

Making Businesses Work Smarter with Mobile Business Intelligence

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Abstract—Through the course of this paper we outline how mobile Business Intelligence (m-BI) can help businesses to work smarter and to improve their agility. When we analyze the industry from the usage perspective or how interaction with the enterprise BI system happens via mobile devices, we may easily understand that there are two major types of mobile BI: passive and active. Active mobile BI gives provisions for users to interact with the BI systems on-the-fly. Active mobile business intelligence often works as a combination of both “push and pull” techniques. Some mistakes were done in the up-to-day progress of mobile technologies and mobile BI, as well as some problems that still have to be resolved. We discussed in the paper rather broadly.

Keywords—Business intelligence, mobile business intelligence, business agility, mobile technologies, optimization

I. INTRODUCTION

MOBILE business intelligence (m-BI) is one of the emerging trends in business intelligence (BI) today. Though the concept of mobile computing has been around for at least a decade, mobile BI picked up only recently.

The shift from a wired world of connectivity to a wireless world of connectivity [1] with the advantage of smart phones and handheld devices has lead to a new era of mobile computing, especially in the field of BI. From a BI perspective, the combination of real-time data integration techniques and the demand from mobile workforce for up to date information creates a necessity for m-BI. Some industries are ahead of others in terms of their mobile BI requirements. Retail, financial institutional, health care and manufacturing industries are willing to push the edge of mobile technologies and BI to give their mobile workforce access to critical data. Companies with a high number of mobile sales and service personnel are also embracing this technology [2].

II. BASIC FEATURES OF MOBILE BUSINESS INTELLIGENCE

The concept of mobile business intelligence is not new. It is as old as BI itself. The morphology of m-BI has evolved over the last couple of years, however.

A. Types of Mobile Business Intelligence

When we analyze the industry from the usage perspective or how interaction with the enterprise BI system happens via mobile devices, we may easily understand that there are two major types of mobile BI: passive and active.

Passive mobile BI has been around for quite a while, in the corner of a few key performance indicators (KPIs) and reports pushed into the users’ mobile devices. Basically, passive mobile BI revolves around a “push” technique. When we look closely, passive m-BI can also be divided into two parts:

- Event-based alerts sent to mobile devices and
- Reports pushed to a mobile device after being refreshed

Though passive m-BI was a great step ahead from the wired world, it was not enough to support the real-time analytical requirements that the users run into.

For example, a sales representative in the field who is able to look at the latest price offered for a service in a specific area will not be able to efficiently sort through information for different customers of similar kinds to arrive at a competitive price for the new customer he is meeting in golf course. Work around for that would be to have all similar reports in his device, which is cluttering of information without knowing the real-time need of the representative.

Though passive m-BI does not help here completely, it will be helpful for users that need to receive just an alert when there is an exceptional event. Active m-BI, on other hand, gives provisions for users to interact with the BI systems on-the-fly. Active mobile business intelligence often works as a combination of both “push and pull” techniques. An initial view of a report could be push and further analytical operations on the report could be pull to get any additional required information.

B. Users of Mobile Business Intelligence

Users of mobile intelligence can be classified into four different categories [3]:

Executives – These users need to know a few high-risk KPIs at the right time, no matter where they are. A business case for this could be a sudden fall in sales or inventory levels brought to the attention of the respective director.

Field workers – These users work in the field and need specific information at specific times. A sales representative, while finding an unexpected opportunity, can browse for required historic information, price negotiation, contract tenure, etc. to give immediate feed-back to the customer.

Business analysts – The users of this segment will need a few strategic KPIs in addition to static reports for analysis. The business cases could be minimal for business analysts, as their job will be mostly strategic. However, growing demand to be mobile in general provides a space for business analysts as users for mobile BI.

Clerical staff – The users of this kind will occasionally need reports while they are on the move. For this group, it is not critical to be users of m-BI. However, it can be a nice feature for them.

