

What Is a Dashboard?

As you have no doubt determined by examining these examples, there's a fair degree of diversity in the products that go by the name "dashboard." One of the few characteristics that most vendors seem to agree on is that for something to be called a dashboard it must include graphical display mechanisms such as traffic lights and a variety of gauges and meters, many similar to the fuel gauges and speedometers found in automobiles. This clearly associates BI dashboards with the familiar versions found in cars, thereby leveraging a useful metaphor—but the metaphor alone doesn't provide an adequate definition. About the only other thread that is common to these dashboard examples is that they usually attempt to provide an overview of something that's currently going on in the business.

After a great deal of research and thought, I composed a definition of my own that captures the essence of what I believe a dashboard is (clearly biased toward the characteristics of this medium that I find most useful and unique). To serve us well, this definition must clearly differentiate dashboards from other forms of data presentation, and it must emphasize those characteristics that effectively support the goal of communication. Here's my definition, which originally appeared in *Intelligent Enterprise* magazine:

Stephen Few, "Dashboard Confusion,"
Intelligent Enterprise, March 20, 2004.

A dashboard is a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance.

Just as the dashboard of a car provides critical information needed to operate the vehicle at a glance, a BI dashboard serves a similar purpose, whether you're using it to make strategic decisions for a huge corporation, run the daily operations of a team, or perform tasks that involve no one but yourself. The means is a single-screen display, and the purpose is to efficiently monitor the information needed to achieve one's objectives.

Visual display
of
the most important information needed to achieve one
or more objectives
which
fits entirely on a single computer screen
so it can be
monitored at a glance

Let's go over the salient points:

Dashboards are visual displays. The information on a dashboard is presented visually, usually as a combination of text and graphics, but with an emphasis on graphics. Dashboards are highly graphical, not because it is cute, but because graphical presentation, handled expertly, can often communicate with greater efficiency and richer meaning than text alone. How can you best present the information so that human eyes can take it in quickly and human brains can easily extract the correct and most important meanings from it? To design dashboards effectively, you must understand something about visual perception—what works, what doesn't, and why.

Dashboards display the information needed to achieve specific objectives. To achieve even a single objective often requires access to a collection of information that is not otherwise related, often coming from diverse sources related to various business functions. It isn't a specific type of information, but information of whatever type that is needed to do a job. It isn't just information that is needed by executives or even by managers; it can be information that is needed by anyone who has objectives to meet. The required information can be and often is a set of KPIs, but not necessarily, for other types of information might also be needed to do one's job.

A dashboard fits on a single computer screen. The information must fit on a single screen, entirely available within the viewer's eye span so it can all be seen at once, at a glance. If you must scroll around to see all the information, it has transgressed the boundaries of a dashboard. If you must shift from screen to screen to see it all, you've made use of multiple dashboards. The object is to have the most important information readily and effortlessly available so you can quickly absorb what you need to know.

Must the information be displayed in a web browser? That might be the best medium for most dashboards today, but it isn't the only acceptable medium, and it might not be the best medium 10 years from now. Must the information be constantly refreshed in real time? Only if the objectives that it serves require real-time information. If you are monitoring air traffic using a dashboard, you must immediately be informed when

something is wrong. On the other hand, if you are making strategic decisions about how to boost sales, a snapshot of information as of last night, or perhaps even the end of last month, should work fine.

Dashboards are used to monitor information at a glance.

Despite the fact that information about almost anything can be appropriately displayed in a dashboard, there is at least one characteristic that describes almost all the information found in dashboards: it is abbreviated in the form of summaries or exceptions. This is because you cannot monitor at a glance all the details needed to achieve your objectives. A dashboard must be able to quickly point out that something deserves your attention and might require action. It needn't provide all the details necessary to take action, but if it doesn't, it ought to make it as easy and seamless as possible to get to that information. Getting there might involve shifting to a different display beyond the dashboard, using navigational methods such as drilling down. The dashboard does its primary job if it tells you with no more than a glance that you should act. It serves you superbly if it directly opens the door to any additional information that you need to take that action.

That's the essence of the dashboard. Now let's add to this definition a couple more supporting attributes that help dashboards do their job effectively:

Dashboards have small, concise, clear, and intuitive display mechanisms. Display mechanisms that clearly state their message without taking up much space are required, so that the entire collection of information will fit into the limited real estate of a single screen. If something that looks like a fuel gauge, traffic signal, or thermometer fits this requirement best for a particular piece of information, that's what you should use, but if something else works better, you should use that instead. Insisting on sexy displays similar to those found in a car when other mechanisms would work better is counterproductive.

Dashboards are customized. The information on a dashboard must be tailored specifically to the requirements of a given person, group, or function; otherwise, it won't serve its purpose.

