Chapter 3. Thirteen Common Mistakes in Dashboard Design

Preoccupation with superficial and functionally distracting visual characteristics of dashboards has led to a rash of visual design problems that undermine their usefulness. Thirteen visual design problems are frequently found in dashboards, including in the examples featured as exemplary by software vendors.

Exceeding the boundaries of a single screen

Supplying inadequate context for the data

Displaying excessive detail or precision

Choosing a deficient measure

Choosing inappropriate display media

Introducing meaningless variety

Using poorly designed display media

Encoding quantitative data inaccurately

Arranging the data poorly

Highlighting important data ineffectively or not at all

Cluttering the display with useless decoration

Misusing or overusing color

Designing an unattractive visual display

The fundamental challenge of dashboard design is the need to squeeze a great deal of information into a small amount of space, resulting in a display that is easily and immediately understandable. If this doesn't sound challenging, either you are an expert designer with extensive dashboard experience, or you are basking in the glow of naiveté. Attempt the task, and you will find that dashboards pose a unique data visualization challenge. And don't assume that you can look to your software vendor for helpif they have the necessary design talent, they're doing a great job of hiding it.

Sadly, it is easy to find many examples of the mistakes you should avoid by looking no further than the web sites of the software vendors themselves. Let's use some of these examples to examine design that doesn't work and learn why it doesn't.

Note: In almost every case, I've chosen to use actual examples from vendor web sites to illustrate dashboard design mistakes. In doing so, I am not saying that the software that produced the example is badI'm not commenting on the quality of the software one way or another. What I am saying is that the design practice is bad. This results primarily from vendors' lack of expertise in or inattention to visual design. These vendors should know better, but they've chosen to focus their energies on other aspects of their products, often highlighting glitzy visual features that actually undermine effective communication. I hope that seeing their work used to illustrate poor dashboard design will serve as a wake-up call to start paying attention to the features that really matter.

3.1. Exceeding the Boundaries of a Single Screen

My insistence that a dashboard should confine its display to a single screen, with no need for scrolling or switching between multiple screens, might seem arbitrary and a bit finicky, but it is based on solid and practical rationale. After studying data visualization for a while, including visual perception, one discovers that something powerful happens when things are seen together, all within eye span. Likewise, something

critical is lost when you lose sight of some data by scrolling or switching to another screen to see other data. Part of the problem is that we can hold only a few chunks of information at a time in short-term memory. Relying on the mind's eye to remember information that is no longer visible is a rocky venture.

One of the great benefits of a dashboard as a medium of communication is the simultaneity of vision that it offers: the ability to see everything that you need at once. This enables comparisons that lead to insightsthose "Aha!" experiences that might not occur in any other way. Clearly, exceeding the boundaries of a single screen negates this benefit. Let's examine the two versions of this problemfragmenting data into separate screens and requiring scrollingindependently.

3.1.1. Fragmenting Data into Separate Screens

Information that appears on dashboards is often fragmented in one of two ways:

- Separated into discrete screens to which one must navigate
- Separated into different instances of a single screen that are accessed through some form of interaction

Enabling users to navigate to discrete screens or different instances of a single screen to access additional information is not, in general, a bad practice. Allowing navigation to further detail or to a different set of information that achieves its purpose best by standing alone can be a powerful dashboard feature. However, when all the information should be seen at the same time to gain the desired insights, that fragmentation undermines the unique advantages of a dashboard. Fragmenting data that should be seen together is a mistake.

Let's look at an example. The dashboard in Figure 3-1 fragments the data that executives need into 10 separate dashboards. This would be fine if the executives wouldn't benefit from seeing these various measures together, but that is hardly the case.

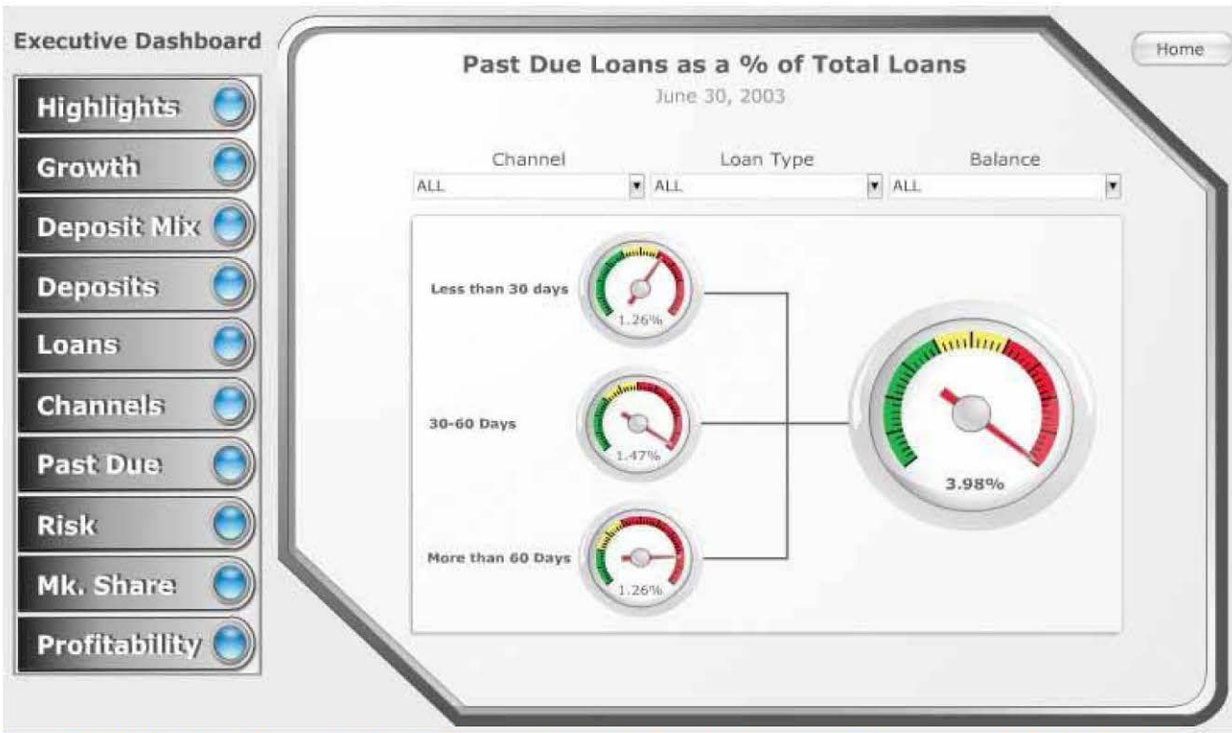


Figure 3-1. This dashboard fragments the data in a way that undermines the viewer's ability to see meaningful relationships.

In this example, a banking executive is forced to examine the performance of the following aspects of the business separately:

- Highlights
- Deposits
- Past due loans
- Profitability
- Growth
- Loans
- Risk
- Deposit mix
- Channels
- Market share

Each of these screens presents a separate, high-level snapshot of a single set of measures that ought to be integrated into a single screen. Despite what you might assume about the available screen labeled "Highlights," it does not provide a consolidated visual overview of the data but consists primarily of a text table that contains several of the measures. A banking executive needs to see these measures together in a way that enables comparisons to understand how they relate to and influence one another.

Splitting the big picture into a series of separate small pictures is a mistake whenever seeing the big picture is worthwhile.

A similar example, from the same software vendor, is shown in Figure 3-2. This time the picture of daily sales has been split into a separate dashboard for each of 20 products. If the intention is to serve the needs of product managers who are each exclusively interested in a single product and never want to compare sales of that product to others, this design doesn't fragment the data in a harmful way. If, however, any benefit can be gained by viewing the sales of multiple products together, which is almost surely the case, this design fails.

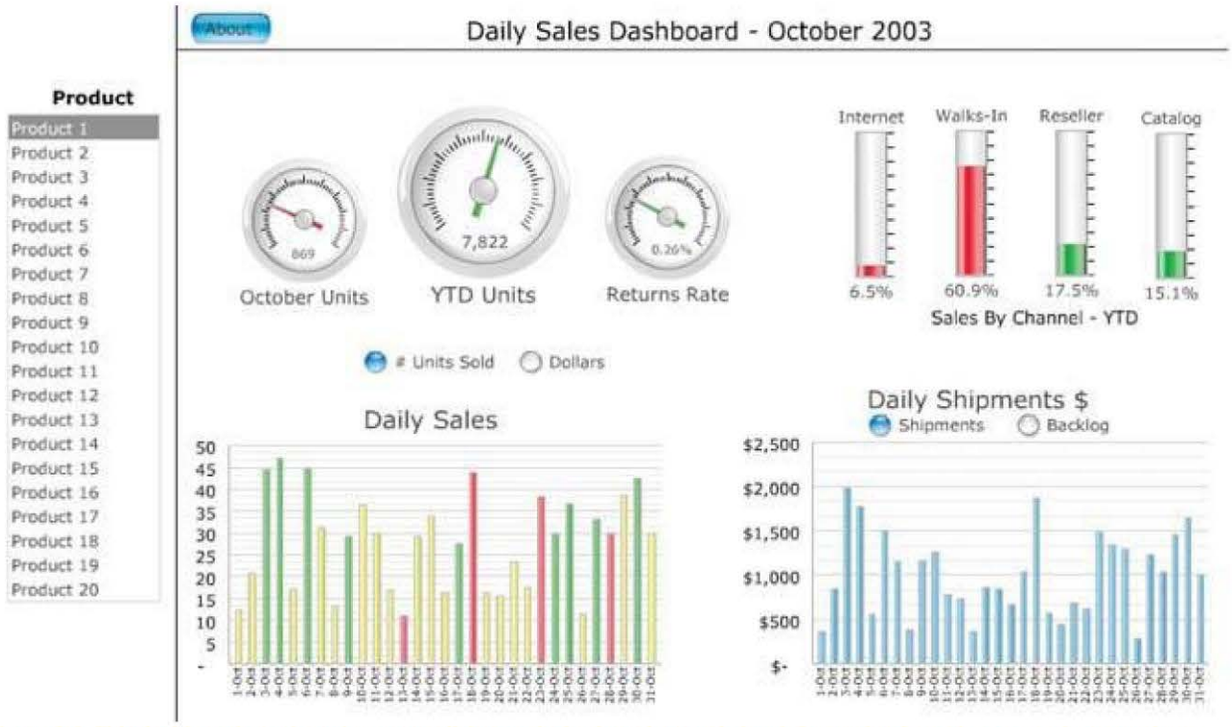


Figure 3-2. This dashboard requires viewers to click on a desired product and view information for only one product at a time.

3.1.2. Requiring Scrolling

The dashboard in Figure 3-3 illustrates the problem that's created when scrolling is required to see all the data. Not only are we left wondering what lies below the bottom of the screen in the dashboard as a whole, but we're also given immediate visual access only to the first of many metrics that appear in the scrollable box at the top right, beginning with "No. Transactions." We'd be better off reading a printed report extending across multiple pages, because at least then we could lay out all of the pages at once for simultaneous viewing. People commonly assume that anything that lies beyond their immediate field of vision and requires scrolling to see is of less importance than what's immediately visible. Many viewers won't bother to look at what lies off the screen, and those who take the time will likely resent the effort.

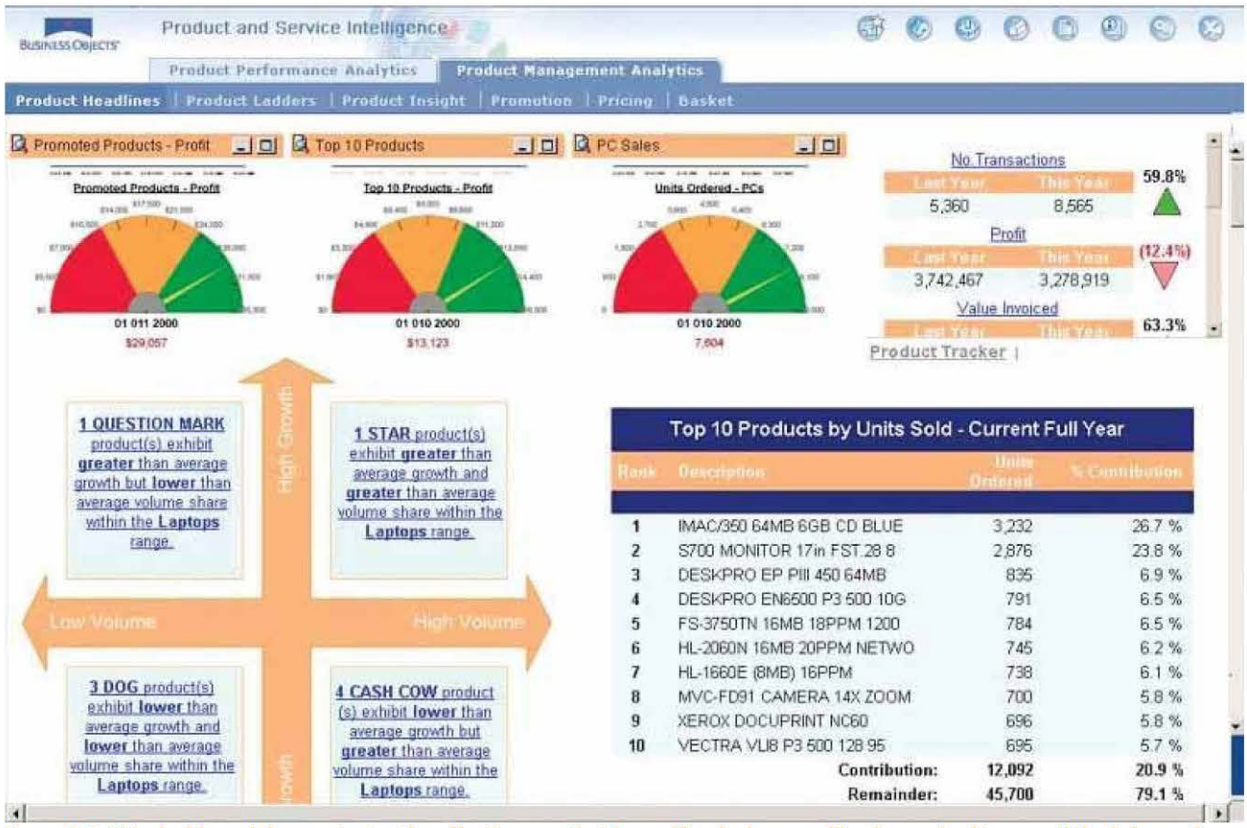


Figure 3-3. This dashboard demonstrates the effectiveness that is sacrificed when scrolling is required to see all the information.

3.2. Supplying Inadequate Context for the Data

Measures of what's currently going on in the business rarely do well as a solo act; they need a good supporting cast to succeed. For example, to state that quarter-to-date sales total $736,502 without any context means little. Compared to what? Is this good or bad? How good or bad? Are we on track? Are we doing better than we have in the past, or worse than we've forecasted? Supplying the right context for key measures makes the difference between numbers that just sit there on the screen and those that enlighten and inspire action.

The gauges in Figure 3-4 could easily have incorporated useful context, but they fall short of their potential. For instance, the center gauge tells us only that 7,822 units have sold this year to date, and that this number is good (indicated by the green arrow). A quantitative scale on a graph, such as the radial scales of tick marks on these gauges, is meant to provide an approximation of the measure, but it can only do so if the scale is labeled with numbers, which these gauges lack. If the numbers had been present, the positions of the arrows might have been meaningful, but here the presence of the tick marks along a radial axis suggests useful information that hasn't actually been included.

Figure 3-4. These dashboard gauges fail to provide adequate context to make the measures meaningful.

These gauges use up a great deal of space to tell us nothing whatsoever. The same information could have been communicated simply as text in much less space, without any loss of meaning:

Table 3-1.	
YTD Units	7,822
October Units	869
Returns Rate	0.26%

Another failure of these gauges is that they tease us by coloring the arrows to indicate good or bad performance, without telling us how good or bad it is. They could easily have done this by labeling the quantitative scales and visually encoding sections along the scales as good or bad, rather than just encoding the arrows in this manner. Had this been done, we would be able to see at a glance how good or bad a measure is by how far the arrow points into the good or bad ranges.

The gauge that appears in Figure 3-5 does a better job of incorporating context in the form of meaningful comparisons. Here, the potential of the graphical display is more fully realized. The gauge measures the average duration of phone calls and is part of a larger dashboard of call-center data.

Supplying context for measures need not always involve a choice of the single best comparisonrather, several contexts may be given. For instance, quarter-to-date sales of $736,502 might benefit from comparisons to the budget target of $1,000,000; sales on this day last year of $856,923; and a time-series of sales figures for the last six quarters. Such a display would provide much richer insight than a simple display of the current sales figure, with or without an indication of whether it's "good" or "bad." You must be careful, however, when incorporating rich context such as this to do so in a way that doesn't force the viewer to get bogged down in reading the details to get the basic message. It is useful to provide a visually prominent display of the primary information and to subdue the supporting context somewhat, so that it doesn't get in the way when the dashboard is being quickly scanned for key points.

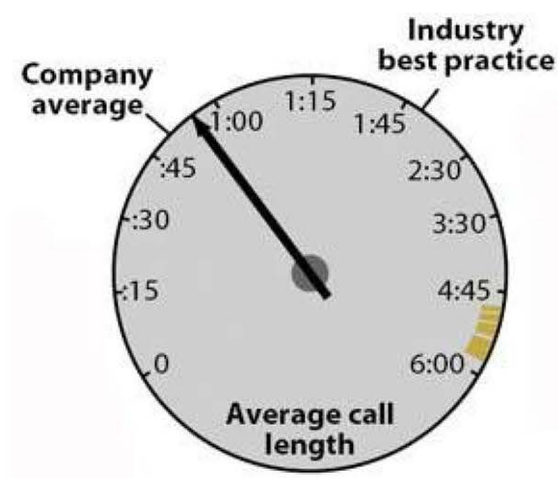


Figure 3-5. This dashboard gauge (found in a paper entitled "Making Dashboards Actionable," written by Laurie M. Orlov and published in December 2003 by Forrester Research, Inc.) does a better job than those in Figure 3-4 of using a gauge effectively.

The amount of context that ought to be incorporated to enrich the measures on a dashboard depends on its purpose and the needs of its viewers. More is not always better, but when more provides real value, it ought to be included in a way that supports both a quick overview without distraction as well as contextual information for richer understanding.[1]

3.3. Displaying Excessive Detail or Precision

Dashboards almost always require fairly high-level information to support the viewer's need for a quick overview. Too much detail, or measures that are expressed too precisely (for example, $3,848,305.93 rather than $3,848,305, or perhaps even $3.8M), just slow viewers down without providing them any benefit. In a way, this problem is the opposite extreme of the one we examined in the previous sectiontoo much information rather than too little.

