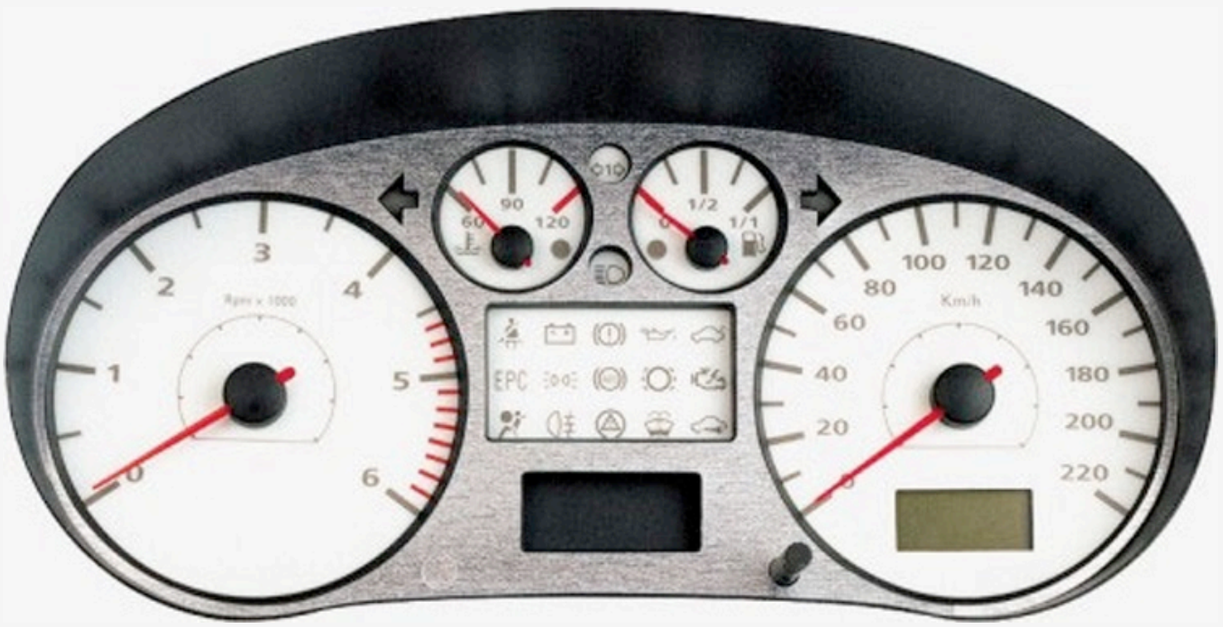
Dashboard Design

for at-a-glance monitoring

Stephen Few, Perceptual Edge

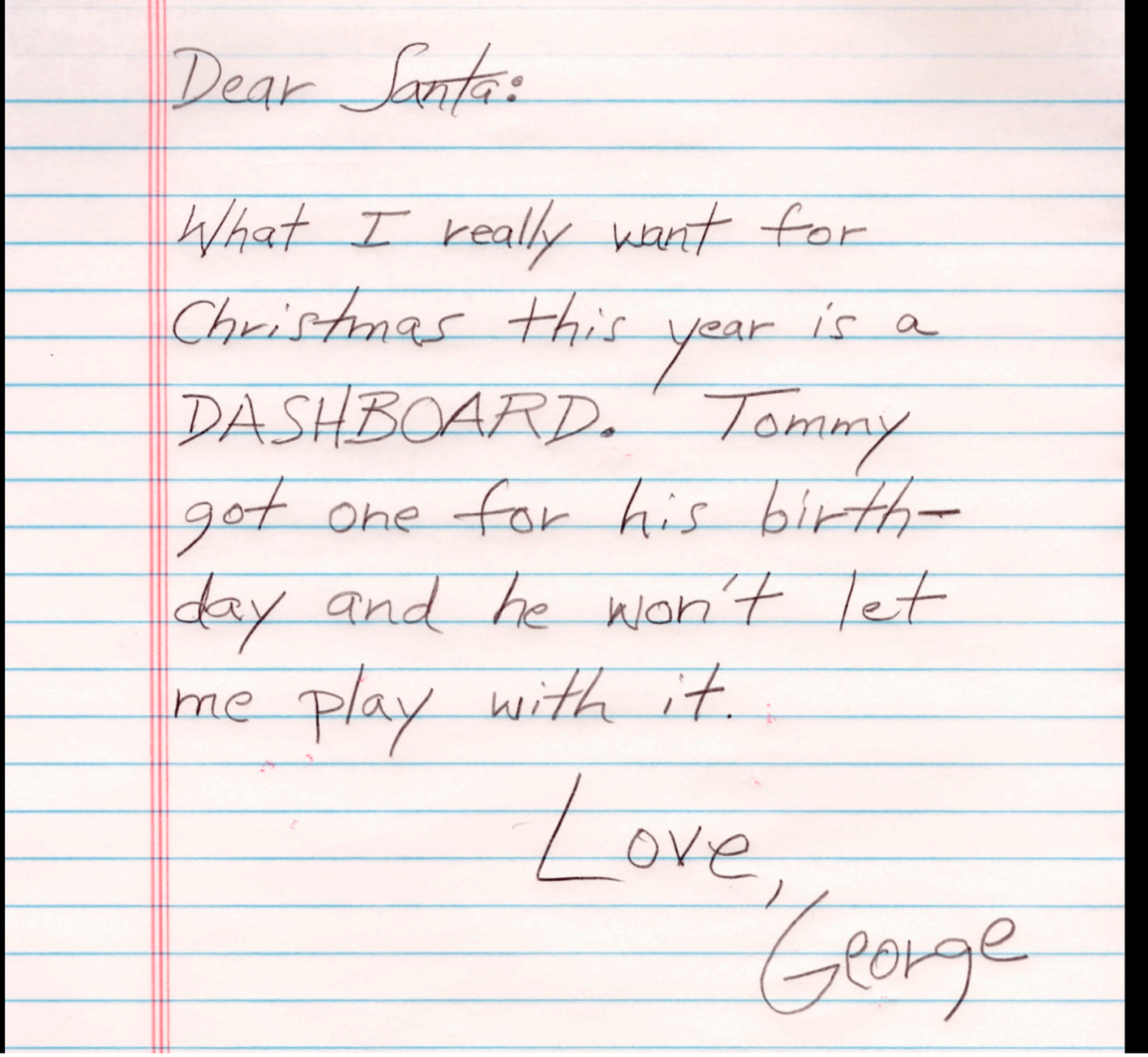


www.perceptualedge.com

Business dashboards were inevitable. But are they giving us the clear view that we need?

Given our love for the automobile in America, I suppose it was inevitable that something called a business dashboard would eventually emerge. This did not occur without precedent. In many respects, the dashboard is the rebirth of the Executive Information Systems (EIS) of the 1980s, which never quite got off the ground. Following that, in the 1990s, the introduction of the Balanced Scorecard by Kaplan and Norton, with its emphasis on key performance indicators (KPIs) as a means to measure what's going on in the business opened the door for the dashboard display. What really boosted the popularity of dashboards in the early 21st century, however, was the Enron scandal in 2001, which made companies desperate for new ways to monitor the business and to demonstrate to their shareholders that they were in control of what was happening.

Now that they are here and have been become popular, the question that we ought to be asking is "Are they doing the job?" In other words, do they communicate what people need to do their jobs clearly and efficiently?



Everybody wants a dashboard these days!

People want dashboards for a variety of reasons, but not always for the right reasons. Popular reasons include:

- dashboards are the latest craze
- the competition has them
- dashboards are sexy
- a vendor insisted: “You can’t live without one.”
- dashboards look fun, like video games
- the IT department is bored
- the data warehouse still hasn’t produced the promised ROI

The best reason to implement a dashboard is because dashboards provide a unique, effective solution to a commo business problem. When designed effectively, dashboards help us deal with the problem of information overload.

> *We feel flooded because we’re getting information unfiltered, unsorted, and unframed. We lack ways to sele what’s important. The design task is to make information digestible.*
> (John Thackara, *In the Bubble: Designing in a Complex World*, The MIT Press, 2005.)

Popularity doesn’t always stem from worth.

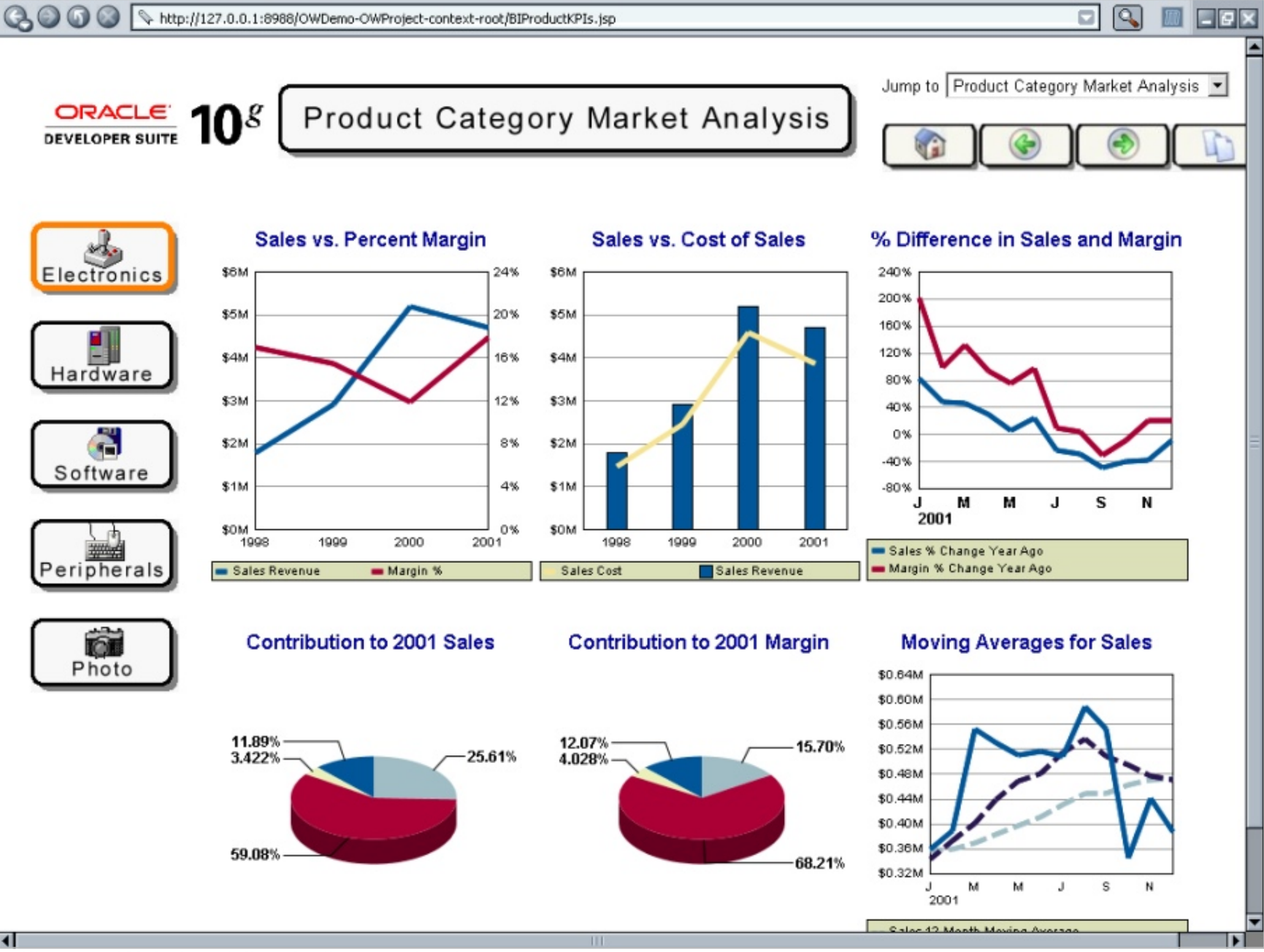
Dashboard

?

Few people have a clear notion of what a dashboard is.

Everyone defines them differently, if at all, including the vendors who sell them. Before proceeding, we need a definition.

The examples that follow in the next few slides are all screen prints of displays that their creators call “dashboards” (or in one case a “cockpit”). See if you can come up with a definition of “dashboard” based on these examples.

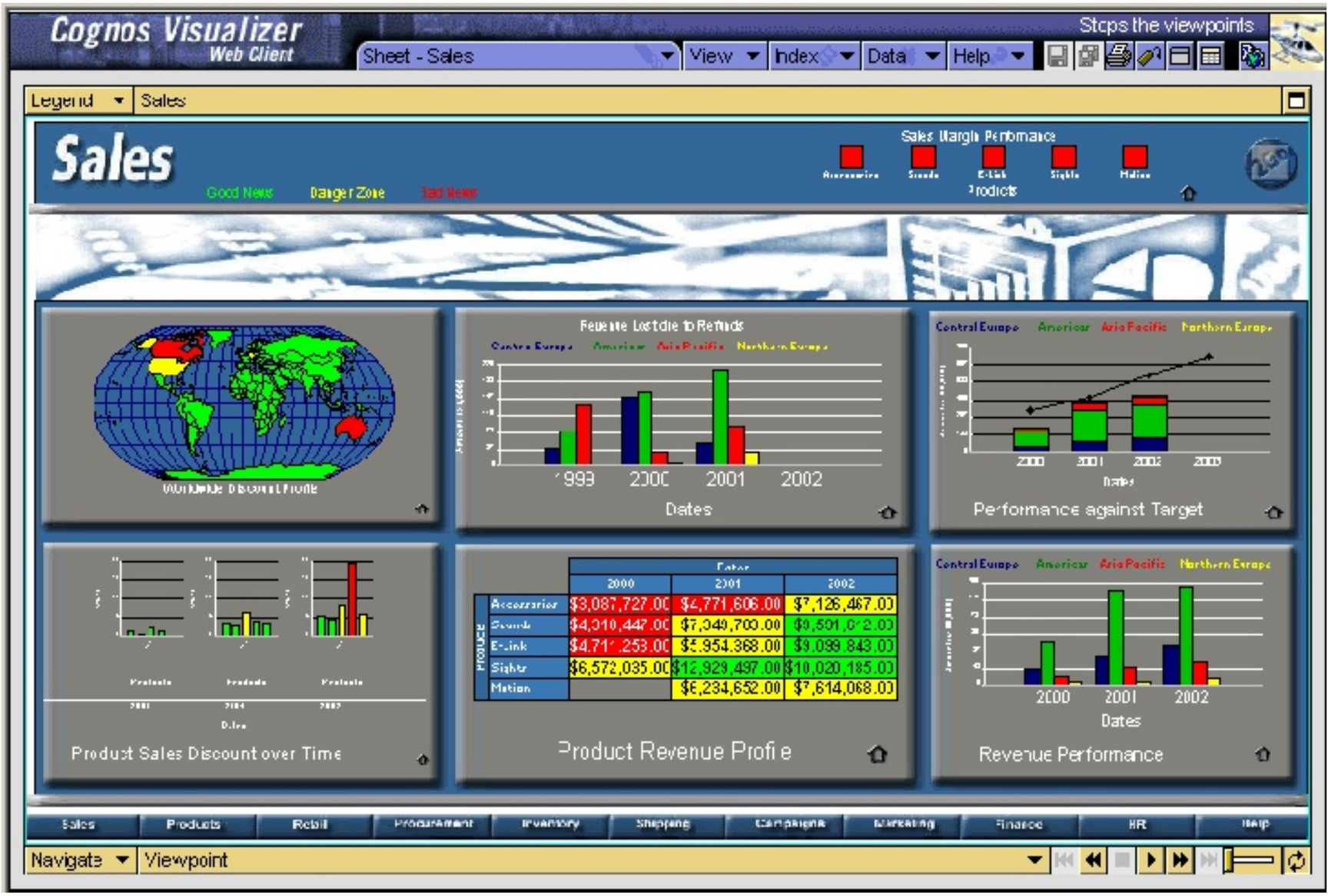


(Source: Website of Oracle Corporation.)

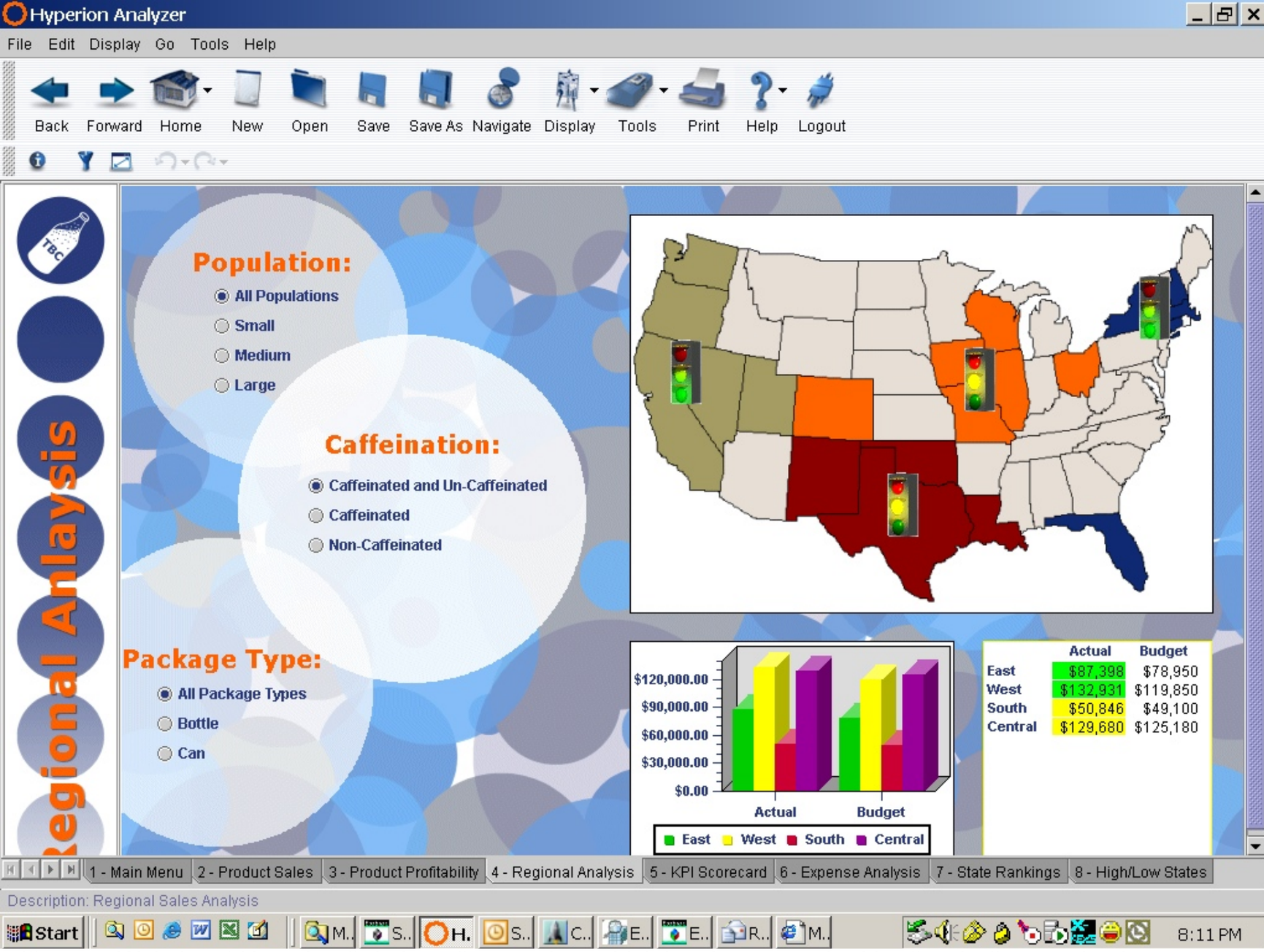
The Pipeline Analytics view enables sales professionals to fully understand their pipelines, allowing them to quickly identify and address issues before they become problems.

(Source: Website of Siebel Systems Incorporated, which has been acquired by Oracle Corporation.)

(Source: Website of Business Objects.)

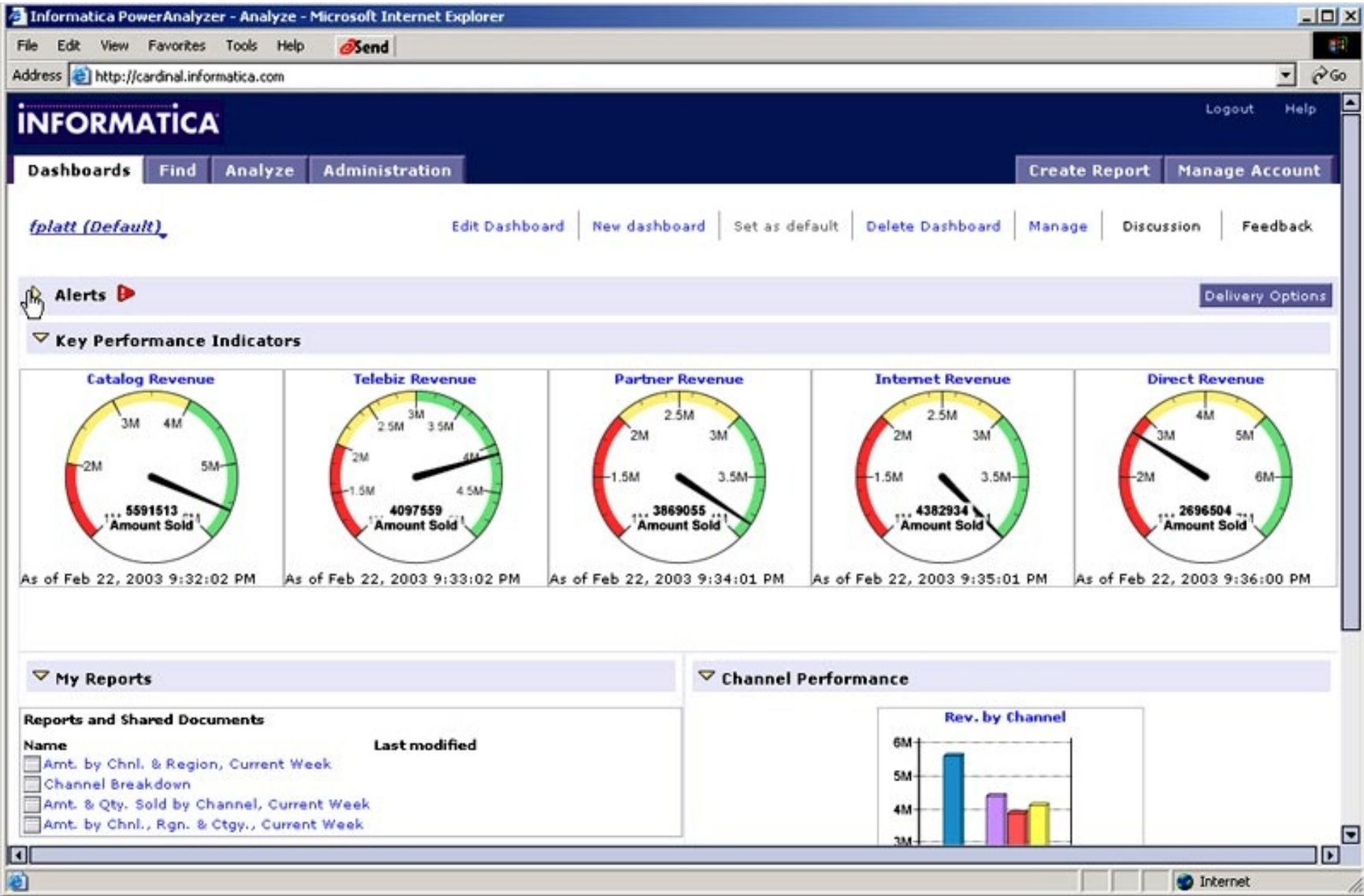


(Source: Website of Cognos Incorporated.)



