Big Data: Driving Innovation in Enterprise Software

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Today's software product managers face a major inescapable trend that affects their customers on a daily basis. The amount of digital business information is exploding. In fact, IDC estimates that the total amount of digital information in the world is growing at 60% annually—essentially increasing ten-fold every five years. It won’t slow down any time soon, thanks to the growth in mobile devices like smartphones and tablets, and social media.

THIS UNPRECEDENTED GROWTH IN DATA VOLUME, VELOCITY, AND VARIETY has created the Big Data challenge that software vendors and enterprises must face, whether their product is an established Business Intelligence (BI) system or simply a solution that manages users' key data—a healthcare information system, a supply chain management solution, or even a social media monitoring tool.

But simply having data, reports and analytics to show users doesn’t automatically translate to better products. Data is only useful if it is presented in the right way to the right user in the right context. It is the ultimate usability challenge.

As Big Data goes mainstream, product managers must capitalize on four rising trends or risk being left behind by the companies that do. They are:

- **Ease of use**—Data doesn’t matter if you can’t interpret it;
- **Verticalization**—The creation of enterprise software featuring analytics for niche verticals, specifically designed for the unique tasks of users working with the software;
- **Mobile BI**—Delivering real-time actionable data wherever the user goes;
- **Visual Discovery**—Allowing users to not just view reports but actively mine data to gather insights.

### 1. EASE OF USE

Ease of use has been cited as of the one of the top barriers to the adoption of BI systems and features\(^1\). Why are companies demanding ease of use after a decade or more of BI and analytics systems that put features and data first, treating usability as secondary?

**Self-service**

Two primary drivers push the ease-of-use analytics trend. First, consumer products that feature modern, simple user interfaces are setting a new bar in the industry. From Apple to Facebook to SalesForce.com, customers who have gotten used to the user experience of consumer products now also expect this level of usability in all software systems.

Google knows this—they’ve tweaked the user interface for Google Analytics twice in the past year as they become the prime example of a consumer-oriented analytics

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1. [Information Week Analytics & Info Management Trends, 2013; Gartner Magic Quadrant for Business Intelligence and Analytics Platforms, 2013]
system for use by home and business users everywhere. In an interview, Lucas Pettinati, the Lead UX Designer of Google Analytics said, “We are contemplating a lot of things to really put the user in control over the reports that they are looking at.” Google recognizes that ease of use means opening what might otherwise be complex data reports to a broad range of new users.

Second, organizations realize that to benefit from analytics, the use of these systems can’t just be limited to expert business analysts. Data needs to be available and pervasive throughout the organization.

With the proliferation of data volume, velocity, and variety, the solution isn’t to push out larger and larger volumes of data to end-users. As Arnab Gupta, CEO of Opera Solutions, said at the 2012 Big Data conference, “The real battlefield, ultimately, is are you making data usable to people on the front line, to a person who is not technical […] but it helps them do their job a lot better?”

To let business users access and analyze data how and when they want, systems must be self-service. Everyone, not just the CEO, but also Charlotte in Accounting, Sateesh in Marketing, and Ryan in Development, must be able to find and parse the data they need, whenever and wherever they want to do it.

**Ease of use? Easier Said Than Done**

Despite the recent hype around usability, many traditional BI solutions still get low marks in this arena. According to Gartner’s BI Platforms User Survey 2013 Report ease of use (for both end users and developers) (51%) followed by functionality (44%) are once again the top BI and analytics platform purchasing criteria.

Ease of use surpassed functionality as the top purchasing criteria in 2010 and has remained in the top spot ever since, indicating a shift in the importance organizations place on business-user usability requirements and the greater influence of the business user in BI and analytics platform purchasing decisions. According to Gartner, the majority of BI vendors tend to have below average ease of use scores. The majority of BI solutions suffer from the fact that the people who actually use the systems aren’t sitting at the table when the buying decision is made, the applications were designed years ago and haven’t been updated to today’s usability standards, and serving too many user groups.

So why do experienced, and educated designers and product managers produce software that frustrates their user base? And how do you avoid falling into the same trap?

As we explain in our paper “Has the Usability Revolution Left Enterprise Software Behind?” product managers face many roadblocks—complicated legacy code, architecture constraints, and the risk of alienating the established user base.
But one of the most prevalent factors at companies large and small is simply that product managers and executives are not given the right resources to carry out meaningful user experience design. Most product managers fully understand the need for usability, but don’t have the right user experience design team in-house or are relying on data scientists or software developers with a strong technical background rather than a usability background.