The dashboard in Figure 3-6 illustrates this type of excess. Examine the two sections that I've enclosed in red rectangles. The lower-right section displays from 4 to 10 decimal digits for each measure, which might be useful in some contexts, but doubtfully in a dashboard. The highlighted section above displays time down to the level of seconds, which also seems like overkill in this context. With a dashboard, every unnecessary piece of information results in time wasted trying to filter out what's important, which is intolerable when time is of the essence.

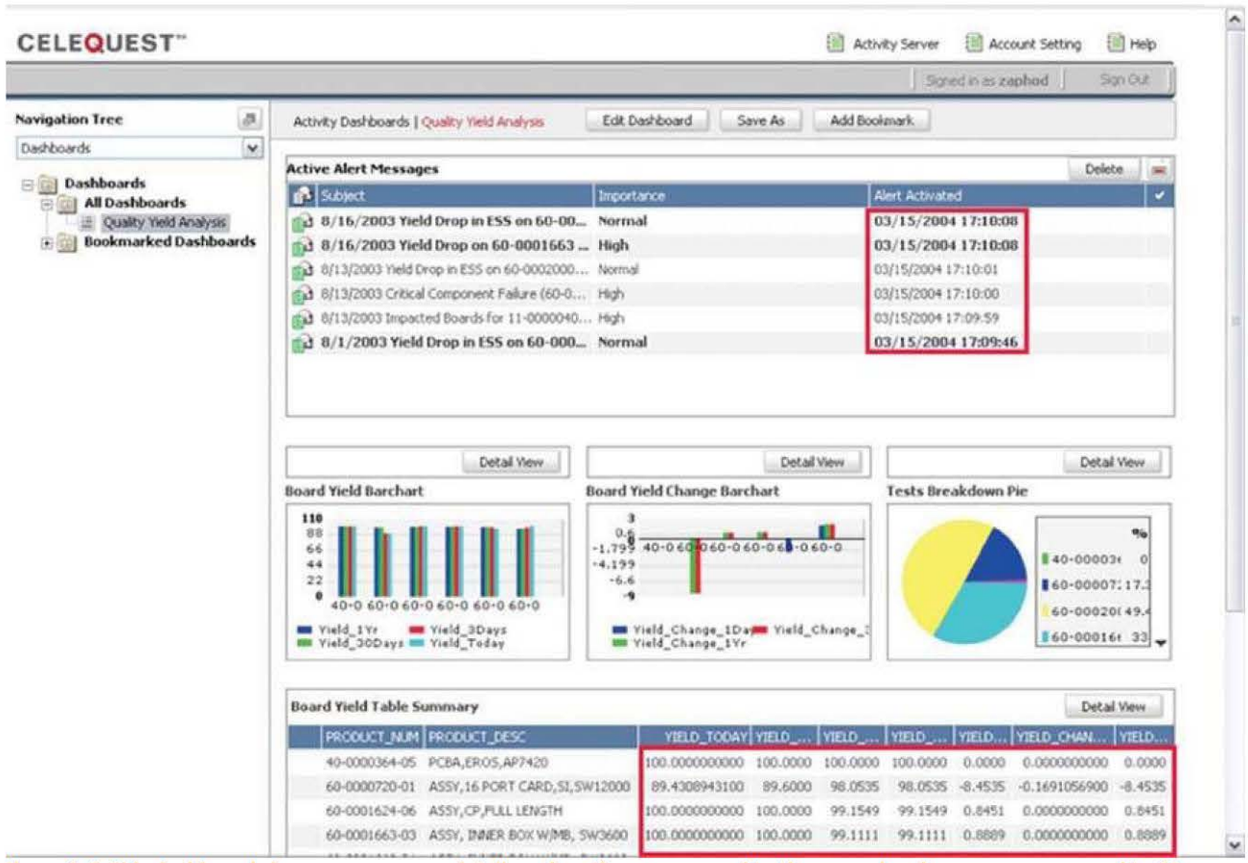


Figure 3-6. This dashboard shows unnecessary detail, such as times expressed to the second and measures expressed to 10 decimal places.

[1] I believe that the circular shape used by gauges like this one wastes valuable space on a dashboard, as I'll explain in Chapter 6, Effective Dashboard Display Media. Nevertheless, I commend this gauge for displaying richer information than most.

3.4. Choosing a Deficient Measure

For a measure to be meaningful, we must know what is being measured and the units in which the measure is being expressed. A measure is deficient if it isn't the one that most clearly and efficiently communicates the meaning that the dashboard viewer should discern. It can be accurate, yet not the best choice for the intended message. For example, if the dashboard viewer only needs to know to what degree actual revenue differs from budgeted revenue, it would be more direct to simply express the variance as9% (and perhaps display the variance of$8,066 as well) rather than displaying the actual revenue amount of $76,934 and the budgeted revenue amount of $85,000 and leaving it to the viewer to calculate the difference. In this case, a percentage clearly focuses attention on the variance in a manner that is directly intelligible.

Figure 3-7 illustrates this point. While this graph displays actual and budgeted revenues separately, its purpose is to communicate the variance of actual revenues from the budget.

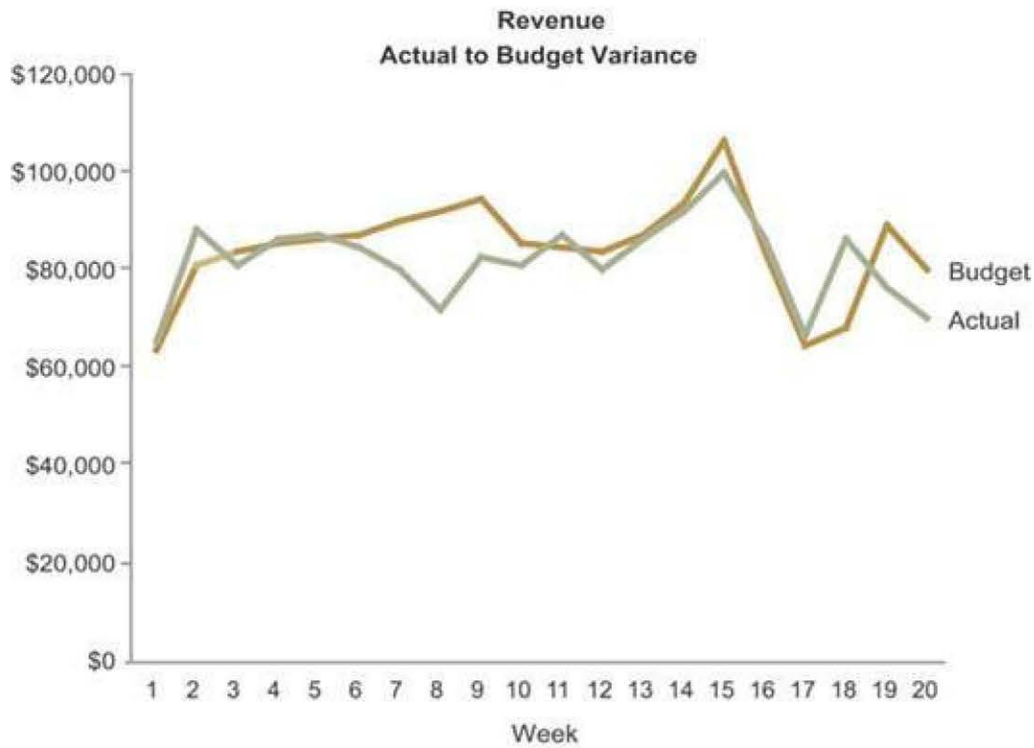


Figure 3-7. This graph illustrates the use of measures that fail to directly express the intended message.

The variance, however, could have been displayed more vividly by encoding budgeted revenue as a reference line of 0% and the variance as a line that meanders above and below budget (expressed in units of positive and negative percentages, as shown on the next page in Figure 3-8). The point here is to always think carefully about the message that most directly supports the viewer's needs, and then select the measure that most directly supports that message.

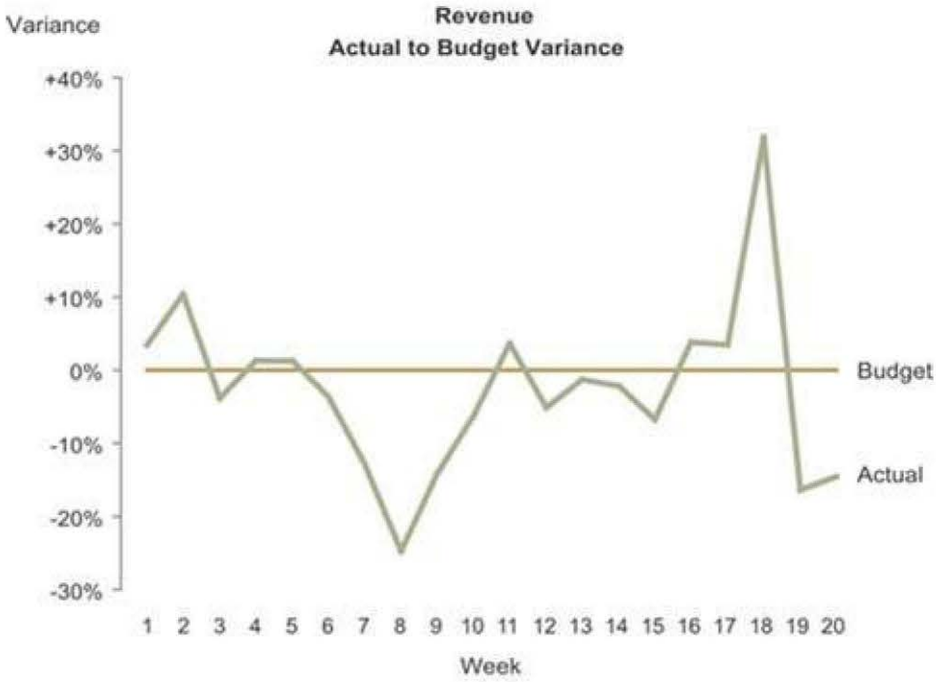


Figure 3-8. This graph is designed to emphasize deviation from a target, which it accomplishes in part by expressing the difference between budgeted and actual revenues using percentages.

3.5. Choosing Inappropriate Display Media

Choosing inappropriate display media is one of the most common design mistakes made, not just in dashboards, but in all forms of quantitative data presentation. For instance, using a graph when a table of numbers would work better, and vice versa, is a frequent mistake. Allow me to illustrate using several examples beginning with the pie chart in Figure 3-9.

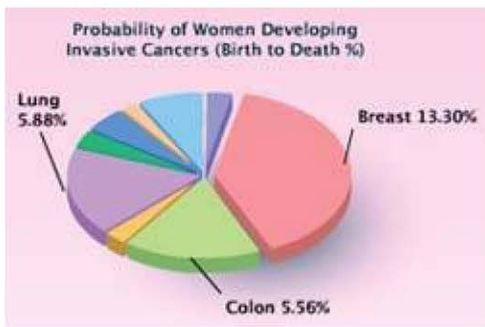


Figure 3-9. This chart illustrates a common problem with pie charts.

This pie chart is part of a dashboard that displays breast cancer statistics. Look at it for a moment and see if anything seems odd.

Pie charts are designed specifically to present parts of a whole, and the whole should always add up to 100%. Here, the slice labeled "Breast 13.30%" looks like it represents around 40% of the piea far cry from 13.3%. Despite the meaning that a pie chart suggests, these slices are not parts of a whole; they represent the probability that a woman will develop a particular form of cancer (breast, lung, colon, and six types that aren't labeled). This misuse of a pie chart invites confusion.

The truth is, I never recommend the use of pie charts. The only thing they have going for them is the fact that everybody immediately knows when they see a pie chart that they are seeing parts of a whole (or

ought to be). Beyond that, pie charts don't display quantitative data very effectively. As you'll see in Chapter 4, Tapping into the Power of Visual Perception, humans can't compare two-dimensional areas or angles very accuratelyand these are the two means that pie charts use to encode quantitative data. Bar graphs are a much better way to display this information.[1]

The pie chart in Figure 3-10 shows that even when correctly used to present parts of a whole, these graphs don't work very well. Without the value labels, you would only be able to discern that opportunities rated as "Fair" represent the largest group, those rated as "Field Sales: 2-Very High" represent a miniscule group, and the other ratings groups are roughly equal in size.

Figure 3-10. This example shows that even when they are used correctly to present parts of a whole, pie charts are difficult to interpret accurately.

Figure 3-11 displays the same data as Figure 3-10, this time using a horizontal bar graph that can be interpreted much more efficiently and accurately.

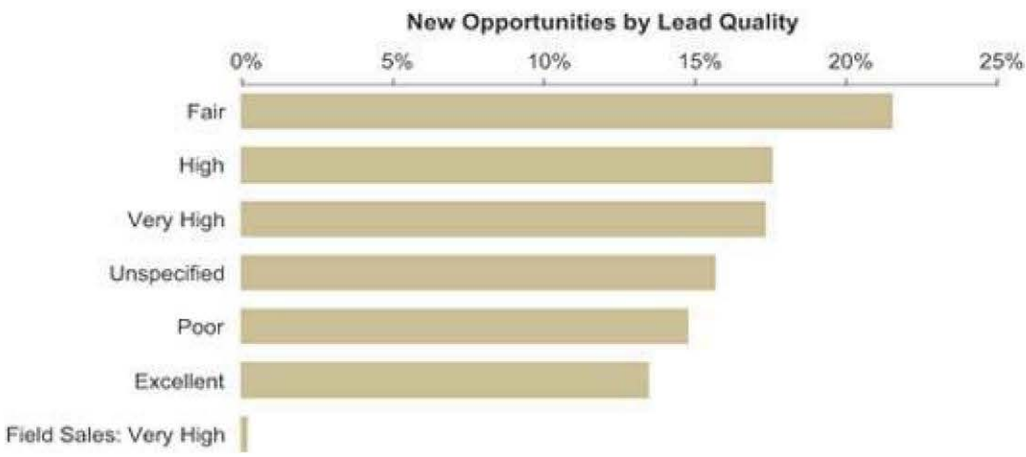


Figure 3-11. This horizontal bar graph does a much better job of displaying part-to-whole data than the preceding pie charts.

[1] Refer to my book Show Me the Numbers: Designing Tables and Graphs to Enlighten (Oakland, CA: Analytics Press, 2004) for a thorough treatment of the types of graphs that work best for the most common quantitative messages communicated in business.

Other types of graphs can be equally ineffective. For example, the graph in Figure 3-12 shows little regard for the viewer's time and no understanding of visual perception. This graph compares revenue to operating costs across five months, using the size of overlapping circles (sometimes called bubbles) to encode the quantities. Just as with the slices of a pie, using circles to encode quantity relies on the viewer's ability to compare two-dimensional areas, which we simply cannot accurately do. Take the values for the month of February as an example. Assuming that operating costs equal $10,000, what is the revenue value?

Figure 3-12. This graph uses the two-dimensional area of circles to encode their values, which needlessly obscures the data.

Our natural tendency is to compare the sizes of the two circles using a single dimensionlength or widthequal to the diameter of each, which suggests that revenue is about three times that of operating costs, or about $30,000. This conclusion is wrong, however, to a huge degree. The two-dimensional area of the revenue circle is actually about nine times bigger than that of the operating costs circle, resulting in a value of $90,000. Oops! Not even close.

Now compare operating costs for the months of February and May. It appears that costs in May are greater than those in February, right? In fact, the interior circles are the same sizemeasure them and see. The revenue bubble in May is smaller than the one in February, which makes the enclosed operating costs bubble in May seem bigger, but this is an optical illusion. As you can see, the use of a bubble chart for this financial data was a poor choice. A simple bar graph like the one in Figure 3-13 works much better.

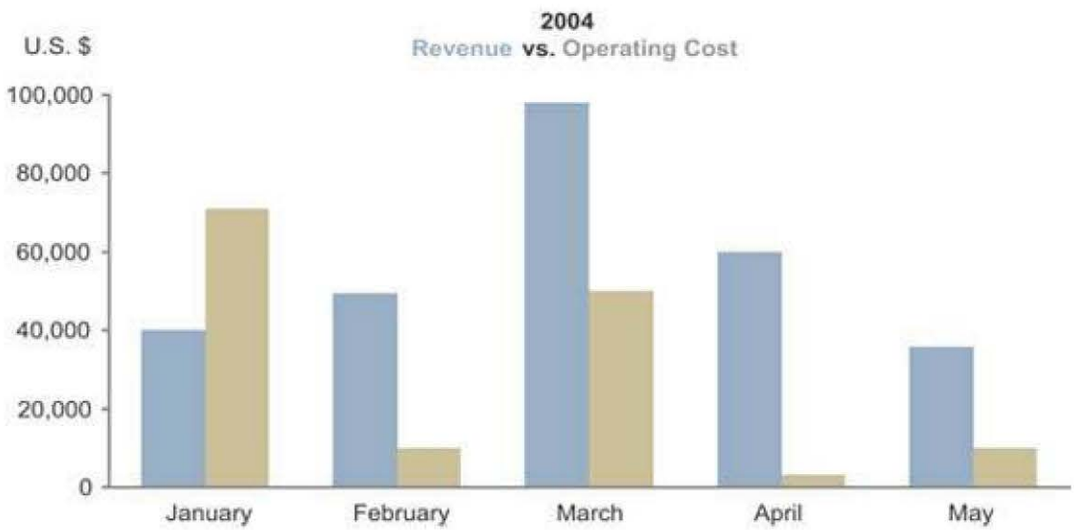


Figure 3-13. This bar graph does a good job of displaying a time series of actual versus budgeted revenue values.

Actual versus budgeted revenue is also the subject of Figure 3-14, but this time it's subdivided into geographical regions rather than time slices and displayed as a radar graph. The quantitative scale on a radar graph is laid along each of the axis lines that extend from the center to the perimeter, like radius lines

of a circle. The smallest values are those with the shortest distance between the center point and the perimeter.

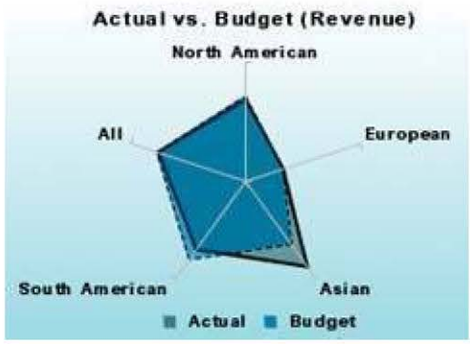


Figure 3-14. This radar graph obscures the straightforward data that it's trying to convey.

The lack of labeled axes in this graph limits its meaning, but the choice of a radar graph to display this information in the first place is an even more fundamental error. Once again, a simple bar graph like the one in Figure 3-15 would communicate this data much more effectively. Radar graphs are rarely appropriate media for displaying business data. Their circular shape obscures data that would be quite clear in a linear display such as a bar graph.