Passive mobile BI only caters to clerical staff. Active mobile BI is required for executives, field workers and business analysts. Future enterprises across different industries will need to have active m-BI to be competitive.

From a user perspective, mobile BI will span three distinct usage models:

- Exception-based, in which workers receive alerts that fall outside predefined norms;
- Pushed information, such as reports or summaries of KPIs that are distributed to mobile workers on a scheduled or as-needed basis; and
- Pulled information, in which mobile workers specify the information they need via structured query or natural-language processing, and the information is delivered in the appropriate

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form to the user's device.

The exception-based and pushed information belong to passive mobile business intelligence, and the pulled information belongs to active mobile business intelligence.

C. Degree of Readiness for Mobile Business Intelligence

Before an enterprise decides to enable m-BI as part of the IT solution, a few factors need to be evaluated to ensure success:

- Business intelligence maturity – The enterprise needs to have a working business intelligence solution in place. This can be evaluated by the data quality, number of active users, etc.
- Need for mobility – This can be measured by the strength of the mobile workforce and the criticality of on-the-field analytical/operational requirements [4].
- Cost of handsets – This might reduce the Return on Investment (ROI) of the m-BI solution if the user base is too large. In order to support a few specific standard operating systems and mobile clients, an enterprise may be forced to supply mobile devices to its employees that are m-BI users
- Cost of mobile client – This might reduce the ROI of a m-BI solution, if the users are on varied types of mobile devices on different operating systems. It could impact when the user base needs a number of different mobile clients for the same application to work on different mobile devices.
- Cost of the solution and availability of sponsors – Mobile business intelligence itself may be rather expensive. Sponsors may be helpful to make even the expensive solution acceptable for the enterprise.

ROI needs to be convincing on top of the previously described factors. Medium and large enterprises with a convincing ROI can target m-BI, based on the analytical and operational needs in the field. Passive m-BI could be less expensive for small enterprises.

III. THE ARCHITECTURAL FRAMEWORK FOR MOBILE BUSINESS INTELLIGENCE DELIVERY

Mobile BI can be client/server architecture with a high level of interactivity as shown in Fig. 1.

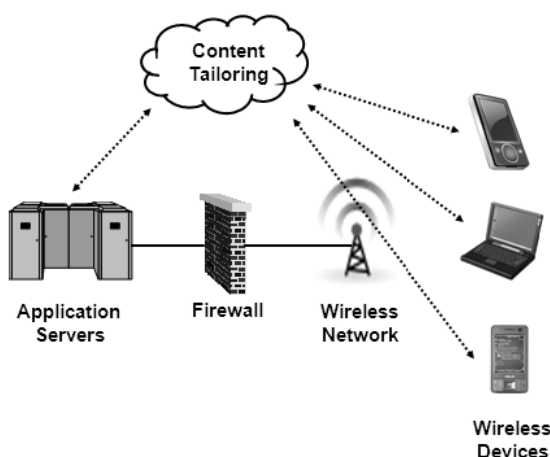


Fig. 1 Mobile BI client/server architecture

A mobile device communicates with an application server using a wireless network offered by mobile service provider via secured network. Users can work with data and applications both online and offline from application servers.

Data components can be stored on mobile devices to allow users to work independently, despite connectivity and bandwidth issues. Content tailoring layers in m-BI architecture can be identified either on the server side or on the client side. Tailoring demands the content to be modified for the small screens of handheld devices.

In the market, there are a few service providers that attempt a middleware type of content tailoring layer that can work on a screen at the server end and suit any small screen. This is more of an attempt to make the mobile clients light, so that the middleware takes care of massaging the contents to suit the screen. However, as of now, the market has witnessed only client-based content tailoring solutions.

Users can get live alerts on business-critical KPIs. Client-based applications have more access to the peripherals, allowing more elaborate functionality, storage access, multimedia display, etc. Some of the merits of this architecture are [5]:

- Rich presentation made for mobile devices;
- Push strategy, key performance metrics or competitive intelligence pushed to end-user devices;
- Offline data storage and analysis for at least a minimal volume of data to work through connectivity and bandwidth issues; and
- Exception-based live alerts about events that fall outside predefined norms.

