Mobile Business Intelligence Usage Patterns

Olgerta Tona
Lund University, School of Economics and Management, Department of Informatics
olgerta.tona@ics.lu.se

Abstract

The generation of new mobile devices and the need to make decisions ‘on the move’ led to a new technology coined as mobile business intelligence (m-BI). M-BI is different from traditional BI in terms of user profiles, level of analytics and functionalities. Although there is a growing interest from both practitioners and academics, very little is known about m-BI in general and even less on its usage. A case study research is conducted to explore how m-BI usage patterns emerge and develop. M-BI is used to investigate after a trigger, monitor real-time data, control and support liminality. Users engage with m-BI based on the their mode (lean back or lean forward) and attention scope (narrow or wide). However, usage patterns developed are not static as m-BI users engage continuously with different usage patterns when shifting among different modes and attention scopes.

Keywords
Mobile business intelligence, usage patterns, attention scope, user’s mode.

Introduction

Decision support systems (DSS) emerged in 1960s to support managerial decision-making process (Arnott and Pervan 2014). Witnessing a diversity of systems being created under the umbrella term of DSS, Silver (1991) argues that researchers should maintain a broad definition of DSS because of (1) advancements of technology leading to new types of DSS, and (2) on-going marketplace dynamics where different systems are produced and pushed in the market. Under these conditions, DSS types may vary and therefore it is essential to describe, understand and differentiate them based on their characteristics instead of hype (Silver 1991).

One type of DSS that came to prominence in DSS field is business intelligence (BI). BI systems provide information to users to support their decision–making processes based on data analysis (Watson and Wixom 2007). In the last few years, BI has been heavily implemented in different industries (Arnott and Pervan 2008). In Society of Information Management (SIM) survey, BI was ranked as the most important of application and technology developments and has been number one for the last five years (Kappelman et al. 2013). Additionally, it is predicted to be on top of the CIOs agendas until 2017 (Arnott and Pervan 2014).

In terms of BI systems, mobile computing is a core element (Arnott and Pervan 2014) that is rapidly emerging within the DSS application area (Power 2013). The new mobile devices generation and the need to make decisions ‘on the move’ led to a new technology coined as mobile BI (Tona and Carlsson 2013). Mobile technologies lead to flexible working times and spaces for employees who rely on their mobile devices, such as smartphones or tablets (Dery et al. 2014). Mobile device usage has a considerable impact on individuals and organizations by changing their perception of a work environment (Middleton et al. 2014); blurring the boundaries between work and non-work activities (Middleton and Cukier 2006); and making work and non-work spaces more fluid (Dery et al. 2014). Due to the light weight, small size and constant connectivity of mobile devices (Cousins and Robey 2015) mobile workforce may access organizational information anytime anywhere while on move (Cowie and Burstein 2007).

“Mobile business intelligence refers to data-driven decision support applications on mobile devices like smartphones and tablet computers” (Power 2013, p.6). Although mobile BI (m-BI) received media attention as early as 2000s, its recognized growth was only after 2010 – the same year the iPad was
released (Tona and Carlsson 2013). M-BI makes it possible to transform decision-making in many industries. According to Watson et al. (2013), via using m-BI the executives and the sales forces in a clothing industry are equipped with the capability to understand the performance, trends, sales and profitability of a company. And in a healthcare system employees can take decisions based on patient bed availability and needs presented as real-time information by an m-BI system (Brooks et al. 2013).

Developing BI on mobile devices is one of the main topics of concern among practitioners and senior executives who have already started to implement m-BI in their companies for a variety of operational purposes (O’Donnell et al. 2012). Industrial studies have also highlighted the growth of m-BI in the market and its significance. A recent research report from Dresner Advisory Services (2013) shows that 57% of its respondents find m-BI to be either a critical or a very important IT initiative.