**Step one: The Right Design Support**

In order to deliver the promise of easy-to-use, self-service analytics to a broad range of users, successful product managers and executives are working with a user experience design team that consists of three distinct skill sets:

**Design research.** Design researchers specialize in uncovering user needs. They train for years to learn how to interview and observe users. Their findings yield incredible insights that can be used to determine how data needs to be presented, and in what context, depending on the type of user.

**Interaction design.** Interaction designers are the masters of intuitive layouts, workflows, and content prioritization. They work with product managers and data scientists to plan what the experience of receiving, exploring and acting on the data will be like—usually in the form of sketches called “wireframes”.

**Visual design.** Visual designers are graphical experts specializing in tools like Photoshop and Illustrator to construct the data visualization. Good visual designers understand that even slightly nuanced visual cues—colors, shades, text—can make a major difference in how the data is understood. They also develop the overall visuals that enable an emotional connection between the user and the product, a critical requirement even for all software today.

To bring true usability to the table, you cannot ignore any of the ingredients of this recipe.

There is a lot to do to ensure your solution provides the ease of use demanded by today’s broad range of customers. But the first thing is to make sure you have the right team behind you. Once you do that, the rest begins to fall into place.

**2. VERTICALIZATION**

According to the **Gartner Group**, when a BI platform isn’t tailored to show the relevant information to the right users in an easily understandable and consumable format, users get frustrated and abandon the platform. In other words, if your customers can’t find and use the information they need, they’ll quickly get frustrated and stop using your software.

In the past, the director of supply chain management for an auto parts manufacturer, the CFO of a hospital, and the marketing manager of a cosmetics company have all been given the same generic BI solution with only a customized report to make it
applicable to their unique role. In many cases, a specialist was assigned to help these people get the results they needed.

That has been the accepted mode of operation, but arguably it never delivered the full vision of actionable intelligence for all. Now with even more data to draw upon, we need to avoid repeating the mistakes of the past.

To deliver the value of these systems to organizations and end users, analytics solutions must be customized for the specific target audience. This might mean customization across categories of enterprise software, vertical markets, business disciplines, levels within the organization, even for combinations of those things.

**The Right Context = Effective Data Delivery**

Product managers must develop a deep understanding of who their users are, what their objectives are, and what results they need to get their job done. Solutions need to consider how and when the results are delivered. Is it in a standard desktop PC environment, on a smartphone or tablet, during office hours or in the evening, in an airport or taxicab?

Understanding the context allows the information to be delivered in the most effective way possible.

An example of the success of this approach is Dimensional Insight, a provider of Business Intelligence and performance management software with a focus on the healthcare market. For over two decades, Dimensional Insight has worked with hospitals across the US to harvest data from multiple systems into interactive reports, dashboards, scorecards, and analytical tools. Clinical, quality, operations, and financial departments rely on the resulting timely access to data to drive improvements.

They may be a small company, but Dimensional Insight has carved out a market by tailoring their offering to their vertical, and the result is that they out-shine the big players in their niche. One of the reasons for their success is that they began from the customer’s workflow and developed their product from there instead of taking a generic product and customizing it.

**The Verticalization of Data**

The verticalization issue is complicated by the sheer volume of data. How do you sift through the mass of information, and figure out the what, where, when, and how of presenting the data in the best way for each user persona?

We have found that the path to true usability is to combine the skills of a product manager who has a deep knowledge of the industry with a usability team. The product manager defines the business segments the application is targeting, and then the UX team researches, designs the interaction, and creates the visual interface, as we outlined earlier. Doing this guarantees a successful partnership and a usable application. This is especially important to target specific verticals. To specialize in a niche market,
you need to truly customize your offering to the expert users in that market. If you already have an existing product, and more importantly, an existing user base, re-engineering your application for a vertical market might feel like a big mountain to climb. Should you start with the application you have and pare it down? Should you start from scratch, taking the chance to rid yourself of spaghetti code and checkbook engineering? Or is rethinking your presentation layer the best plan?

The answers will be different depending on the maturity of your product and the business goals of your company. One of the key factors to such a large change is to maintain the goodwill of your existing users. If you have a loyal existing customer base, you risk alienating them with a UI redesign, yet the massive forces pressing on the BI and analytics markets mean that every product will have to change or be left behind. To help mitigate your risks, but still adapt your UI to be more in line with a particular vertical, we recommend our paper, *Overhaul a UI design Without Upsetting Users*.