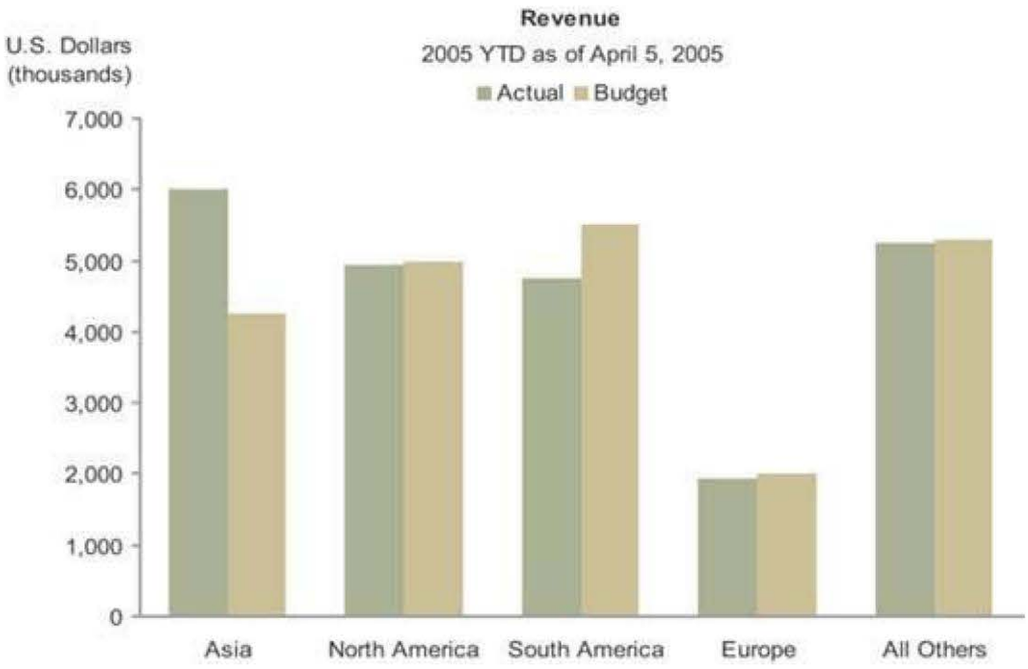


Figure 3-15. This bar graph effectively compares actual to budgeted revenue data.

The last example that I'll use to illustrate my point about choosing inappropriate means of display appears in Figure 3-16.

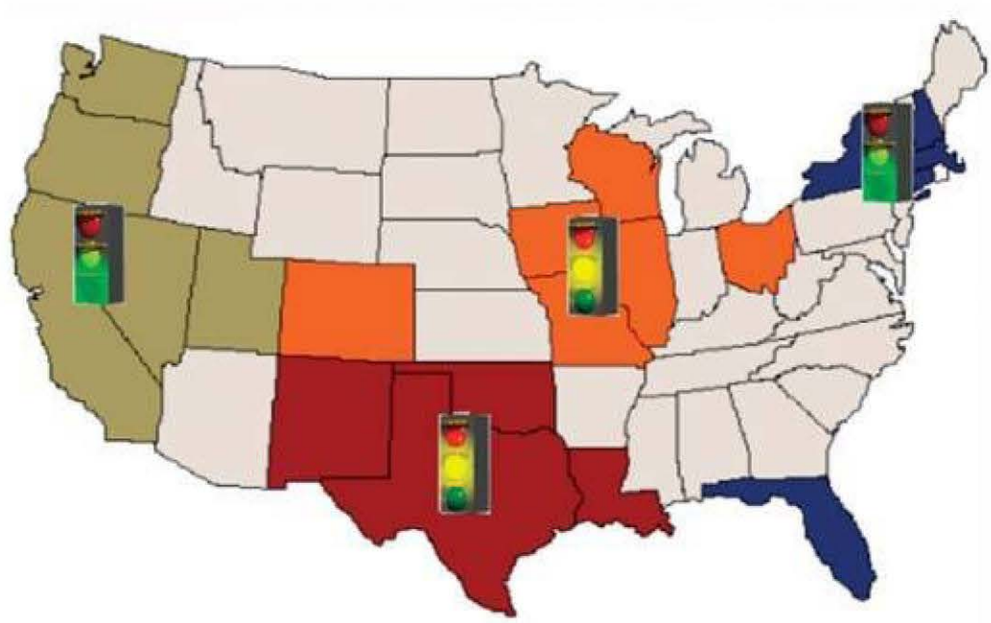


Figure 3-16. This display uselessly encodes quantitative values on a map of the United States.

There are times when it is very useful to arrange data spatially, such as in the form of a map or the floor plan of a building, but this isn't one of them. We don't derive any insight by laying out revenue informationin this case, whether revenues are good (green light), mediocre (yellow light), or poor (red light), in the geographical regions South (brown), Central (orange), West (tan), and East (blue)on a map.

If the graphical display were presenting meaningful geographical relationshipssay, for shipments of wine from California, to indicate where special taxes must be paid whenever deliveries cross state linesperhaps a geographical display would provide some insight. With this simple set of four regions with no particular factors attached to geographical location, however, the use of a map simply takes up a lot of space to say no more than we find in the table that appears on this same dashboard, which is shown in Figure 3-17.

	Actual	Budget
East	$87,398	$78,950
West	$132,931	$119,850
South	$50,846	$49,100
Central	$129,680	$125,180

Figure 3-17. This table, from the same dashboard, provides a more appropriate display of the regional revenue data that appears in Figure 3-16.

3.6. Introducing Meaningless Variety

The mistake of introducing meaningless variety into a dashboard design is closely tied to the one we just examined. I've found that people often hesitate to use the same type of display medium multiple times on a dashboard, out of what I assume is a sense that viewers will be bored by the sameness. Variety might be the spice of life, but if it is introduced on a dashboard for its own sake, the display suffers. You should always select the means of display that works best, even if that results in a dashboard that is filled with nothing but multiple instances of the same type of graph. If you are giving viewers the information that they desperately need to do their jobs, the data won't bore them just because it's all displayed in the same way. They will definitely get aggravated, however, if forced to work harder than necessary to get the information they need due to arbitrary variety in the display media. In fact, wherever appropriate,

consistency in the means of display allows viewers to use the same perceptual strategy for interpreting the data, which saves time and energy.

Figure 3-18 illustrates variety gone amok. This visual jumble requires a shift in perceptual strategy for each display item on the dashboard, which means extra time and effort on the user's part.

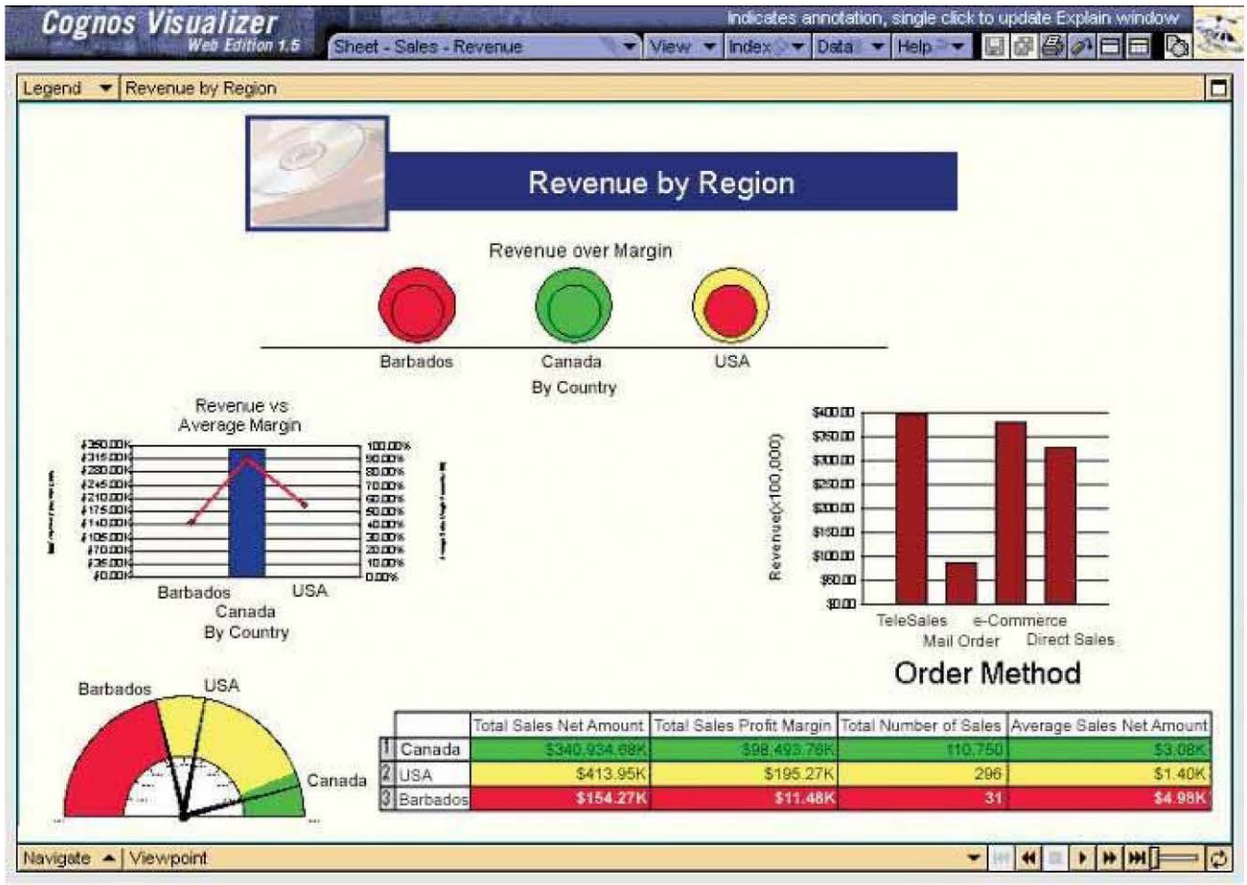


Figure 3-18. This dashboard exhibits an unnecessary variety of display media.

3.7. Using Poorly Designed Display Media

It isn't enough to choose the right medium to display the data and its messageyou also must design the components of that medium to communicate clearly and efficiently, without distraction. Most graphs used in business today are poorly designed. The reason is simple: almost no one has been trained in the fundamental principles and practices of effective graph design. This content is thoroughly covered in my book Show Me the Numbers: Designing Tables and Graphs to Enlighten, so I won't repeat myself here. Instead, I'll simply illustrate the problem with a few examples.

In addition to the fact that a bar graph would have been a better choice to display this data (the division of revenue between six sales), Figure 3-19 exhibits several design problems. Look at it for a moment and see if you can identify aspects of its design that inhibit quick and easy interpretation.

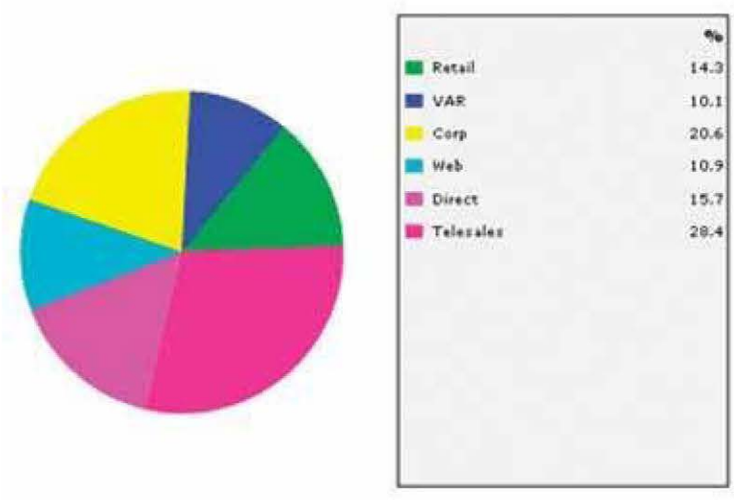


Figure 3-19. This pie chart illustrates several design problems.

Here are the primary problems that I see:

A legend was used to label and assign values to the slices of the pie. This forces our eyes to bounce back and forth between the graph and the legend to glean meaning, which is a waste of time and effort when the slices could have been labeled directly.

The order of the slices and the corresponding labels appears random. Ordering them by size would have provided useful information that could have been assimilated instantly.

The bright colors of the pie slices produce sensory overkill. Bright colors ought to be reserved for specific data that should stand out from the rest.

The pie chart in Figure 3-20 also illustrates a problem with color choice.

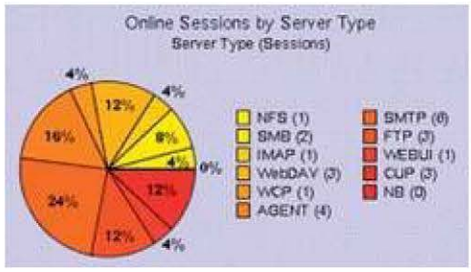


Figure 3-20. This pie chart uses of colors for the slices that are too much alike to be clearly distinguished.

In this case, the 11 colors that were chosen are too similar. It is difficult to determine which of the hues along the yellow through orange to red spectrum in the legend corresponds to each slice of the pie. This kind of eye-straining exercise is deadly, especially on a dashboard.

Another example of an ineffective display medium is shown in Figure 3-21. These meters are an attempt to be true to the metaphor of a car dashboard. Notice that the numbers look just like they would on an odometer: they lack the commas normally used to delineate every set of three digits to help us distinguish thousands from millions, and so on. In a misguided effort to make these meters look realistic, their developers made the numbers harder to readengineers designed these meters, not business people. Notice also that numbers along the quantitative scale are positioned inside rather than outside the axis, which will cause them to be obscured by the needle when it points directly to them, and that the positioning of the

text at the bottom of each meter (for example, "4382934 Amount Sold" on the "Internet Revenue" meter) obstructs the needle for measures near the bottom or top of the scale.

Figure 3-21. These dashboard meters have definitely taken the dashboard metaphor too far.

In the last section, I spoke of bar graphs as a preferable alternative to certain other display media. However, while bar graphs can do an excellent job of displaying quantitative data, they can be misused as well. Examine the graph in Figure 3-22, and take a moment to list any problems with its design that you see. Write down your observations below before reading on, if you'd like.

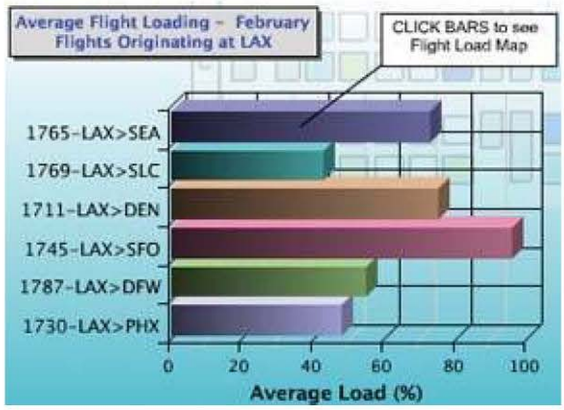


Figure 3-22. This bar graph, found on a dashboard, exhibits several design problems.

You might have noticed that the grid lines on the graph (not to mention the background pattern of colored rectangles) do nothing but distract from the data. Grid lines such as these, especially when visually prominent, make it more difficult to see the shape of the data. Perhaps you also noticed that the 3-D effect of the graph not only added no value, but also made the values encoded by the bars harder to interpret. Anything else? Well, this graph illustrates a common problem with color. Why is each of the bars a different color? The colors aren't being used to identify the bars, as each one has a label to its left. Differences in the color of data-encoding objects should always be meaningful; otherwise, they needlessly grab our attention and cause us to search for meaning that isn't there.

The distinct colors of the bars in Figure 3-23 do, thankfully, carry meaning, but here the colors are distractingly bright and the 3-D effect makes them hard to read.

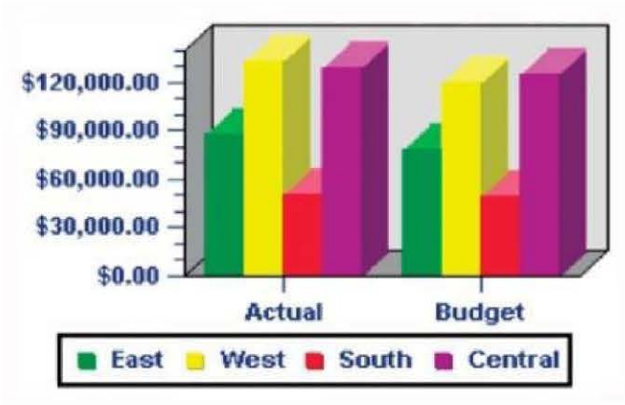


Figure 3-23. This bar graph, found on a dashboard, was poorly designed in a number of ways.

However, this isn't the problem that I most want you to notice. The purpose of the graph is to compare actual to budgeted revenues for each of the four regions, but something about its design makes this difficult. Can you see the problem? Given its purpose, the bars for actual and budgeted revenues for each region should have been placed next to one another. As they are, it is unnecessarily difficult to compare them. Simple design mistakes like this can significantly undermine the success of a dashboard.

Several of the examples that we've examined have been rendered in 3D, even though the third dimension of depth doesn't encode any meaning. Even when the third dimension is used to encode a separate variable, however, it still poses a problem. The graph in Figure 3-24 uses the third dimension of depth to represent time (the four quarters of the year 2001). The problem in this case isn't that the third dimension is meaningless, but rather that you can't read everything on the chart. This is caused by occlusion. Adding the dimension of depth causes some of the bars to be hidden behindor occluded byothers. For instance, what were fax revenues for Quarter 3? You can't tell because the bar is completely hidden. Whether the third dimension is used to encode data or not, you should almost always avoid 3-D graphs. Exceptions to this rule are rare when displaying typical business data.

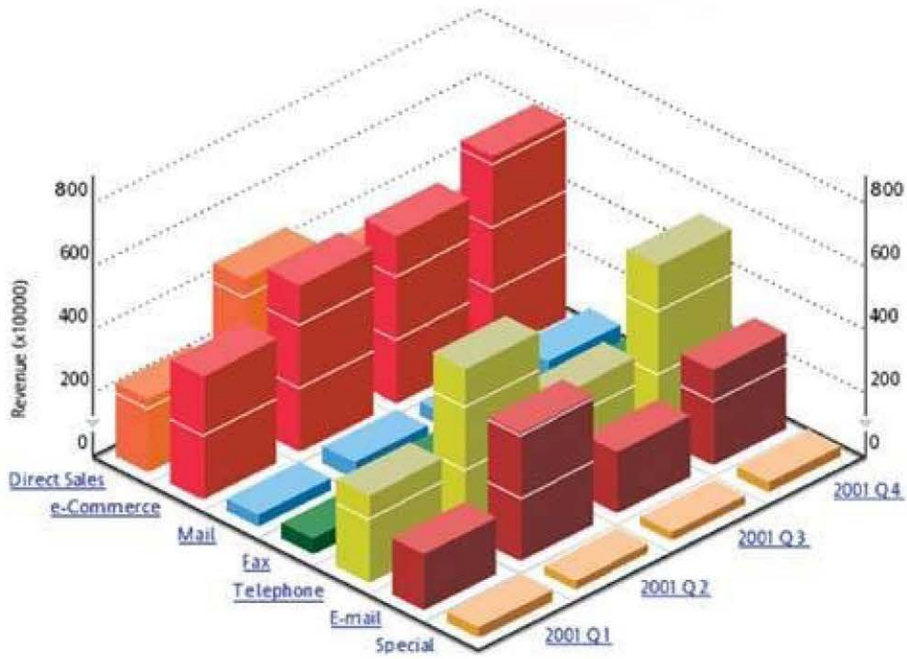


Figure 3-24. This 3-D bar graph illustrates the problem of occlusion.