Advancements in mobile technologies are challenging the traditional DSS because of the anytime/anywhere mobile access to organizational information (Hosack et al. 2012). Since the academic research on m-BI is still in its early stages (Chen et al. 2012), researchers are calling for more studies in m-BI area due to its increasing importance (Arnott and Pervan 2014; Gao 2013). Given that, m-BI is different from other DSS types, such as BI, in terms of user profiles, level of analytics and functionalities (Tona and Carlsson 2013) and since material differences in a technology matter (Orlikowski and Scott 2008), m-BI becomes a significant research object. In terms of m-BI usage, different people engaging with the same technology may develop different usage patterns (Mazmanian 2013) and studying its patterns of use increase our understanding of practice (Dery et al. 2014). Moreover, it provides bases on how to better design and implement m-BI to boost productivity of its users. Therefore, we propose the following research question:

RQ: Under what circumstances do m-BI usage patterns emerge and develop?

The remainder of the paper is organized as follows. A short description of how m-BI may affect decision-makers’ attention is given. Section 3 discusses the methodology and data collection, which is followed by the analyses. Conclusions and future research are presented in the final section.

Decision-Makers’ Attention and Users’ Mode

Mobile technologies have been widely applied in consumer-oriented areas (Gebauer and Shaw 2004) and following the same line of thought m-BI is used to consume information rather than to author it (Tona and Carlsson 2013). However, individuals devote resources in terms of attention and time to consume information because of their limited processing cognitive abilities (Simons 1995). Some of the organizational decision-making theories and models concentrate on limited resources related to attention. Thus, it is important to design DSS that are congruent in how an organization channels and distributes the attention of its decision-makers (Carlsson 2008). M-BI has the potential to influence the focus of decision makers’ attention (Tona and Carlsson 2014) by providing them access anytime and anywhere to issues (Middleton et al. 2014) that need their attention. By supporting users’ mobility and connectedness (Cousins and Robey 2015) m-BI becomes part of the situations and contexts that decision-makers find themselves consequently reducing the decision time (Tona and Carlsson 2014). Generally, the main target group of m-BI users are mobile users who according to Dahlbom and Ljungberg (1998) are classified as: wanderers, travellers and visitors. Wandering is related to the local mobility within a working environment; a traveller usually travels from one place to another; and the visitor spends some time in another location. Being most of the time on road, m-BI should support mobile users’ need for information just in time.

“What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention” (Simon 1997). In decision situations many issues are relevant to consider, therefore decision-makers receive too many signals but not every signal can be attended to at once or attended at all (Ocasio 1997). Issues are related to problems, opportunities and threats faced by the company whereas answers are the actions taken such as projects, proposals and routines. “While it is difficult to specify the conditions under which the identification or creation of opportunities will occur, we can state that innovations and solutions cannot be created without organizational attention...” (Simons 1995, p.16). In general a decision maker will make a decision as a response to a stimulus that influences his behavior by shifting his attention focus (Simon 1976). Alerting an m-BI user either through the system or external sources will narrow his attention focus and most
probably he will look for additional information to support him in making a decision. On the other hand when there is a lack of stimuli his attention focus is wide and he may scan information in overall with no specific goal in mind.

In terms of information scanning, based on El Sawy (1985) all types of information scanning create a continuum with two opposing ends: general scanning (corresponding to a wide attention focus) and specific scanning (corresponding to a narrow attention focus). We propose that during information scanning, the fact that a m-BI user may or may not take a decision or action after, position users in two main modes during m-BI interaction. We will draw on two main metaphors to better explore a user’s mode: ‘lean back’ and ‘lean forward’. Metaphors play an important role in generating an image of the research object even though there are slight differences between them two (Morgan 1980). Some practitioner magazines (Nielsen 2008; Rashbass 2012) use these two concepts to better describe how reading experience changes based on the devices being used. In the ‘lean back’ mode a reader reclines backwards usually in a chair when interacting with a mobile device, whereas in a ‘lean forward’ mode a reader bends forward when interacting with a PC or laptop as there is a need to reach the mouse, keyboard or monitor to be able to read.

