [29]

3 Limitations, advantages and trends

Many limitations of the MBI applications are related to the physical features of the mobile devices and also to the architecture of the mobile operating systems (MOS) they are running on.
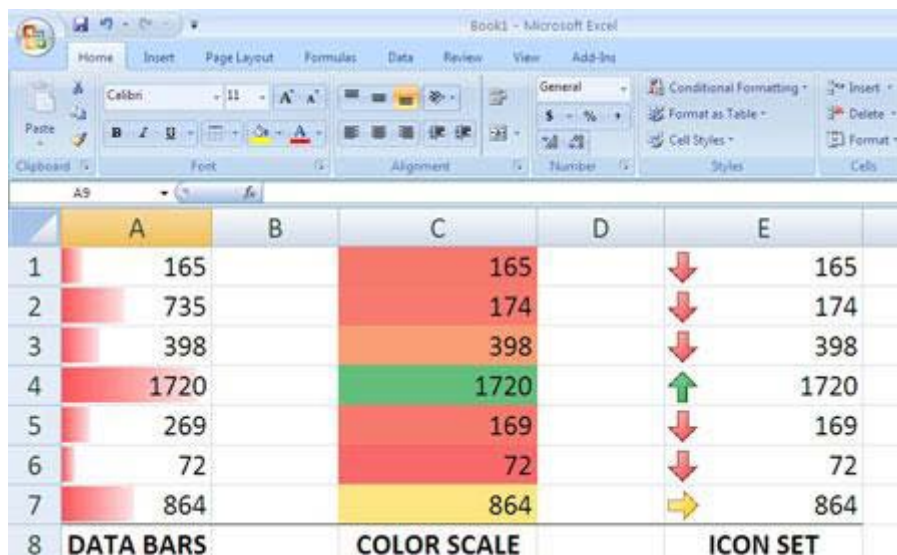
The first important problem is due to some technical futures as:

- Poor resolution (maximum 800x480 points);
- Tiny screens – no more than 3.7 [11] or maximum 4 [12] inches screen (diagonal distance) which makes impossible to follow some accurate graphical details in complex graphs and maps;
- Low memory (256 to 512 MB of RAM) and low memory burst rates (flash cards or solid state disks);
- Low processing power (maximum 1 GHz [13] ARM CPUs - the fastest mobile CPU, ARM Cortex-A8, is by far overtaken by the slowest X86 CPU, Intel Atom N330) [14].

Another problem is caused by the input devices, the poor editing facilities and also by their effect on the user interface (UI). In fact, nowadays many mobile devices have a tiny and hardly functional physical keyboard or, if not, at least a virtual one. Anyway the mobile operating system (OS) provides this function but when editing the rest of the UI is blocked or somehow drawback and that induce gaps in the whole application behavior (for example when editing a parameter needed to customize an ad-hoc report).

Some other serious limitations are caused by the mobile operation systems and by their lack of compatibility with traditional ones used by personal computers [15], often because of commercial reasons [16]. Their common points are limited to some operations with office, graphical, video and audio files and also to web browsing. Although most office files are compatible from one platform (PC OS) to the other (MOS), there are also incompatibilities. For example, some Excel 2007 sheets conceived as Business Intelligence reports [17], [18] are not completely readable even on the newest Microsoft mobile platforms [19] (Fig. 5.).

Fig. 5. Excel BI report unreadable on most mobile platforms [30]

In addition, the multitude of mobile browsers (Internet Explorer, Opera, Safari, etc.) and their lacks about flash support [20], configuring, plug-ins and codec's makes it very difficult to manage the web browsing. It is also true that mobile CPUs tend to invade the PC market - especially netbooks [21]. Thus we explain the effort to adapt of some PC OS (e.g. Ubuntu) to the mobile CPU architecture (Sharp Netwalker Z1) [22].

Another problem is related to the poor visual multitasking of most mobile operation

systems and that could badly affect the ease of use of many applications running simultaneously. Moreover those applications are not as maneuverable as the traditional ones (windowed) that we are so used to.

Of real concern are also the security issues and the difficulty to maintain, back-up and restore a mobile OS. In addition, the wireless networks are easy to be sniffed from outside and they require encrypted data and additional service provided by typical wireless servers.

All these complicate too much the idea of having a reliable ultra mobile system useful to remotely connect in order to input data, find-out critical information, take real-time decisions and communicate them.

On the other hand, powered by the constantly increasing amounts of RAM, the in-memory databases are promising a lot although this technology is at the very starting point. The secret is to store information in the main memory of the system instead of on disk. That provides a performance boost and leads to completely new applications in areas such as predictive analytics, users being able to conduct multi-step queries in less than one second [23]. So it is very likely that the in-memory computing will be exploited by the mobile applications. Although the in-memory technology limits the number of megabytes that a mobile device can store, it also can support a much higher compression rate than relational technologies, thus creating exciting possibilities for mobile BI. Effective data compression results in a smaller footprint for both online and offline viewing and usage of data [5].

In addition, the performance of wireless networks has improved as these networks have expanded into the most remote corners of the earth.

Some other factors [24] that could induce limits and advantages refer to cultural aspects, geographic aspects, political and regulatory aspects, pricing factors for Internet access, and the penetration rate of the wired Internet within different countries.

4 Conclusions

The Mobile Business Intelligence approach is just another way of sustaining the competitive advantage. But it might generate an obvious difference between two high-rated competitors within an environment with equal access to capital, technology, market research, customer data and distribution facilities because of the people behavior and above all because of the quality and speed of the decisions they make. Moreover, the integration of all data channels can offer a broader analytical perspective on the business for any such competitor.

Despite of all the optimistic arguments concerning the Mobile Business Intelligence field the reality is somehow different because there are still barriers to overcome and challenges to respond to.

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