3.8. Encoding Quantitative Data Inaccurately

Sometimes graphical representations of quantitative data are mistakenly designed in ways that display inaccurate values. In Figure 3-25, for instance, the quantitative scale along the vertical axis was improperly set for a graph that encodes data in the form of bars. The length of a bar represents its quantitative value. The bars in this graph that represent revenue and costs for the month of January suggest that revenue was about four times costs. An examination of the scale, however, reveals the error of this natural assumption: the revenue is actually less than double the costs. The problem is that the values begin at $500,000 rather than $0, as they always should in a bar graph.

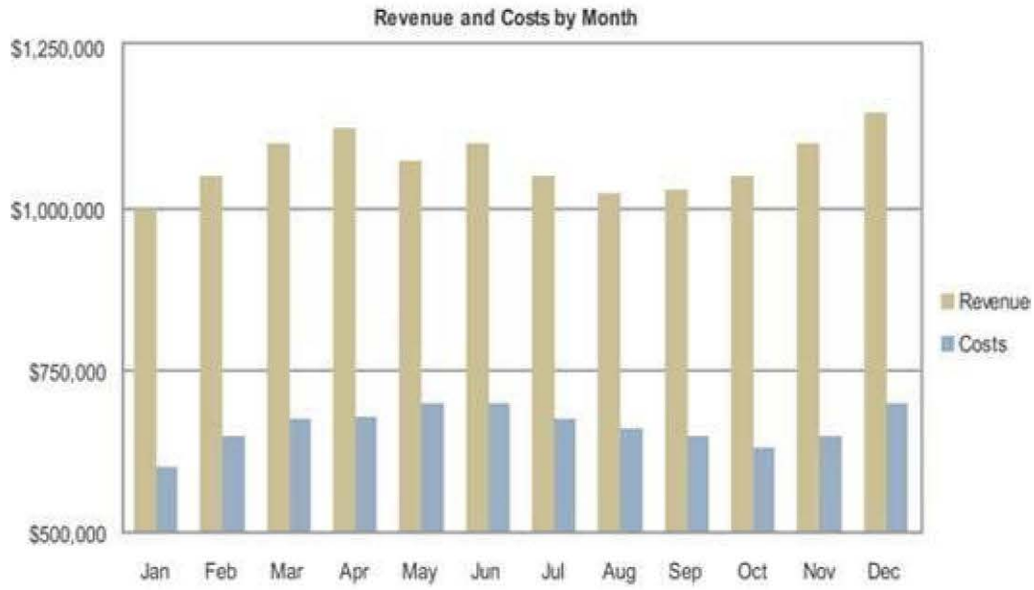


Figure 3-25. This bar graph encodes the quantitative values as bars inaccurately, by failing to begin the scale at zero.

3.9. Arranging the Data Poorly

Dashboards often need to present a large amount of information in a limited amount of space. If the information isn't organized well, with appropriate placement of information based on importance and desired viewing sequence, along with a visual design that segregates data into meaningful groups without fragmenting it into a confusing labyrinth, the result is a cluttered mess. Most examples of dashboards found on the Web are composed of a small amount of data to avoid the need for skilled visual design, but they still often manage to look cluttered and thrown together. The goal is not simply to make the dashboard look good, but to arrange the data in a manner that fits the way it's used. The most important data ought to be prominent. Data that require immediate attention ought to stand out. Data that should be compared ought to be arranged and visually designed to encourage comparisons.

The dashboard in Figure 3-26 illustrates some of the problems often associated with poor arrangement of data. Notice first of all that the most prominent position on this dashboardthe top leftis used to display the vendor's logo and navigational controls. What a waste of prime real estate! As you scan down the screen, the next information that you see is a gauge that presents the average order size. It's possible that average order size might be someone's primary interest, but it's unlikely that, of all the information that appears on this dashboard, this is the most important. As I'll discuss in Chapter 5, Eloquence Through Simplicity, the least prominent real estate on the screen is the lower-right corner. However, in this example the large amount of space taken up by the graphs that present "Computers Returns Across Models," as well as the larger font sizes used in this section, tends to draw attention to data that seems tangential to the rest. This dashboard lacks an appropriate visual sequence and balance based on the nature and importance of the

data. Notice also that the bright red bands of color above each section of the display, where the titles appear in white, are far more eye-catching than is necessary to declare the meanings of the individual displays. This visually segments the space to an unnecessary degree. Lastly, note that the similarity of the line graphs that display order size and profit trends invites our eyes to compare them. This is probably a useful comparison, but the positional separation and side-by-side rather than over-under arrangement of the two graphs makes close comparison difficult. As this example illustrates, you can't just throw information onto the screen wherever you can make it fit and expect the dashboard to do its job effectively.

Figure 3-26. This dashboard exemplifies poorly arranged data.

3.10. Highlighting Important Data Ineffectively or Not at All

When you look at a dashboard, your eyes should immediately be drawn to the information that is most important, even when it does not reside in the most visually prominent areas of the screen. In Chapter 5, Eloquence Through Simplicity, we'll examine several visual techniques that can be used to achieve this end. For now, we'll look at what happens when this isn't done at all, or isn't done well.

The problem with the dashboard in Figure 3-27 is that everything is visually prominent, and consequently nothing stands out. The logo and navigation controls (the buttons on the left) are prominent both as a result of their placement on the screen and the use of strong borders, but these aren't data and therefore shouldn't be emphasized. Then there are the graphs where the data reside: all the data are equally bold and colorful, leaving us with a wash of sameness and no clue where to focus. Everything that deserves space on a dashboard is important, but not equally sothe viewer's eyes should always be directed to the most crucial information first.

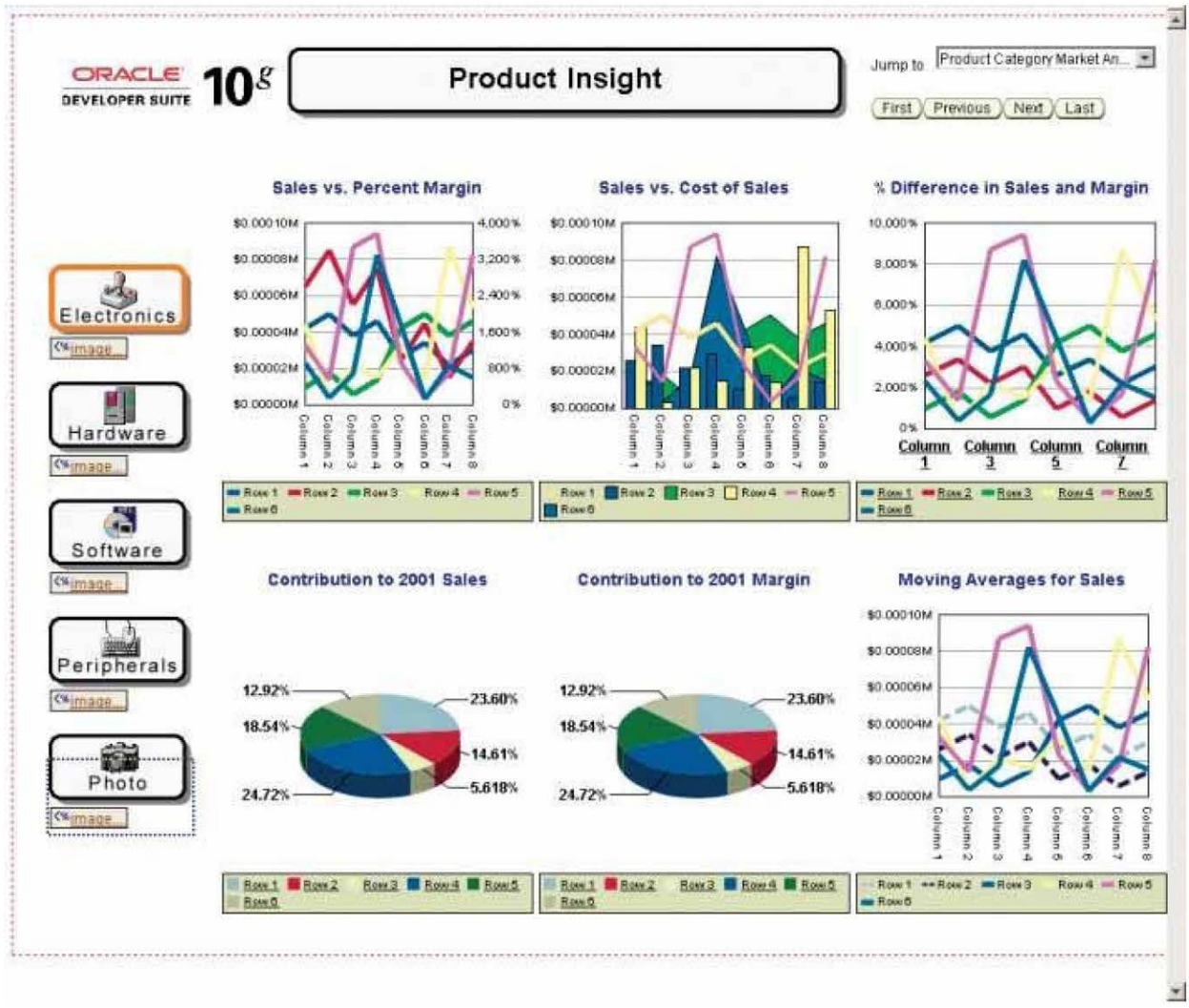


Figure 3-27. This dashboard fails to differentiate data by its importance, giving relatively equal prominence to everything on the screen.

3.11. Cluttering the Display with Useless Decoration

Another common problem on the dashboards that I find on vendor web sites is the abundance of useless decoration. They either hope that we will be drawn in by the artistry or assume that the decorative flourishes are necessary to entertain us. I assure you, however, that even people who enjoy the decoration upon first sight will grow weary of it in a few days.

The makers of the dashboard in Figure 3-28 did an exceptional job of making it look like an electronic control panel. If the purpose were to train people in the use of some real equipment by means of a simulation, this would be great, but that isn't the purpose of a dashboard. The graphics dedicated to this end are pure decoration, visual content that the viewer must process to get to the data.

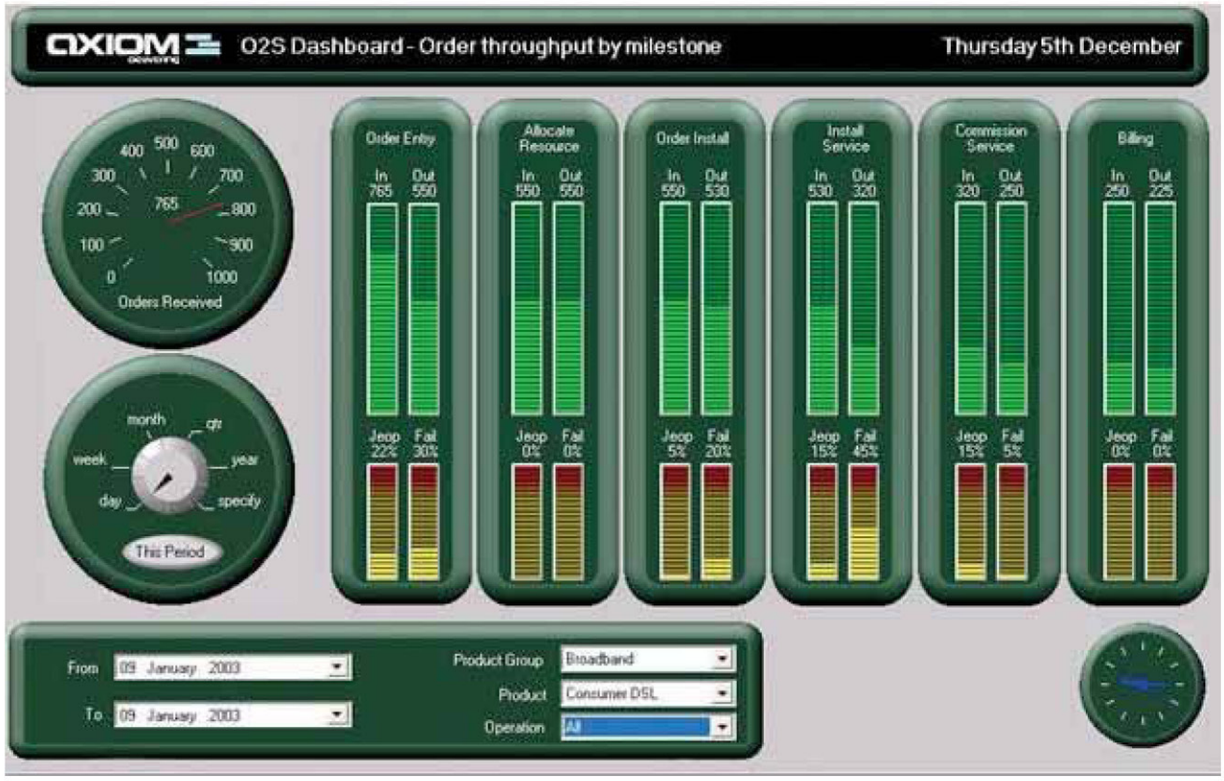


Figure 3-28. This dashboard is trying to look like something that it is not, resulting in useless and distracting decoration.

I suspect that the dashboard in Figure 3-29 looked too plain to its designer, so she decided to make it look like a page in a spiral-bound bookcute, but a distracting waste of space.

Figure 3-29. This dashboard is another example of useless decorationthe designer tried to make the dashboard look like a page in a spiral-bound notebook.

Likewise, I'd guess that the designer of the dashboard in Figure 3-30 after creating a map, a bar graph, and a table that all display the same data decided that he had to fill up the remaining space, so he went wild with an explosion of blue and gray circles. Blank space is better than meaningless decoration. Can you imagine yourself looking at this every day?

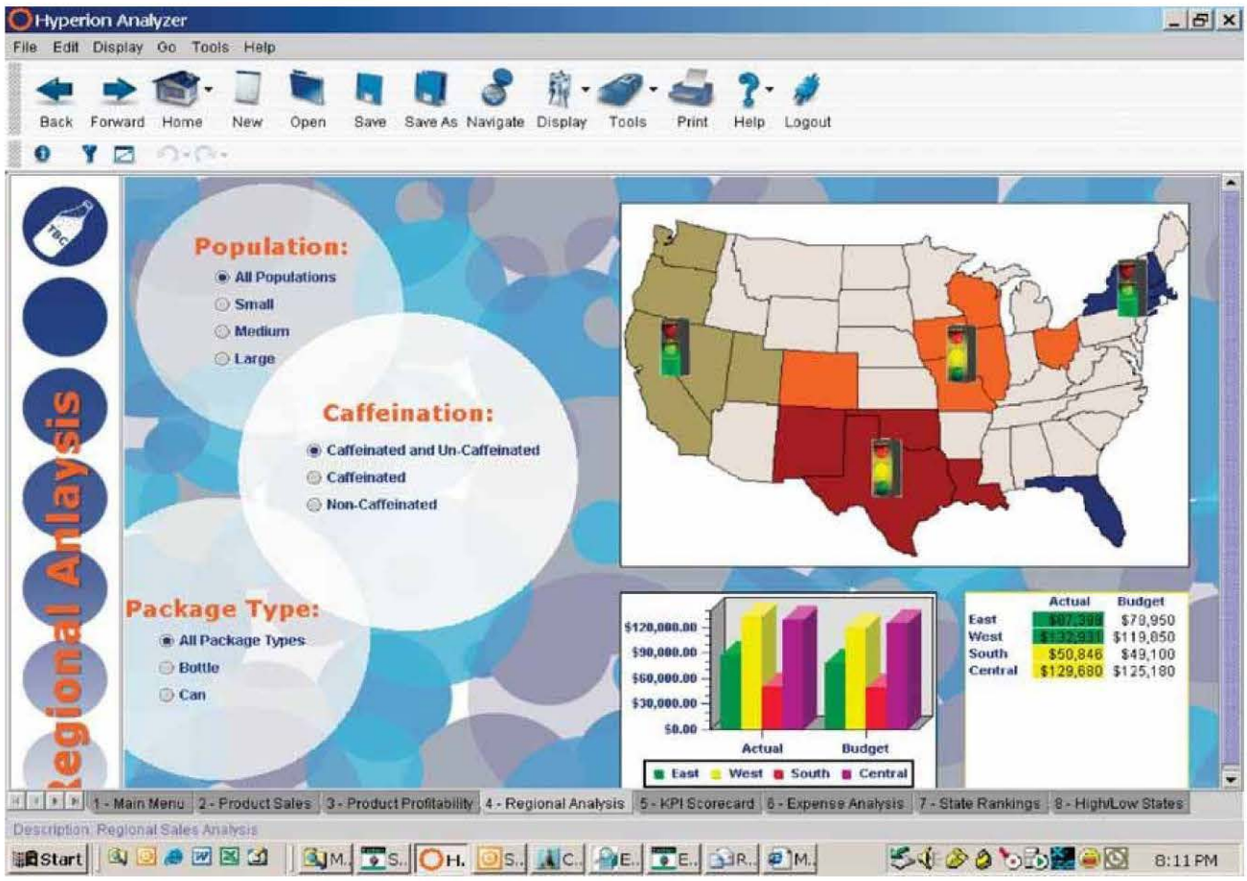
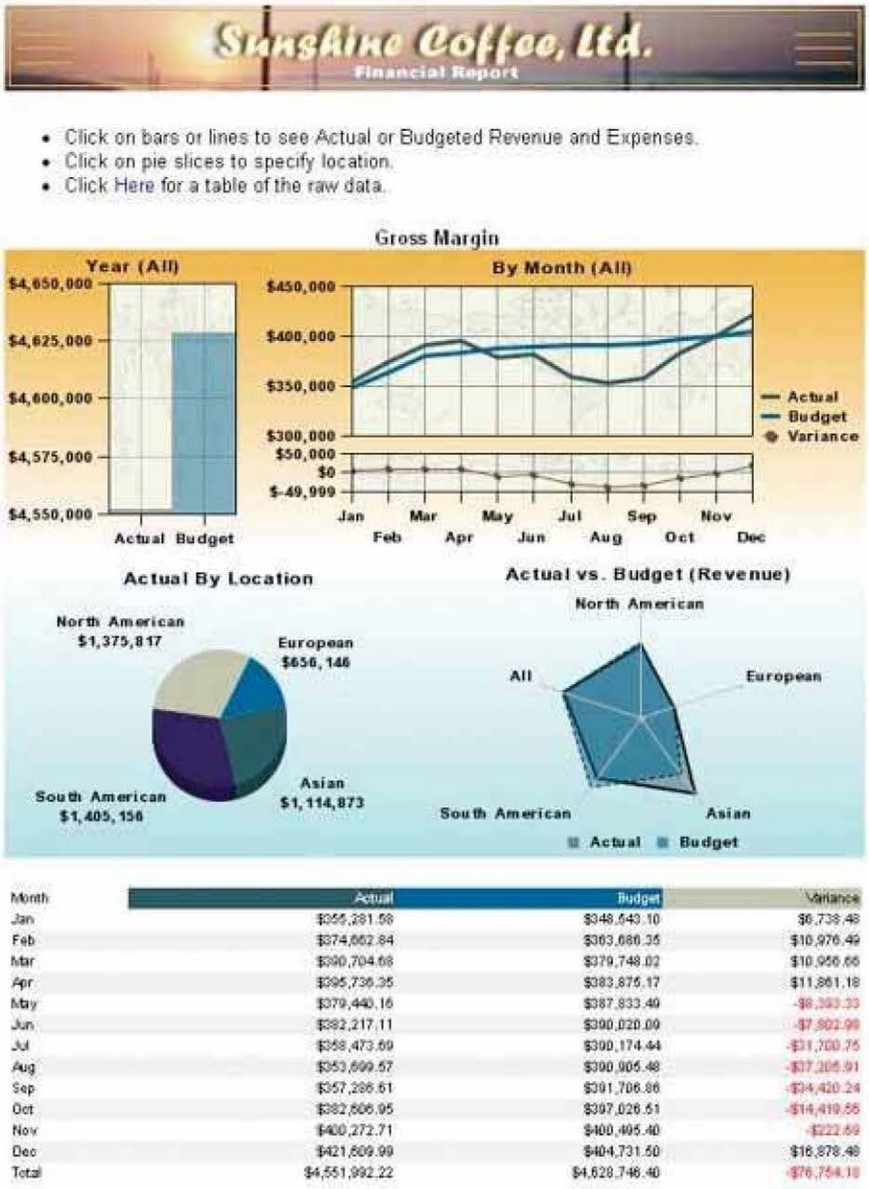


Figure 3-30. This dashboard is a vivid example of distracting ornamentation.