Used in an m-BI context the metaphors broadly portray the user’s mode when interacting with m-BI application on the same devices, i.e. mobile devices. Since leaning back is associated with a passive activity (Nakatsu et al. 2005), an m-BI user in a "lean back" mode consumes information passively. He may complete 1) an undirected scanning with no purpose in mind rather than just exploring the information in general (Aguilar 1967), or 2) a conditioned scanning where a user scans only the type of information he is interested in and knowledgeable, most probably related to his own work (Aguilar 1967). When in this mode, an m-BI user is not expected to take any actions rather than trying to make sense by answering the question “what’s going on here?” (Weick et al. 2005). On the other hand since leaning forward is associated with an active activity (Nakatsu et al. 2005), an m-BI user in a "lean forward" mode consumes information actively. An m-BI user conducts a problematic search triggered by a stimulus (Cyert and March 1992). This means that an m-BI user has a goal when scanning the information. “What do I do next?” is the question he tries to answer (Weick et al. 2005) and in this mode an action to find a solution to the problem is taken (Cyert and March 1992).

Concluding, we assume that m-BI is used when decision-makers may have a narrow or wide attention focus and may be in a lean back or lean forward mode, thus influencing m-BI usage patterns.

Research Methodology

We adopt a case study research strategy to explore m-BI usage patterns and how they emerge and develop within a single setting (Eisenhardt 1989). To find a case we focused on retail industry because sales force—consisting of mobile users who visit stores and customers-- is a considerable large group of m-BI users (Tona and Carlsson 2013). Additionally, since m-BI started to grow from 2010 (Tona and Carlsson 2013) we selected a company which decided to implement and use m-BI for 5 years – an acceptable time length for the usage patterns to emerge. Additionally, a qualitative method over a quantitative one is chosen because it is considered a good approach in capturing patterns and behaviors and also because of the m-BI immaturity research.

Setting

The case study is conducted in EROL company. EROL (a pseudonym) is a Scandinavian company established in 1955 and operating in the retail industry. Since its start it has expanded by acquiring different store concepts and reaching 1400 employees. The company has around 300 stores in Scandinavia and its main activity is producing and selling wearable products to customers. The group headquarter is situated in Scandinavia but there are offices in China too for sourcing and product development.

In 2008 they implemented BI for all the employees in the company. Their main BI provider is Oracle and the core of this solution is a data warehouse. Information coming from different sources (e.g. a database containing sales transactions within 2 minutes the transaction is completed) is loaded in a data warehouse and the number of sources getting connected increases by time. The data in the data warehouse are further analyzed and information is visualized (in form of tables, charts and gadgets) and can be accessed
through a browser-based portal. Thus, different users are looking at the same figures throughout the organization.

After 2 years, in 2010, they extended their BI solution by introducing a mobile BI app. The main user groups that served as a driver to extend BI further to m-BI were regional managers. Regional managers are most of the time in the field and responsible for about 20 stores. They need to be frequently updated with data sales and main key performance indicators (KPIs) regarding their stores. Furthermore, m-BI usage extended by including other managers who may frequently be on business trips or have a need to consume data anytime anywhere. In the first version of m-BI app, BI team had to select which information to show on mobile devices through the application due to limited technology capabilities. However, after an upgrade, now users have access to the whole BI information similarly as they have on their desktops or laptops, and adoptable to their screen size. In this way, business analysts do not have to redesign new dashboards for mobile devices access rather they focus on the overall BI platform developments independently from any access devices.

**Data Collection and Analyses**

Data collection in EROL took place from April 2014 till February 2015. 12 interviews have been conducted ranging from 30min - 90min with different user groups (see Table 1). Managers were the ones who were frequently out of the office such as the regional managers, business area managers and purchasing managers. Business controllers were users of m-BI even though their position was office related. And the last group, the IT support team included the business analyst, IT operation manager and system developer who are responsible for designing the dashboards and maintaining the BI infrastructure. Some of the interviews with regional managers were conducted inside the stores they were responsible for, which helped to provide an image of their ‘office’ inside the store, whereas other interviews were conducted at the company’s headquarter. For each interviewee we got the respective usage BI logs in terms of days/week and hours/day through queries in the database based on users id-s. Through the logs we got an insight of the usage frequency corresponding to each interviewee.