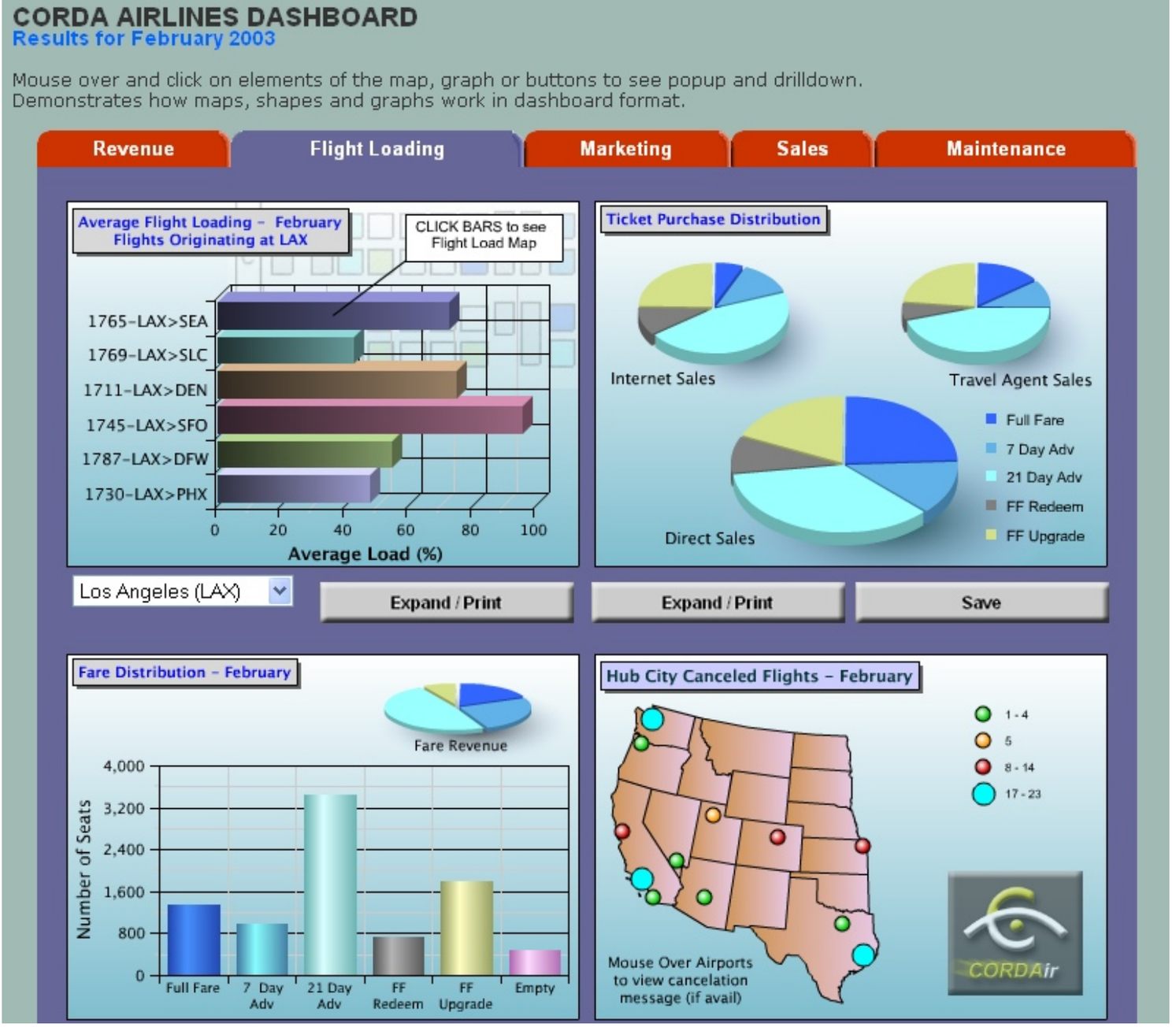
(Source: Website of Hyperion Solutions Corporation, which has been acquired by Oracle Corporation.)

(Source: Website of Hyperion Solutions Corporation. Brio Software was acquired by Hyperion, which has since been acquired by Oracle Corporation.)



(Source: Website of Informatica Corporation.)

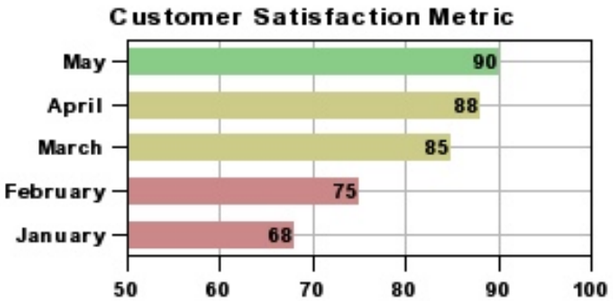
(Source: Website of Infommersion Incorporated, which has been acquired by Business Objects.)

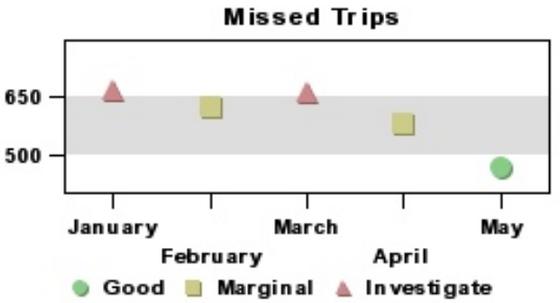


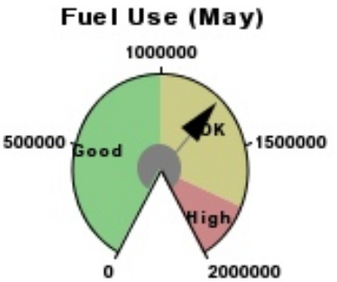
(Source: Website of Corda Technologies Incorporated.)

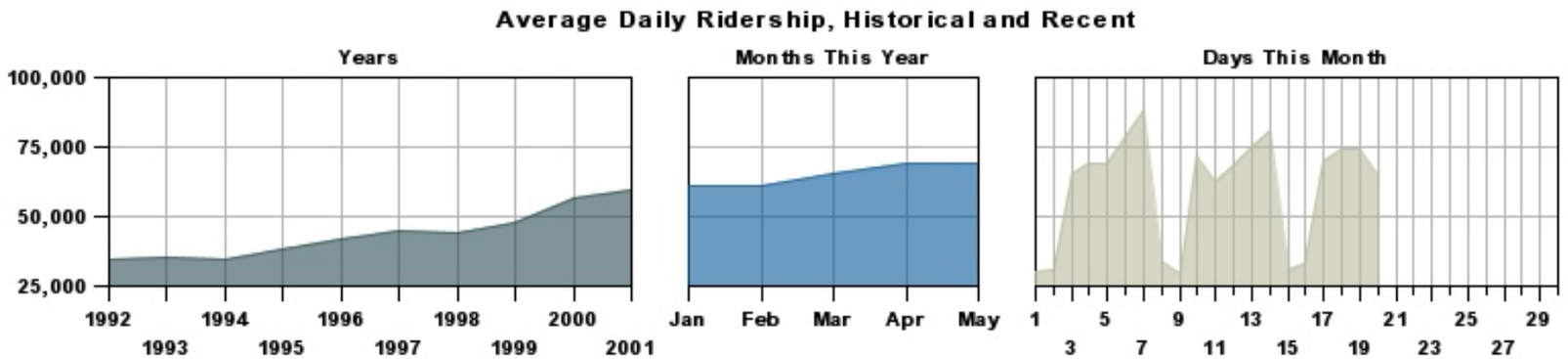
Springfield Transit System - Executive Dashboard View

Month	Operating Costs	Revenues
January	$14,489,300.00	$13,823,458.00
February	$12,944,984.00	$14,123,458.00
March	$14,123,458.00	$14,829,455.00
April	$12,584,953.00	$14,314,590.00
May	$12,974,004.00	$13,723,999.00

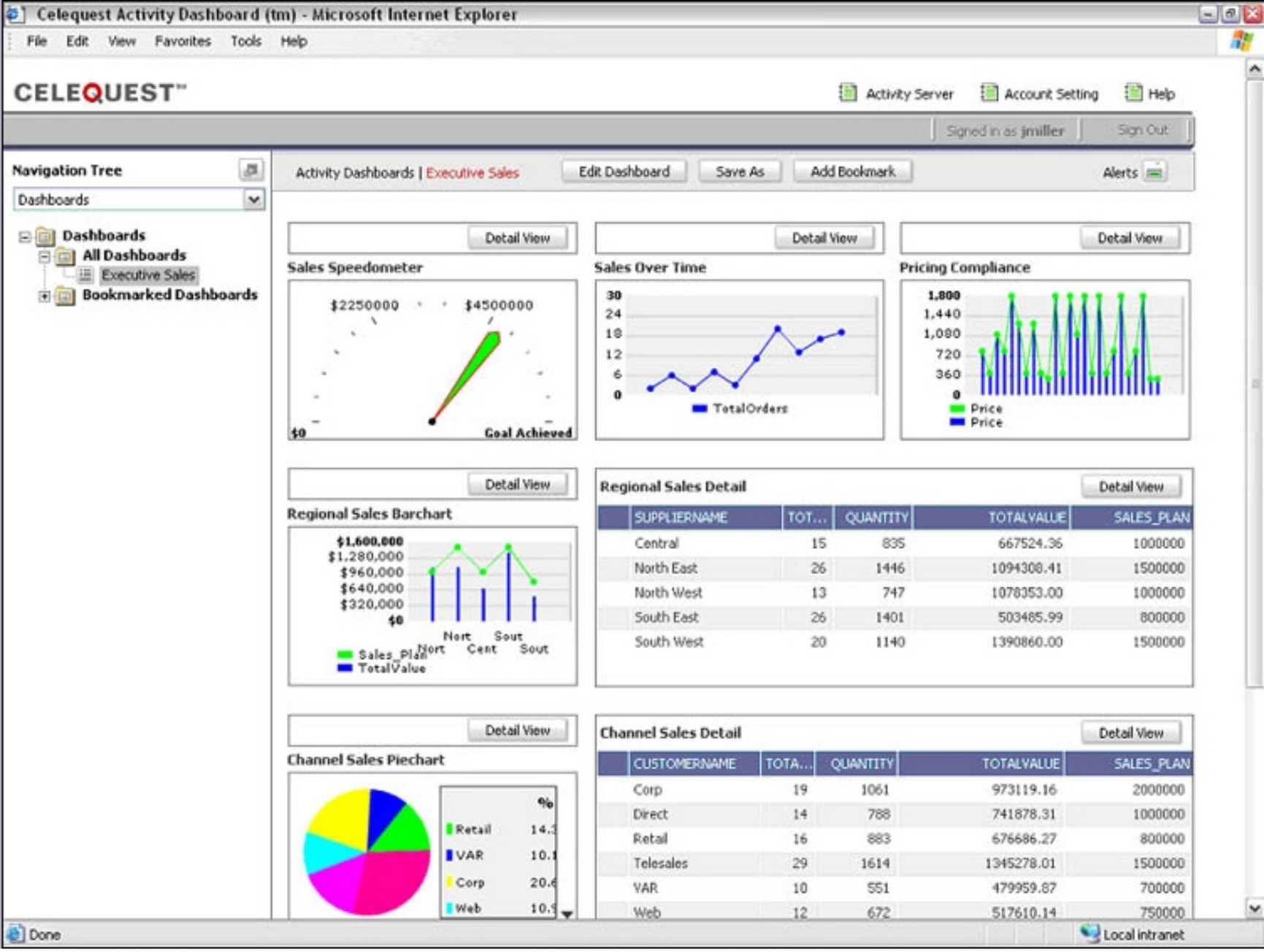




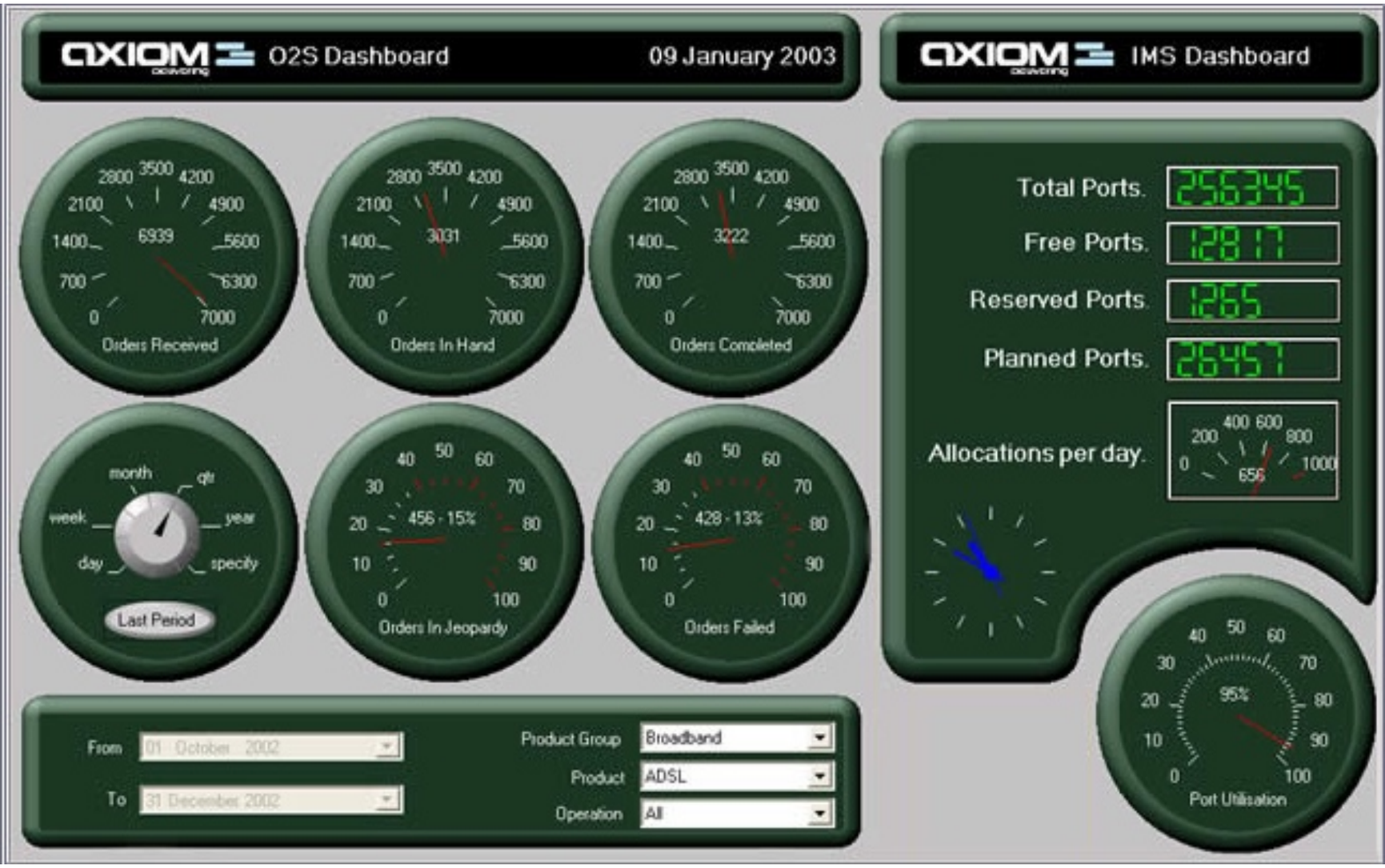




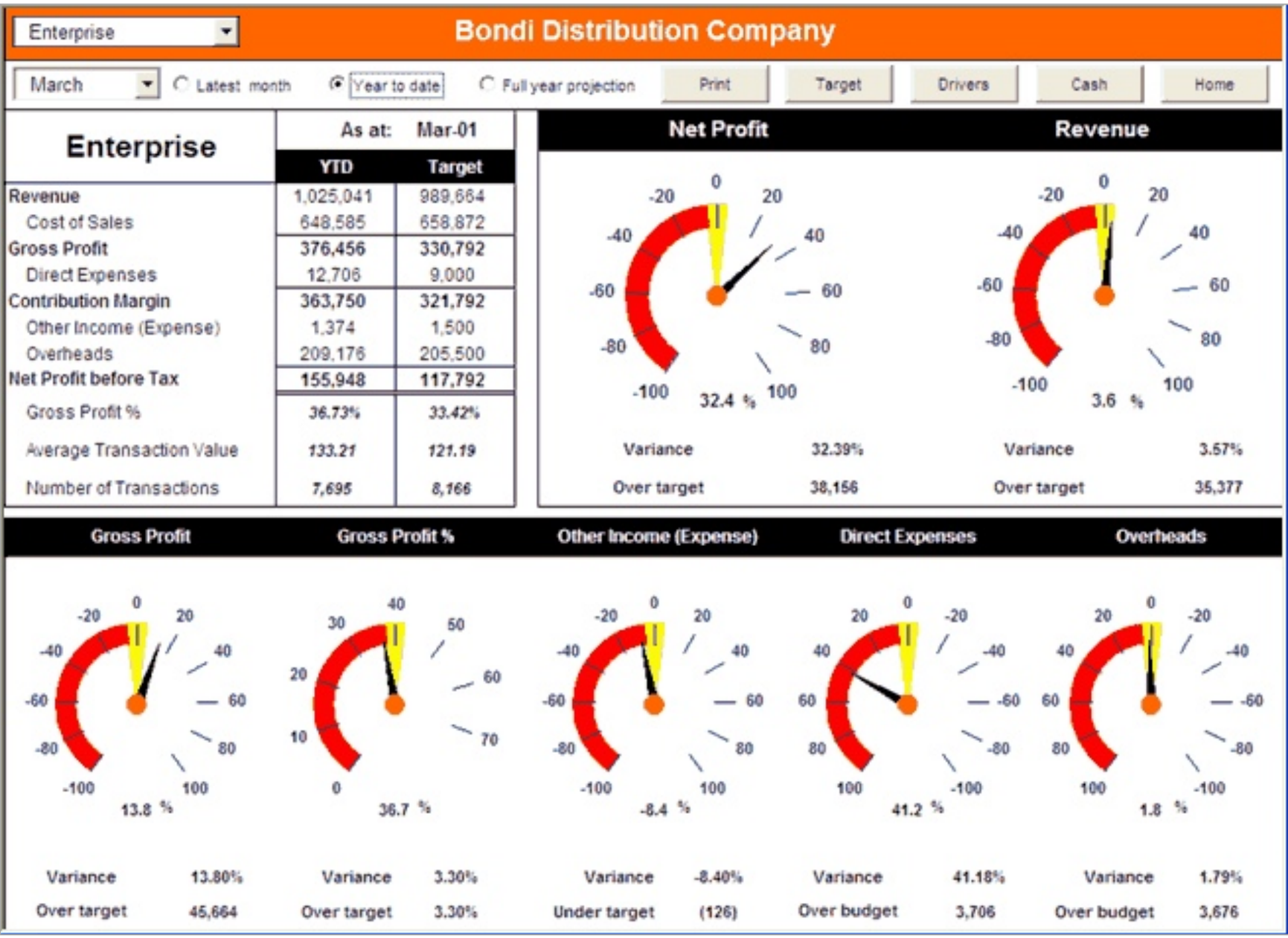
(Source: Website of Visual Mining, Incorporated.)



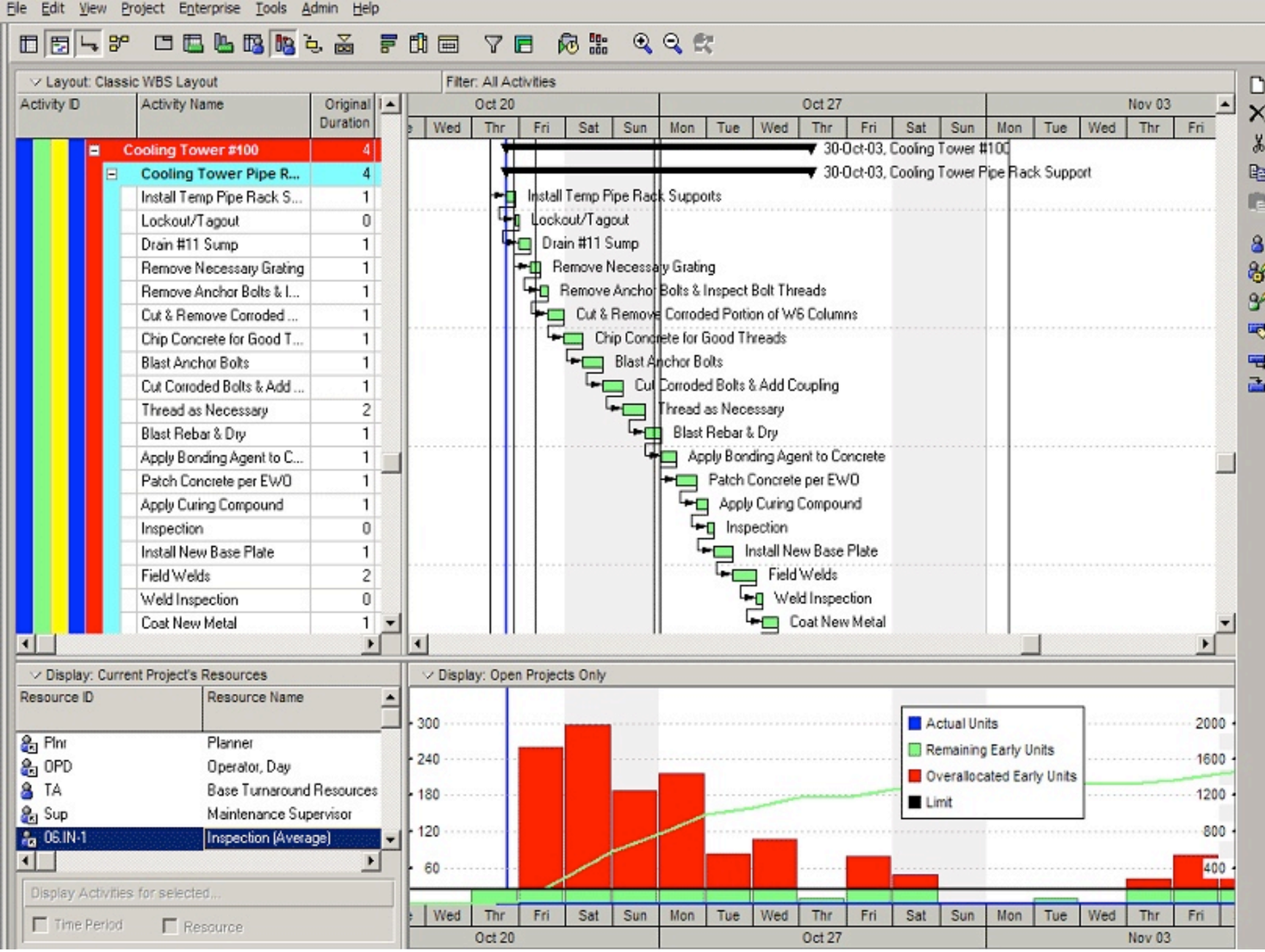
(Source: Website of Celequest Corporation, which has been acquired by Cognos Incorporated.)



(Source: Website of Axiom Systems.)

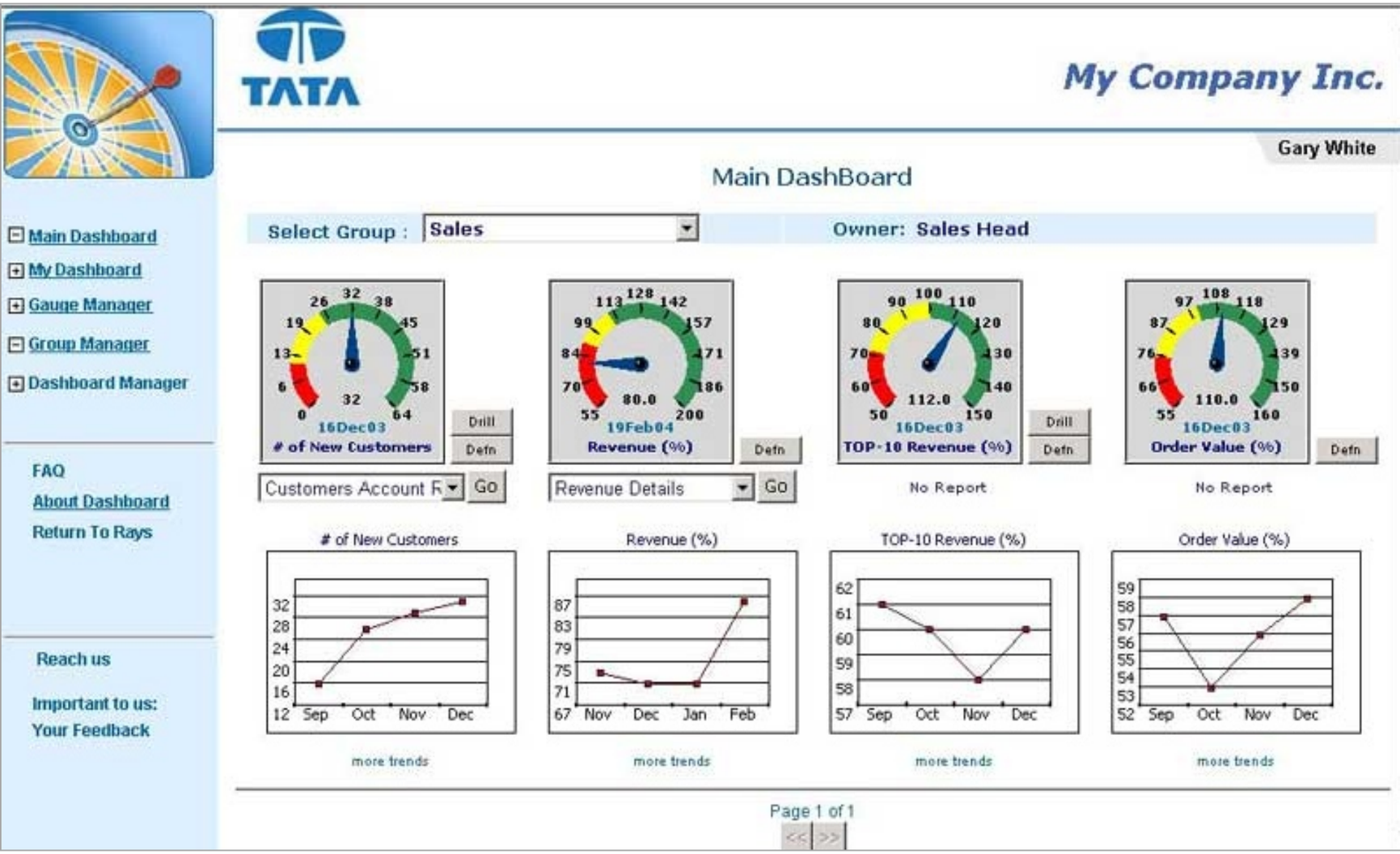


(Source: Website of Principa.)