The last example, Figure 3-31, includes several elements of decoration that ought to be eliminated. To begin with, a visually ornate logo and title use up the most valuable real estate across the entire top of the dashboard. If a logo must be included for branding purposes, make it small and visually subtle, and place it somewhere out of the way. The background colors of gold and blue certainly draw our eyes to the data, but they do so in an unnecessarily heavy-handed manner. Also, the color gradients from dark to light provide visual interest that supports no real purpose and is therefore distracting. Lastly, the maps in the background of the three upper graphs, though visually muted, still distract from the data itself.



Month	Actual	Budget	Variance
Jan	$355,281.58	$348,543.10	$6,738.48
Feb	$374,662.84	$363,686.35	$10,976.49
Mar	$390,704.68	$379,748.02	$10,956.66
Apr	$395,736.35	$383,875.17	$11,861.18
May	$379,440.16	$387,833.49	-$8,393.33
Jun	$382,217.11	$390,020.09	-$7,802.98
Jul	$358,473.69	$390,174.44	-$31,700.75
Aug	$353,699.57	$390,905.48	-$37,205.91
Sep	$357,286.61	$391,706.86	-$34,420.24
Oct	$382,606.95	$397,026.51	-$14,419.56
Nov	$400,272.71	$400,495.40	-$222.69
Dec	$421,609.99	$404,731.50	$16,878.48
Total	$4,551,992.22	$4,628,746.40	-$76,754.18

Figure 3-31. This dashboard exhibits several examples of dysfunctional decoration.

As data visualization expert Edward Tufte observes:

> ***Inept graphics also flourish because many graphic artists believe that statistics are boring and tedious. It then follows that decorated graphics must pep up, animate, and all too often exaggerate what evidence there is in the data... If the statistics are boring, then you've got the wrong numbers.***[1]

3.12. Misusing or Overusing Color

We've already seen several examples of misused or overused color. The remaining point that I want to emphasize here is that color should not be used haphazardly.

[1] Edward R. Tufte, The Visual Display of Quantitative Information (Cheshire, CT: Graphics Press, 1983), 80.

Color choices should be made thoughtfully, with an understanding of how we perceive color and the significance of color differences. Some colors are hot and demand our attention, while others are cooler and less visible. When any color appears as a contrast relative to the norm, our eyes pay attention and our brains attempt to assign meaning to that contrast. When colors in two different sections of a dashboard are the same, we are tempted to relate them to one another. We merrily assume that we can use colors such as red, yellow, and green to assign important meanings to data, but in doing so we exclude the 10% of males and 1% of females who are color-blind. In Chapter 4, *Tapping into the Power of Visual Perception*, we'll learn a bit about color and how it can be used meaningfully and powerfully.

3.13. Designing an Unattractive Visual Display

Not being one to mince words for the sake of propriety, I'll state quite directly that some dashboards are just plain ugly. When we see them, we're inclined to avert our eyes hardly the desired reaction to a screen that's supposed to be supplying us with important information. You might have assumed from my earlier warning against unnecessary decoration that I have no concern for dashboard aesthetics, but that's not the case. When a dashboard is unattractive unpleasant to look at the viewer is put in a frame of mind that is not conducive to its use. I'm not advocating that we add touches to make dashboards pretty, but rather that we attractively display the data itself, without adding anything that distracts from or obscures it. (We'll examine the aesthetics of dashboard design a bit in Chapter 7, Designing Dashboards for Usability.)

Figure 3-32 on the next page is a stellar example of unattractive dashboard design. It appears that the person who created this dashboard attempted to make it look nice, but he just didn't have the visual design skills needed to succeed. For instance, in an effort to fill up the space, some sections (such as the graph at the bottom right) were simply stretched. Also, although shades of gray can be used effectively as the background color of graphs, this particular shade is too dark. The image that appears under the title "Manufacturing" is clearly an attempt to redeem this dreary dashboard with a splash of decoration, but it only serves to distract from the data and isn't even particularly nice to look at. The guiding design principle of simplicity alone would have saved this dashboard from its current agony.

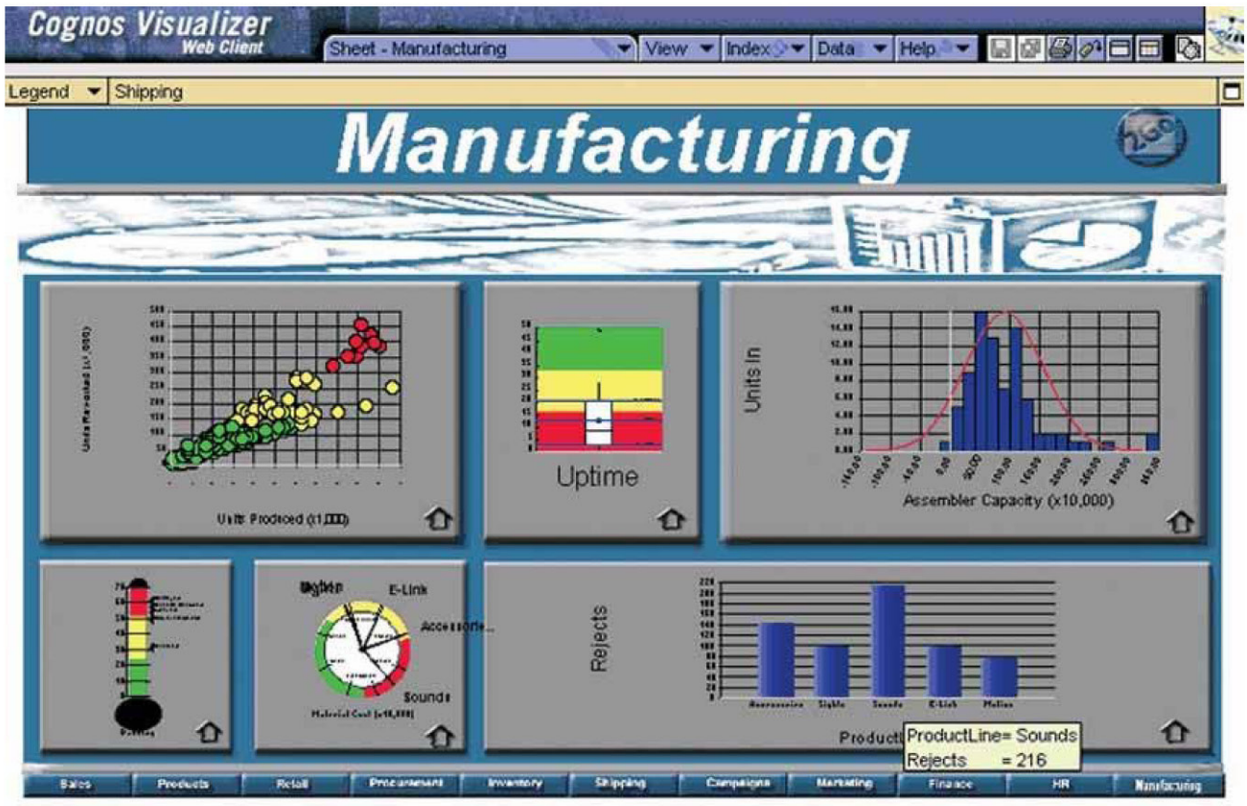


Figure 3-32. This is an example of a rather unattractive dashboard.

You don't need to be a graphic artist to design an attractive dashboard, but you do need to understand a few basic principles about visual perception. We'll examine these in the next chapter.

Chapter 5. Eloquence Through Simplicity

Now that you're familiar with some of the science behind dashboard design, it's time to take a look at a few strategies you can employ to create effective displays. The guiding principle in dashboard design should always be simplicity: display the data as clearly and simply as possible, and avoid unnecessary and distracting decoration.

Characteristics of a well-designed dashboard

Reducing the non-data pixels

Enhancing the data pixels

In earlier chapters, we concentrated on what doesn't work. Now it's time to shift our focus to what does, beginning with the design process itself the goals and steps necessary to produce dashboards that inform rapidly with impeccable clarity.

5.1. Characteristics of a Well-Designed Dashboard

The fundamental challenge of dashboard design involves squeezing a great deal of useful and often disparate information into a small amount of space, all the while preserving clarity. This certainly isn't the only challenge others abound, such as selecting the right data in the first place but it is the primary challenge that is particular to dashboards. Limited to a single screen to keep all the data within eye span, dashboard real estate is extremely valuable: you can't afford to waste an inch. Fitting everything in without sacrificing meaning doesn't require muscles, it requires finesse.

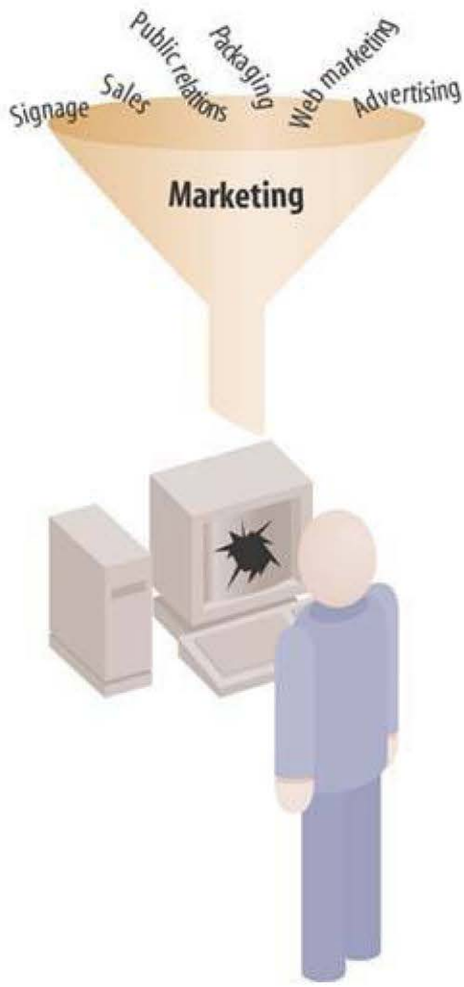


Figure 5-1. The fundamental challenge of dashboard design is to effectively display a great deal of often disparate data in a small amount of space.

Unless you know what you're doing, you'll end up with a cluttered mess. Think for a moment about the cockpit of a commercial jet. Years of effort went into its design to ensure that despite the many things

pilots must monitor, they can see everything that's going on at a glance. Every time I board a plane, I'm grateful that skilled designers worked hard to present this information effectively. Similar care is needed for the design of dashboards, but unlike aircraft cockpit design, few of those who create dashboards have actually studied the science of design. You can become an exception to this unfortunate and costly norm. It is unlikely that people will lose their lives if you fail, but businesses do occasionally crash and burnand frequently lose moneydue to failed communication of just this sort.

Henry David Thoreau once penned the same word three times in succession to emphasize an important quality of life that applies to design as well: *"Simplify, simplify, simplify!"*[1] Though I often fail, I strive to live my life and to design all forms of communication according to Thoreau's sage advice to keep things simple. Eloquence in communication is often achieved through simplification. Too often we smear a thick layer of gaudy makeup over data in an effort to impress or entertain, rather than focusing on communicating the truth of the matter in the clearest possible way.

When designing dashboards, you must include only the information that you absolutely need, you must condense it in ways that don't decrease its meaning, and you must display it using visual display mechanisms that, even when quite small, can be easily read and understood. Well-designed dashboards deliver information that is:

- Exceptionally well organized
- Condensed, primarily in the form of summaries and exceptions
- Specific to and customized for the dashboard's audience and objectives
- Displayed using concise and often small media that communicate the data and its message in the clearest and most direct way possible

Dashboards tell people what's happening and should help them immediately recognize what needs their attention. Just like the dashboard of a car, which provides easily monitored measures of speed, remaining fuel, oil level, battery strength, engine trouble, and so on, a business information dashboard provides an overview that can be assimilated quickly, but doesn't necessarily give you all the information you might need to thoroughly respond to any problems or opportunities that are revealed.

A full diagnosis to determine how to respond to the data gleaned from a dashboard often requires additional information. This is as it should be, because a dashboard that tried to give you everything you need to do your job, including all the details, would be unreadable. Instead, dashboards should provide a broad and high-level overview that informs you instantly about the state of things. If they go further by providing quick and easy access to the additional information that you might need, that's wonderful but that journey takes you beyond the dashboard itself.

5.1.1. Condensing Information via Summarization and Exception

The best way to condense a broad spectrum of information to fit onto a dashboard is in the form of summaries and exceptions. Summarization involves the process of reduction. Summaries represent a set of numbers (often a large set) as a single number. The two most common summaries that appear on dashboards are sums and averages. Measures of distribution and correlation are sometimes appropriate, but these are relatively rare.

Given the purpose of a dashboard to help people monitor what's going on, much of the information it presents is necessary only when something unusual is happening; something that falls outside the realm of

[1] Henry David Thoreau, Walden (originally published in 1864).

normality, into the realm of problems and opportunities. Why make someone wade through hundreds of values when only one or two require attention? We call these critical values exceptions.

The best dashboards are designed to specifically address information needs related to a particular objective or set of objectives. Not only should the information be narrowed to what directly applies, but the communication of that information should use its audience's vocabulary. You wouldn't express the relationship between the costs of marketing and resulting revenues as a linear correlation coefficient if the audience had no idea what that was or how to make sense of it. A familiar graph would do a better job. Likewise, you wouldn't break the data into months if the audience were composed of sales managers who think entirely in terms of weeks. Customization is vital to the success of a dashboard.

An aspect of customization that is often overlooked involves expressing quantitative data at a level of precision that is appropriate to the task at hand. The greater the numeric precision, the more time it will take viewers to absorb the data. When examining financials, most executives rarely need to see numbers down to the level of cents or even beyond the nearest thousand, ten thousand, hundred thousand, or even million, but the manager of accounting might need to see every penny.

Display media must be designed to say exactly what they need to sayno moredirectly, clearly, and without any form of distraction, in a way that communicates the maximum meaning in the minimum amount of space. If a display mechanism that looks like a fuel gauge, thermometer, or traffic signal communicates the necessary information in this manner, then that's what you ought to use. If, however, it fails any of these tests, it ought to be replaced with something that does the job better. Insisting on cute displays when other means would work better is counterproductive, even if everyone seems to be in love with them. This love is fickle. The appeal of cuteness will fade quickly, and the only thing that will matter then is how well the display device works: how efficiently and effectively it communicates.

Two fundamental principles should guide the selection of the ideal dashboard display media:

- It must be the best way to display a particular type of information that is commonly found in dashboards.
- It must be able to serve its purpose even when sized to fit into a small space.

In the next chapter, we'll examine an ideal library of dashboard display media that fulfill these requirements. For now, let's examine some design principles.

5.2. Key Goals in the Visual Design Process

Edward R. Tufte introduced a concept in his 1983 classic The Visual Display of Quantitative Information that he calls the "data-ink ratio." When quantitative data is displayed in printed form, some of the ink that appears on the page presents data, and some presents visual content that is not data (a.k.a. non-data). Figure 5-2 shows two displays of quantitative data: one in the form of a table and the other in the form of a graph. Take a minute to examine them and try to differentiate the data ink from the non-data ink.

2005 YTD (U. S. $)

Region	Units	Bookings	Bookings %
Americas	3,888	229,392	43%
Europe	2,838	167,442	31%
Asia	1,788	105,492	20%
Other	509	30,031	6%
Total	$9,023	$532,357	100%

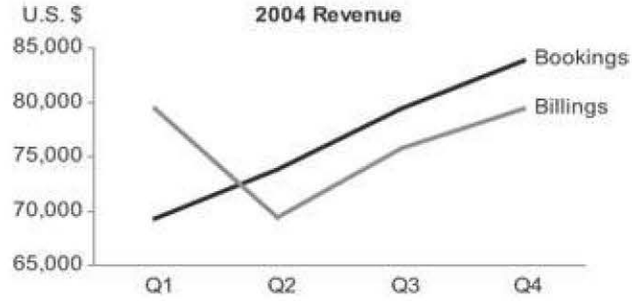


Figure 5-2. This table and graph consist of both data ink and non-data ink.