In addition to the interviews, we have been supplied with internal documents that explained the technical features of the implemented m-BI and strategies and tactics used for its implementation. Additionally, some of the interviewees demonstrated how they used the m-BI app during their work.

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<th>Data Source</th>
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<td>Usage BI logs</td>
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<td>Documents</td>
<td>- Technical features and capabilities of m-BI</td>
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<td>- Overview of EROL’s BI journey &amp; PowerPoint presentation on challenges and benefits from BI and m-BI implementation</td>
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<td>Product demonstration</td>
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<td>- M-BI demonstration (from m-BI users)</td>
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**Table 1: Data collection sources**

All the interviews have been recorded with the consent of the interviewees and analyzed using Nvivo10, which supports content analyses. We used a two-level coding schema: etic and emic level (Miles and
Huberman 1994). Etic level codes are general codes created based on the theory and conceptual framework adopted in this study. We started to code based on the attention focus when using m-BI: narrow or wide. Afterwards, we continued by developing more codes nested inside the general codes using an inductive technique. These codes are called emic level codes and they are more specific to the cases (Miles and Huberman 1994) such as: investigate after triggers, live data monitoring, control and support liminality.

**Case Study Analyses**

In terms of m-BI usage patterns, four main themes were identified during the data analyses. Use patterns revealed that employees used m-BI to 1) investigate after a trigger, 2) real-time data monitoring, 3) control, and 4) support liminality.

**Investigate after a trigger**

We observed that in some cases external triggers (not coming from the m-BI system), such as a phone call or receiving an email from other colleagues, prompted m-BI usage:

*I am out in the field and I got a call from the office and they say: ‘We can see that this store has a low turnover or something. Can you check it out?’ Ok. And then I stop the car, and I go in and I check it. Then I call the stores and say ‘I can see here that this turnover is low, do you know why?’ And then... I call the office again to say that I have checked it out. So, that's when I use it. (Regional manager)*

Working outside the office the phone call acted as a stimulus for the manager. A decision to be taken follows the stimulus (Simon 1976). However before taking an action, the manager tries to make sense of the situation (Weick 1995). Being on road he decides to investigate the related KPIs via m-BI. He logs in to m-BI application on his smartphone and checks the appropriate KPIs related to the specific issue he is interested in. His attention focus is narrow and after investigation he decides to take further action such as contacting the responsible person to discuss the situation. Other data provided by m-BI remains outside his scope of attention.

*It's more like we have made a phone call: look at this. And then they are sitting in the car and they watch it and then they say we must do something about it. It's more like that. So we need to talk to each other anyway. (Business Controller)*

This case is in line with the above quote from the regional manager. A business controller raises the awareness of regional managers (acting as an external trigger) about some issues that they need to attend. Although they are supplied with updated information, still communicating (Weick et al. 2005) with their colleagues, either in the headquarter or in the respective stores is an important part during their sense-making process of the situation.

**Real-time data monitoring**

Most of organizational data are updated on a daily basis, however sales data have an update frequency of 30 minutes. This high update frequency provides m-BI users with real time sales data that are important to regional managers due to their main responsibilities. Although there is no clear definition of real time in terms of quantity of minutes, real-time BI aims to reduce the time between data transactions and readability of the data to be analyzed (Chaudhuri et al. 2011). In this case regional managers are able to access a potential sale transaction within 30 minutes from its occurrence. Through real-time BI employees may monitor the current situation (Negash and Gray 2008) and adding the mobility component (Cousins and Robey 2015) monitoring occurs independently of time and space. This usage patterns was enacted under certain organizational changes such as the opening of a new store:

*By m-BI usage* I know, for example, if we have the opening of a new store and we are not selling what we want to sell we make a phone: ‘OK what's the problem’. (Regional Manager)