The architectural frameworks of the most popular BI platforms are now robust enough to support the information needs of mobile users. Advances in mobile devices are also making it common for them to handle more than just the most basic data delivery.

IV. MISTAKES AND PROBLEMS CONCERNING MOBILE BUSINESS INTELLIGENCE

The important thing to remember when trying to implement mobile BI is, simply put, that mobile business intelligence is not just a mobile version of traditional BI. Generally, the common mistake is to overlook the unique considerations required for implementation.

From this common deceit several more particular mistakes may result. A brief explanation follows.

A. Assuming Mobile BI Implementation Is a Project

The nature of a mobile BI engagement is more like a program rather than a project [6]. It is a fact that mobile BI is an extension of enterprise BI. However, mobile BI should be focused on delivering measurable business value rather than just meeting scheduled objectives. In mobile BI engagements, it's more important to derive effectiveness.

For a traditional BI implementation, it is important whether the planned activities were completed within the time and budget allotted; however, for mobile BI it is more important to measure how particular information, when made available through mobile apps, can make a difference to the decision makers/users.

For execution purposes, the requirements-gathering for mobile BI should be focused on identifying which reports, dashboards and alerts will be beneficial on handsets. The emphasis is on the value of the data with respect to time rather than look and feel of the reports/dashboards itself.

B. Underestimating Mobile BI Security Concerns

The top concern in mobile BI adoption is security, and if not designed correctly, it really can be an issue. It is the most discussed aspect in the mobile BI world today and has a very direct impact on the rate of adoption.

Security for any application beyond the enterprise firewall has always been a debate. However, the interesting fact about mobile BI security is that, when designed optimally, it can leverage more security layers and features than traditional BI applications:

- Device level security – The handset/device security features should be utilized to protect the data, including features like full-disk encryption, the ability to remotely wipe content on the device, and antivirus and firewall software.
- Transmission level security – The security features of cryptographic shared key systems, secure socket layers and virtual private networks (VPNs) all ensure that the data can be secured at the network layer.
- Application/network level security – The authorizations and authentications can be enforced on the applications at the infrastructure front. Most BI tools extend the same security model to mobile BI that they have designed for their native BI applications. On top of the network, policies can be enforced the same way it is done for the enterprise.

C. Rolling Out Mobile BI for All Users

Mobile BI applications should not be put in the same category as management BI reporting applications. The purpose and use of mobile BI applications are very specific and different than managerial business intelligence applications. The most important factor is to understand who will need information at all times and what decisions will be impacted by having or not having the information always accessible.

Are these users always mobile and have only a limited amount of time to access the data, or do they have a role where they do not need to frequently check the data? Define the user group(s) and design the mobile BI app based on these role definitions.

Typical candidates for the application are users responsible for mission-critical environments, such as a data center hosting payment servers for banks, or to solve real-time problems as they arise, like power station operations. Mobile BI investment will be justified only when users and usage are understood and aligned realistically.

D. Believing Mobile BI ROI Cannot Be Derived

Every investment has a justification, and a business sponsor will definitely demand one. Whenever there is cost involved, there will be a means to track it and determine the

return on investment (ROI). It might be challenging in mobile BI initiatives, but quantifying the business benefits can be done.

When deriving ROI following key aspects should be considered [7]:

- Benefits associated with mobile BI – The initiative should be focused on whether m-BI will increase productivity, shorten sales cycles and lower overall business costs.
- Investment associated with mobile BI – The initiative should determine the costs of buying devices (handsets, iPads, etc.) or investing in infrastructure (hardware, software, maintenance, service and training).

When this is done, the ROI can be calculated using the defined tangible and intangible metrics.

E. Implementing Mobile BI Only for Operational Data

The mobile BI application can be pushed to accommodate all reports and/or dashboards available in a traditional BI environment, but that will defeat the purpose of having an initiative like mobile BI. A categorization of the good-fit data has to be done with each initiative.