There isn't much non-data ink in either the table or the graph, because they were intentionally designed to keep it to a minimum. Figure 5-3 shows the same table and graph, this time with the non-data ink encoded as red.

2005 YTD (U. S. $)

Region	Units	Bookings	Bookings %
Americas	3,888	229,392	43%
Europe	2,838	167,442	31%
Asia	1,788	105,492	20%
Other	509	30,031	6%
Total	$9,023	$532,357	100%

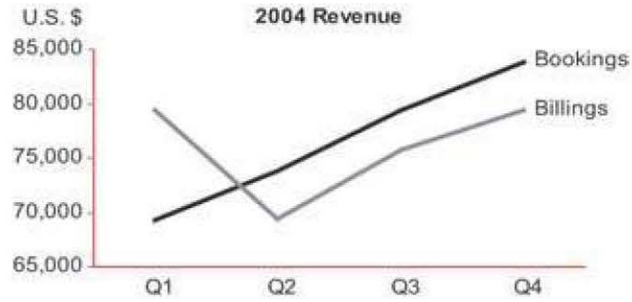


Figure 5-3. Here, the non-data ink is highlighted in red.

Tufte defines the data-ink ratio in the following way:

> ***A large share of ink on a graphic should present data-information, the ink changing as the data change. Data-ink is the non-erasable core of a graphic, the non-redundant ink arranged in response to variation in the numbers represented. Then,***
>
> ***Data-ink ratio***
>
> ***= data-ink / total ink used to print the graphic***
> ***= proportion of a graphic's ink devoted to the non-redundant display of data-information***
> ***= 1.0 - proportion of a graphic that can be erased without loss of data-information.***[1]

He then applies it as a principle of design: *"Maximize the data-ink ratio, within reason. Every bit of ink on a graphic requires a reason. And nearly always that reason should be that the ink presents new information."*[2]

This principle applies perfectly to the design of dashboards, with one simple revision: because dashboards are always displayed on computer screens, I've changed the word "ink" to "pixels." Across the entire dashboard, non-data pixels any pixels that are not used to display data, excluding a blank background should be reduced to a reasonable minimum. Take a moment to examine the dashboard in Figure 5-4 on the next page and try to identify the non-data pixels that can be eliminated without sacrificing anything meaningful.

[1] Edward R. Tufte, The Visual Display of Quantitative Information (Cheshire, CT: Graphics Press, 1983), 93.
[2] Ibid., 96.

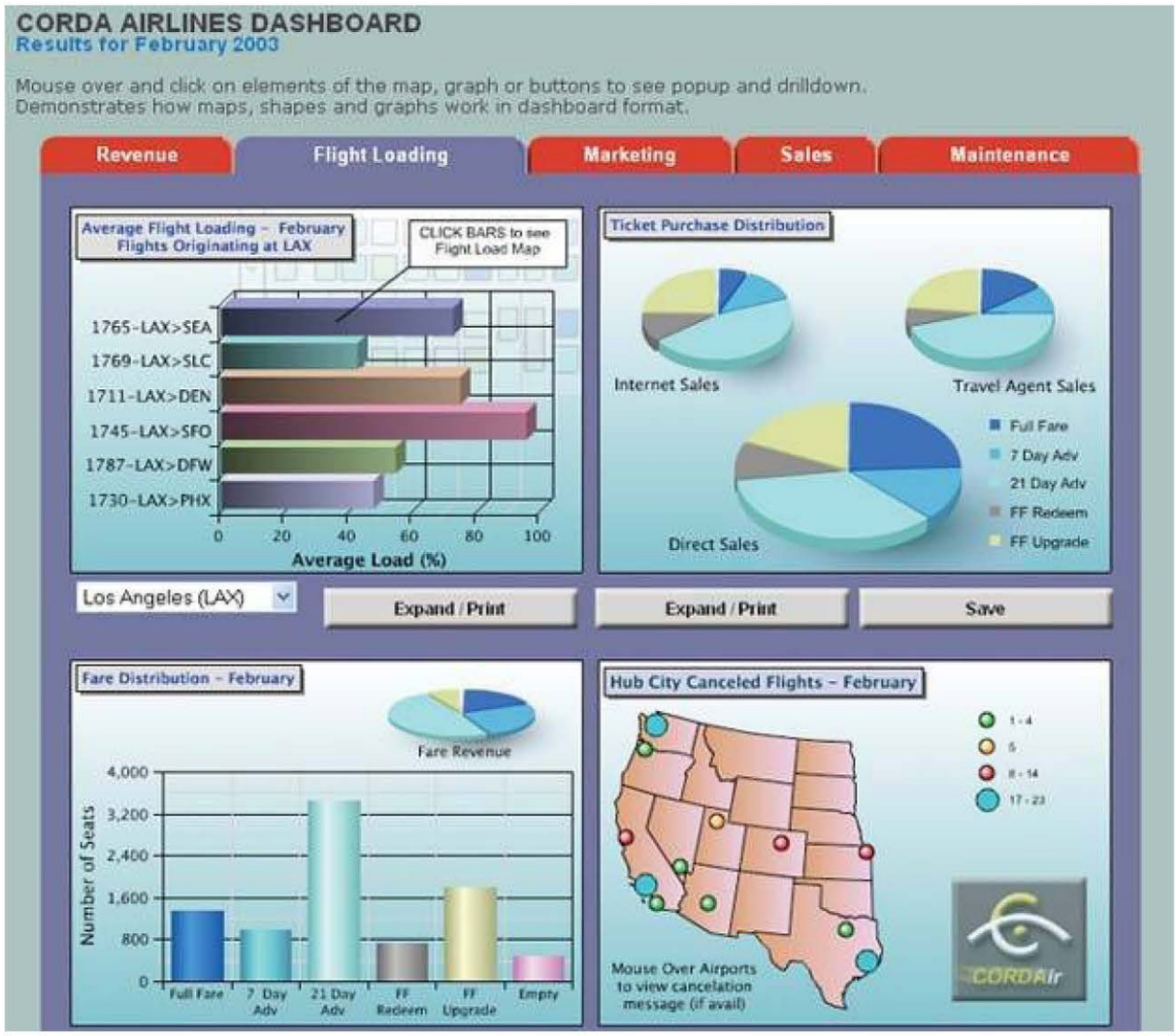


Figure 5-4. This dashboard displays an excessive amount of non-data pixels.

The non-data pixels that you could easily eliminate without any loss of meaning include:

- The third dimension of depth on all the pie charts and on the bars in the upper bar graph
- The grid lines in the bar graphs
- The decoration in the background of the upper bar graph
- The color gradients in the backgrounds of the graphs, which vary from white at the top through shades of blue as they extend downward

Some of the data pixels on this dashboard could also be removed without a loss of useful meaningwe'll come back to that in a moment.

Reducing the non-data pixels to a reasonable minimum is a key objective that places us on the path to effective dashboard design. Much of visual dashboard design revolves around two fundamental goals:

1. Reduce the non-data pixels.
2. Enhance the data pixels.

You start by reducing the non-data content as much as possible, and then proceed to enhance the data content with as much clarity and meaning as possible, working to make the most important data stand out above the rest (Figure 5-5).

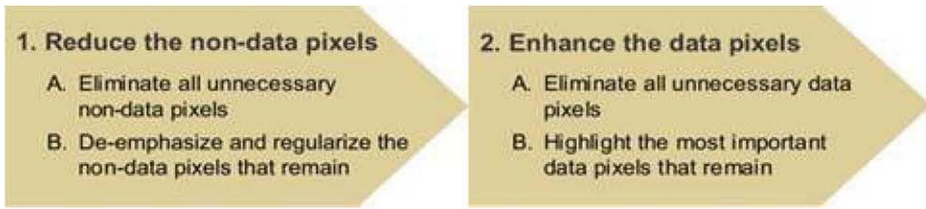


Figure 5-5. Key goals and steps of visual dashboard design.

5.2.1. Reduce the Non-Data Pixels

The goal of reducing the non-data pixels can be broken down into two sequential steps:

1. Eliminate all unnecessary non-data pixels.
2. De-emphasize and regularize the non-data pixels that remain.

Let's take a look at how to accomplish these two goals.

5.2.1.1. Eliminate all unnecessary non-data pixels

Dashboard design is usually an iterative process. You begin by mocking up a sample dashboard, and then you improve it through a series of redesigns, each followed by a fresh evaluation leading to another redesign, until you have it right. As you get better and better at this, the number of iterations that will be required will decrease, partly because you won't be including unnecessary non-data pixels in the first place. No matter how far you advance, however, the step of looking for unnecessary non-data pixels will never cease to be productive.

The next few figures provide examples of non-data pixels that often find their way onto dashboards but can usually be eliminated without loss.

Graphics that serve merely as decoration (Figure 5-6).

Figure 5-6. You should eliminate graphics that provide nothing but decoration.

Variations in color that don't encode any meaning (Figure 5-7).

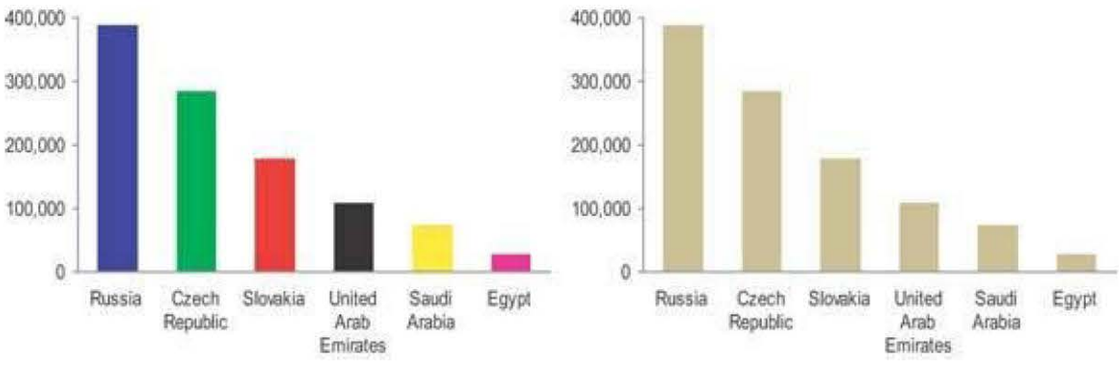


Figure 5-7. These bars vary in color for no meaningful reason.

Borders that are used to delineate sections of data when the simple use of white/blank space alone would work as well (Figure 5-8).

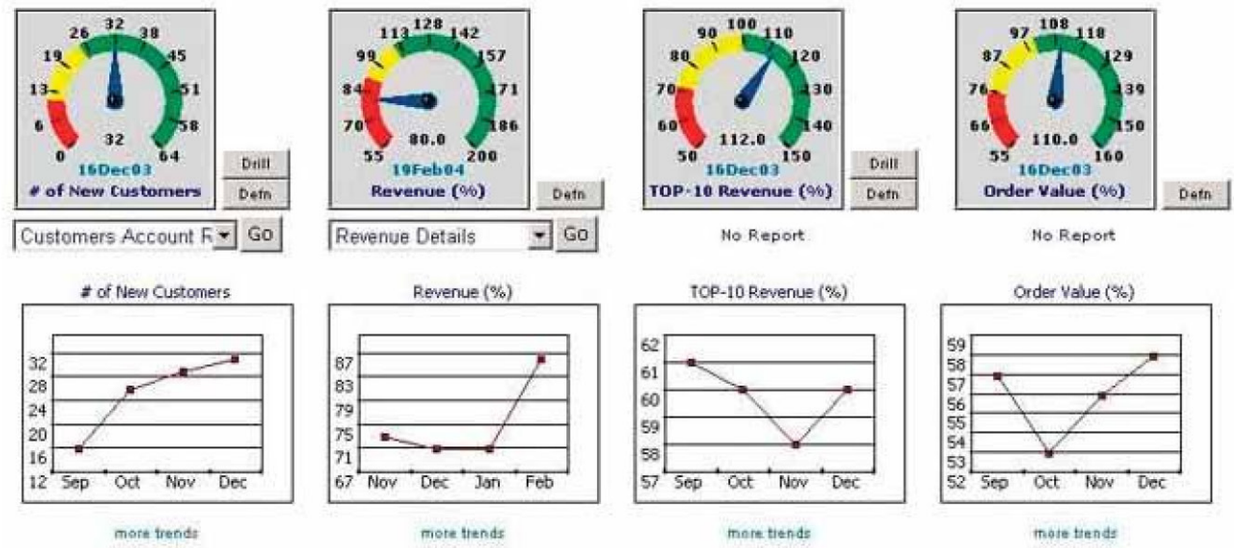


Figure 5-8. Unnecessary borders around sections of data fragment the display.

Fill colors that are used to delineate sections of content such as a title, the data region or legend of a graph, the background of a table, or an entire section of data, when a neutral background would work as well (Figure 5-9).

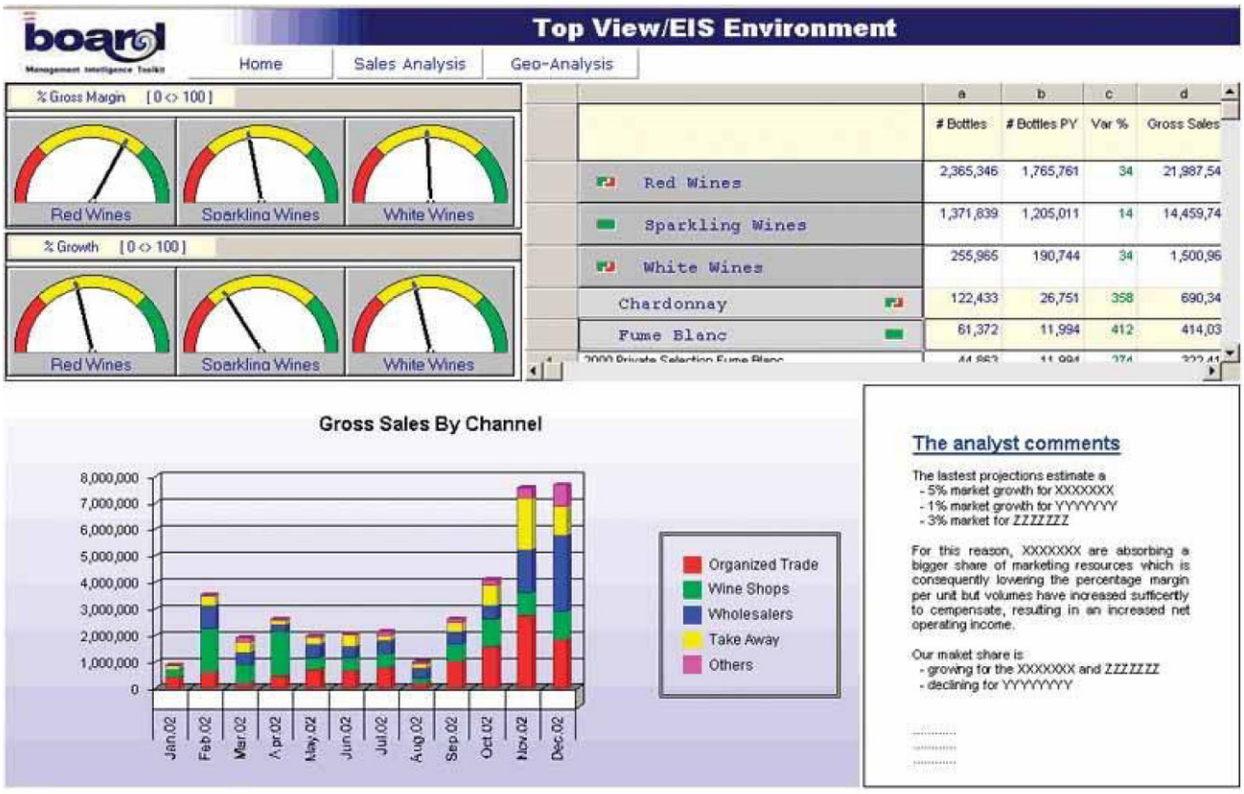


Figure 5-9. Fill colors to separate sections of the display are unnecessary.

Gradients of fill color when a solid color would work as well (Figure 5-10).

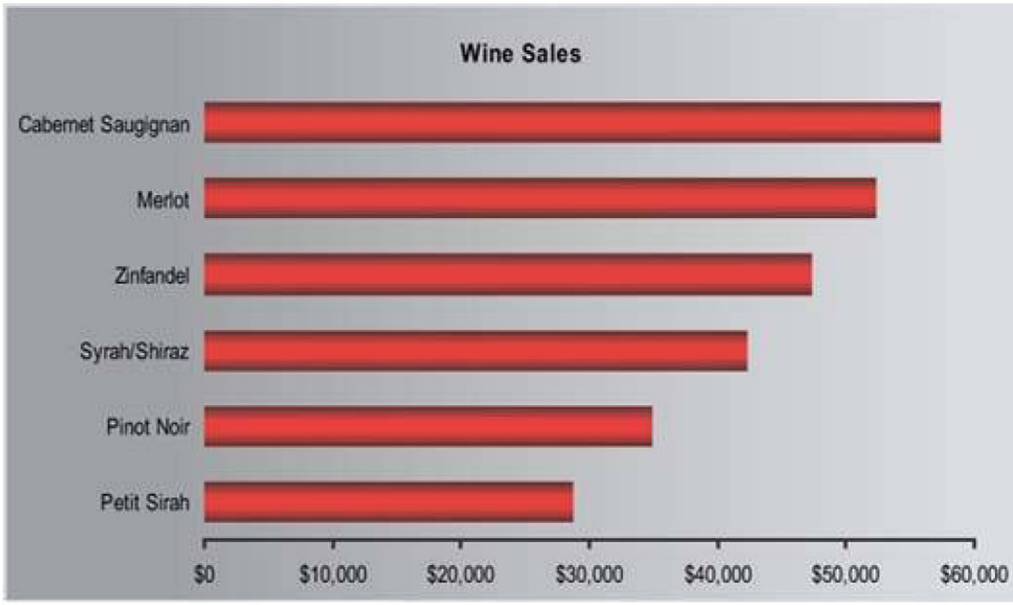


Figure 5-10. Gradients of color both on the bars of this graph and across the entire background add distracting non-data pixels.

Grid lines in graphs (Figure 5-11).