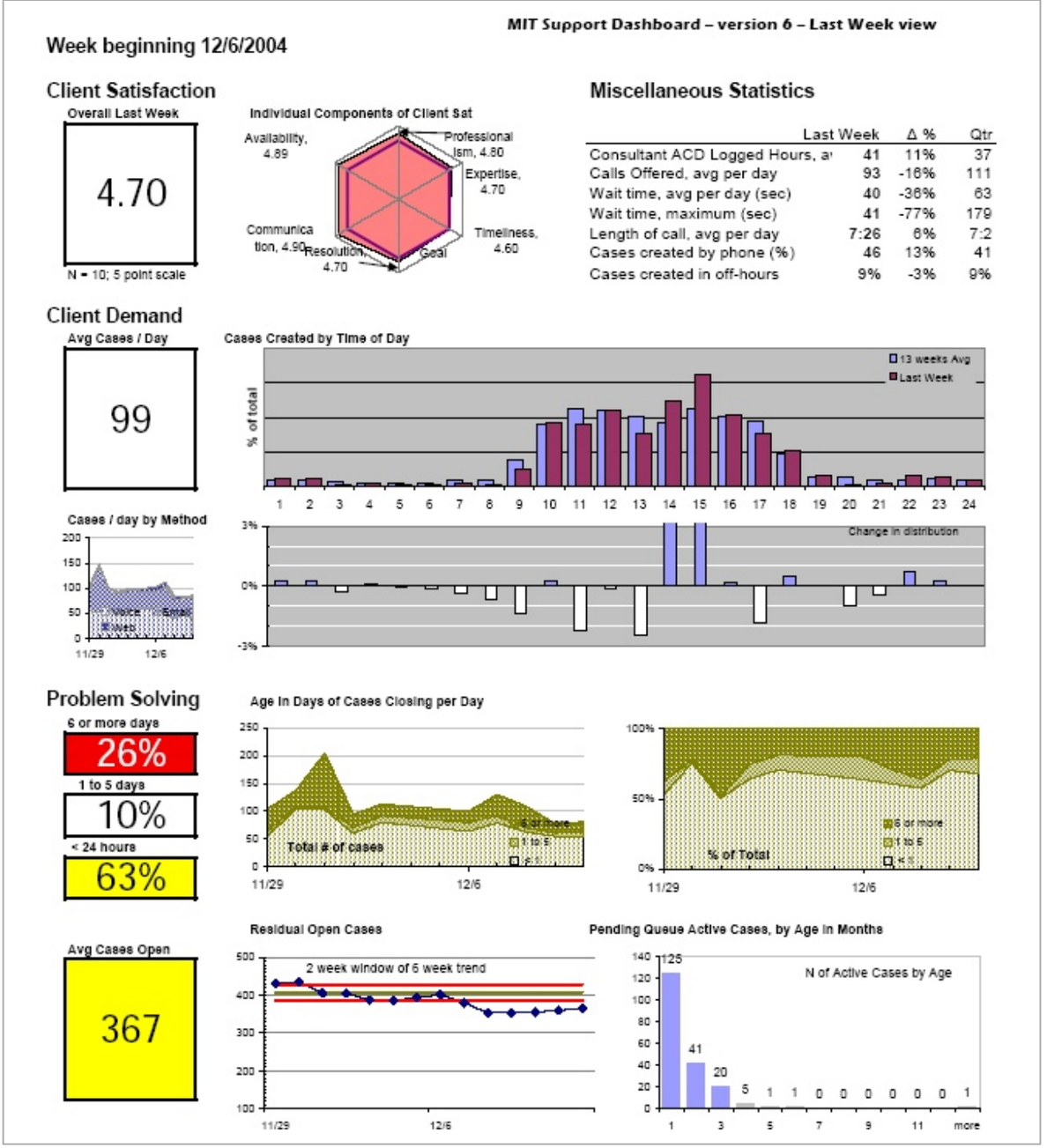


(Source: Website of Primavera Systems, Incorporated.)

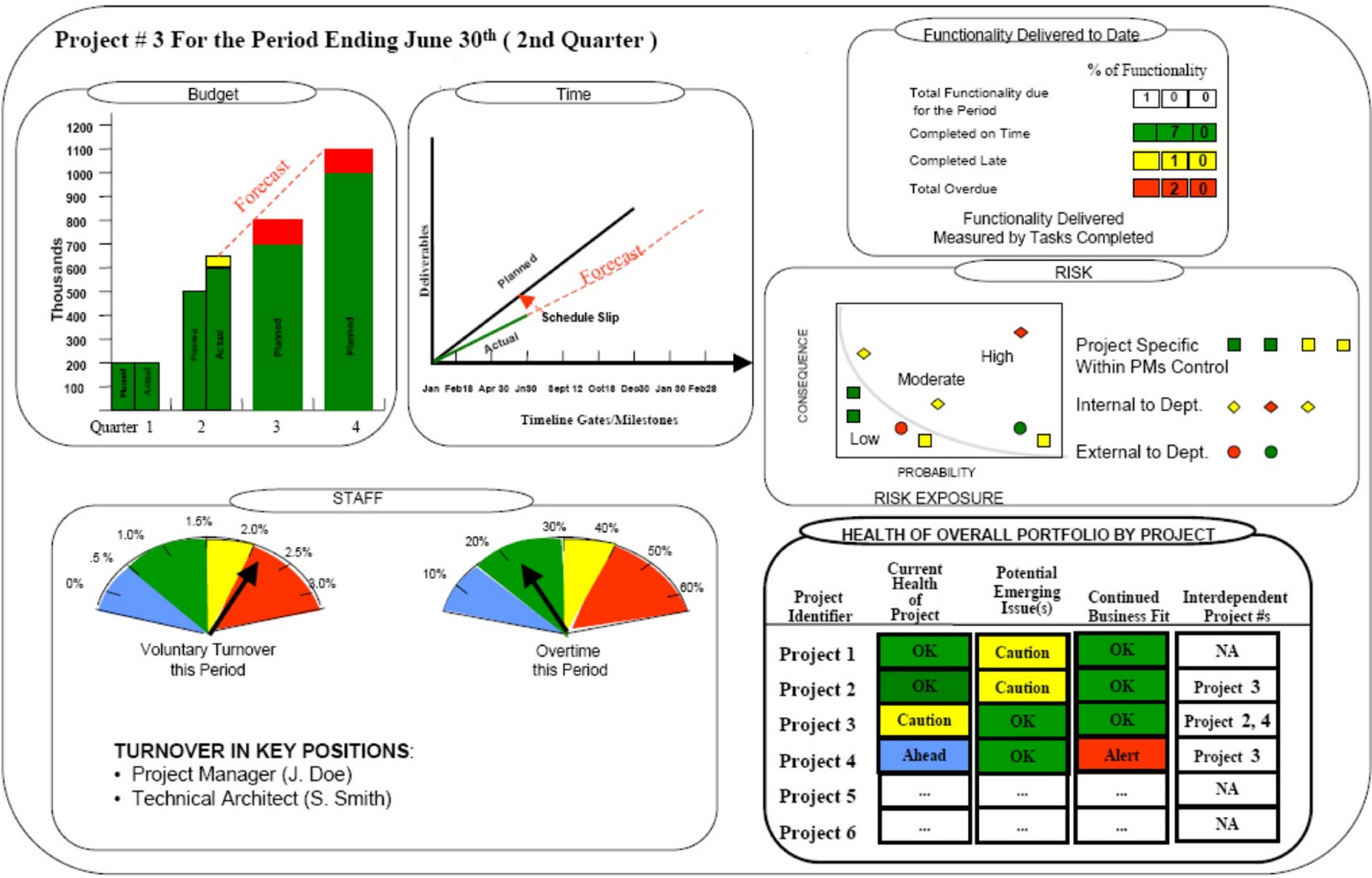
(Source: Website of Visium Solutions.)



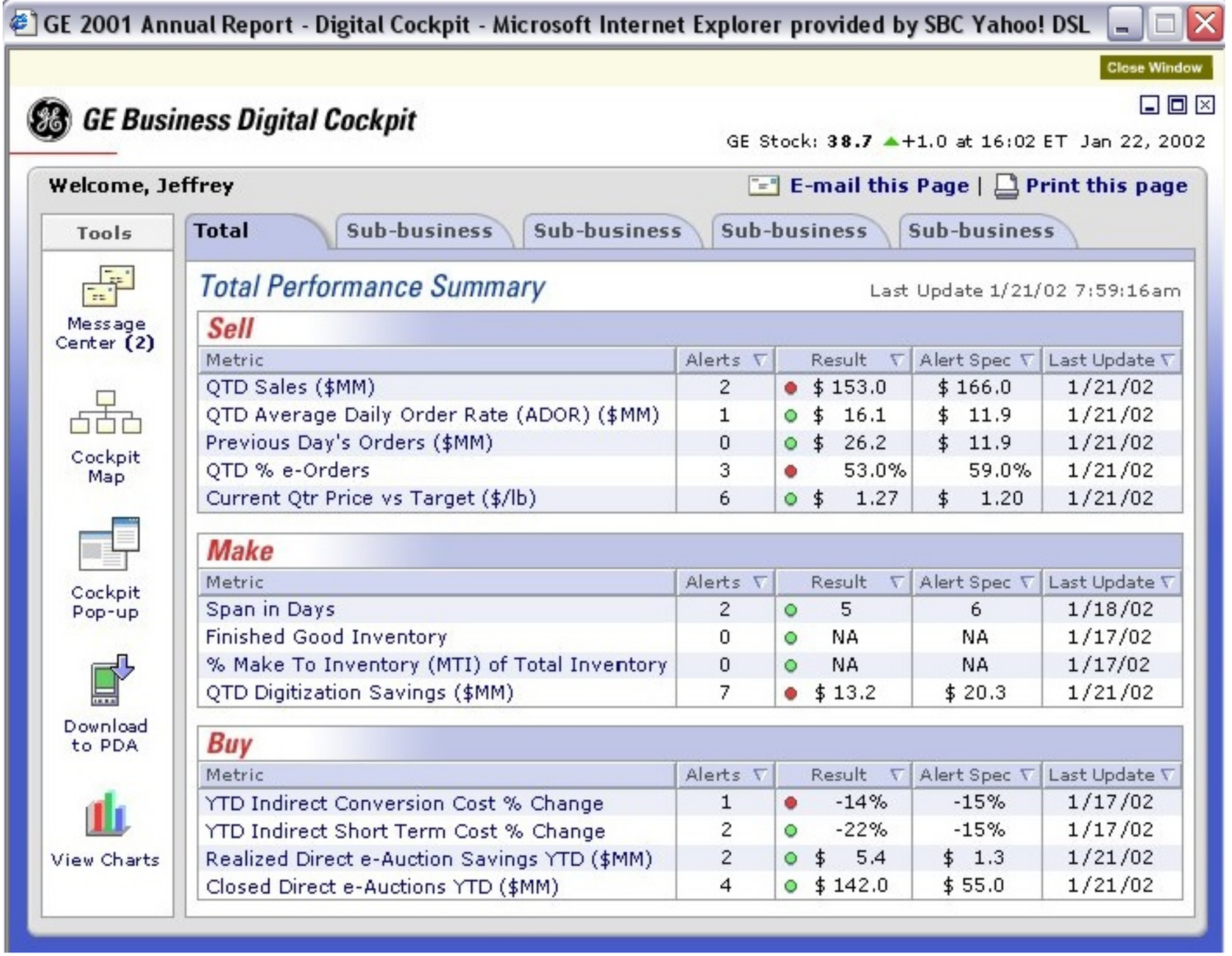
(Source: Website of Tata Infotech, LTD.)



(Source: Website of MIT.)



(Source: Website of the Treasury Board of Canada.)



(Source: Website of General Electric.)

RealTime Balanced ScoreCard

April-04

Financial

Revenues QTD (In $M)	Tgt.>	Act.
	$40.4	$41.7

Gross Margins YTD (In %)	Tgt.>	Act.
	20.0%	21.1%

Growth: Cash Reserves YTD (In $M)	Tgt.>	Act.
	$4.00	$3.30

Age of Receivables (In Days)	Tgt.<	Act.
	60	63

Expenses Vs. Targets QTD (In $M)	Tgt.<	Act.
	$20.00	$19.97

Revenue per Employee (In $K)	Tgt.>	Act.
	$400.0	$398.7

Market/Customers

Revenue: Top 10 Customers (In $M)	Tgt.>	Act.
	$68.00	$64.53

Orders YTD (In $M)	Tgt.>	Act.
	$102.7	$97.4

Revenue From New Products (In %)	Tgt.>	Act.
	65.0%	64.1%

Demos to New Eur/Asia Custs (In YTD #s)	Tgt.>	Act.
	80	81

Customer Complaints (In #s)	Tgt.<	Act.
	20	18

Customer Satisfaction (7 Point Scale)	Tgt.>	Act.
	5.5	5.2

Operational Excellence

Product Dvpt. Slippage (In %)	Tgt.<	Act.
	20%	66%

Direct Labor Hours / Unit (In Hrs.)	Tgt.<	Act.
	4.12	4.21

BOM Costs As % of Targets	Tgt.<	Act.
	100%	105%

Ops COGS As % of Revenue	Tgt.<	Act.
	70.0%	77.3%

Inventory Turns (In #)	Tgt.>	Act.
	4.5	3.3

On-Time Shipments (In %)	Tgt.>	Act.
	90.0%	91.8%

Cost of Quality (As %of COGS)	Tgt.<	Act.
	10%	11.4%

In-Warranty Turn-Around Time (In Days)	Tgt.<	Act.
	14	18.7

People Productivity

Headcount (In #s)	Tgt.	Act.
	715	713

Women in the Workplace (In %)	Tgt.>	Act.
	30%	26.9%

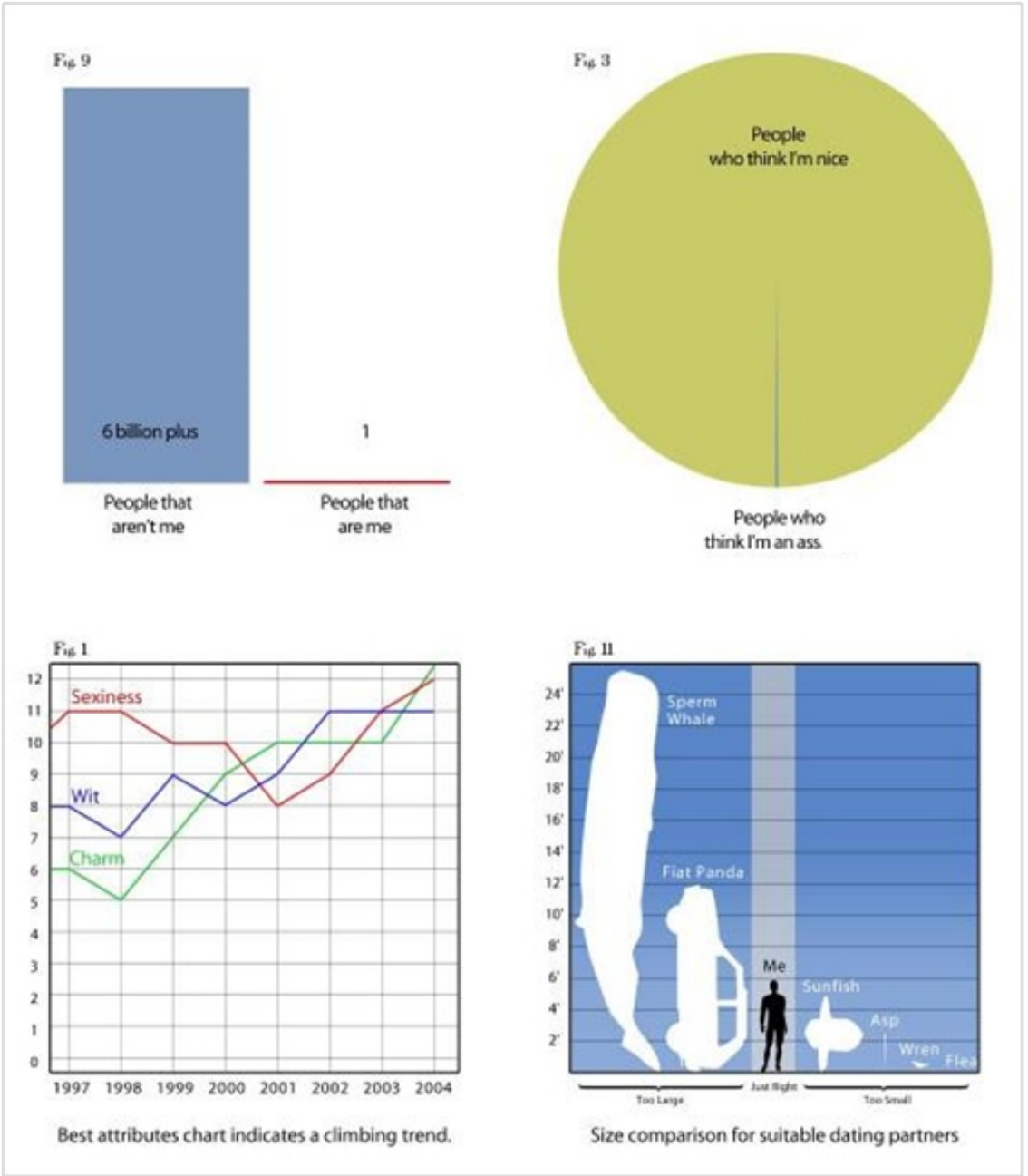
Overage Reqs (% > 60 Days)	Tgt.<	Act.
	20%	33%

People Trained: Key Programs	Tgt.>	Act.
	215	175

Voluntary Attrition (In %)	Tgt.<	Act.
	20%	21%

Employee Satisfaction (10 Pt. Scale)	Tgt.>	Act.
	7.5	6.6

(Source: Created by Michael Selby.)



(Source: An anonymous Internet dater who posted this dashboard-like display of his vital statistics on www.Craigslist.com.)

Dashboard defined

A visual display

of

the most important information needed
to achieve one or more objectives

that has been

consolidated on a single computer screen

so it can be

monitored and understood at a glance

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.

This definition first appeared in the March 20, 2004 issue of *Intelligent Enterprise* magazine in an article written by Stephen Few entitled “Dashboard Confusion.”

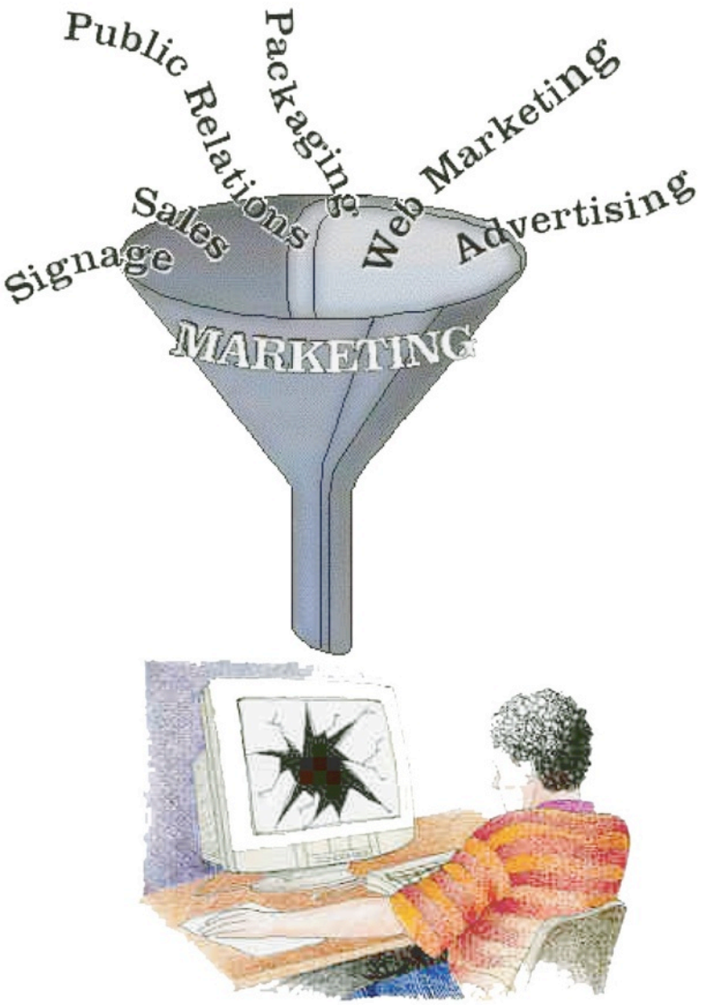
Dashboards are **not** comprehensive.

They are not:

- comprehensive tools for analysis
- comprehensive tools for decision making
- comprehensive tools for management

They do not provide comprehensive information and they do not replace the full set of tools required to do so. If you look only at the dashboard while driving a car, what happens? Crunch! The same is true in business. However, they can serve as launch pads for any process that requires comprehensive information.

The fundamental design challenge



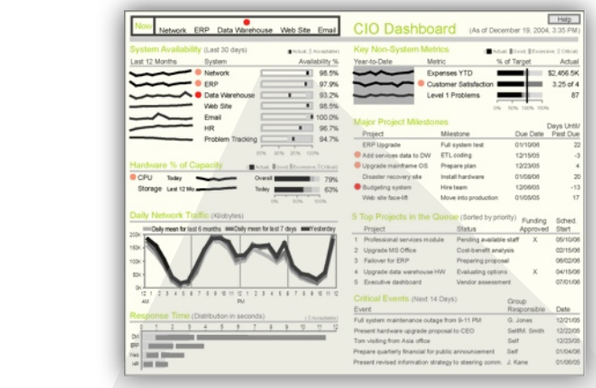
The fundamental challenge of dashboard design is to display all the required information on a single screen:

- clearly and without distraction
- in a manner that can be quickly examined and understood

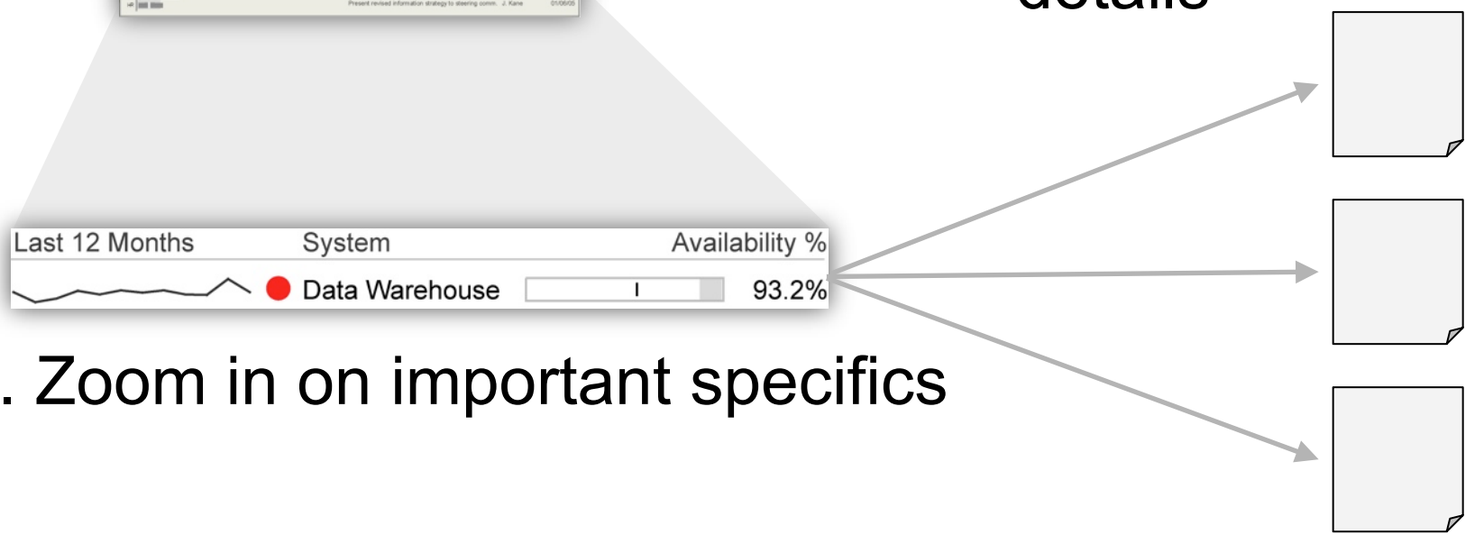
Think about the cockpit of a commercial jet. Years of effort went into its design to enable the pilot to see what's going on at a glance, even though there is much information to monitor. Every time I board a plane, I'm grateful that knowledgeable designers worked hard to present this information effectively. Similar care is needed for the design of our dashboards. This is a science that few of those responsible for creating dashboards have studied.