This is important because the question of “which data is good for which enterprise?” is very subjective, and only respective business users can answer this. For example, a workflow approval might be critical in one environment, whereas having current currency rates handy at all times might be critical for a different user.

Operational data is definitely a strong contender for m-BI. It is justified because most operational data is time bound, and, especially within regulated environments, an enterprise might end up paying expensive fines for having missed critical information and reacting late to an event. Extending workflows to mobile devices might also speed up process efficiency by itself.

However, it's also true that mobile BI is not limited to operational data alone. The features offered by mobile tools, such as alerts, filters, the ability to drill for additional information, etc., enable analytical data to be extended to mobile devices.

The best scenario is the ability to demonstrate tangible analytics to a prospective customer and close the deal on the spot. That may be viewed as a Win-Win situation for having mobile analytics [8].

It is quite possible to track a trend through KPIs, and specific trends that can be useful on mobile devices include indicators of a situation getting better or worse, a scorecard value, the current value of a key metric, etc. Also, analytics for pricing and inventory will be good candidates for mobile to enable instant, informed decisions.

The proper data has to be identified for the best fit for mobile BI to cater to the right users. The data selection in mobile BI is a much more serious affair than in traditional BI, because the user community for mobile BI is small but has a great need to make decisions based on timely, available information.

F. Assuming m-BI Is Appropriate for All Kinds of Data

Mobile BI should be more focused on the near-term data rather than future-planning data. "Should I be opening a new store in a particular location next year?" is not the right kind of data to analyze with mobile BI.

It is more useful to analyze something like, "Should I order a particular inventory immediately?" This near-term information will help bottom-line sales figures. All data mining activities should be kept away from mobile, as it is not a good fit.

Not all data is useful in handsets, and identifying which data is suitable for mobile BI should be done very carefully. If the data categorization selected is not appropriate, no matter what technology and skills you engage, it's going to be a failure. Having extra information on the move will help users make better decisions.

Suitable data for mobile BI allows the user to:

- Answer critical questions;
- Take quick actions, like approving or passing on the information/alert to someone who will take immediate action on the event;
- Close the sale with all information handy (like rates, offers, etc.); and
- See mission-critical data where key metrics are tracked every few minutes.

Situations that require examining pages of documents or understanding a complex diagram are not optimal for mobile.

Similarly, reports that are detailed and generated only on a periodic basis are definitely not candidates for mobile. It is not that they cannot be put on mobile, but the usability and benefit behind making them mobile will not be worth the investment of time and money.

G. Designing Mobile BI Similar to Traditional BI design

A different focus is required for designing mobile BI applications. Mobile BI design has special considerations when compared to BI report and dashboard design.

Technically, everything available in enterprise BI can be extended to mobile. However, the design varies when it comes to formatting and fitting it on the small screens.

For example, the design changes you would make for an iPad or other tablet will be different from the design considerations for mobile phone like iPhone or BlackBerry. The dashboard design best practice for mobile BI is clean and uncluttered presentation. Limit the objects to be placed on dashboards.

Furthermore, the design for mobile should take care of the categorization of which reports and dashboards are suitable for small screens to navigate, from a size perspective and ultimately from a usability perspective. As a mobile BI application, the expectation is to have all capabilities that a BI has, such as drill-through, drill up/down, filter, rank, etc.

The size of the handset and the little key strokes in it might increase complexity and reduce ease of use if not carefully designed.

H. Assuming that BI Is the Only Data Source for m-BI

While focusing on designing the mobile BI applications, a special focus should be to analyze the kind of data being brought to mobile. Mobile BI should not be treated as just an interface for accessing traditional business intelligence. One should be able to clearly identify specific questions that the data is going to answer when extended to mobile.

All the data sources that cater to traditional BI can be utilized in mobile BI, including databases, enterprise resource planning (ERP), Web services, spreadsheets, etc. [9] The design should be robust enough for a presentable and stable form on the device.