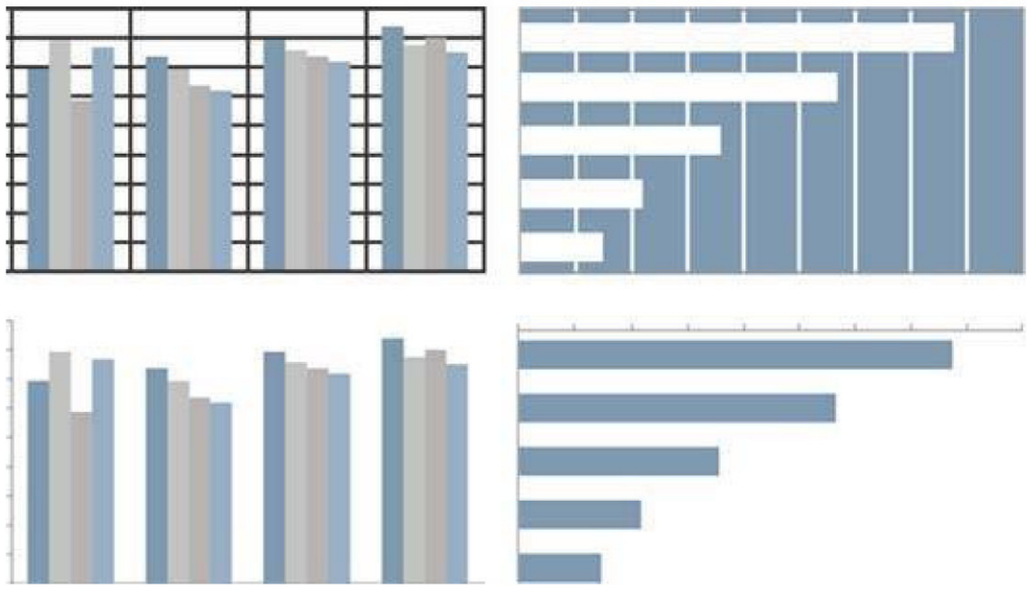


Figure 5-11. Grid lines in graphs are rarely useful. They are one of the most prevalent forms of distracting non-data pixels found in dashboards.

Grid lines in tables, which divide the data into individual cells or divide either the rows or the columns, when white space alone would do the job as well (Figure 5-12).

Salesperson	Jan	Feb	Mar
Robert Jones	2,834	4,838	6,131
Mandy Rodriguez	5,890	6,482	8,002
Terri Moore	7,398	9,374	11,748
John Donnelly	9,375	12,387	13,024
Jennifer Taylor	10,393	12,383	14,197
Total	$35,890	$45,464	$53,102

Salesperson	Jan	Feb	Mar
Robert Jones	2,834	4,838	6,131
Mandy Rodriguez	5,890	6,482	8,002
Terri Moore	7,398	9,374	11,748
John Donnelly	9,375	12,387	13,024
Jennifer Taylor	10,393	12,383	14,197
Total	$35,890	$45,464	$53,102

Figure 5-12. Grid lines in tables can make otherwise simple displays difficult to look at.

Fill colors in the alternating rows of a table to delineate them when white space alone would work as well (Figure 5-13).

Sell

Metric	Alerts	Result	Alert Spec	Last Update
QTD Sales ($MM)	2	$ 153.0	$ 166.0	1/21/02
QTD Average Daily Order Rate (ADOR) ($MM)	1	$ 16.1	$ 11.9	1/21/02
Previous Day's Orders ($MM)	0	$ 26.2	$ 11.9	1/21/02
QTD % e-Orders	3	53.0%	59.0%	1/21/02
Current Qtr Price vs Target ($/lb)	6	$ 1.27	$ 1.20	1/21/02

Figure 5-13. Fill colors should be used to delineate rows in a table only when this is necessary to help viewers' eyes track across the rows.

Complete borders around the data region of a graph when one horizontal and one vertical axis would sufficiently define the space (Figure 5-14).

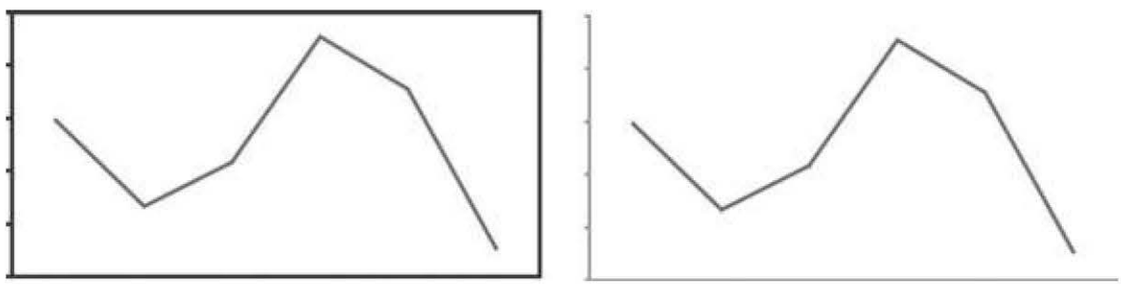


Figure 5-14. A complete border around the data region of a graph should be avoided when a single set of axes would adequately define the space.

3D in graphs when the third dimension doesn't correspond to actual data (Figure 5-15).

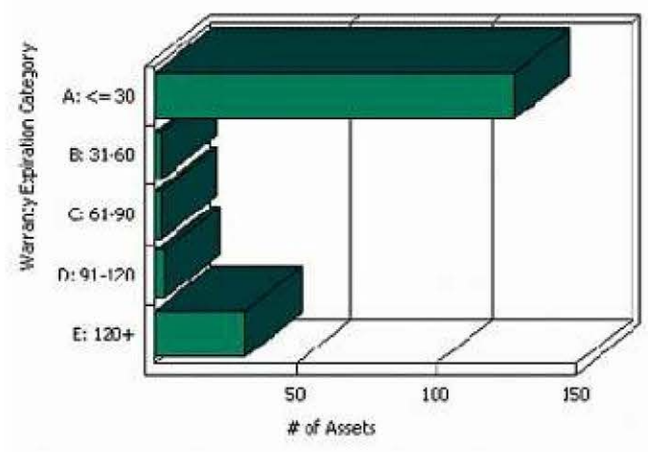


Figure 5-15. 3D should always be avoided when the added dimension of depth doesn't represent actual data.

Visual components or attributes of a display medium that serve no purpose but to make it look more like a real physical object or more ornate (Figure 5-16).

Figure 5-16. This dashboard is filled with visual components and attributes that serve the sole purpose of simulating real physical objects.

This is by no means a comprehensive list, but it does cover much of the non-data content that I routinely run across on dashboards. When you find that you've included useless non-data pixels such as those in any of the above examples, simply remove them.

5.2.1.2. De-emphasize and regularize the non-data pixels that remain

Not all non-data pixels can be eliminated without losing something useful. Some support the structure, organization, or legibility of the dashboard. For instance, when data is tightly packed, sometimes it is necessary to use lines or fill colors to delineate one section from another, rather than white space alone. In these cases, rather than eliminating these useful non-data pixels, you should simply mute them visually so they don't attract attention. Focus should always be placed on the information itself, not on the design of the dashboard, which should be almost invisible. The trick is to de-emphasize these non-data pixels by making them just visible enough to do their job, but no more.

Beginning on the next page are a few examples of non-data pixels that are either always or occasionally useful. I've shown each of these examples in two ways: 1) a version that is too visually prominent, which illustrates what you should avoid; and 2) a version that is just visible enough to do the job, which is the objective.

Axis lines that are used to define the data region of a graph (Figure 5-17).

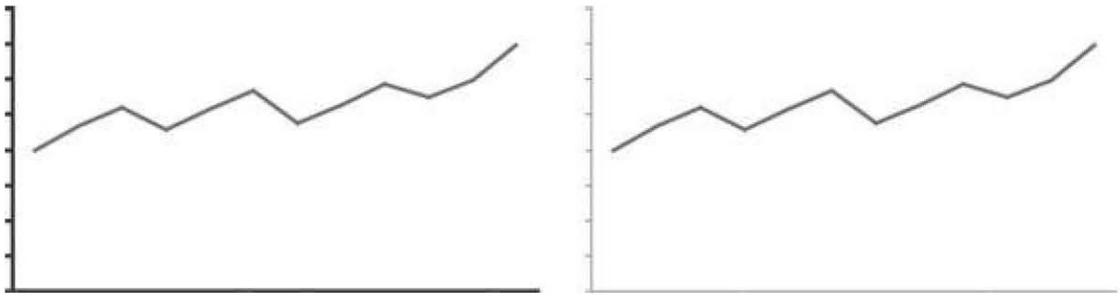


Figure 5-17. Axis lines used to define the data region of a graph are almost always useful, but they can be muted, like those on the right.

Lines, borders, or fill colors that are used to delineate sections of data when white space is not enough (Figure 5-18).

Figure 5-18. Lines can be used effectively to delineate adjacent sections of the display from one another, but the weight of these lines can be kept to a minimum.

Grid lines in graphs when necessary to read the graph effectively (Figure 5-19).

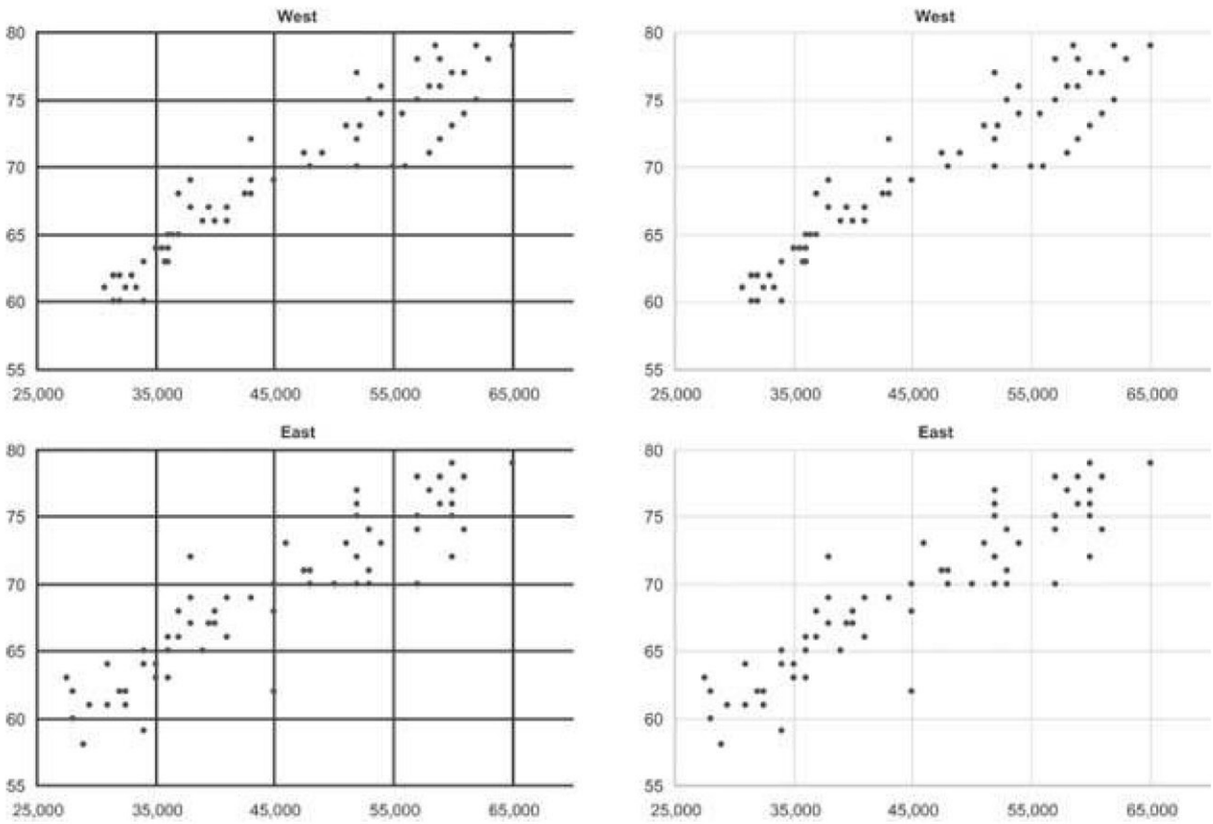


Figure 5-19. Grid lines are useful when they help viewers compare specific subsections of graphs, such as the range of values that fall within 65 to 75 on the vertical scale and 35,000 to 45,000 on the horizontal scale.

Grid lines and/or fill colors in tables when white space alone cannot adequately delineate columns and/or rows (Figure 5-20).

Product	Jan	Feb	Mar	Q1 Total	Apr	May	Jun	Q2 Total	YTD Total
Product A	93,993	84,773	88,833	267,599	95,838	93,874	83,994	273,706	541,305
Product B	87,413	78,839	82,615	248,867	89,129	87,303	78,114	254,547	503,414
Product C	90,036	81,204	85,093	256,333	91,803	89,922	80,458	262,183	518,516
Product D	92,737	83,640	87,646	264,023	94,557	92,620	82,872	270,048	534,072
Product E	83,733	75,520	79,137	238,390	85,377	83,627	74,826	243,830	482,220
Total	447,913	403,976	423,323	1,275,212	456,705	447,346	400,264	1,304,314	2,579,526

Product	Jan	Feb	Mar	Q1 Total	Apr	May	Jun	Q2 Total	YTD Total
Product A	93,993	84,773	88,833	267,599	95,838	93,874	83,994	273,706	541,305
Product B	87,413	78,839	82,615	248,867	89,129	87,303	78,114	254,547	503,414
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Product E	83,733	75,520	79,137	238,390	85,377	83,627	74,826	243,830	482,220
Total	447,913	403,976	423,323	1,275,212	456,705	447,346	400,264	1,304,314	2,579,526

Figure 5-20. Grid lines and fill colors can be used in tables to clearly distinguish some columns from others, but this should be done in the muted manner seen below rather than the heavy-handed manner seen above.

Fill colors in the alternating rows of a table when white space alone cannot adequately delineate them (Figure 5-21).

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Product 01	93,993	84,773	88,833	95,838	93,874	83,994	84,759	92,738	93,728	93,972	93,772	99,837	$1,100,111
Product 02	87,413	78,839	82,615	89,129	87,303	78,114	78,826	86,246	87,167	87,394	87,208	92,848	$1,023,103
Product 03	90,036	81,204	85,093	91,803	89,922	80,458	81,191	88,834	89,782	90,016	89,824	95,634	$1,053,796
Product 04	92,737	83,640	87,646	94,557	92,620	82,872	83,626	91,499	92,476	92,716	92,519	98,503	$1,085,410
Product 05	86,245	77,785	81,511	87,938	86,136	77,071	77,773	85,094	86,002	86,226	86,043	91,608	$1,009,432
Product 06	88,833	80,119	83,956	90,576	88,720	79,383	80,106	87,647	88,582	88,813	88,624	94,356	$1,039,714
Product 07	82,614	74,511	78,079	84,236	82,510	73,826	74,498	81,511	82,382	82,596	82,420	87,751	$966,934
Product 08	85,093	76,746	80,421	86,763	84,985	76,041	76,733	83,957	84,853	85,074	84,893	90,384	$995,942
Product 09	87,646	79,048	82,834	89,366	87,535	78,322	79,035	86,475	87,399	87,626	87,440	93,095	$1,025,821
Product 10	90,275	81,420	85,319	92,047	90,161	80,672	81,406	89,070	90,021	90,255	90,063	95,888	$1,056,595
Total	$884,886	$798,085	$836,307	$902,255	$883,765	$790,751	$797,953	$873,070	$882,391	$884,688	$882,805	$939,903	$10,356,860

Product	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Product 01	93,993	84,773	88,833	95,838	93,874	83,994	84,759	92,738	93,728	93,972	93,772	99,837	$1,100,111
Product 02	87,413	78,839	82,615	89,129	87,303	78,114	78,826	86,246	87,167	87,394	87,208	92,848	$1,023,103
Product 03	90,036	81,204	85,093	91,803	89,922	80,458	81,191	88,834	89,782	90,016	89,824	95,634	$1,053,796
Product 04	92,737	83,640	87,646	94,557	92,620	82,872	83,626	91,499	92,476	92,716	92,519	98,503	$1,085,410
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Product 06	88,833	80,119	83,956	90,576	88,720	79,383	80,106	87,647	88,582	88,813	88,624	94,356	$1,039,714
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Total	$884,886	$798,085	$836,307	$902,255	$883,765	$790,751	$797,953	$873,070	$882,391	$884,688	$882,805	$939,903	$10,356,860

Figure 5-21. Fill colors can be used to delineate rows in a table when necessary to help viewers' eyes scan across the rows, but this should always be done in the muted manner seen below rather than the visually weighty manner seen above.

These examples demonstrate how the visual prominence of non-data pixels can usually be de-emphasized by using light, lowly saturated colors, such as light grays, and minimal stroke weights (that is, thin lines).

Non-data pixels also can be pushed further from notice by regularizing them (that is, by making them consistent). If the axis lines of all graphs look the same say, if you use the same light gray lines wherever they appear no one graph is likely to catch a viewer's eyes more than the others. Differences seldom go unnoticed, even when they are expressed in muted tones. Don't vary the color, weight, or shape of non-data pixels that serve the same purpose in the dashboard.

Another category of content often found on dashboards that can be considered non-data pixels is that which supports navigation and data selection. Buttons and selection boxes are often used to allow users to navigate to another screen or to choose the data that appears on the dashboard (for example, by selecting a different subset, such as hardware rather than software). These elements might serve an important function, but they don't display data. As such, they should not be given prominence. If they must exist,

place them in an out-of-the-way location such as the bottom-right corner of the screen and mute them visually, so they won't compete with the data for attention. Notice how much of the dashboard in Figure 5-22 is dedicated to buttons and data selection controls, which I've highlighted with red borders. These elements take up far more valuable and prominent real estate on the dashboard than is required.

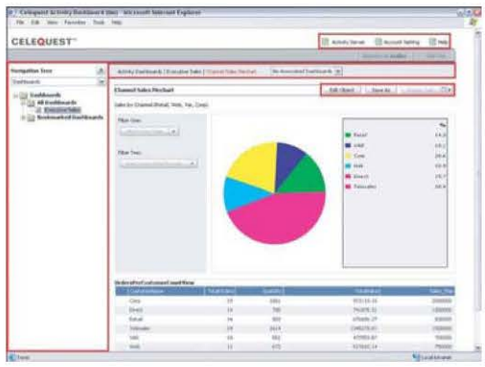

Figure 5-22. This dashboard gives navigational and data selection controls far more dominance and space than they deserve.

Similarly, while it may sometimes be necessary to include on the dashboard instructions that provide important support information, any nonessential text just takes up space that could be used by data, attracts attention away from the data, and clutters the dashboard's appearance. It usually works best to place most instructional or descriptive content either on a separate screen that can easily be reached when needed or, if possible, in the form of pop-ups that can be accessed when necessary with a click of the mouse. Notice how much prime real estate is wasted on the dashboard in Figure 5-23 to provide instructions that viewers will probably only need the first time they use the dashboard.