A dashboard is a type of display, a form of presentation, not a specific type of information or technology. Keep this distinction clear, and you will be freed to focus on what really matters: designing dashboards to communicate.

A Timely Opportunity

Several circumstances have recently combined to create a timely opportunity for dashboards to add value to the workplace, including technologies such as high-resolution graphics, emphasis on performance management and metrics, and a growing recognition of visual perception as a powerful channel for information acquisition and comprehension. Dashboards offer a unique solution to the problem of information overload—not a complete solution by any means, but one that helps a lot. As Dr. Hovis wrote in that same article in *DM Direct*:

The real value of dashboard products lies in their ability to replace hunt-and-peck data-gathering techniques with a tireless, adaptable, information-flow mechanism. Dashboards transform data repositories into consumable information.

Gregory L. Hovis, "Stop Searching for Information – Monitor it with Dashboard Technology," *DM Direct*, February 2002

Dashboards aren't all that different from some of the other means of presenting information, but when properly designed the single-screen display of integrated and finely tuned data can deliver insight in an especially powerful way.

Dashboards and visualization are cognitive tools that improve your "span of control" over a lot of business data. These tools help people visually identify trends, patterns and anomalies, reason about what they see and help guide them toward effective decisions. As such, these tools need to leverage people's visual capabilities. With the prevalence of scorecards, dashboards and other visualization tools now widely available for business users to review their data, the issue of visual information design is more important than ever.

Richard Brath and Michael Peters, "Dashboard Design: Why Design is Important," *DM Direct*, October 2004

The final sentiment that Brath and Peters expressed in this excerpt from their article underscores the purpose of this book. As data visualization becomes increasingly common as a means of business communication, it is imperative that expertise in data visualization be acquired. This expertise must be grounded in an understanding of visual perception, and of how this understanding can be effectively applied to the visual display of data—what works, what doesn't, and why. These skills are rarely found in the business world, not because they are difficult to learn, but because the need to learn them is seldom recognized. This is true in general, and especially with regard to dashboards. The challenge of presenting a large assortment of data on a single screen in a way that produces immediate insight is by no means trivial. Buckle up; you're in for a fun ride.

2

VARIATIONS IN DASHBOARD USES AND DATA

Dashboards can be used to monitor many types of data and to support almost any set of objectives a business deems important. There are many ways to categorize dashboards into various types. The way that relates most directly to a dashboard's visual design involves the role it plays, whether strategic, analytical, or operational. The design characteristics of the dashboard can be tailored to effectively support the needs of each of these roles. While certain differences such as these will affect design, there are also many commonalities that span all dashboards and invite a standard set of design practices.

Categorizing dashboards

Common threads in dashboard data

Non-quantitative dashboard data

Dashboards are used to support a broad spectrum of information needs, spanning the entire range of business efforts that might benefit from an immediate overview of what's going on. Dashboards can be tailored to specific purposes, and a single individual might benefit from multiple dashboards, each supporting a different aspect of that person's work. The various data and purposes that dashboards can be used to support are worth distinguishing, for they sometimes demand differences in visual design and functionality.

Categorizing Dashboards

Dashboards can be categorized in several ways. No matter how limited and flawed the effort, doing so is useful because it helps us to examine the benefits and many uses of the medium. I'm one of those people who enjoys the process of classifying things, breaking them up into groups. It's an intellectual exercise that forces me to dig beneath the surface. I don't, however, assign undue worth to any one way of categorizing something, and I certainly don't ever want to give in to the arrogance of claiming that mine is the only way.

Taxonomies—a scientific term for systems of classification—are always based on one or more variables (that is, categories consisting of multiple potential values). For instance, based on the variable "platform," a dashboard taxonomy could consist of those that run in client/server mode and those that run in web browsers. The following table lists several variables that can be used to structure dashboard taxonomies, along with potential values for each. This list certainly isn't comprehensive; these are simply my attempts to express the variety and explore the potential of the dashboard medium.

Variable	Values
Role	Strategic Analytical Operational
Type of data	Quantitative Non-quantitative
Data domain	Sales Finance Marketing Manufacturing Human Resources
Type of measures	Balanced Scorecard (for example, KPIs) Six Sigma Non-performance
Span of data	Enterprise-wide Departmental Individual
Update frequency	Monthly Weekly Daily Hourly Real time or near real time
Interactivity	Static display Interactive display (drill-down, filters, etc.)
Mechanisms of display	Primarily graphical Primarily text Integration of graphics and text
Portal functionality	Conduit to additional data No portal functionality

Classifying Dashboards by Role

Perhaps one of the most useful ways to categorize a dashboard, and the one that I'll focus on, is by its role—the type of business activity that it supports. My breakdown of dashboards into three roles (strategic, analytical, and operational) is certainly not the only way to express the types of business activities a dashboard can support. However, this is the only classification that significantly relates to differences in visual design.