Apart from this, mobile BI is a program, and one should always hunt for those nontraditional information sources which, when integrated to the mobile platform, will increase the clarity of the decisions.

The combination of multiple data sources will produce the best real-time results. Change is the only constant, and mobile BI apps should be designed and built with scalability in mind as a priority.

I. Believing m-BI Implementation Is a One-Time Activity

Mobile BI is extremely dynamic in its nature and is heavily dependent on what information has priority at what time and who the users are. This might change from time to time. Hence, a word of caution: It is not wise for mobile BI implementers to tie the implementation strategy to a specific technology or platform. It might not always be possible to keep a framework design, per se. However, at every step, best practices can be imposed to keep mobile BI applications ready to be ported to any other platform as seamlessly as possible. The mobile BI platform may be small, but it has a bigger impact when integrated with traditional BI. All the options of having a browser-based application or a thick client-based approach should be evaluated. There will always be pros and cons to each approach. It should be thoroughly evaluated which compromise the users are willing to make temporarily and in the long-term.

For example, having only a client-based application would require frequent upgrades in the future when compared to the browser-based approach.

J. Claiming Any Device Is Good for the m-BI applications

There are many mobile devices and platforms available today. The list is constantly growing and so is the platform support. There are hundreds of models available today, with multiple hardware and software combinations.

The enterprise must select a device very carefully. The target devices will impact the mobile BI design itself because the design for a smart phone will be different than for a tablet [10]. The screen size, processor, memory, etc. all vary. The mobile BI program must account for lack of device standardization from the providers by constantly testing devices for the mobile BI applications. Some best practices can always be followed. For example, a smart phone is a good candidate for operational mobile BI. However, for analytics and what-if analysis, tablets are the best option.

Hence, the selection or availability of the device plays a big role in the implementation.

K. Some Additional Problems

In addition to the mistakes elaborated, there are a few problems that need to be handled to make m-BI more affordable in the future:

- Different mobile devices and mobile operating systems need different client software. This usually causes a rise in software implementation and upgrade costs.
- Servers must account for multiple versions of clients and increasing complexity.
- Data synchronization and device management is required, making mobile BI implementation more demanding and time-consuming.
- Heavy memory requirements in mobile devices need to accommodate large downloads needed.

Some believe that leveraging the Internet on mobile devices using thin-client architecture is a workable solution to overcoming the demerits of mobile clients. Though this brings in the inherent advantages of thin-client architecture, there are some problems with this as well:

- Server and browser resolution may not match with the devices.
- Analysis supported by mobile BI cannot be progressed in offline mode.
- When using m-BI, the need is evidenced for extensive session management.

All mentioned above should be considered and resolved prior to mobile business intelligence becomes truly applicable and useful in day-to-day business.

V. SOME PRELIMINARY RESULTS OF THE SURVEY ON MOBILE BUSINESS INTELLIGENCE USAGE IN CROATIA

A survey on mobile BI usage in the Republic of Croatia was conducted during January and February 2012. The answering rate was about 26% since answers were obtained from 88 Croatian enterprises.

The questionnaire contained 22 questions of which 4 were related to mobile BI implementation and usage.

Table 1 lists the percentage figures related to usage of any kind of business intelligence and especially mobile BI in Croatian firms.

TABLE I
BI USAGE IN CROATIAN ENTERPRISES

Type of the enterprise	Percentage using any kind of BI	Percentage using mobile BI
Large	62	21
Medium	33	19
Small	18	12

For those who know the situation in Croatia, the relatively low percentages of usage of business intelligence in all kinds of enterprises is not surprising. But, what is surprising is that percentage of those enterprises using mobile BI is falling proportional to the size of the enterprise.

Fig. 2 shows percentage of mobile BI usage in Croatian firms utilizing any kind of business intelligence.