Visual monitoring

1. Scan the big picture

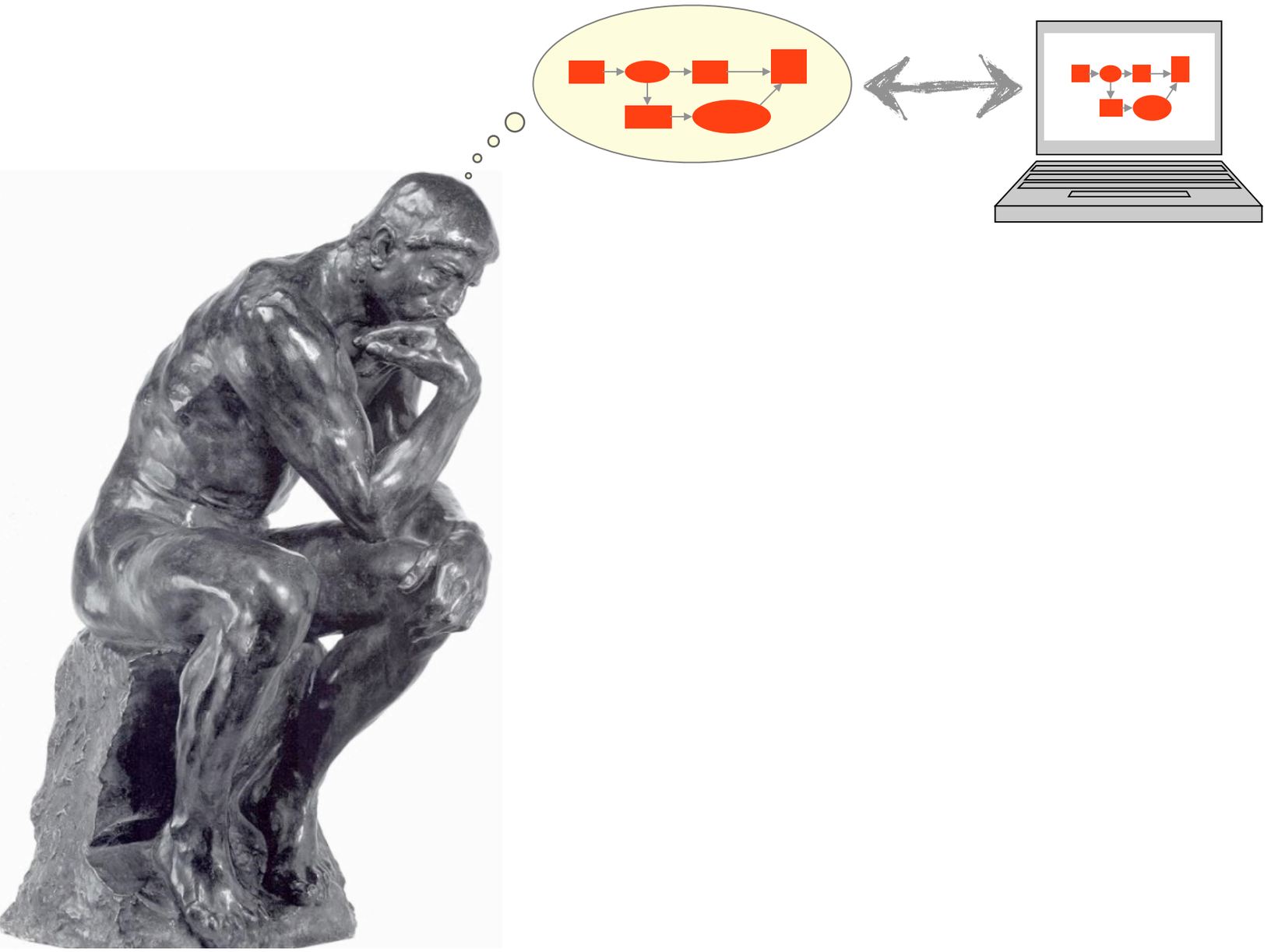


3. Link to supporting details



2. Zoom in on important specifics

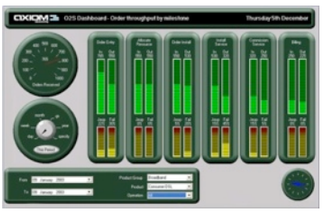
The process of visual monitoring involves a series of sequential steps that the dashboard should be designed to support. The user should begin be getting an overview of what's going on and quickly identifying what needs attention. Next, the user should look more closely at each of those areas that need attention to be able to understand them well enough to determine if something should be done about them. Lastly, if additional details are needed to complete the user's understanding before deciding how to respond, the dashboard should serve as a seamless launch pad to that information, and perhaps even provide the means to initiate automated responses, such as sending emails to those who should take action.

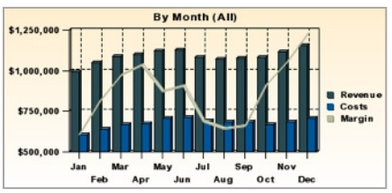


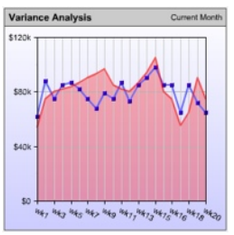
Visually represent the user’s mental model.

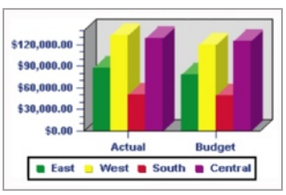
When people develop expertise in a domain, they build a mental model of the domain—its parts and how they related to one another. Whey they monitor what’s going on, they plug what they observe into this mental model to make sense of it and use the observations to determine if action must be taken. When dashboards that are designed to reflect this mental model, it is easy for people to plug the information that the dashboard displays into this model. This means that part of the job of a dashboard designer is to become familiar, as much as possible, with the model of the domain that the people who will use the dashboard have constructed in their minds. One way to help people express this model, which is often so well integrated into their understanding that they are no longer consciously aware of the model, is to ask them to sketch a simple diagram to explain to you the various parts of the domain and how they relate to one another. For instance, a simple process flow diagram might do the trick.

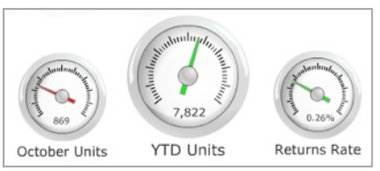
13 common mistakes in dashboard design

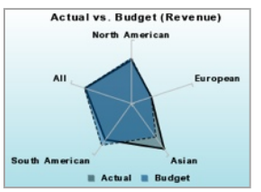


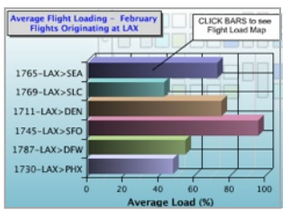


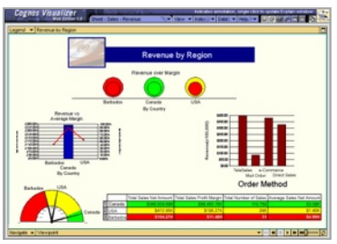


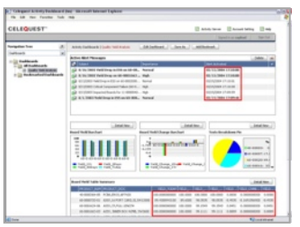












Too many dashboard vendors and designers have lost sight of the bottom line: communication. They emphasize graphical glitz over clear and efficient content. For every item of information on the screen the designer should ask the question: “How can I display this information in the most meaningful, clear, and efficient way possible?”

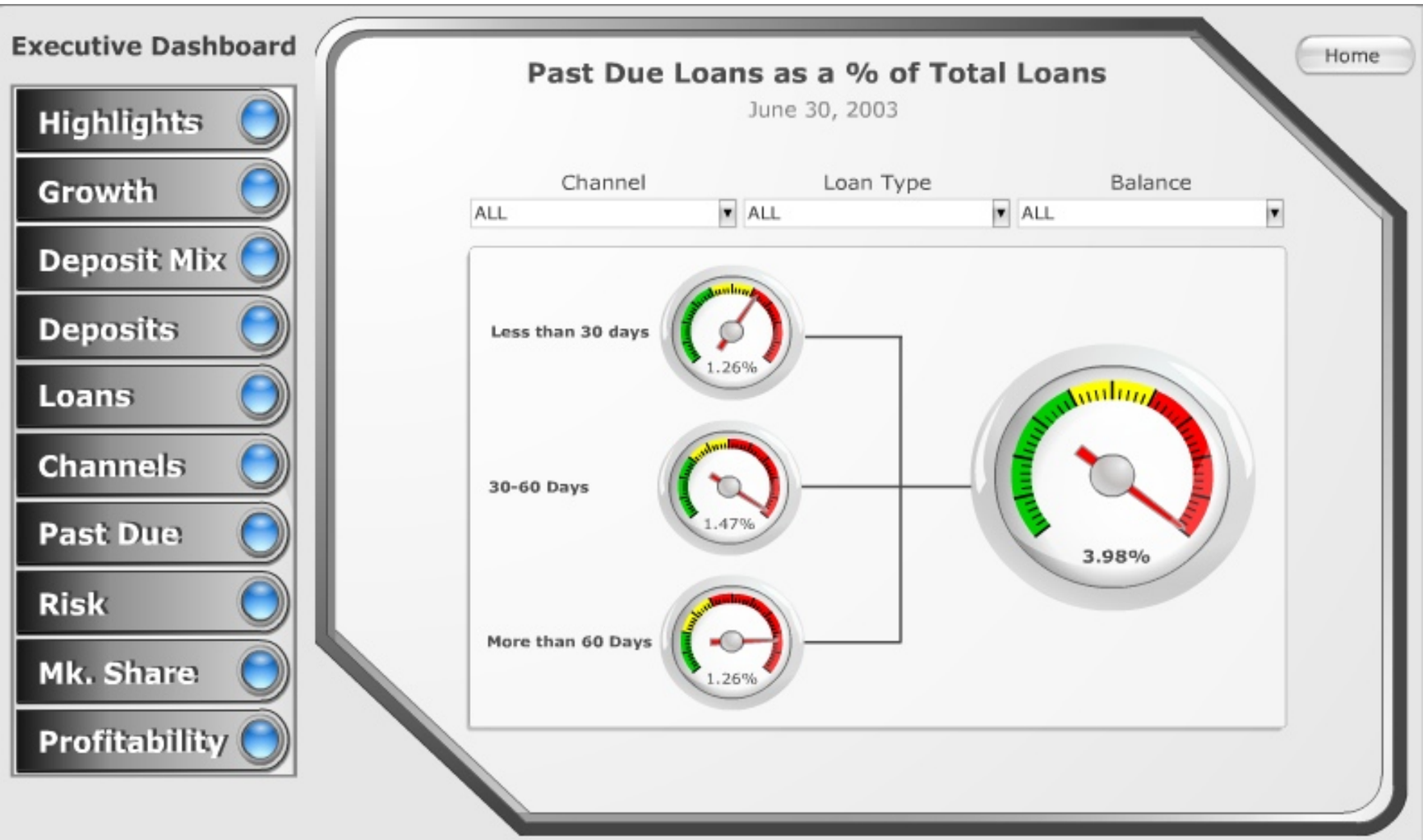
1. Exceeding the boundaries of a single screen

My insistence that a dashboard confine its display to a single screen with no need for scrolling might seem arbitrary, but it is based on the findings of perceptual and cognitive research. Something powerful happens when you see things together, all within eye span. You are able to make comparisons, spot relationships, and see the big picture. This ability is lost when you must lose sight of some data in order to scroll down or over to see other data. Part of the problem is that we can only hold a few chunks of information at a time in short-term memory. Relying on the mind's eye to retain a visualization that is no longer visible is a limited venture. One of the great benefits of a dashboard is the simultaneity of vision, the ability to see everything that you need at once. This enables comparisons that lead to insights that might not occur in any other way.

The dashboard shown above not only leaves us wondering what lies below the bottom of the screen, we're also only given immediate visual access to the first of many metrics that appear at the top right, under the heading "No. of transactions". Don't force your viewers to scroll around to see what they need. I'd prefer a printed report that extends across multiple pages, because at least then I could lay out all of the pages at once for simultaneous viewing.

(Source: Website of Business Objects.)

1. Exceeding the boundaries of a single screen



Data is often fragmented into separate screens in one of two ways:

- It is separated into discrete screens to which one must navigate.
- It is separated into different versions of a single screen that are accessed individually.

When the information should all been seen at the same time to gain the desired insights and to make the needed connections, this fragmentation undermines the unique advantages of a dashboard.

The dashboard above fragments the data that the executives need into 10 separate dashboards. This would be fine the executives would not benefit from seeing these various measures together, but that is hardly the case. Splitting the big picture into a series of separate, small pictures is a mistake when seeing the big picture is worthwhile.

(Source: Website of Infommersion Incorporated.)

2. Supplying inadequate context for the data

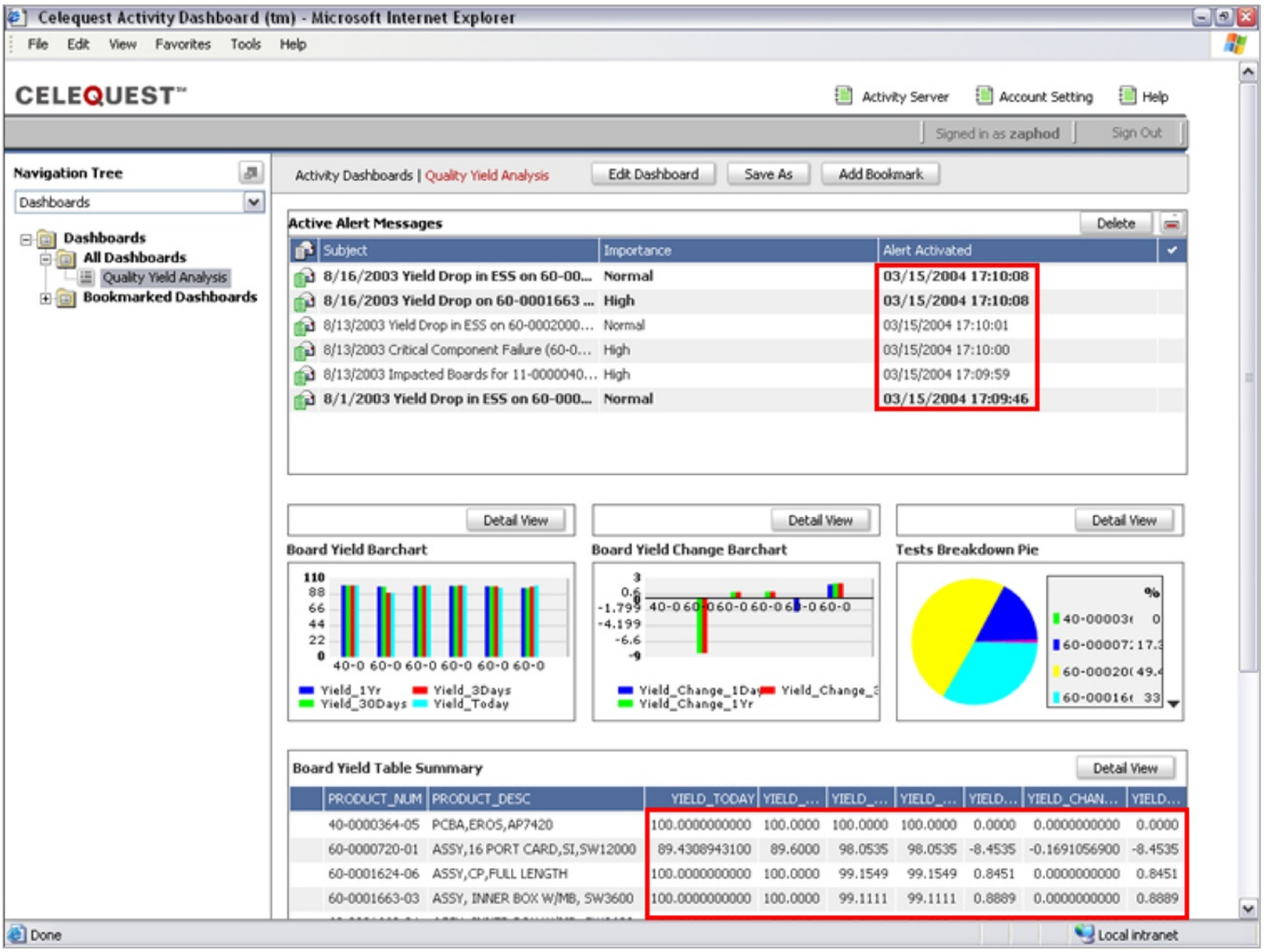
Measures of what's going on in the business rarely do well as solo acts; they need a good supporting cast to get their message across. To state that quarter-to-date sales total $736,502 without any context means little. Compared to what? Is this good or bad? How good or bad? Are we on track? Is this better than before? The right context for the key measures makes the difference between numbers that just sit there on the screen and those that enlighten and inspire action.

The gauges above could have easily incorporated useful context, but they fall short of their potential. The center gauge tells us only that 7,822 units have sold year to date and that this number is good, indicated by the green arrow.

Quantitative scales on a graphic, such as those suggested by the tick marks around these gauges, are meant to help us interpret the measures, but they can only do so when scales are labeled with numbers, which these gauges lack. A great deal of the space that is used by these gauges tells us nothing whatsoever.

(Source: Website of Informmersion Incorporated.)

3. Displaying excessive detail or precision



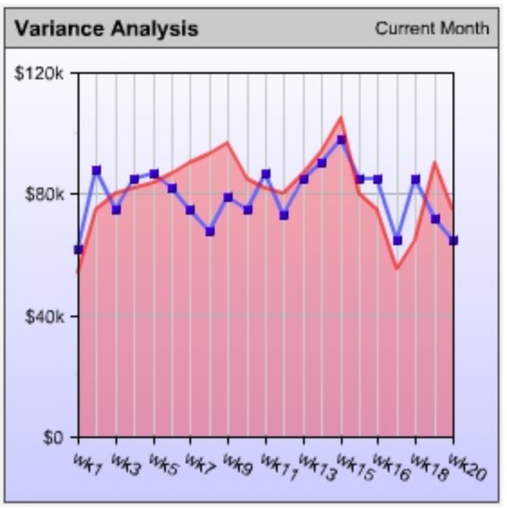
Dashboards almost always require fairly high-level information to support the viewer's needs for a quick overview. Too much detail or measures that are expressed too precisely (for example, $3,848,305.93 rather than $3,848,306 or perhaps even $3.8M) just slow viewers down without benefit.

Examine the two sections above that I've enclosed in red rectangles. The lower right section displays from four to ten decimal digits for each measure, which might be useful in some contexts, but doubtfully on a dashboard. The highlighted section above displays time down to the level of seconds, which seems like overkill in this context. With a dashboard, every unnecessary piece of information results in wasted time, which is intolerable when time is definitely of the essence.

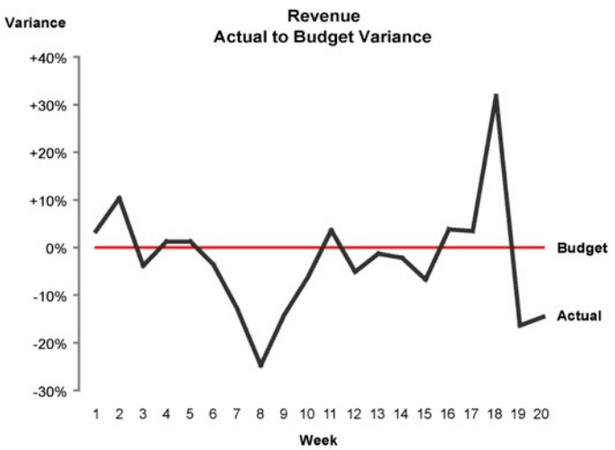
(Source: Website of Celequest Corporation.)

4. Expressing measures indirectly

Bad



Good



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 poorly expressed if it fails to directly, clearly, and efficiently communicate the meaning that the dashboard viewer must discern. If the dashboard viewer only needs to know by how much actual revenue differs from budgeted revenue, 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, or even by displaying the variance of -$8,066 as well, it would be more direct to simply express the variance as –10%. In this case a percentage clearly focuses attention on the variance and does so in a manner that is directly intelligible.

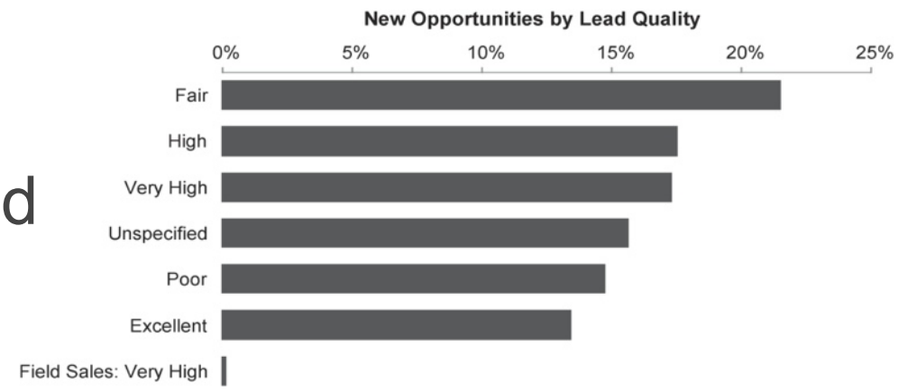
The top variance analysis graph above illustrates this point. I assume that of the red line and the blue line on the graph, one represents the actual revenue and one represents budgeted revenue. The variance, however, could have been displayed more vividly by encoding budgeted revenue as a reference line of 0% and the variance as a line that meanders above and below budget expressed in units of positive and negative percentages.

(Source: Website of Corda Technologies Incorporated.)

5. Choosing inappropriate display media

Bad

Good

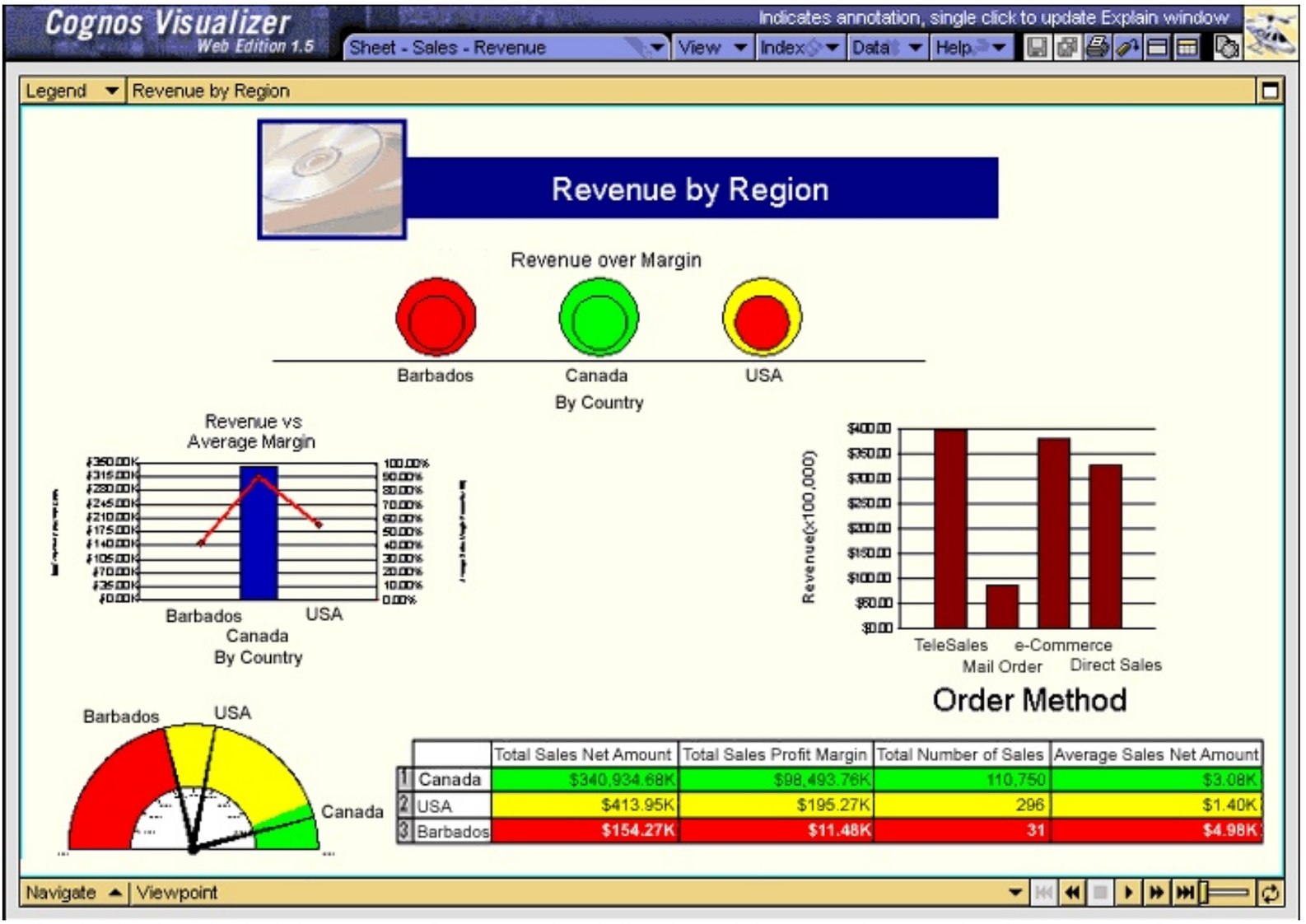


This is one of the most common design mistakes made, not just on dashboards, but in all forms of data presentation. Using a graph when a table of numbers would work better and vice versa is a frequent mistake, but the one that stands out as the most common and egregious is using the wrong type of graphic.

Without the value labels on the pie chart above, you would conclude that all of the slices are roughly the equal in size. The bar graph below it, however, tells the story clearly and quickly, because it is a better medium of display for this information.

(Source: Website of Corda Technologies Incorporated.)