Or when a new marketing campaign for a specific product is launched:
...we have new shoes to market so we go and put them in magazines. And it’s on Tuesday ... Then I look on the iPhone and see what’s happening. Are we having better sales or not? And that's a sign for me to say it works out or not but nothing more than that in fact. And if it doesn’t work then what’s the problem: is it the weather or was it something wrong with the product we put in the newspaper... We analyze that...(Business Area Manager)

In these use scenarios, m-BI users could monitor how sales were progressing under the effect of certain changes. An m-BI user is interested in a specific product, store or region; therefore his attention focus is narrow. However real time data monitoring does not directly lead to an action. Still, if the sales figures being monitored are not turning out as expected then they may serve as triggers coming directly from the system. Under these conditions, m-BI users being influenced by a trigger may decide to investigate further certain measures through the m-BI to increase their understanding or call directly the responsible person.

**Control**

The need to have a sense of control on what is happening in the organization at any time unfolds another usage scenario. The intensity of the sense of control increases because of ubiquitous mobile devices (Mazmanian et al. 2006). Obtaining a picture of the overall performance of the company and the main KPIs related to employees’ work reduce their stress (Mazmanian et al. 2005) indirectly through making sure that they have everything under control. In terms of time frame, this usage pattern emerges either during weekends, or when employees are away from the company for some time on a business trip or vacation.

*How did the sales go so far on Saturday? Sometimes I go in and check that one so I am updated. When I come to work on Monday there’s no surprise. I don’t need to take time when I came back on Monday to check the sales.* (Regional Manager)

Regional managers scan sales information on different dimensions such as product-based, region-based, time-based and they can perform different comparison with the sales figures of previous year. Since stores are open seven days a week, regional managers want to be able to monitor sales in their non-working hours in order to be kept away from ‘surprises’ once they are back at work. This reduces their uncertainty.

*I think I got full control of everything in Oracle. That’s why I use it... we are never surprised in that way.* (Regional Manager)

Having a wide attention focus, allows m-BI users to scan information in overall without looking at details and without having a specific purpose in mind other than reducing their uncertainty and increasing their sense of having control.

M-BI users may spot KPIs, trends or numbers that requires specific attention and further action when interacting with information. However, when asked if they can take some actions on the weekend under these circumstances one regional manager answered:

*No, no, absolutely not. We have to wait till Monday* (Regional Manager)

Additionally another business controller states:

*It was in the weekend now, I was very interested how the selling went on Saturday so I log on and watched the selling, I did nothing about it but I got the information.* (Business controller)

During official non-working hours other than consuming the overall information and making sense of the organization performance, no further action is taken.

**Support liminality**

Another usage pattern emerges early mornings, before users start their daily business day. This relates to boundaries of working and non-working activities that are blurring through mobile technologies (Sarker et al. 2012). Accessing m-BI just before work sets users in a transition phase between work and non-work. We will refer to this transition phase that users experience as liminality (Turner 1969) that is temporary and ambiguous. The liminal phase is ambiguous in that way that employees have a working and non-working feeling at the same time.
...every day in the morning when I wake up I use it. For me it's a response to the last days and yesterday sales. I see that. And it's supportive to start the day with that. (Business Area Manager)

In liminality they have the freedom to choose the device or application they want to use. M-BI usage supports the smooth transition to work by providing updated information according to users' needs.

But I always start the day by checking sales from yesterday. So, I start with my phone and I log on to Oracle BI and look at the sales number from yesterday. So, that's the start of my day... I sit home when eating breakfast and start to have a look and check. I don't really put my laptop on the table but rather use the mobile (Regional Manager).

In liminality, users don't have a specific issue in mind when scanning the information; rather they want to have an understanding of the organization performance in overall. It makes them feel prepared and less anxious on what lies ahead that business day.