Dashboards for strategic purposes

The primary use of dashboards today is for strategic purposes. The popular “executive dashboard,” and most of the dashboards that support managers at any level in an organization, are strategic in nature. They provide the quick overview that decision makers need to monitor the health and opportunities of the business. Dashboards of this type focus on high-level measures of performance, including forecasts to light the path into the future. Although these measures can benefit from contextual information to clarify the meaning, such as comparisons to targets and brief histories, along with simple evaluators of performance (for example, good and bad), too much information of this type or too many subtle gradations can distract from the primary and immediate goals of the strategic decision maker.

Extremely simple display mechanisms work best for this type of dashboard. Given the goal of long-term strategic direction, rather than immediate reactions to fast-paced changes, these dashboards don’t require real-time data; rather, they benefit from static snapshots taken monthly, weekly, or daily. Lastly, they are usually unidirectional displays that simply present what is going on. They are not designed for the interaction that might be needed to support further analysis, because this is rarely the direct responsibility of the strategic manager. You’ll be lucky if you can get an executive to view the information on a computer screen rather than a piece of paper, let alone deal with the navigational demands of interactive online analysis.

Dashboards for analytical purposes

Dashboards that support data analysis require a different design approach. In these cases the information often demands greater context, such as rich comparisons, more extensive history, and subtler performance evaluators. Like strategic dashboards, analytical dashboards also benefit from static snapshots of data that are not constantly changing from one moment to the next. However, more sophisticated display media are often useful for the analyst who must examine complex data and relationships and is willing to invest the time needed to learn how they work. Analytical dashboards should support interactions with the data, such as drilling down into the underlying details, to enable the exploration needed to make sense of it—that is, not just to see what is going on but to examine the causes. For example, it isn’t enough to see that sales are decreasing; when your purpose is analysis, you must be made aware of such patterns so that you can then explore them to discover what is causing the decrease and how it might be corrected. The dashboard itself, as a monitoring device that tells the analyst what to investigate, need not support all the subsequent interactions directly, but it should link as seamlessly as possible to the means to analyze the data.

Dashboards for operational purposes

When dashboards are used to monitor operations, they must be designed differently from those that support strategic decision making or data analysis. The characteristic of operations that uniquely influences the design of dashboards most is their dynamic and immediate nature. When you monitor operations, you must maintain awareness of activities and events that are constantly changing and might require attention and response at a moment's notice. If the robotic arm on the manufacturing assembly line that attaches the car door to the chassis runs out of bolts, you can't wait until the next day to become aware of the problem and take action. Likewise, if traffic on your web site suddenly drops to half its normal level, you want to be notified immediately.

As with strategic dashboards, the display media on operational dashboards must be very simple. In the stressful event of an emergency that requires an immediate response, the meaning of the situation and the appropriate responses must be extremely clear and simple, or mistakes will be made. In contrast to strategic dashboards, operational dashboards must have the means to grab your attention immediately if an operation falls outside the acceptable threshold of performance. Also, the information that appears on operational dashboards is often more specific, providing a deeper level of detail. If a critical shipment is at risk of missing its deadline, a high-level statistic won't do; you need to know the order number, who's handling it, and where it is in the warehouse. Details like these might appear automatically on an operational dashboard, or they might be accessed by drilling down on or hovering the mouse over higher-level data, so interactivity is often useful.

The ways that dashboard design must take different forms in response to different roles are clearly worth your attention. We'll examine some of these differences in more detail in Chapter 8, *Putting It All Together*, when we review several examples of what works and what doesn't for various purposes.

Typical Dashboard Data

Dashboards are useful for all kinds of work. Whether you're a meteorologist monitoring the weather, an intelligence analyst monitoring potential terrorist chatter, a CEO monitoring the health and opportunities of a multi-billion dollar corporation, or a financial analyst monitoring the stock market, a well-designed dashboard could serve you well.

The Common Thread in Dashboard Diversity

Despite these diverse applications, in almost all cases dashboards primarily display *quantitative measures of what's currently going on*. This type of data is common across almost all dashboards because they are used to monitor the critical information needed to do a job or meet one or more particular objectives, and most (but not all, as we'll see later) of the information that does this best is quantitative.

The following table lists several measures of “what's currently going on” that are typical in business.