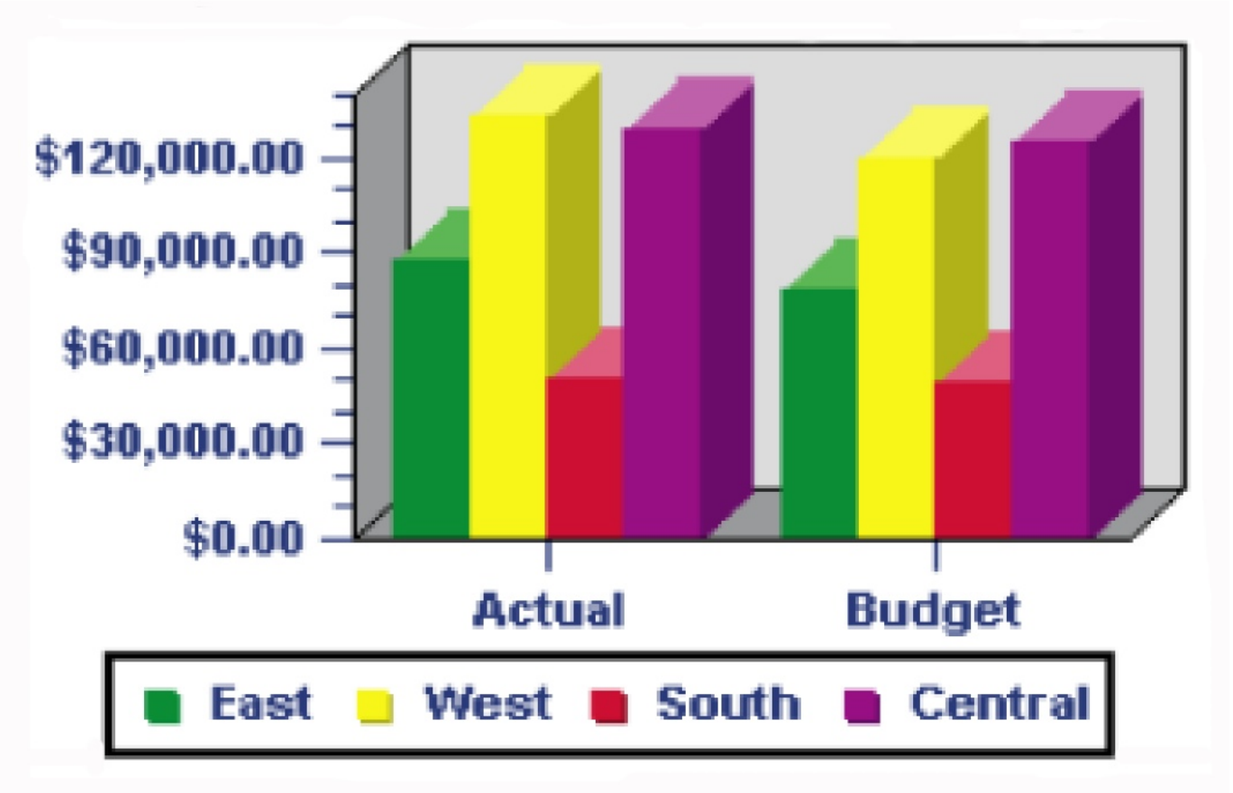
6. Introducing meaningless variety



This mistake is closely tied the one we just examined. I've found that people often hesitate to use the same type of display mechanism multiple times on a dashboard out of what I assume is a sense that viewers will get bored with 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 if it's all displayed in the same way, but they will definitely get aggravated if forced to work harder than necessary to get the information they need due to unnecessary variety. In fact, consistency in the means of display whenever appropriate allows viewers to use the same perceptual strategy for interpreting the data, which saves them time and energy. The dashboard above illustrates variety gone amok.

(Source: Website of Cognos Incorporated.)

7. Using poorly designed display mechanisms



It isn't enough to choose the right means to display the information and its message; you must also design the components of that display to communicate clearly and efficiently, without distraction.

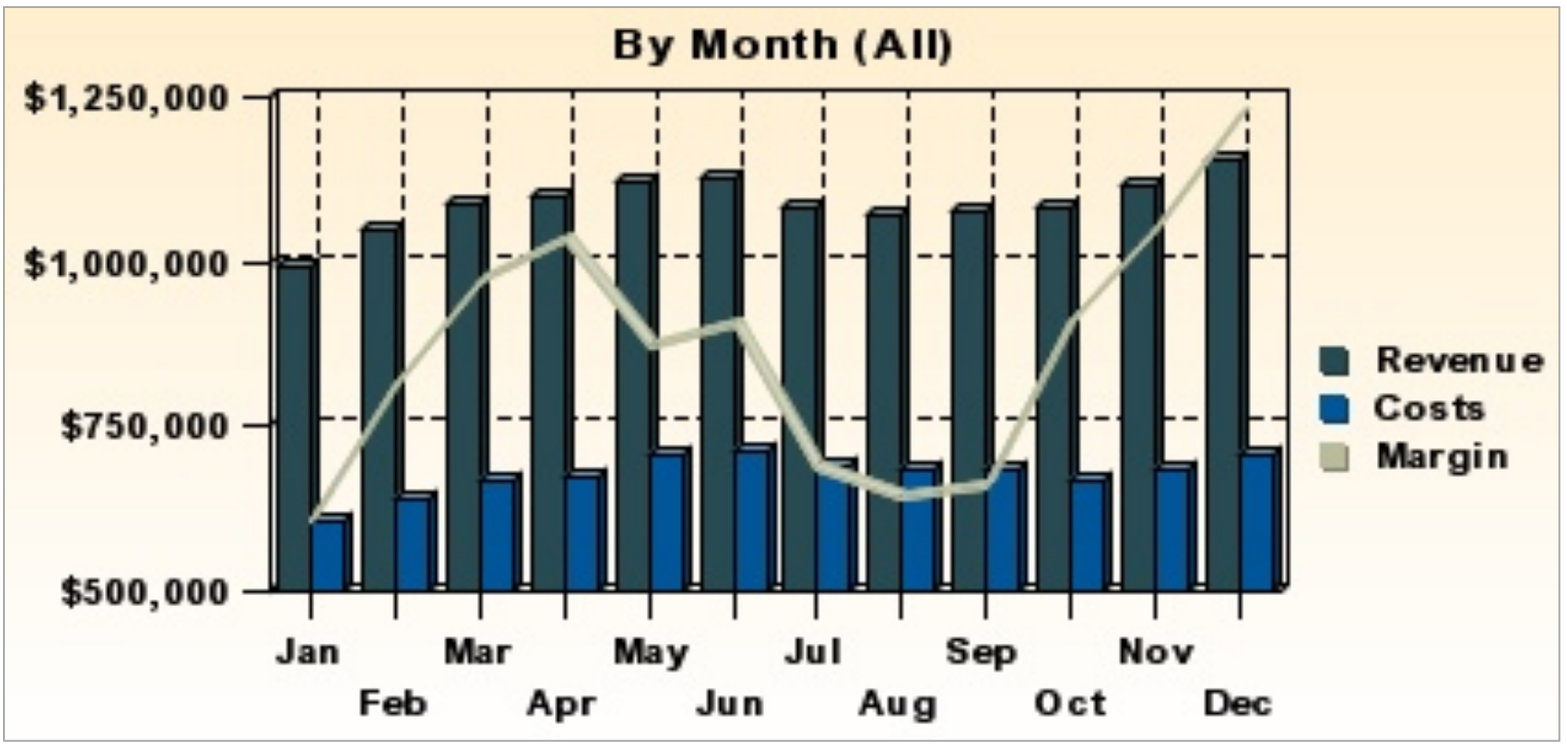
The graph above illustrates several design problems.

- The colors of the bars are distractingly bright
- The 3-D effect makes the bars hard to read
- The purpose of the graph is to compare actual to budgeted revenue for each of the four regions, but layout makes this difficult. Given its purpose, the bars for actual and budgeted revenues for each region should have been placed next to one another, otherwise it is unnecessarily difficult to compare them.

Simple design mistakes like this can significantly undermine the success of a dashboard.

(Source: Website of Hyperion Solutions Corporation.)

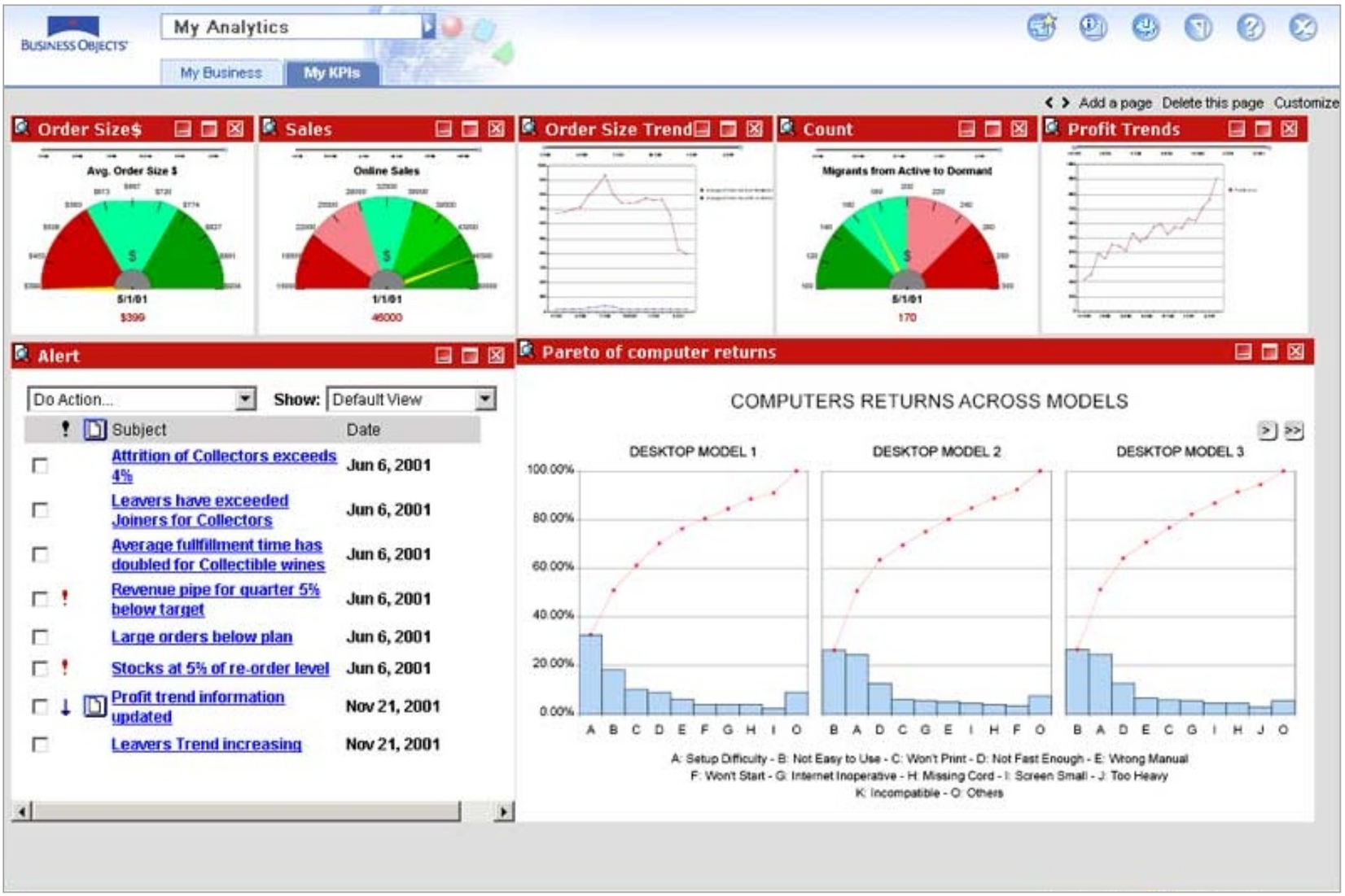
8. Encoding quantitative data inaccurately



Sometimes graphical representations of quantitative data are actually miss-designed in ways that inaccurately display the quantities. The quantitative scale along the vertical axis in the above graph 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 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: revenue is actually less than double the costs.

(Source: Website of Visual Mining Incorporated.)

9. Arranging the data poorly

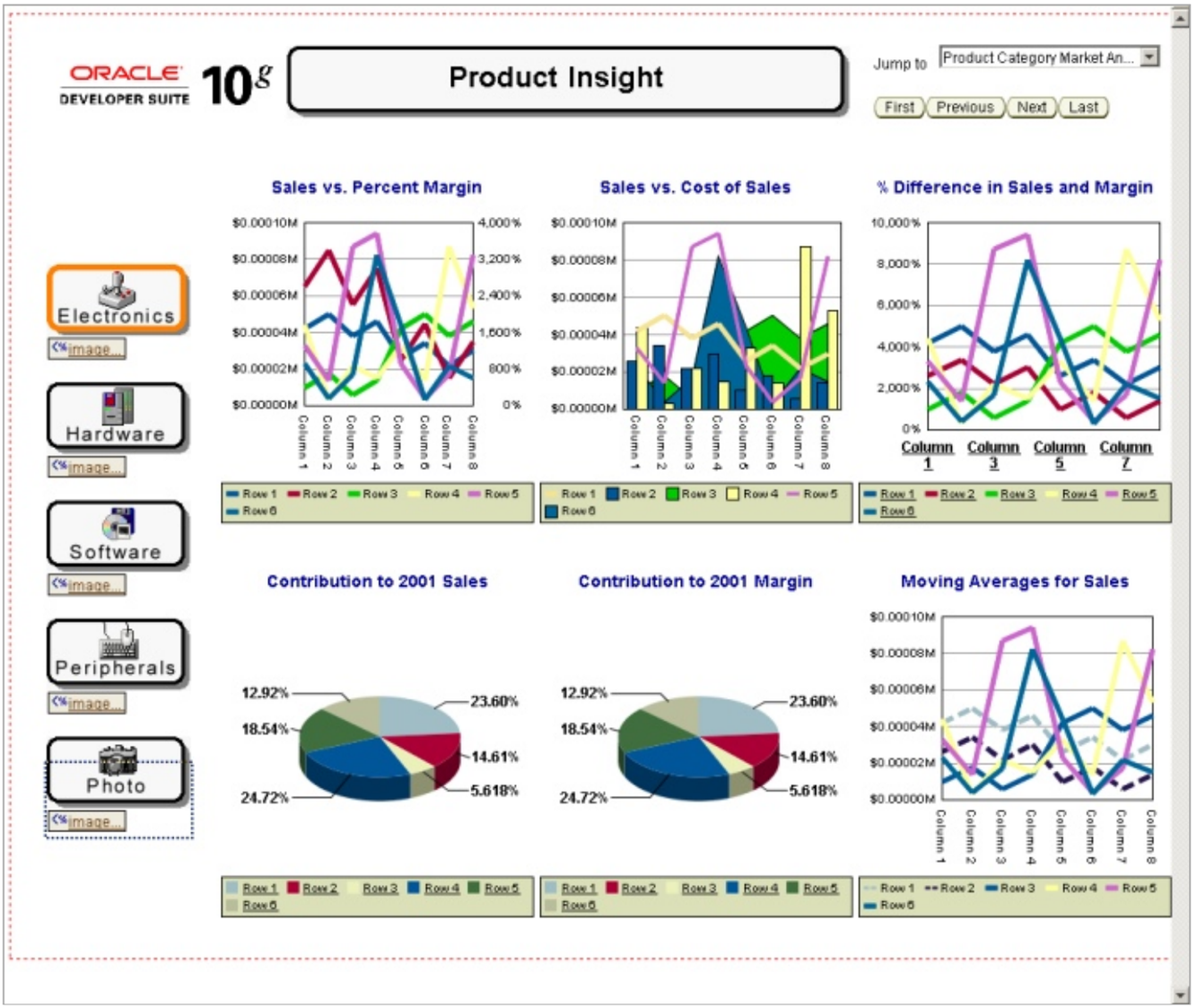


If a dashboard isn't organized well with appropriate placement of information based on importance and desired viewing sequence, and visual design that segregates data into meaningful groups without fragmenting it into a confusing labyrinth, the result is a cluttered mess. The goal is not simply to make 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 requires immediate attention ought to stand out. Data that should be compared ought to be arranged and visually designed to encourage comparisons.

Notice on the dashboard above that the most prominent position – the top left – is 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 meter that presents the average order size. It's possible that average order size might be someone's primary interest, but unlikely that of all the information that appears on this dashboard, this is the most important. Notice also that the line graph in the top center position displays the historical trend of order size, which logically relates to the average order size data that appears in the meter on the left, so why isn't it next to the meter so their relationship can be easily seen. This dashboard lacks an appropriate visual balance based on the nature and importance of the data.

(Source: Website of Business Objects.)

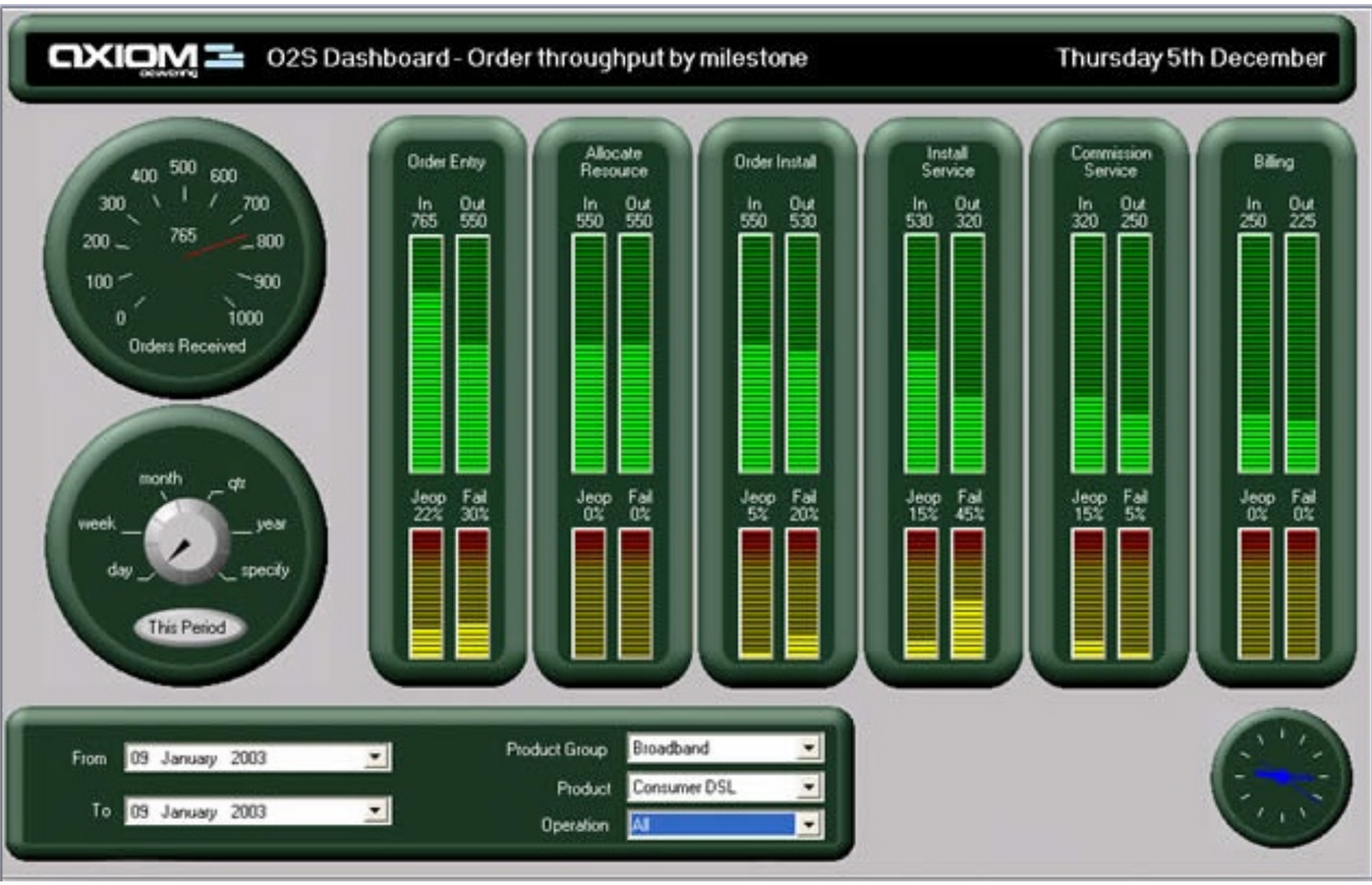
10. Ineffectively highlighting what's important



You should be able to look at a dashboard and have your eyes immediately drawn to the information that is most important. The problem with the dashboard above is that everything is visually prominent, which results in nothing standing 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 should therefore be subdued. Then there are the graphs, where the data resides, but all the data is 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 so.

(Source: Website of Oracle Corporation.)

11. Cluttering it with useless decoration

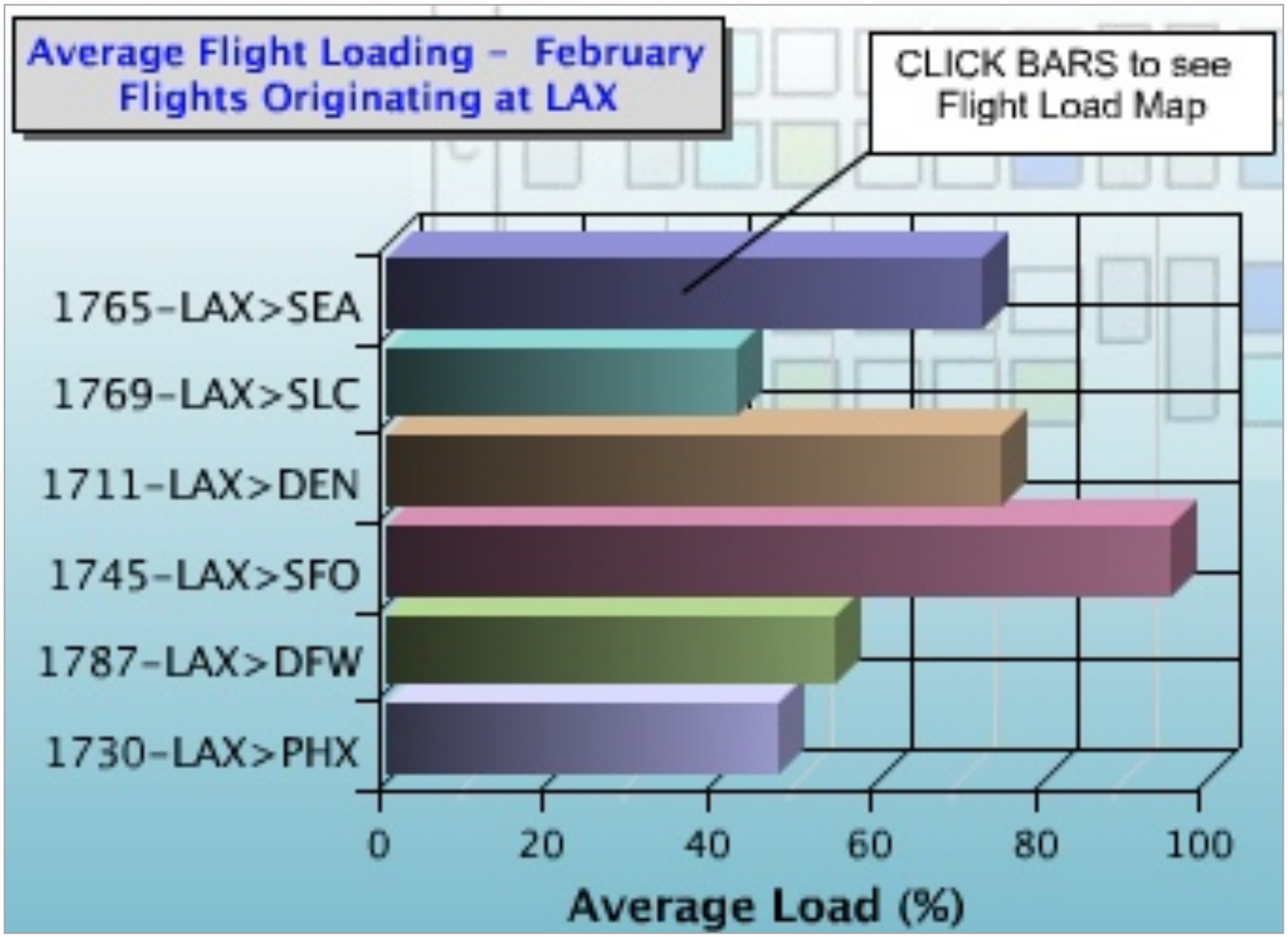


One of the most common problems on dashboards that are found on vendor websites is the abundance of useless decoration. They either hope that we will be drawn in by the artistry or assume that the decorative flourishes are necessary to keep us entertained. I assure you, however, that even people who enjoy the decoration upon first sight will grow weary of it in a short time.

The makers of the dashboard above did an exceptional job of making it look like an electronic control panel. If the purpose were to train people in the use of equipment that actually looks like this by simulating it, then 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.

(Source: Website of Axiom Systems.)