3. MOBILE BI

HISTORICALLY, BI PROVIDED DASHBOARDS to see requested information from past actions, a rearview mirror to what had happened in the business, which facilitated reactive decision-making. As dashboards evolved, users could see and process information in real-time and make decisions based on current information. Now we see the concept of a BI control panel that delivers real-time analytics and allows users to take action from the same interface. This is like an airplane cockpit that shows a pilot that the plane is descending faster than desired and allows them to correct the situation.

The true power of analytics is giving the user the right real-time data and allowing them to take action on that data. But to allow users to take action effectively, they need access to their real-time data whenever and wherever they are. The solution? Mobile BI.

5 Principles of Mobile BI Design

Providing a mobile app that your customer can use is a challenge when that app has to present the massive amounts of data involved that BI software parses. As vendors learned in 2010 when the iPad was first released, a straight-up port of a desktop-based solution results in an unusable disaster on a tablet screen. When designing analytics for mobile, you have to be aware of the significant usability and context of use constraints. Tableau is a modern analytics software vendor that offers a popular whitepaper, "5 Best Practices For Mobile Business Intelligence", outlining specific design principles we’ve found to be largely true:

- Avoid dashboard proliferation
- Write to a smaller form factor
- Consider an audience on the go
- Account for new mobile scenarios
- Leverage mobile’s natural process of collaboration
Mobile products that don’t feel like they’ve been designed for the specific mobile platform are disappointing. This occurs when the vendor’s mindset is to “port” the application from desktop, when the developers don’t have intimate knowledge of the mobile platform, and most often when the designer does not have experience with the unique nature of Mobile BI design.

Mobile users might be more hurried, have trouble switching cognitive context, or just be unable to use features the same way they would with a mouse and keyboard. Many features may need to be dropped, simplified, or adapted for users on the go.

Understanding users’ needs, the context of use, mobile device design constraints, and building on the right technology platform (HTML5? Native? Hybrid?) are all complicated decisions with a multitude of trade-offs to consider.

**Mobile BI still hit-and-miss**

Though experienced user experience designers are out there and companies like Tableau have published mobile design best practices for the unique constraints of analytics software, today’s Mobile BI solutions are still hit-and-miss.

In early 2012, Mark Smith from Ventana Research reviewed “Oracle Business Intelligence Mobile”. His primary criticisms revolve around violations of two of the aforementioned Mobile BI design principles.

According to Smith’s research search and navigation are the top two requested needs of business users, however Oracle failed to support search operations as simply as it could. This ties back to design principle #3, Consider An Audience on the Go, in which Tableau recommends “Provide content search: Make it easy for users to search for different content by project, publisher, date, name and other facets.”

Under design principle #5, Leverage mobile’s natural process of collaboration, Tableau stresses “Provide interactive filtering, sorting, panning, and zooming so that users can walk through data live over the course of a meeting. […] Make sure your solution is fast enough that it can keep up with the pace of a discussion. People will move ahead without the necessary information if the dashboard fails to load quickly.”

Smith’s review of Oracle’s application notes “I expect any business intelligence application to support basic interactive user needs, from drill, pivot and page to sort, filter and rank selections. Oracle BI does some of these, but it’s not intuitive about when you can drill down or if you are just zooming into a chart or table, and if you want to pivot, it’s not clear whether that is possible. Paging through data is simple enough, but any level of sort, filter and ranking is impossible. [And] after any interactions the application is slow to respond and refresh.”

Our point is not to berate Oracle. Oracle is a well-established company that has been working in the BI and analytics software for decades. But if Oracle is still having
challenges with their latest mobile offerings, this speaks to the challenge, and opportunity, open to the rest of the industry.

Mobile BI is the key to unleashing real-time analytics and ultimately the promise of Big Data—actionable intelligence for all users, anytime anywhere. The design principles have started to be established, but nothing can make up for lack of experience. Only trained designers and developers who have worked with analytics systems and understand the details of the target mobile platform are truly positioned to succeed.

4. VISUAL DISCOVERY

Visual discovery in combination with data mining is another aspect of big data that that is in the spotlight. Most solutions offer visual analytics in the form of dashboards, allowing the user to monitor specific metrics and KPIs and take action on them. But visual discovery is about exploring data without a pre-determined goal, digging into different view—heat maps, spark lines, trellis plots—and visually uncovering insights.

Visual discovery is the holy grail of self-service. Users of all skill levels and across different industries explore views of data and spot patterns, from a government worker digging for ways of optimizing a grant program to a sales manager exploring geographic sales history using a virtual map.