Category	Measures
Sales	Bookings Billings Sales pipeline (anticipated sales) Number of orders Order amounts Selling prices
Marketing	Market share Campaign success Customer demographics
Finance	Revenues Expenses Profits
Technical Support	Number of support calls Resolved cases Customer satisfaction Call durations
Fulfillment	Number of days to ship Backlog Inventory levels
Manufacturing	Number of units manufactured Manufacturing times Number of defects
Human Resources	Employee satisfaction Employee turnover Count of open positions Count of late performance reviews
Information Technology	Network downtime System usage Fixed application bugs
Web Services	Number of visitors Number of page hits Visit durations

These measures are often expressed in summary form, most often as totals, slightly less often as averages (such as average selling price), occasionally as measures of distribution (such as a standard deviation), and rarer still as measures of correlation (such as a linear correlation coefficient). Summary expressions of quantitative data are particularly useful in dashboards, where it is necessary to monitor an array of business phenomena at a glance. Obviously, the limited real estate of a single screen requires concise communication.

Variations in timing

Measures of what's currently going on can be expressed in a variety of timeframes. A few typical examples include:

- This year to date
- This week to date
- This quarter to date
- Yesterday
- This month to date
- Today so far

The appropriate timeframe is determined by the nature of the objectives that the dashboard supports.

Enrichment through comparison

These measures can be displayed by themselves, but it is usually helpful to compare them to one or more related measures to provide context and thereby enrich their meaning. Here are perhaps the most typical comparative measures, and an example of each.

Comparative measure	Example
The same measure at the same point in time in the past	The same day last year
The same measure at some other point in time in the past	The end of last year
The current target for the measure	A budgeted amount for the current period
Relationship to a future target	Percentage of this year's budget so far
A prior prediction of the measure	Forecast of where we expected to be today
Relationship to a future prediction of the measure	Percentage of this quarter's forecast

Comparative measure	Example
Some measure of the norm for this measure	Average, normal range, or a benchmark, such as the number of days it normally takes to ship an order
An extrapolation of the current to measure in the form of a probable future, either at a specific point in the future or as a time series	Projection out into the future, such as the coming year end
Someone else's versions of the same measure	A competitor's measure, such as revenues
A separate but related measure	Order count compared to order revenue

These comparisons are often expressed graphically to clearly communicate the differences between the values, which might not leap out as dramatically through the use of text alone. However, text alone is often adequate. For example, when only the comparison itself is required and the individual measures (a primary measure and a comparative measure) aren't necessary, a single number expressed as a percentage can be used (such as 119% of budget or -7% of where we were this time last year).

Measures of what's currently going on may be displayed either as a single measure, as a single measure combined with one or more individual comparative measures, or as one of the following:

- Multiple instances of a measure, each representing a categorical subdivision of the measure (for example, sales subdivided into regions or a count of orders subdivided into numeric ranges in the form of a frequency distribution)
- Temporal instances of a measure (that is, a time series, such as monthly instances of the measure)

Time series in particular provide rich context for understanding what's really going on and how well it's going.

Enrichment through evaluation

Because with a dashboard a great deal of data must be evaluated quickly, it also is quite useful to explicitly declare whether something is good or bad. Such evaluative information is often encoded as special visual objects (for example, a traffic light) or as visual attributes (for example, by displaying the measure in bright red to indicate a serious condition). When designed properly, simple visual indicators can clearly alert users to the state of

particular measures without altering the overall design of the dashboard. Evaluative indicators need not be limited to binary distinctions between good and bad, but if they exceed the limit of more than a few distinct states (for example, very bad, bad, acceptable, good, and very good), they run the risk of becoming too complex for efficient perception.

Non-Quantitative Dashboard Data

Many people think of dashboards and KPIs as nearly synonymous. It is certainly true that dashboards are a powerful medium for presenting KPIs, but not all quantitative information that might be useful on a dashboard belongs to the list of defined KPIs. In fact, not all information that is useful on dashboards is even quantitative—the critical information needed to do a job cannot always be expressed numerically. Although most information that typically finds its way onto a dashboard *is* quantitative, some types of non-quantitative data, such as simple lists, are fairly common as well. Here are a few examples:

- Top 10 customers
- Issues that need to be investigated
- Tasks that need to be completed
- People who need to be contacted

Another type of non-quantitative data occasionally found on dashboards relates to schedules, including tasks, due dates, the people responsible, and so on. This is common when the job that the dashboard supports involves the management of projects or processes.

A rarer type involves the display of entities and their relationships. Entities can be steps or stages in a process, people or organizations that interact with one another, or events that affect one another, to name a few common examples. This type of display usually encodes entities as circles or rectangles and relationships as lines, often with arrows at one or both ends to indicate direction or influence. It is often useful to integrate quantitative information that is associated with the entities and relationships, such as the amount of time that passed between events in a process (for example, by associating a number with the line that links the events or by having the length of the line itself encode the duration) or the sizes of business entities (perhaps expressed in revenues or number of employees).

Now that you know a bit about how and why dashboards are used, it's time to take a closer look at some design principles. In the next chapter, we'll delve into some of the mistakes that are commonly made in dashboard design.