12. Misusing or overusing color



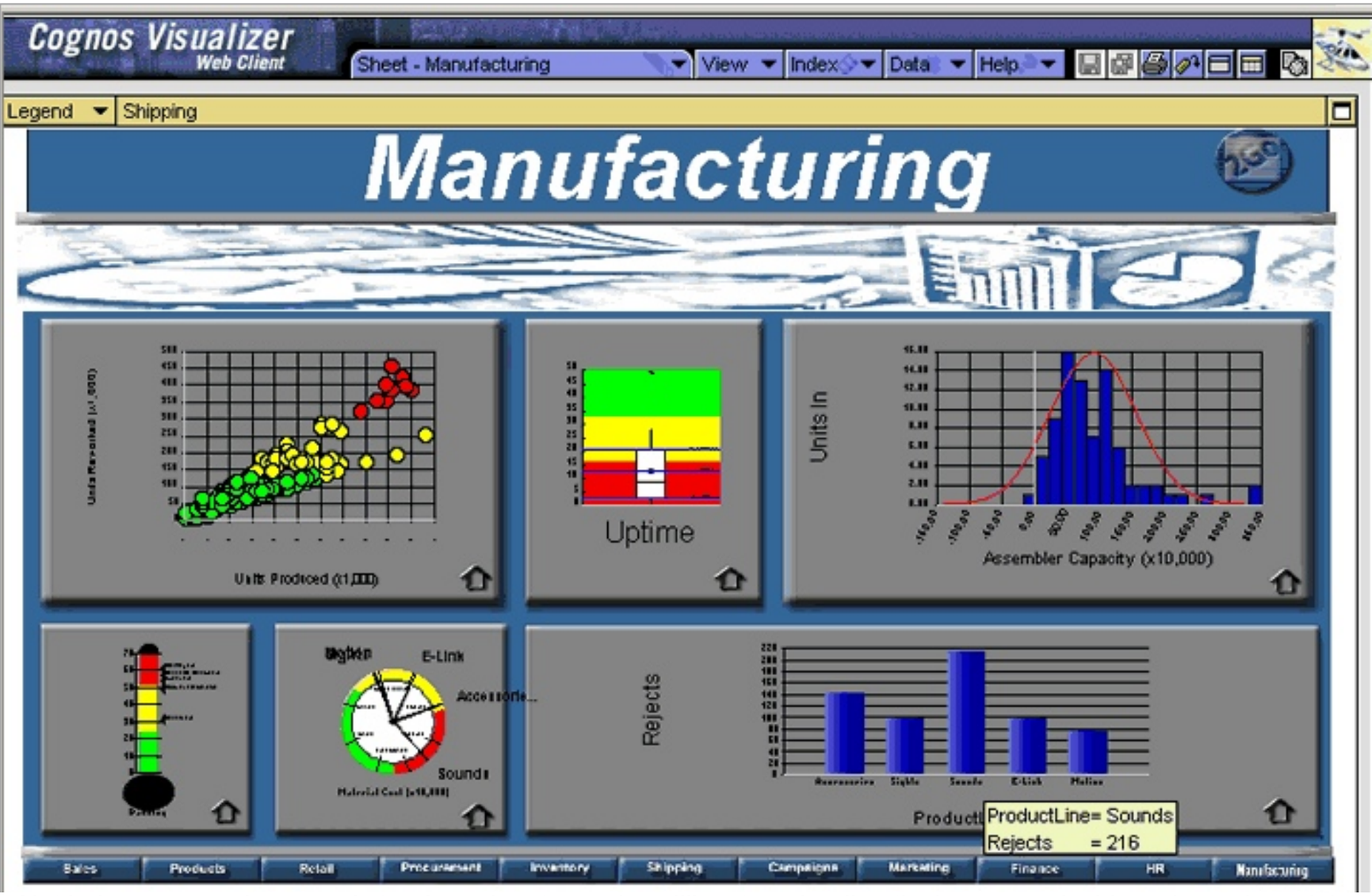
Color can be used to highlight data, encode data, and create a relationship between individual items on the screen. Color choices should be made thoughtfully, based on an understanding of how we perceive color and the significance of color differences. Some colors are hot and demand our attention while others are cooler and less demanding. When any color appears as a contrast to the norm, our eyes pay attention and our brains attempt to assign meaning to that difference. When colors in two different displays are the same we are tempted to relate them to one another. We merrily assume that we can use colors like 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 colorblind.

Using too many colors is a common problem, especially bright colors. Because dashboards are often densely packed with information, the visual content must be kept as simple as possible. Using of too many colors can be visually assaulting.

The graph above, taken from a dashboard, misuses color in several ways, but one problem stands out as most egregious. What is the meaning of the separate color for each bar? The correct answer is that the colors mean nothing. There is no reason to assign different colors to the bars for they are already labeled along the Y axis. Nevertheless, time is wasted as our brains—whether consciously or unconsciously—search for the meaning of these differences which isn't there. It is best to keep colors subdued and neutral, except when you are using color to highlight something as especially important.

(Source: Website of Corda Technologies.)

13. Designing an unappealing 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 reaction you want from a screen that regularly supplies people with important information. You might have assumed from my earlier warning against decoration that I have no concern for dashboard aesthetics, but that is not the case. When a dashboard is unattractive – unpleasant to see – the viewer is put in a frame of mind that is not conducive to its effective 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 whatsoever.

It appears that the person who created the dashboard above made an attempt to make it pretty, but just didn't have the visual design skills needed to succeed. In an effort to fill up the space, some sections such as the graph at the bottom right were simply stretched. 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 the dreary dashboard with a splash of decoration, but even this is rather ugly and is certainly unnecessary.

(Source: Website of Cognos Incorporated.)

Characteristics of good dashboard design

- Exceptional organization
- Data condensed in the form of summaries and exceptions
- Data specific to and customized for the task
- Concise, clear, and often small display mechanisms

Eloquence through simplicity

To clearly present everything on a single screen, even the slightest lack of organization will result in a confusing mess. You must condense the information, you must include only what you absolutely need, and you must use display media that can be easily read and understood even when they are small, which is often necessary.

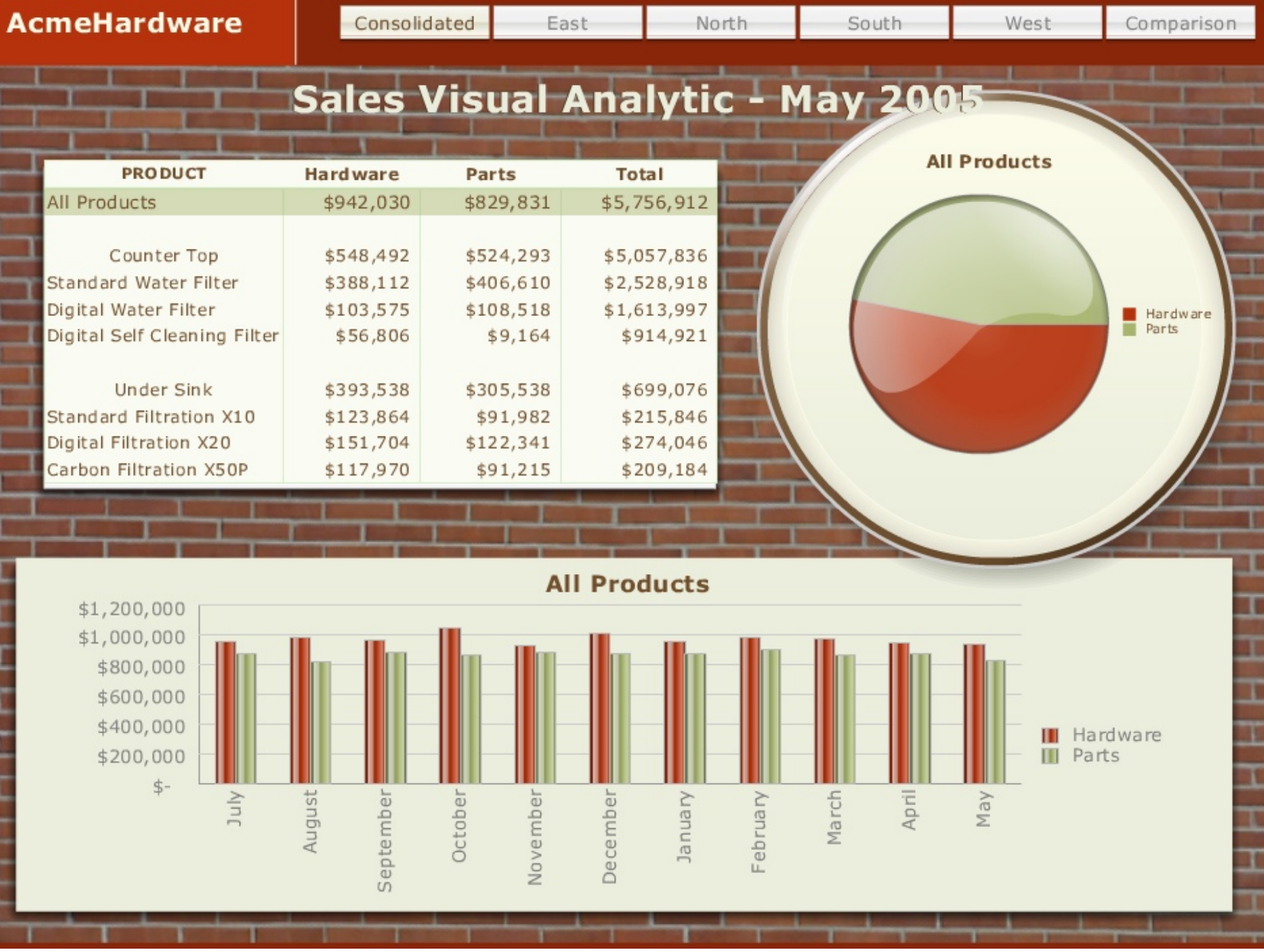
Elegance in communication is often achieved through simplicity of design. Too often we smear a thick layer of gaudy makeup on top of the data in an effort to impress, rather than to communicate the truth in the clearest possible way.

"Simplify, simplify, simplify."

Henry David Thoreau

John Maeda, in *The Laws of Simplicity*, offers a maxim about design simplicity, which I have massaged into the following statement:

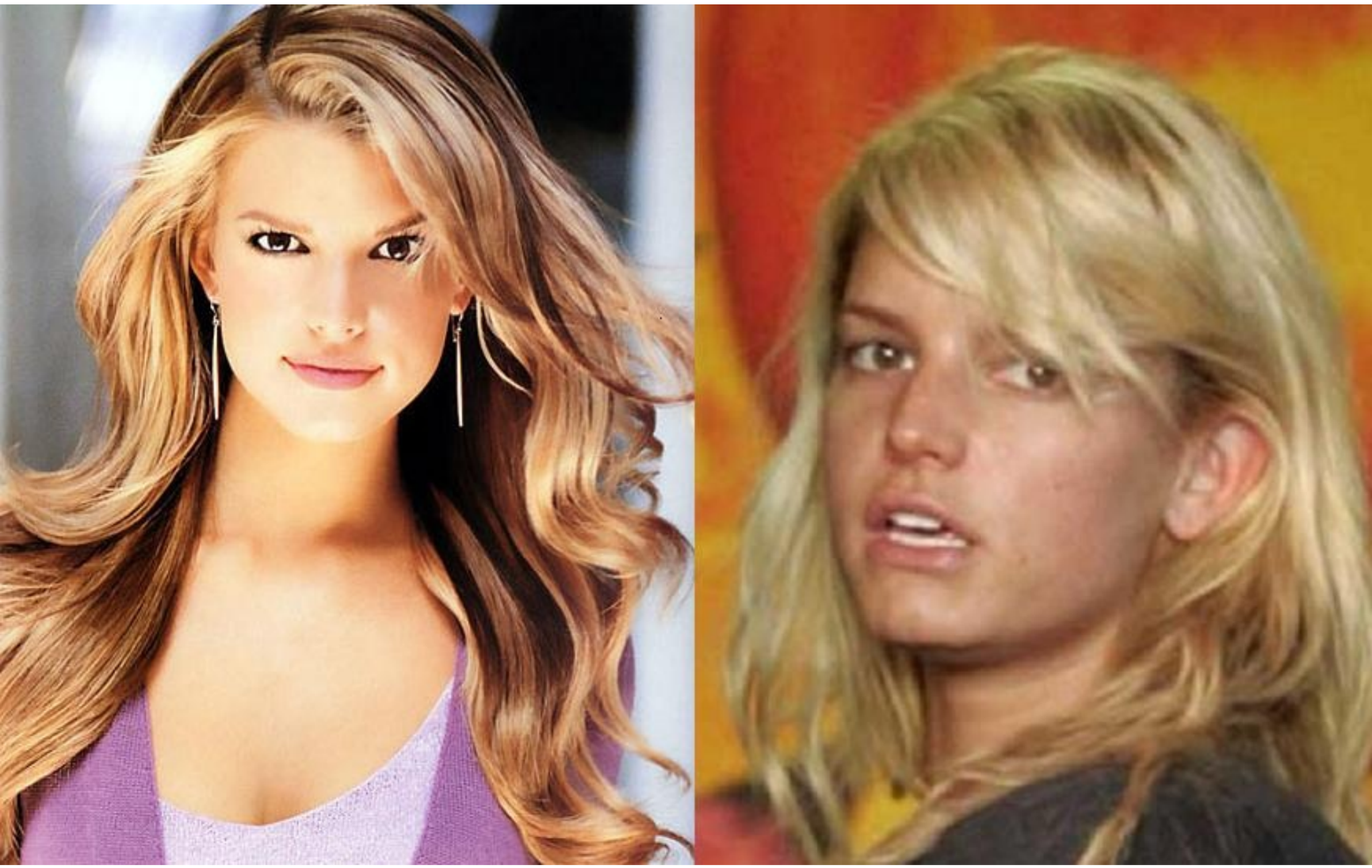
> *Simplicity is about eliminating the obvious (and everything else that doesn't support your purpose), and enhancing the meaningful.*



Graphical glitz is distracting.

Too many dashboard vendors and designers have lost sight of the bottom line: communication. They emphasize graphical glitz over clear and efficient content. For every item of information on the screen the designer should ask the question: “How can I display this information in the most meaningful, clear, and efficient way possible?”

The graphics in this dashboard from Infommersion (recently acquired by Business Objects) are beautifully rendered, but are each of the different items of information displayed in the most effective way possible? The folks at Infommersion clearly possess exceptionable graphical skill, but they seem to lack communication skill. This is not a video game; this is supposed to be a business tool for effective and efficient communication.



Which would you rather look at? What if you are Jessica’s dermatologist?

Dressing things up is appropriate for advertising, because the illusion pleases and sells. When you’re responsible for discovering the truth and understanding it, makeup only gets in the way.

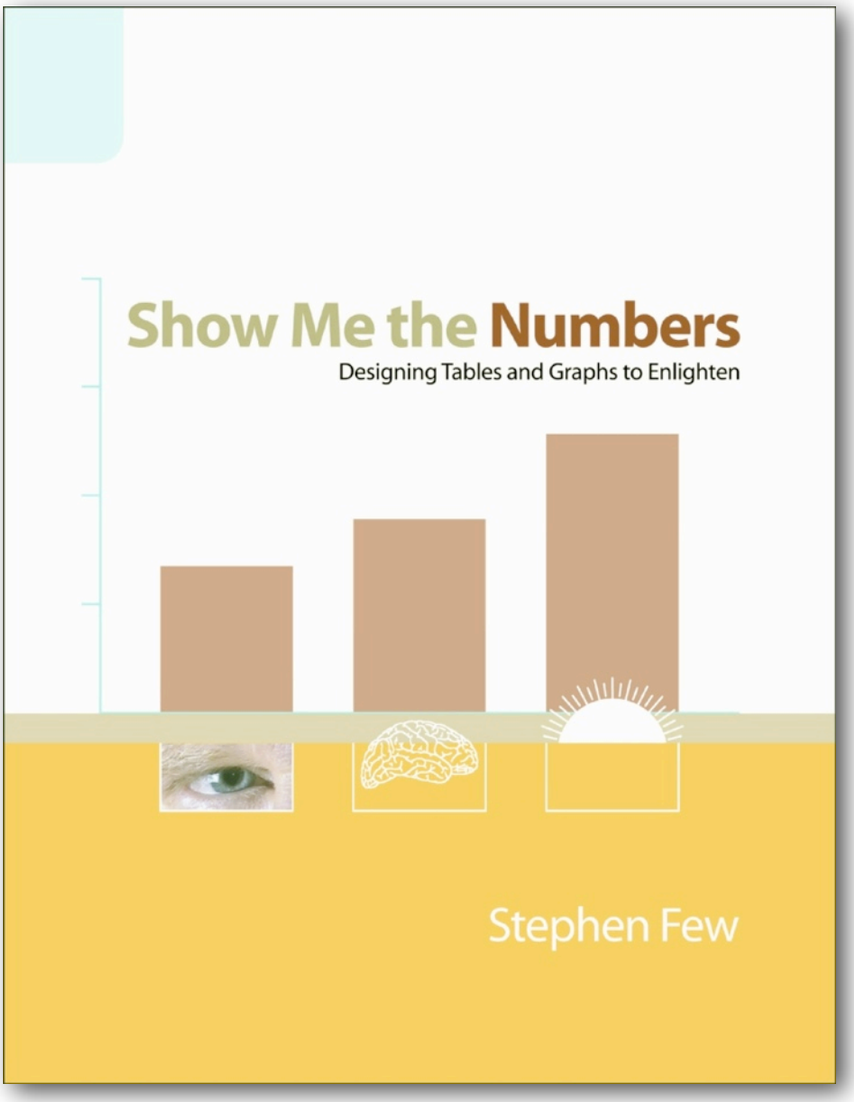
Maximize the data-ink (or data-pixel) ratio.

1. Reduce the non-data ink.

2. Enhance the data ink.

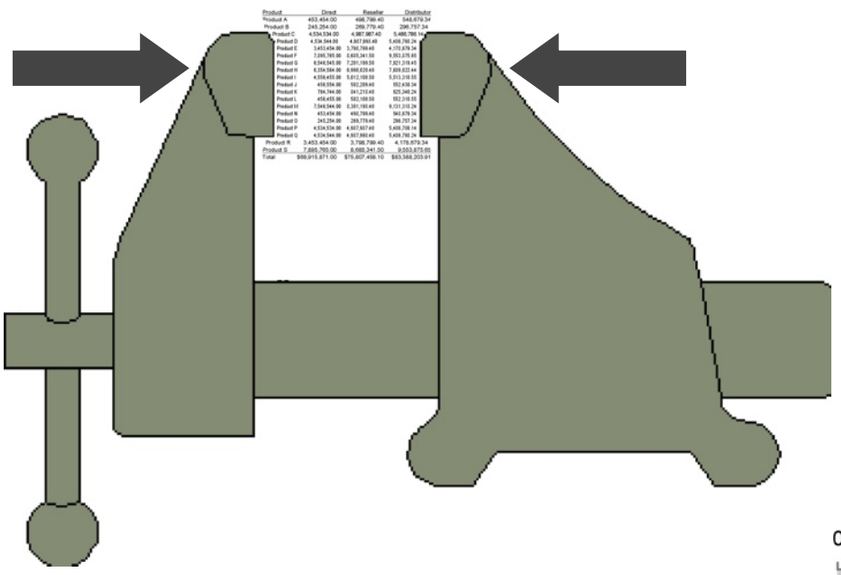
Edward R. Tufte introduced the concept of the “data-ink ratio” in his 1983 classic *The Visual Display of Quantitative Information*. He argues that the ratio of ink used to display data to total ink on the page should be high. In other words, ink that is used to display anything but data should be reduced to a minimum. Because we are dealing with dashboards in this workshop, I’ve taken the liberty to change the term “ink” to “pixels.”

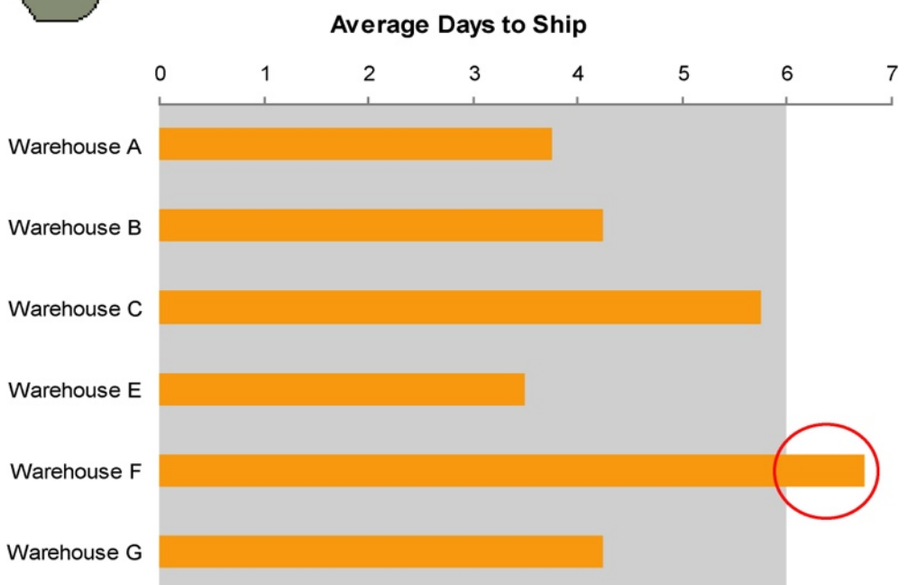
Reduce non-data pixels.



One of the benefits of *Show Me the Numbers: Designing Tables and Graphs to Enlighten* is its step-by-step instructions in the process of reducing data presentations to the clear essence of the data.

Enhance data pixels.





The first step in enhancing the data pixels is to get rid of all data that isn't necessary. This will automatically place a greater focus on the data that remains.

Next, the data that remains can be further reduced by condensing it into summaries (for example, sums, averages, or high-low-close) or filtering it into exceptions only.

Other steps include providing context to make the data as meaningful as possible and means to instantly identify whether the data is good or bad, or concern or not.

Common dashboard data consists of…

…measures of what's currently going on,
each compared to something to provide context
and evaluated to declare its qualitative state.

Current YTD Sales: $382,305

Current Sales Target: $450,000

POOR

Here are the types of related measures that commonly provide analytical context for the current quantitative measures:

- The same measure at the same point in time in the past (for example, the same day last year)
- The same measure at some other point in time in the past (for example, the end of last year)
- The current target for the measure (for example, a budget for the current period)
- Relationship to a future target for the measure (for example, we're at 75% of this year's budget)
- A prior prediction of the measure (for example, a forecast of where we expected to be today)
- Relationship to a future prediction of the measure (for example, we're at 90% of this quarter's forecast)
- Some measure of the norm for this measure (for example, monthly average or normal range)
- An extrapolation of the current measure in the form of a probable future, either at a specific point in the future or as a time series
- Competitors' versions of the same measure (either individual or multiple measures in a time series)
- A separate, but related, measure (for example, revenue compared to profit)

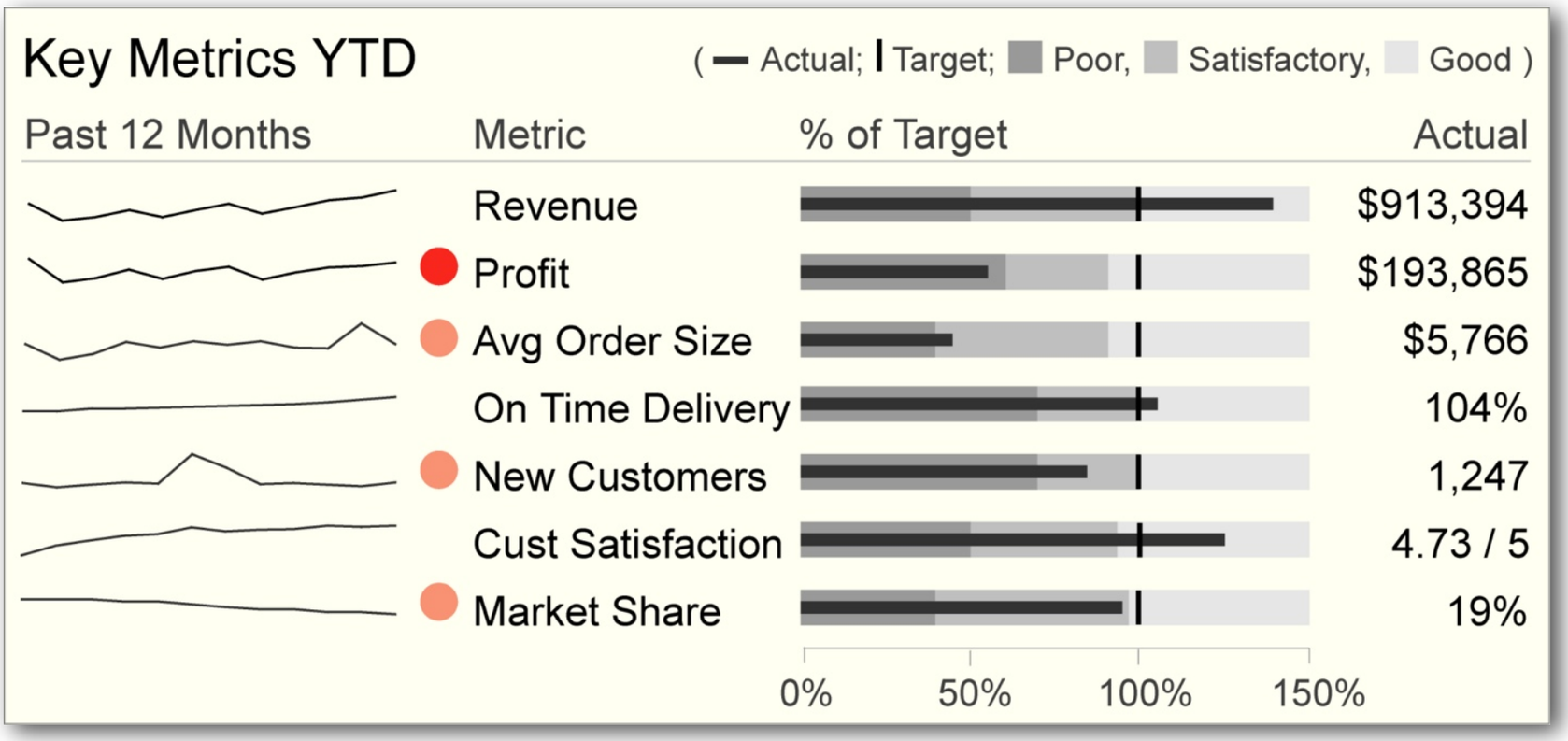
YTD Units: 7,822

Display data fully and meaningfully.