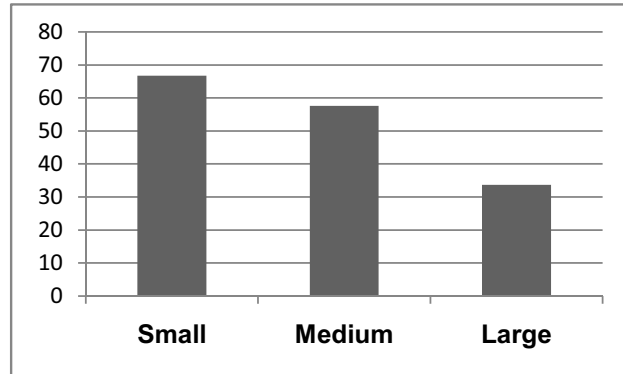


Fig. 2 Percentage of mobile BI usage in Croatian firms utilizing any kind of business intelligence

Results shown on Fig. 2 can be understood as being strong evidence that smaller Croatian enterprises are more agile as well as prone and opened to adoption of new technologies and solutions while larger enterprises are more inert.

When respondents to the survey for this report were asked to select the three top pressures driving their organization to adopt mobile BI, over half identified a belief as their organization's primary driver: the belief that mobile BI can provide them a competitive advantage (see Fig. 3).

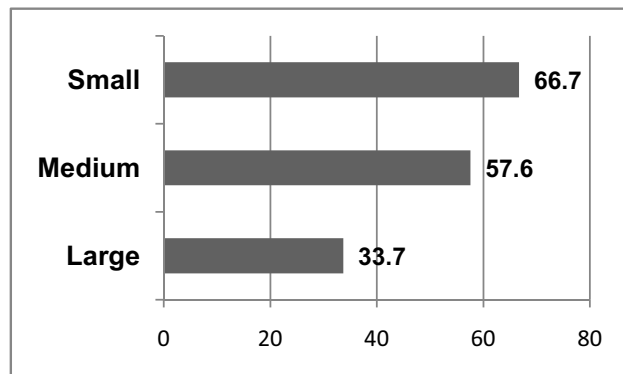


Fig. 3 The top pressures driving mobile BI adoption

As expected, the primary obstacle to stronger mobile BI implementation and usage in Croatian enterprises are costs, followed by security concerns and problematic ability to measure and justify mobile BI and device performance.

The top obstacles to mobile BI implementation in Croatian enterprises with appropriate percentages of answers are shown in Fig 4.

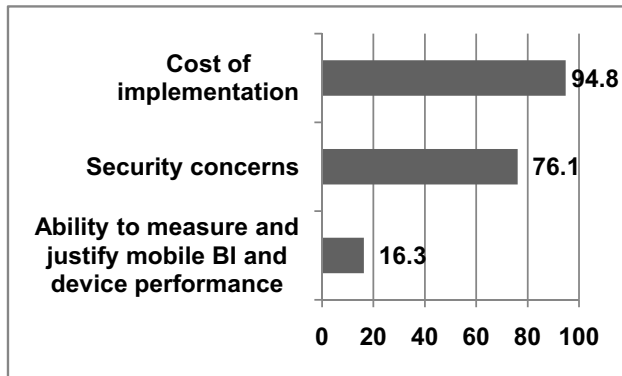


Fig. 4 The top obstacles to mobile BI adoption

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VI. CONCLUSIONS

Globally we see an increasing trend that enterprises choose to have the liberty of mobility instead of all the work being held in office. A virtual office may be a common reality very soon. The last decade witnessed the growth of data warehouses, while the previous decade saw it as a luxury. Mobile business intelligence is nowadays rapidly becoming a critical component of IT architecture.

Power of information is the mantra behind the success of winning enterprises. Because delayed information is like no information, by making business-critical information available on wireless handheld devices, BI has the potential to make intelligent businesses.

Of course, there are some mistakes that were done in the up-to-day progress of mobile technologies and mobile BI, as well as some problems that still have to be resolved. We discussed in the paper rather broadly. But we also strongly believe that mobile BI as a form of common enterprise business intelligence portfolio has a bright future.

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