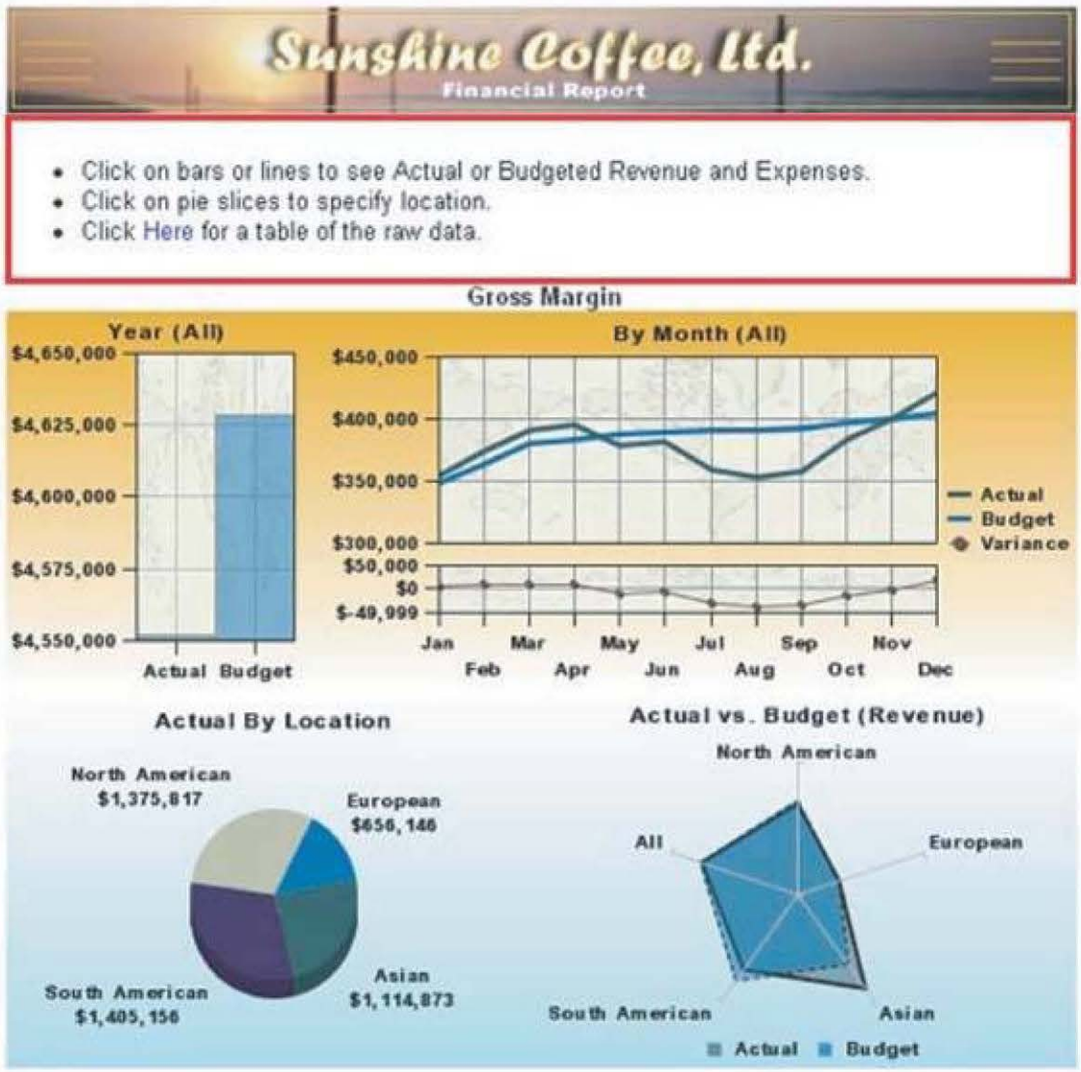

Figure 5-23. As you can see in the area highlighted in red, this dashboard uses up valuable space to display instructions that could have been provided only when needed through a separate screen or a pop-up menu.

5.2.2. Enhance the Data Pixels

Just like the reductionof non-data pixels, the process of enhancing the data pixels can be broken down into two sequential steps:

- Eliminate all unnecessary data pixels.
- Highlight the most important data pixels that remain.

Let's examine these two tasks.

5.2.2.1. Eliminate all unnecessary data pixels

When you're designing a dashboard, it is tempting to throw everything you think anyone could ever possibly want onto it. Those of us who have worked in the field of business intelligence for a while have grown weary of being asked for more (always more!), so the thought of heading off this demand by giving folks everything up front can be appealing. On a dashboard, however, where immediate insight is the goal, this is a costly mistake. I'm not suggesting that you force people to get by with less than they really need, but rather that you honor the consideration of what they really need for the task at hand as a strict

criterion for the selection of data. By removing any information that isn't really necessary, you automatically increase focus on the information that remains.

Elimination of unnecessary data pixels is achieved not only through the complete removal of less relevant data but also by condensing data through the use of summaries and exceptions, so that the level of detail that is displayed doesn't exceed what's necessary. For most applications, it would be absurd to include detailed information such as transaction-level sales data on a dashboardsome level of summarization is needed, and it is often up to you to determine what that level is. You might choose to display a single quarter-to-date value, a value per region, or a value per month, just to name a few possibilities.

Exceptions are an especially useful means to reduce the data on a dashboard to what is essential for the task at hand. Often, the state of something need not be presented unless there is a problem or an opportunity that requires action. If you care about staff expenses only when someone has exceeded a defined threshold, why clutter the dashboard with a complete list of all staff members and their expenses?

Beware of taking this useful practice of managing by exception too far, however. I received an email recently from an executive of a software company that specializes in dashboards. We were discussing my definition of a dashboard, and in the course of this discussion he stated that a customer once asserted that his ideal dashboard would display a single traffic signal to indicate if everything was all right or if anything needed attention. The idea was that he didn't want to be bothered with unnecessary information if all was well, and when something was wrong, he could drill down from that single alert to additional, more detailed dashboards or reports to determine exactly what was wrong before taking action. For an instant I found myself enamored with this idea, attracted to its Spartan simplicity but only for a moment. The next moment my mind became haunted by visions of executives trying to run their businesses in ignorant bliss, completely out of touch unless thresholds built into the software determined that they ought to be informed. Anyone who has a job to do needs to keep up with a basic picture of what's going on, even when all is well. Too often leaders whether in business, academia, religion, or politics forge ahead with their agendas, relying entirely on others to tell them what they think they should know, only to discover after the dust of some destructive event settles that they knew far too little to lead effectively.

Before departing from the topic of summaries and exceptions, I want to focus in on a particular summarizing technique that I find useful on occasion. This technique involves what I call multi-foci displays. When it is useful to display historical context for a measure, such as the last 12 months or the last 5 years, often information that is more distant from the present is less important than recent history. In such cases, there is no reason to display the full range of data at the same level of detail. For instance, you might want to display the current month as daily measures, the preceding 12 months as monthly measures, and the preceding 4 years as annual measures. This display would consist of three sections, each expressed in different intervals of time, with longer intervals and more summarization used for the period the most distant from the present. Graphic displays can be designed to present time series in this manner, as illustrated in Figure 5-24.

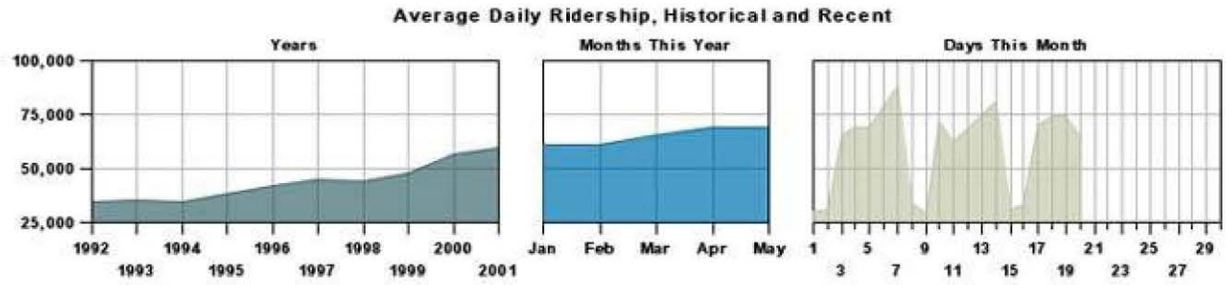

Figure 5-24. These three time-series graphs displaying public transportation rider statistics contain three levels of detail: daily for the current month, monthly for the current year, and yearly for the last 10 years.

Varying interest can correspond to distances in space as well as time. For instance, a viewer might be most interested in data from his immediate geographical region, and gradually less interested in data from increasingly distant geographical areas.[1]

5.2.2.2. Highlight the most important data pixels that remain

All the information that finds its way onto a dashboard should be important, but not all data is created equal: some data is more important than other data. The most important information can be divided into two categories:

- Information that is always important
- Information that is only important at the moment

When you consider the entire collection of information that belongs on a dashboard, you should be able to prioritize it according to what is usually of greatest interest to viewers. For instance, a dashboard that serves the needs of a corporation's executives might display several categories of financial, sales, and personnel data. On the whole, however, the executives usually care about some key measures more than others.

The other category of especially important information is that which is important only when it reveals something out of the ordinary. A measure that has fallen far behind its target, an opportunity that has just arisen and won't last for long, or an operational condition that demands immediate attention all fall into this category.

These two categories of important information require different means of highlighting on a dashboard. The first category information that is always important can be emphasized using static means, but the second category information that is important only at the moment requires a dynamic means of emphasis.

The location of data on the screen the layout is an aspect of a dashboard's appearance that doesn't, or at least shouldn't, change dynamically. This is true not only because it would be technically difficult to dynamically rearrange the placement of data on the screen, but also because after some use viewers will come to expect specific data to appear in specific locations, which is good because it helps them to scan the

[1] Multi-foci displays are not exclusively relevant to dashboards. I have a fondness for beautifully rendered maps, and I enjoy exploring geography and tracing my travels across the surface of maps. In fact, I keep three maps mounted on the walls of my office: an extremely large one of California, my home state; a slightly smaller one of the entire United States; and an even smaller one of the entire world. This might seem counter to the logical arrangement, because the world is certainly larger than California, but it serves my needs precisely. I want to see great detail in places close to home, where I spend most of my time, and gradually less and less detail as the distance from home grows.

dashboard quickly. Because location is static, this is a variable that we can leverage to highlight information that is always important.

Few aspects of visual design emphasize some data above the rest as effectively as its location. Figure 5-25 identifies the emphasizing effect that different regions of a dashboard provide. The top-left and center sections of the dashboard are the areas of greatest emphasis. The greater emphasis tied to the upper left is primarily due to the conventions of most western languages, which sequence words on a page from left to right and top to bottom. Contrary to the influence of reading conventions, however, the very center of the screen is also a region of strong emphasis, due to a more fundamental inclination of visual perception. I've found, however, that placing information in the center results in emphasis only when it is set apart somewhat from what surrounds it, such as through the use of white space.

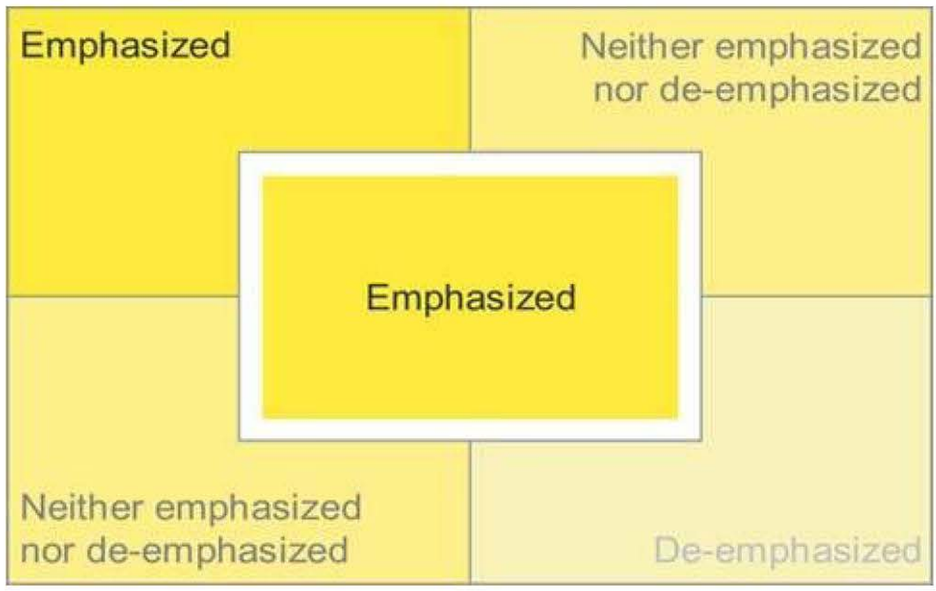

Figure 5-25. Different degrees of visual emphasis are associated with different regions of a dashboard.

As much as possible, place the information that is always of great importance in the upper-left or center regions of the dashboard. Never waste this valuable real estate by placing a company logo or controls for navigation or data selection in these areas. Figure 5-26 provides a vivid example of what you should avoid when designing the layout of a dashboard.

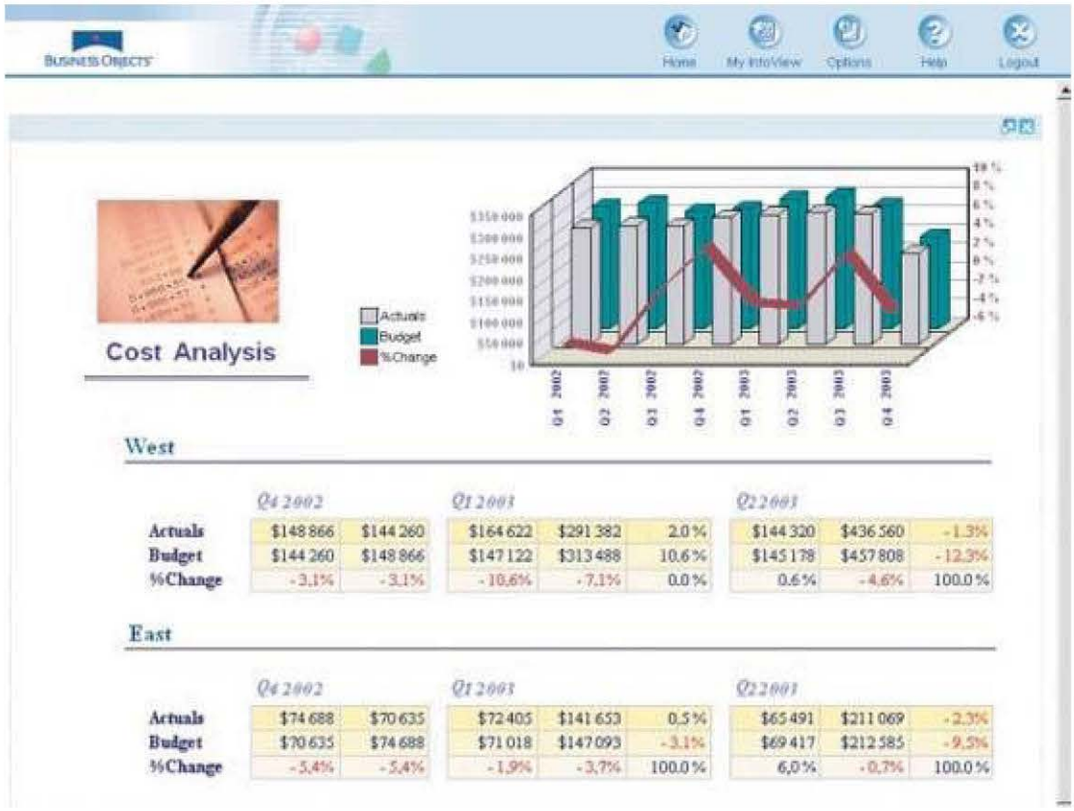

Figure 5-26. The most valuable real estate on this dashboard is dedicated to a company logo and meaningless decoration.

Visual attributes other than location on the screen are usually easy to manipulate in a dynamic manner on a dashboard. As such, dynamic techniques can be used to highlight information that is of great importance only at particular times. These techniques can also be used to highlight information that is always important, once you've used up the prime screen locations for other important data.

Many of the visual attributes that we examined in Chapter 4, Tapping into the Power of Visual Perception, can be used effectively to highlight data, both statically and dynamically. Here are two approaches that you can take:

- Use expressions of visual attributes that are greater than the norm (for example, brighter or darker colors).
- Use expressions of visual attributes that simply contrast with the norm (for example, blue text when the norm is black or gray).

Expressions of visual attributes don't need to be greater than others to stand out; contrast from a predominant pattern is all it takes. Visual perception is highly sensitive to differences and ever vigilant to assign meaning to them when they are detected.

Some useful expressions of visual attributes that are perceived as greater than others include the following:

Table 5-1.

Visual attribute	Useful expressions	Illustrations
Color	A darker or more fully saturated version of any hue is naturally perceived as	

intensity	greater than a lighter or less-saturated version.
Size	Bigger things clearly stand out as more important than smaller things.
Line width	Thicker lines stand out as more important than thinner lines.

Some useful expressions of visual attributes that stand out merely through contrast to the norm include the following:

Table 5-2.

Visual attribute	Useful expressions	Illustrations
Hue	Any hue that is distinct from the norm will stand out. [1]	
Orientation	Anything oriented differently than the norm will stand out.	
Enclosure	Anything enclosed by borders or surrounded by a fill color will stand out if different from the norm.	
Added marks	Anything with something distinctly added to it or adjacent to it will stand out.	

Any of these visual attributes can be used to make the most important information stand out from the rest. Color is especially useful because distinct differences in color stand out very clearly and because it is a variable that is normally easy to change dynamically using dashboard software based on predefined data conditions.

I've also found that one of the best ways to draw attention to particular items, especially those expressed as text, involves the use of an added mark with a distinct color. For example, causing a simple symbol such as a circle, checkmark, or asterisk to appear next to items that need attention does the job nicely. Choosing one color and varying its intensity to indicate varying degrees of importance or urgency works better than using different colors, because even those who are colorblind can detect distinct intensities of the same color. Figure 5-27 illustrates this practice. Different symbols could also be used to indicate different levels of importance or urgency with no need to vary their colors, but increasing color intensities corresponding to increasing levels of importance or urgency are understood more intuitively.

[1] Red does not signify that something is important, urgent, or a problem in all cultures. For example, in China, red connotes happiness. Bear in mind also when choosing symbolic colors that a significant chunk of the population is colorblind.

Metric	Actual	Variance
Revenue	$913,394	+$136,806
Profit	$193,865	-$73,055
Avg Order Size	$5,766	-$297
On Time Delivery	104%	+4%
New Customers	247	-62
Cust Satisfaction	4.73 / 5	+0.23

Figure 5-27. Simple symbols can be used along with varying color intensities to dynamically highlight data.

When highlighting important information, you must always be careful to restrict the definition of what's important. If you highlight too much information, nothing will stand out and your effort to communicate will fail. When used with discretion, however, visual highlighting can achieve the goal of immediate recognition and quick response.