Not all dashboard widgets are equally effective. Those that work well exhibit the following characteristics:

- Clear display for efficient reading
- Clear meaning for efficient understanding
- Appropriate medium for the message
- Maximum relevant content in the space available

The gauge at the top takes up a lot of space to display a number and label. It tells you that 7,822 units have been sold year to date and indicates by the green needle (pointer) that this is good – but how good and compared to what? The simple label and number below the gauge presents the same information much more simply and in less space. If richer information is useful, the graphical display at the bottom tells the viewer more information, including 1) units sold compared to the target (the small vertical line), 2) how well unit sales are doing (sales extend well into the light gray range, which represents the good range). Also, the use of varying shades of gray (or any single hue) to define the ranges (bad, satisfactory, and good) can be read by people who are color blind.

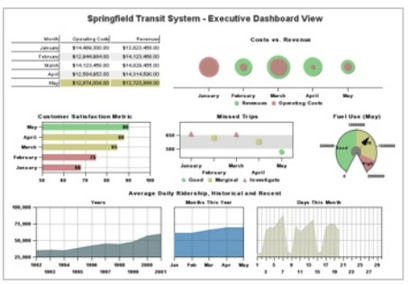


This is a portion of a larger sales dashboard. Take a moment to notice the richness of information that has been combined in a small space without sacrificing clarity.

The “Past 12 Months” data lines are called *sparklines*. They were invented by Edward Tufte. Although Tufte didn’t have dashboards specifically in mind when he created them, sparklines are ideal for dashboards, but so far no dashboard vendors support them.

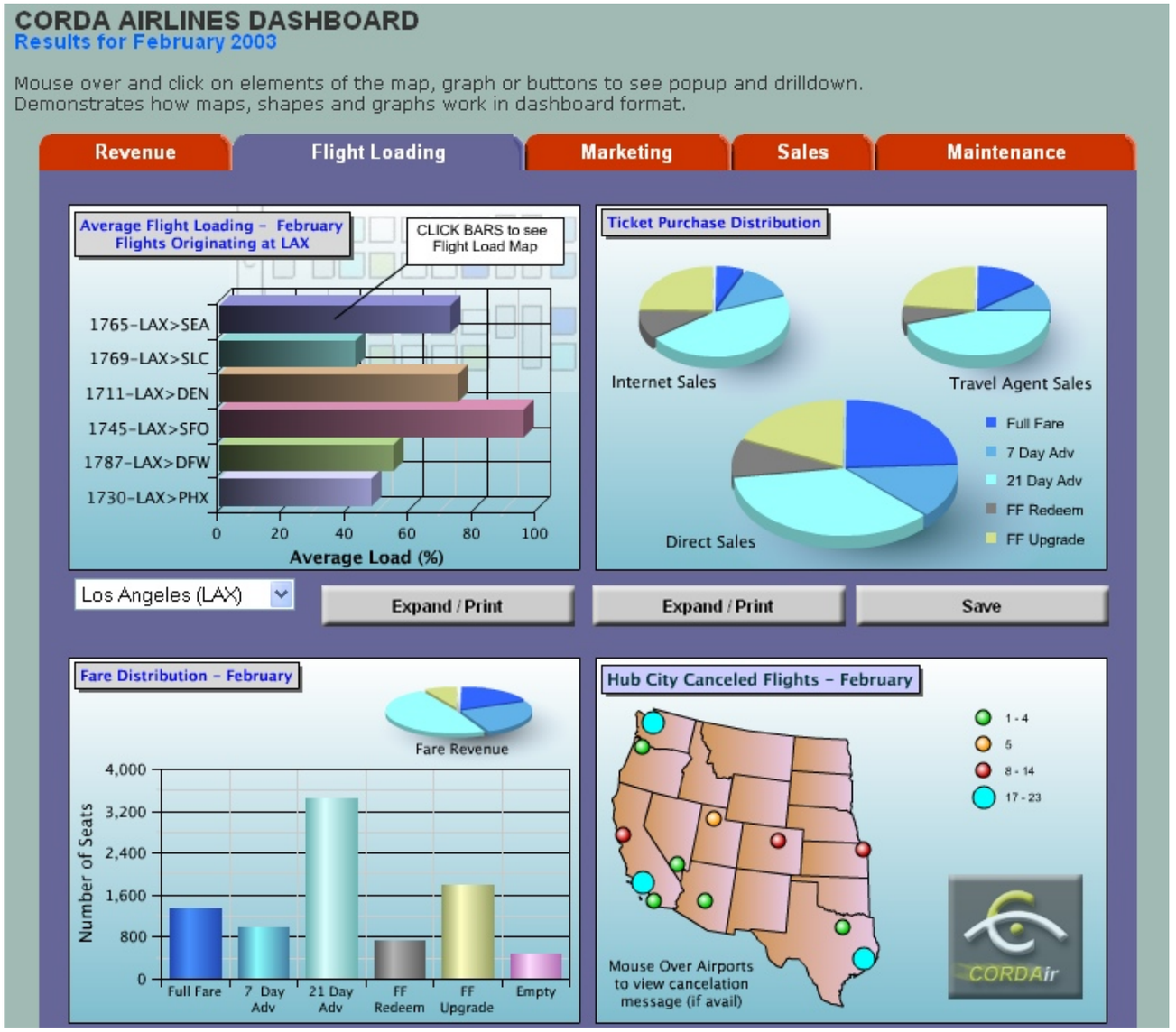
The graphics labeled “% of Target” are called *bullet graphs*. These are my simple invention, which were designed specifically for dashboards as an alternative to typical meters and gauges.

Exercise



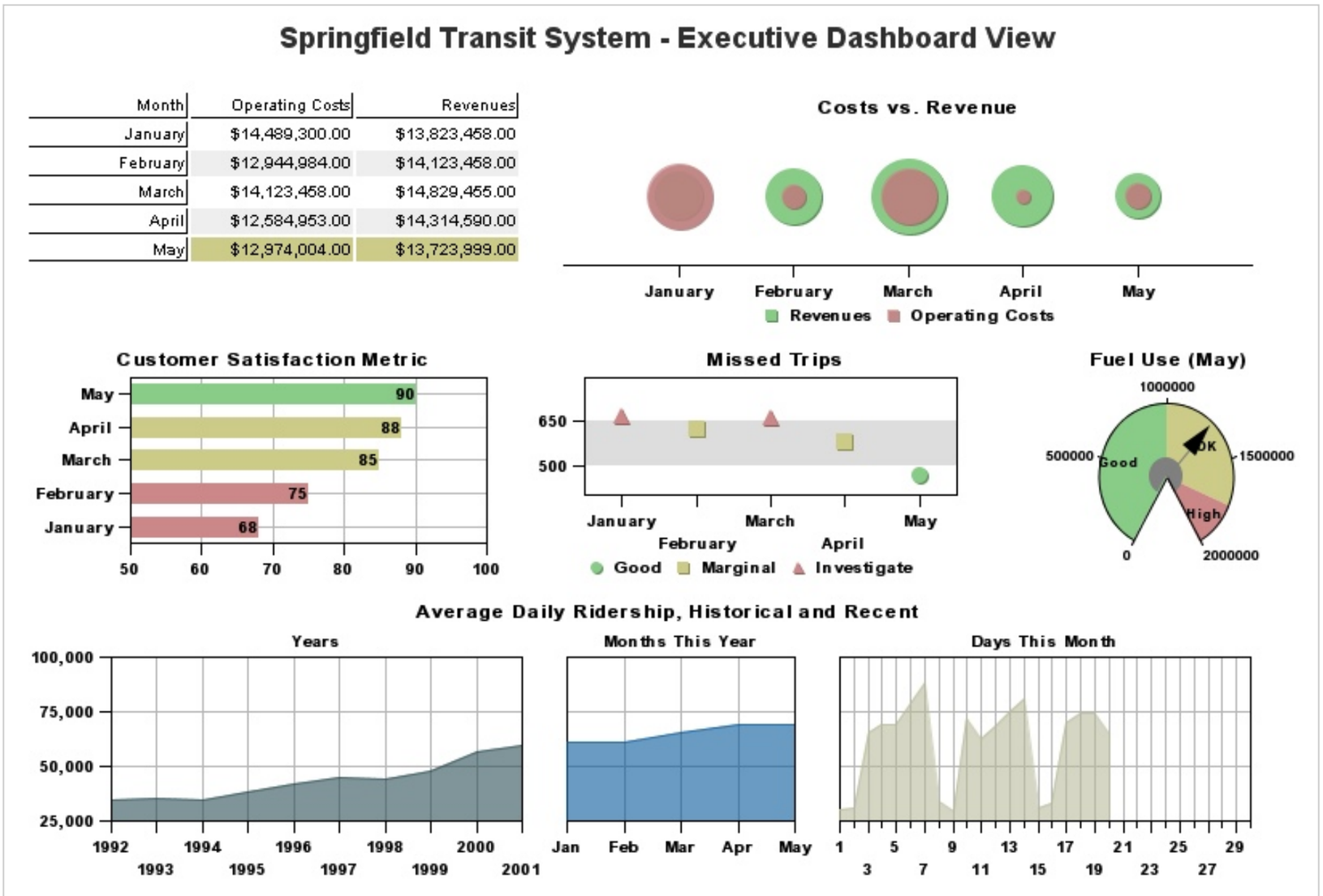
This exercise involves critiquing a dashboard as a way to practice recognizing what doesn't work. The primary goal is to focus on the need for clear organization and the use of display mechanisms that are well designed to display specific types of information clearly in the least amount of space.

Exercise: Example #1



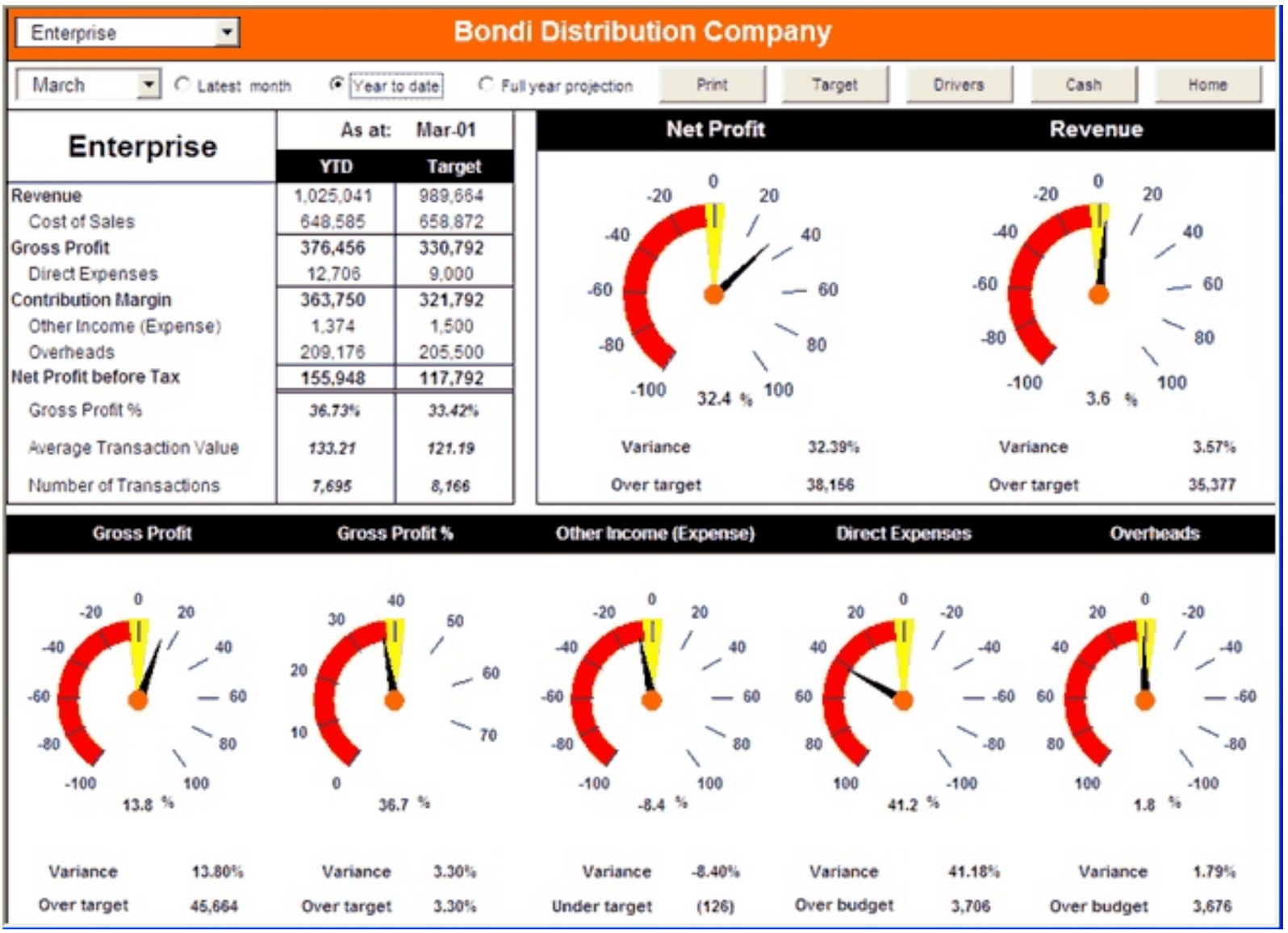
(Source: Website of Corda Technologies, Incorporated)

Exercise: Example #2



(Source: Website of Visual Mining, Inc.)

Exercise: Example #3

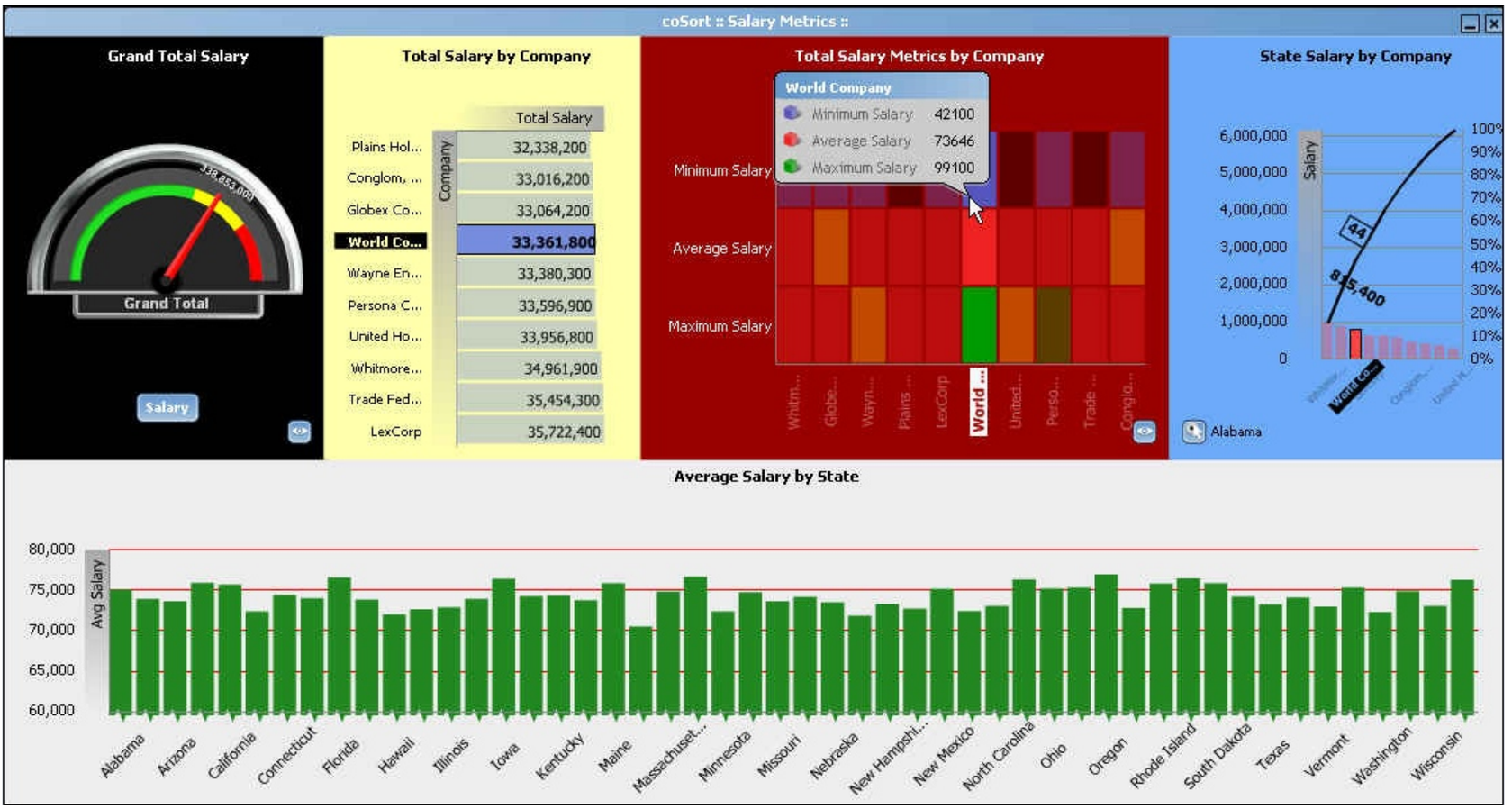


(Source: Website of Principa)

Exercise: Example #4

(Source: Website of Infommersion.)

Exercise: Example #5



(Source: iDashboards.)

Dashboard information is not always quantitative.

Is all dashboard information quantitative? Most is quantitative, but non-quantitative information is also useful at times.

Examples:

- Project dates (e.g., overdue tasks)
- Lists of items (e.g., sales opportunities or top customers)

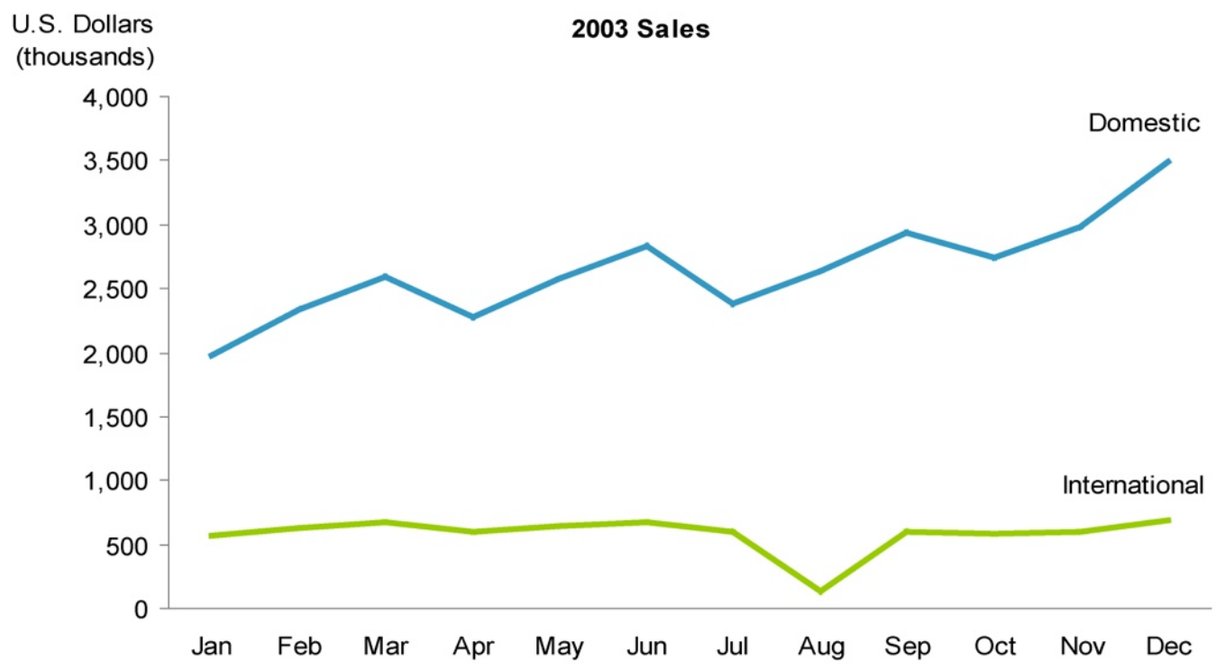
(Source: This dashboard image was found on the website of Primavera.)

Select the best medium of display.

2003 Sales (U.S. dollars in thousands)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Domestic	1,983	2,343	2,593	2,283	2,574	2,838	2,382	2,634	2,938	2,739	2,983	3,493
International	574	636	673	593	644	679	593	139	599	583	602	690
	$2,557	$2,979	$3,266	$2,876	$3,218	$3,517	$2,975	$2,773	$3,537	$3,322	$3,585	$4,183

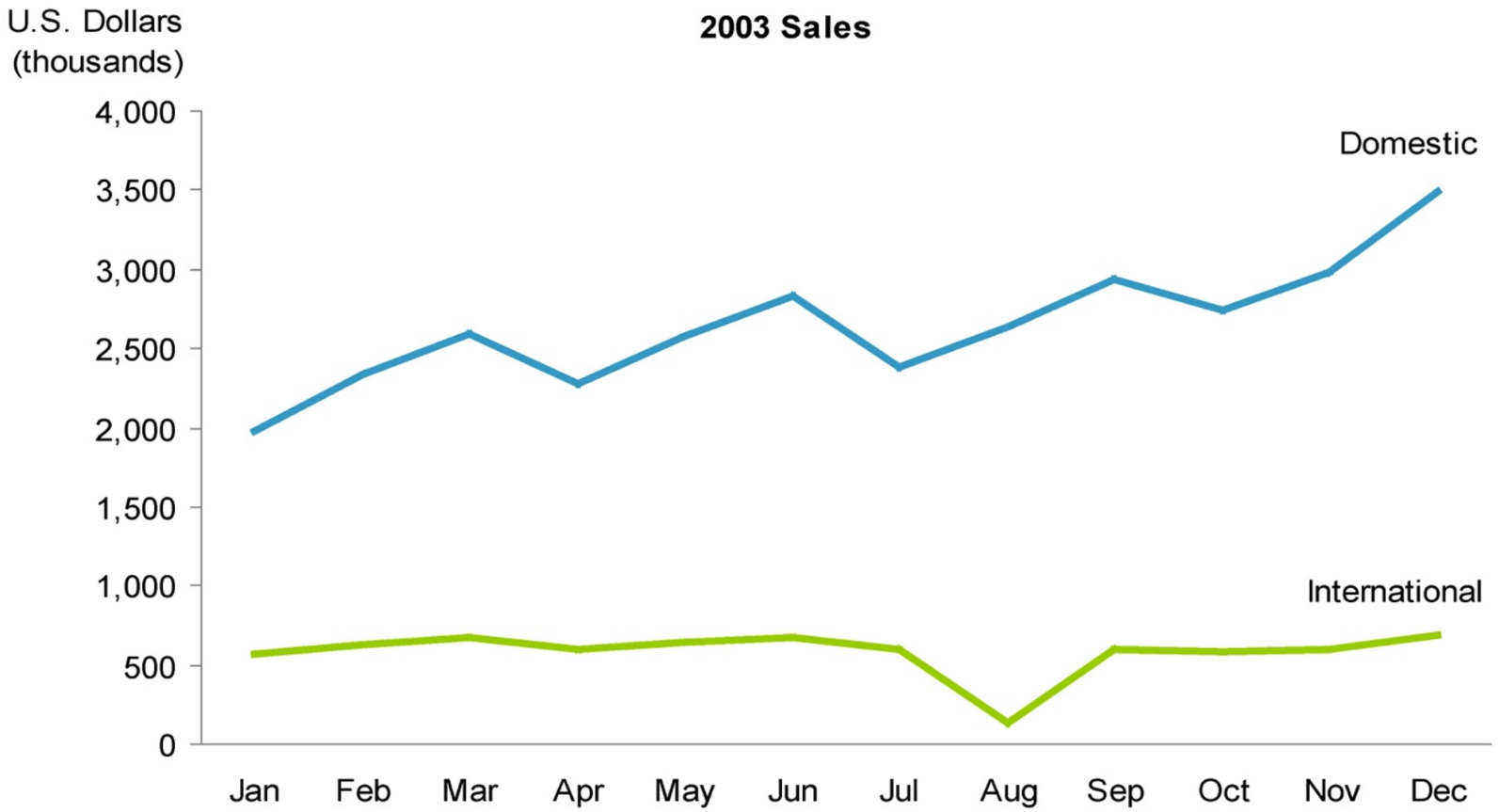
or



Different types of display are useful for different purposes and different types of information.

- Tables
  - For look up
  - To display sets of individual measures
  - To display simple lists
  - To display simple rankings
  - For numeric precision
  - For combining summary and details in the same display
- Graphs
  - To display relationships in the data (e.g., trends, patterns, and exceptions)
- Other graphics
  - To assign qualitative assessments to data
  - To highlight urgent or important data

Graphs bring trends, patterns, and exceptions to light.



The old saying, “A picture is worth a thousand words,” applies quite literally to quantitative graphs. By displaying quantitative information in visual form, graphs efficiently reveal information that could never be communicated as effectively with any number of words.