GE Healthcare, a leader in healthcare products, recently revealed a new initiative called SimIndia, a visual discovery tool showing health data across a virtual map of underserved populations in India. The tool would be used by government decision-makers to explore the data and make decisions on how to serve different areas, for example by building a new hospital.

Howson lists the leaders in visual discovery as QlikTech, Tableau and TIBCO. Certainly these companies are ahead of the pack, but the race is only beginning. Visual discovery is a nascent field where any software vendor with the right mix of domain expertise, usability and design skills can innovate.

Interactive Dynamics

Howson provides a detailed list of criteria for evaluating a visual discovery solution. Are advanced visualizations such as trellis plots available? Can multiple data sources be displayed at once and joined? Can the user perform tabular manipulations and aggregations? But the most important criterion is simply “ease of use for the author”, which is listed as “essential, a “show stopper” or feature that significantly affects deployability and/or cost of ownership”.

Traditionally, the field of data visualization has focused mainly on the creation of charts and graphs that were easy to interpret. Stephen Few is a thought leader in this area, educating the industry in the best practices of table and graph design and dashboard design.
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But in visual discovery, these are table stakes. The new challenge is guiding users through the interactive dynamics of a visual discovery session, in other words, the entire flow and experience from starting the initial views of data, to exploring the data, to annotating and recording the results. Jeffrey Heer from Stanford University and Ben Schneiderman from the University of Maryland have published a paper, “Interactive Dynamics for Visual Analysis,” one of the few publications to date that begins to establish best practices around the overall workflow of a visual discovery session.

The paper essentially divides a visual discovery session into 3 parts: data & view specification, view manipulation, and process & provenance. Each is then further broken down into different usability considerations, from filtering and sorting to navigation and annotation.

**Data and View Specification**
- Visualize data by choosing visual encodings.
- Filter out data to focus on relevant items.
- Sort items to exposure patterns.
- Derive data or models from source data.

**View Manipulation**
- Select items to highlight, filter, or manipulate them.
- Navigate to examine high-level patterns and low-level detail.
- Coordinate views for linked, multi-dimensional exploration.
- Organize multiple windows and workspaces.

**Process and Provenance**
- Record analysis histories for revisitation, review and sharing.
- Annotate patterns to document findings.
- Share views and annotations to enable collaboration.
- Guide users through analysis tasks or stories.

**Visual Discovery—Open for Design Innovation**

Heer and Schneiderman’s paper is remarkable in that it encompasses a framework for the ease of use in visual analysis, but it also reveals many areas that are very new and open to design innovation. For example, within the Data & View Specification area, the paper recognizes that most design solutions today are still complex to the point that novice users would need help from power users to get started. “Novel interfaces for visualization specification are still needed. A formal grammar that uses graphical marks (rectangles, lines, plotting symbols, etc.) as its basic primitives provides a conceptual model compatible with interactive design tools. New tools requiring little to no programming might place custom visualization design in the hands of a broader audience.”

In the View Manipulation section, the authors point out the potential to significantly improve ways that users could visually select data for deeper investigation: “Designing more expressive selection methods remains an active area of research. For example, researchers have proposed methods to map mouse gestures over a time-series visualization to select perceptually salient data regions such as peaks, valleys, and...
slopes or to query complex patterns of temporal variation. [...] Of course, selection need not be limited to the mouse and keyboard: input modalities such as touch, gesture, and speech might enable new, effective forms of selection.”

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Unlike Mobile BI where the fundamentals of mobile design are established and the challenge is simply finding usability professionals with the right experience, designing for visual discovery is wide open for design research and innovation. Academic circles and industry thought leaders have begun to establish frameworks and point out areas for further research. The industry is beginning to copy a handful of leaders like QlikTech, Tableau and TIBCO. But when it comes to the interactive dynamics of the entire visual discovery experience, particularly for non-expert users, the area is still wide open for new leaders to make a name for themselves through design innovation.

A State of Design Innovation

The analytics space is in a state of innovation right now, with shifts like Big Data, Usability, Mobility, Verticalization, and Visual Discovery changing everything. With innovation comes uncertainty for every product executive responsible for analytics within a software system. The opportunities for innovation are vast and expanding as companies across all verticals recognize they can use truly intelligent business information to drive their enterprises forward.

Taking advantage of these opportunities means fulfilling the promise of analytics. As industry leaders are proving—it is dedication to usability research and user experience design that will make the difference in your team’s success in this revolution.

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