The first thing I do when I open my eyes is that [using m-BI]...I think it's a habit. I mean, when I come to the office I see the figures, but I want to know before. (Purchasing Manager)

...in the morning, I am very curious how it went yesterday. I use it see if there are really nice numbers or red. (Regional Manager)

The above use case illustrates how a regional manager checks m-BI to see the sales of yesterday. If they were not good then most probably a busy day may follow, or the contrary if there were good sales numbers. Thus, m-BI users get reassured.

Discussion

Investigate after a trigger; real-time data monitoring; control, and support liminality are four usage patterns identified in this case study. We argue that an m-BI usage pattern will emerge based on a user's mode and attention scope (see Figure 1). The first m-BI usage pattern observed in our empirical data was investigating specific information (mostly in a form of KPI or measure) when triggered by a stimulus. M-BI users operate in an environment of decision that provides stimuli to them to take action (Ocasio 1997).

In terms of m-BI system being used two main types of stimuli are observed: external and internal. External stimuli come from outside an m-BI system whereas internal stimuli are generated from the m-BI system itself when an m-BI user is scanning the information. However, at individual level, m-BI users focus their attention on limited information because of their cognitive abilities and limitation (Ocasio 1997). Stimuli, either internal or external, narrow the attention scope of m-BI users to the specific issue that they decide to attend. A user therefore is in a lean forward mode, where he conducts a problemistic scanning (Cyert and March 1992) and an action is expected to take place after interaction with m-BI.

The second m-BI usage pattern is monitoring real time data. This is different from routine monitoring (Sawy 1985) because there is an interest on non-routine activities' progress that need to be monitored through real-time data. Since the focus is on a certain activity, a user's attention scope is narrow and he is in a lean-back mode when scanning the information conditionally via m-BI. However, no actions are expected to be taken.

In the third and the forth usage pattern an m-BI user has a wider attention scope and a lean back mode. They feel secure and have a sense of control on organization performance and their own work because of information availability at anytime and anywhere (Tona and Carlsson 2013). They scan the information in overall to be updated on the main activities of the organization, but they don't take any further actions. Having a sense of control reduces their stress when it comes to their tasks and work. Additionally, they use m-BI to have a smooth transition from non-work to work activities. Therefore supporting the ambiguous phase of liminality.
The usage patterns are not necessarily mutually exclusive. We see an m-BI user moving to different quadrants in Figure 1 within the same session of interacting with m-BI. If a user is performing live data monitoring in a certain activity and he observes that a measure is progressing below expectations, the ‘unexpected result’ will act as a trigger. Under this condition, he leans forward, narrows his attention and another usage pattern emerges which is investigation after a trigger. Or if a user is investigating after a trigger he may decide to lean back and monitor it for the first hours without changing his attention. Thus, the real-time data monitoring usage pattern emerges. The same holds true when they use m-BI to control the overall performance. If they encounter some issues in need of their attention, then they move from a lean back mode to a lean forward mode with a narrow attention and therefore engaging in another usage pattern.

**Conclusion and Further Research**

This research paper investigated m-BI usage patterns and how they emerge and develop. Two main dimensions explored in relation to usage patterns are: user’s mode (lean back – lean forward) and attention scope (wide – narrow). Four main m-BI usage patterns are explored and discussed how different patterns emerge based on the user’s mode and attention. Users develop different patterns of the traditional DSS usage based on their experience working with the system for sometime (Alter 1980). However, in this study we found that the usage patterns developed are not static and in a short time an m-BI user can shift from one mode to another and from an attention scope to another, continuously engaging with different usage patterns.

This study pinpoints also some areas that require future research. First, the conclusions call for more research in terms of m-BI design. An interesting question would be how to design m-BI application that makes easier the transition from lean back to lean forward mode and how an optimal non-work to work transition is being guaranteed. Second, future studies should broaden the scope of this study by including other information systems and sources to investigate if users are going to engage with similar usage patterns. Third, this research should continue by exploring on how each usage pattern is made possible by technical capabilities and are connected to performance in terms of efficiency and effectiveness.

**REFERENCES**