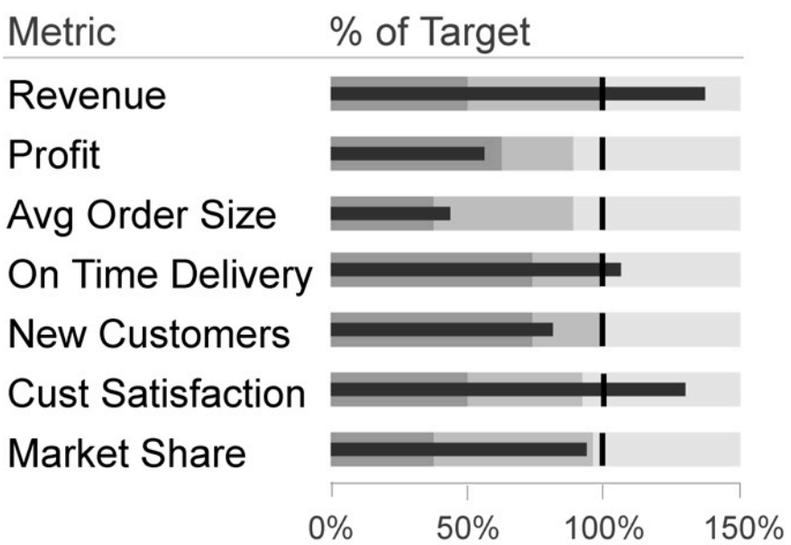
“[When] we visualize the data effectively and suddenly, there is what Joseph Berkson called ‘interocular traumatic impact’: a conclusion that hits us between the eyes.” William S. Cleveland, *Visualizing Data*, Hobart Press, 1993.

Take a moment to identify the various types of information that are revealed by the shape of the data in this graph.

Slow and serial

Metric	Variance to Target
Revenue	-0.68%
Profit	-17.90%
Avg Order Size	-5.90%
On Time Delivery	2.35%
New Customers	58.38%
Cust Satisfaction	-12.22%
Market Share	-13.33%

Fast and parallel

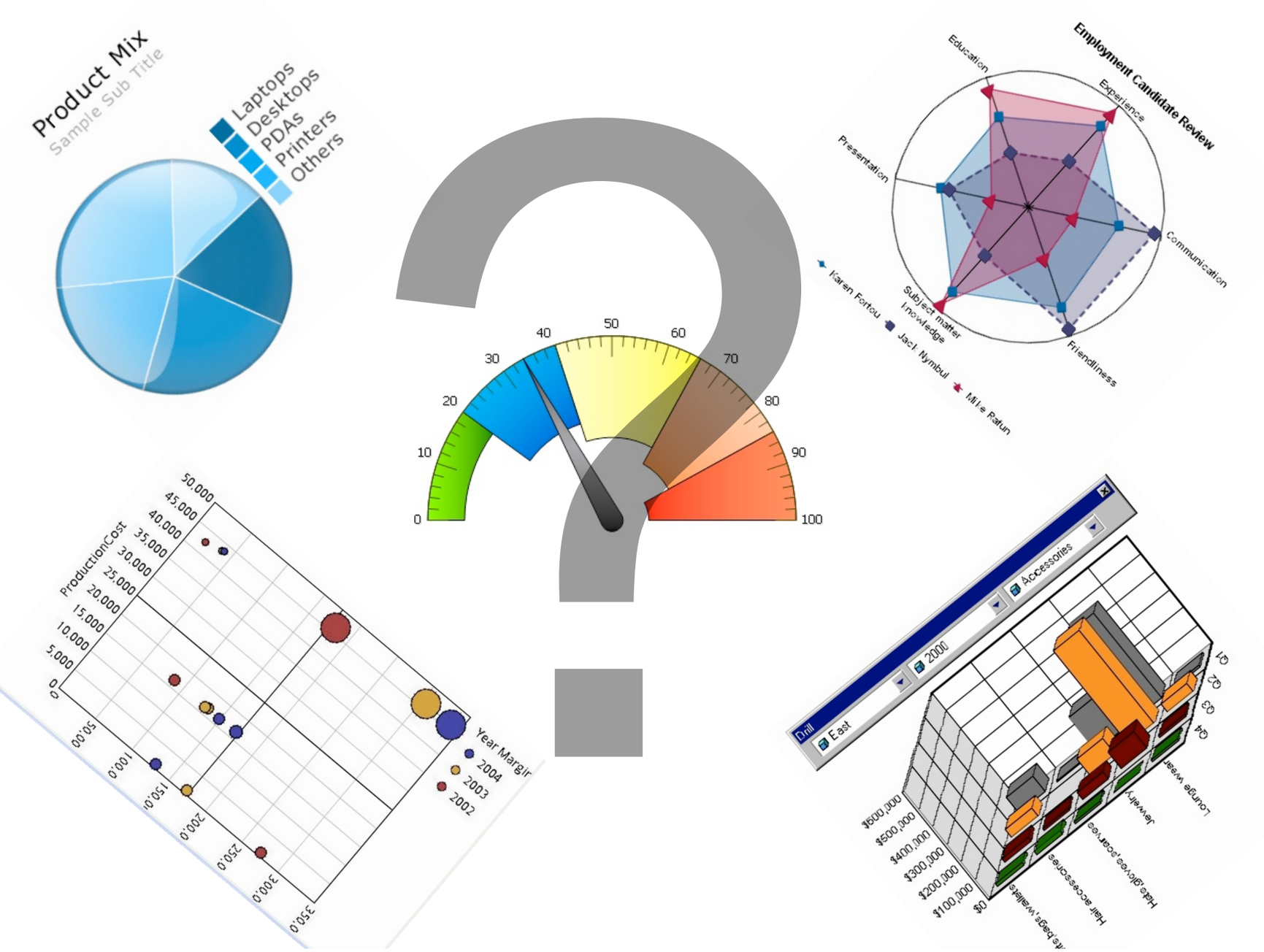


Graphs shift the work from our brains to our eyes.

The visual orientation of dashboards is important due to the speed of perception that's usually required to monitor information. The faster you must assess what's going on, the more you should rely on graphical means to display the information.

Text must be read, which involves a relatively slow, serial process.

Certain visual properties, however, can be perceived at a glance, without conscious thought. With the graphical display on the right, it's quick and easy to see which bars exceed target, marked by the short vertical line, and which fall short.



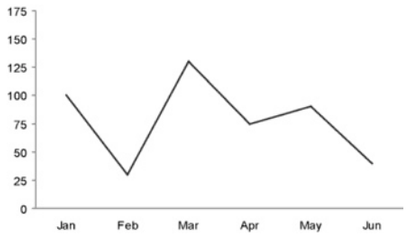
What types of graphical display work well?

The unique purpose and constraints of dashboards require a tailored set of display devices.

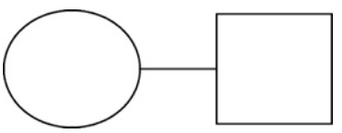
An ideal library of dashboard display mechanisms

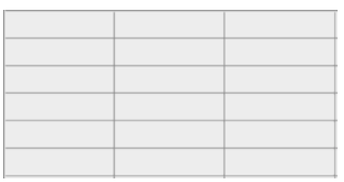
Six categories:

- Graphs
- Icons
- Text
- Images
- Drawings
- Organizers



YTD Revenue: $2,398,384

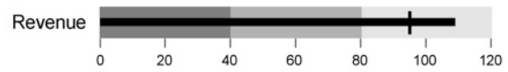




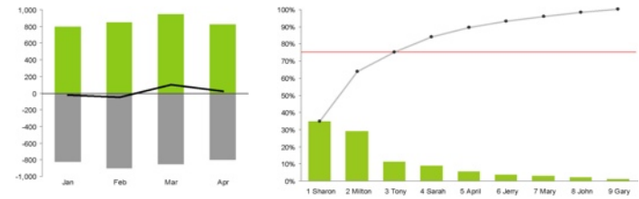
Only a limited selection of display devices is needed to design effective business dashboards.

Graphs

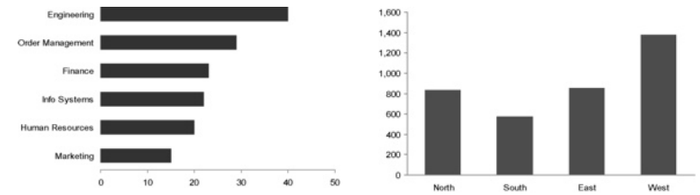
Bullet Graph



Combination Bar and Line Graph

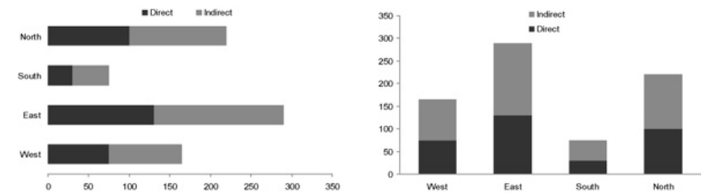


Bar Graph

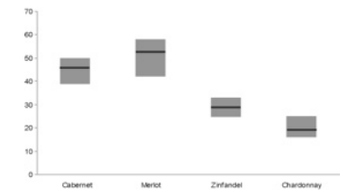


Sparkline

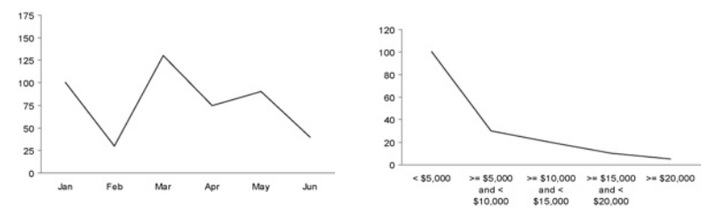
Stacked Bar



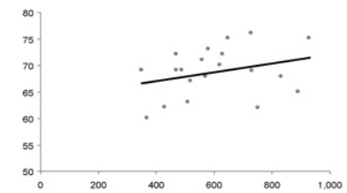
Box Plot



Line Graph

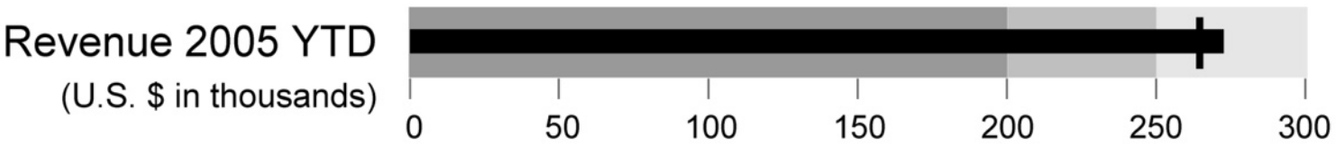


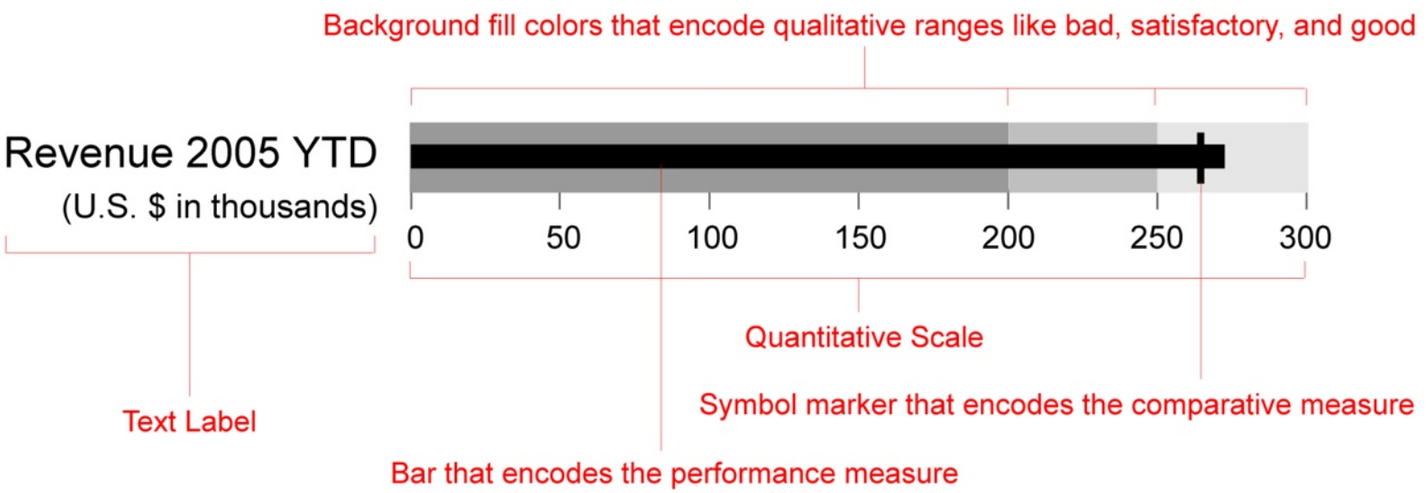
Scatter Plot



- **Bullet Graphs** are used to display a single quantitative measure compared to one or more related measures (for example, a target) and optionally with a qualitative scale subdivided into ranges (for example, good, satisfactory, a bad).
- **Bar Graphs** are used to display a quantitative measure subdivided into categories (for example, sales regions or units of time, such as months); if a time series (i.e., subdivided into units of time), emphasis is on the distinct value rather than the overall shape of the data.
- **Stacked Bar Graphs** are used only when part-to-whole data must be displayed for each of multiple categorical subdivisions (for example, sales regions or months.)
- **Line Graphs** are used to display time series or a frequency distribution with focus on the shape of the data.
- **Combination Bar and Line Graphs** are used when some data in the graph can be displayed best as bars and ot data can be displayed best as a line. This is sometimes appropriate with time-series data and also with Pareto graphs, which simultaneously display ranked data as bars and the running total of that data as a line.
- **Sparklines** are used to display a time series with focus on the shape of the data and no need for quantitative precision. (Sparklines are an invention of Edward Tufte.)
- **Scatter Plots** are used to display correlations between two paired sets of quantitative data.
- **Box Plots** are used to display measures of distribution across multiple categorical subdivisions. Can be used to display open-high-low-close stock data, as well as any other combination of a distribution and specific measures, such as averages.

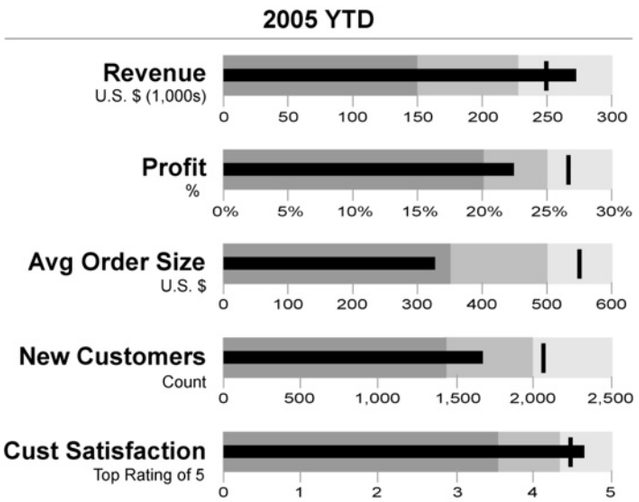
Bullet Graphs

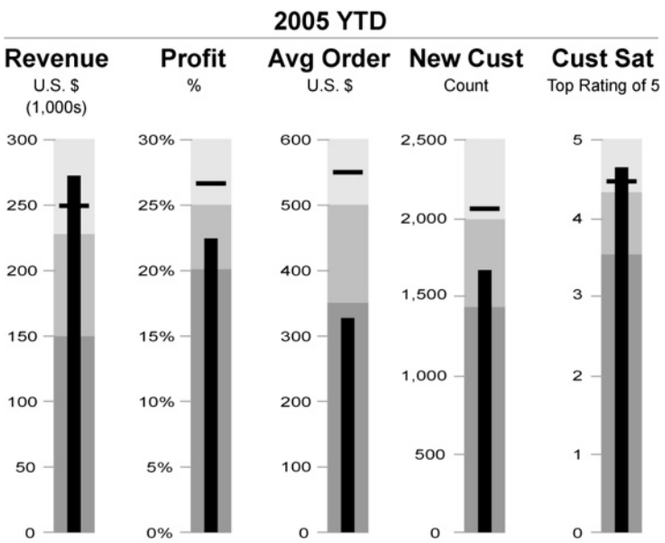




A *bullet graph* is an invention of my own to fix the problems commonly associated with gauges and meters. It is designed to display a single key measure of performance compared to one or more related measures (for example, a target) with varying color intensities in the background to indicate qualitative ranges (for example, poor, mediocre, and good).

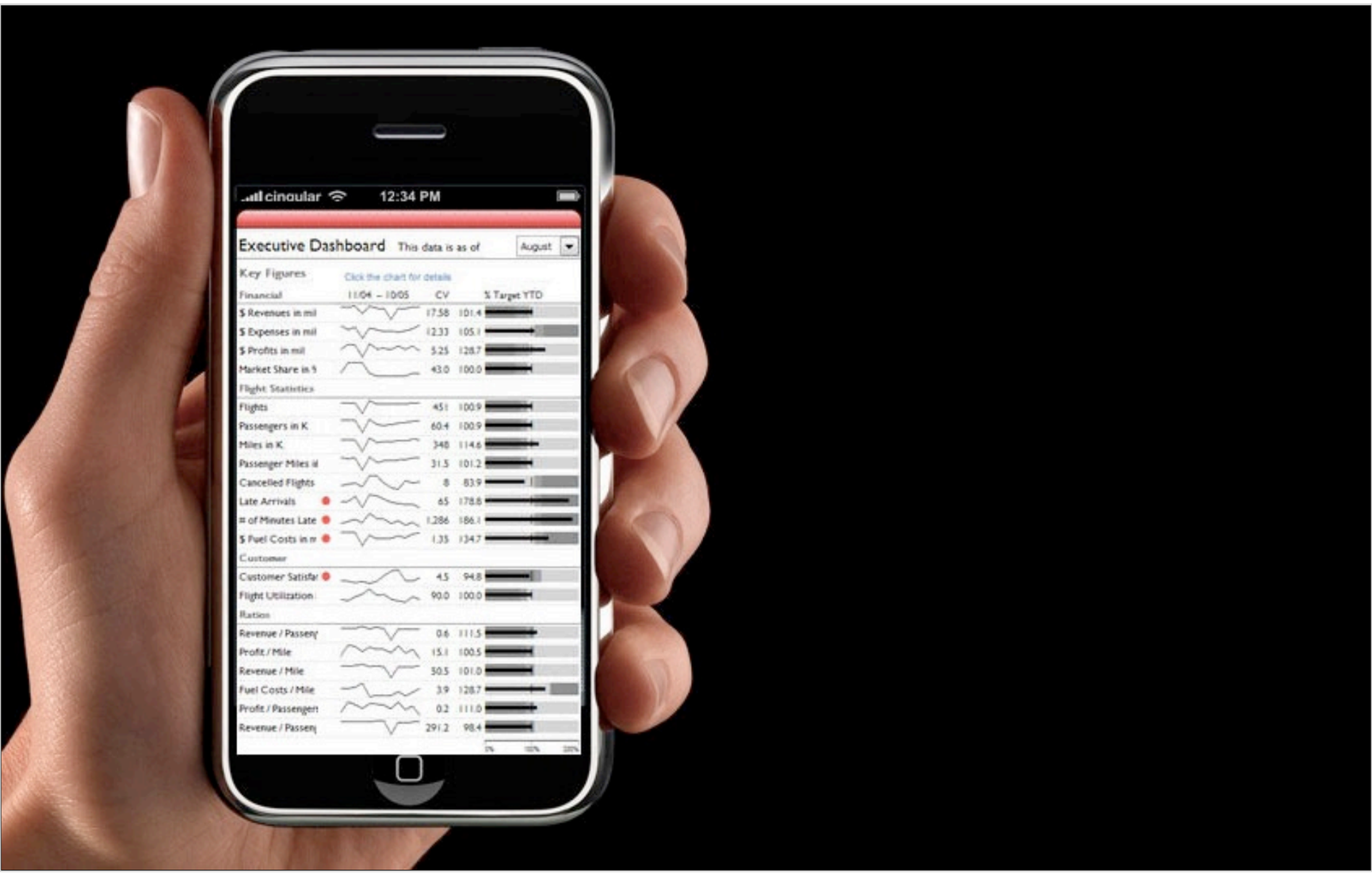
Many can fit into a small space.





Bullet graphs require less space than gauges. I've tested the speed and accuracy of people's perception of bullet graphs versus radial gauges and found them to be superior. Even if they were no better in these respects than radial gauges, they are clearly better designed for dashboards in that they can be reduced to occupy less space and easily stacked or arranged side-by-side to use space more efficiently.

Many can fit into a small space.

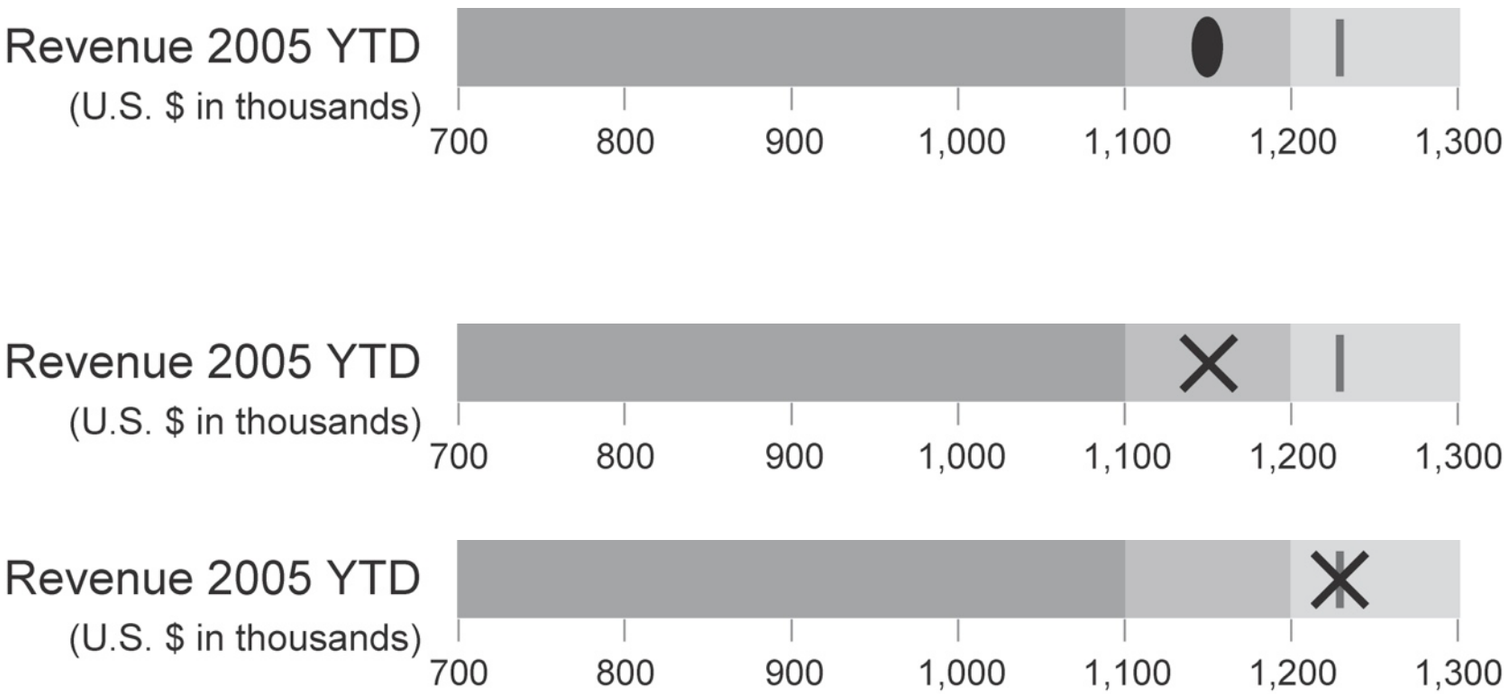


This tiny iPhone dashboard gives an idea of how much information you can pack into a small space when you use small graphics such as bullet graphs and sparklines.

Two comparative measures

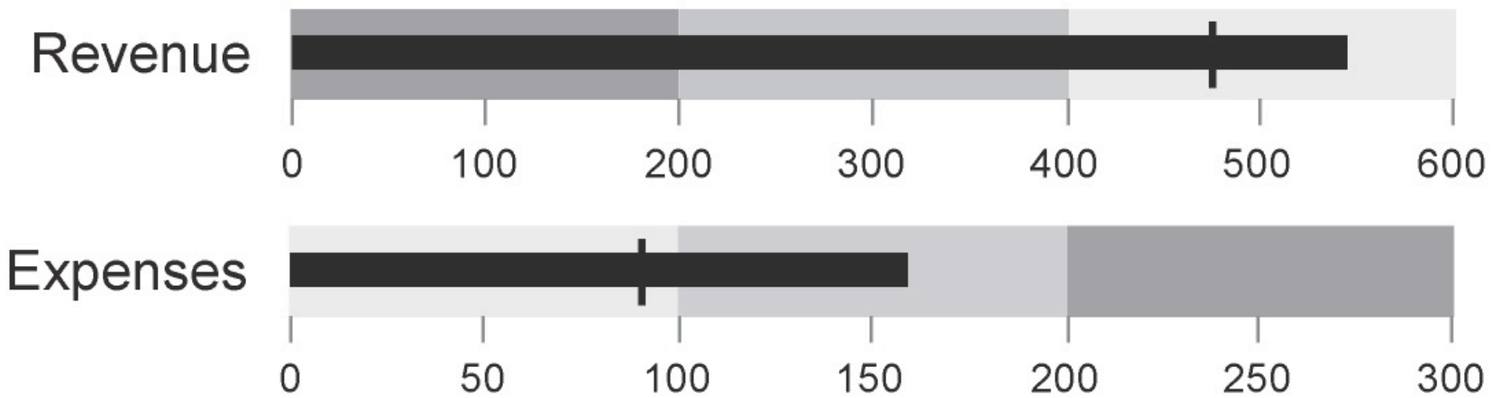
Even though bullet graphs usually include a single comparative measure, such as a target, they can include another as well. For example, you might want to compare revenue to the target and to the amount of revenue on this day last year. Generally, you wouldn’t want to include more than two comparative measures, because this will slow people down, forcing them to read bullet graphs rather than scanning them.

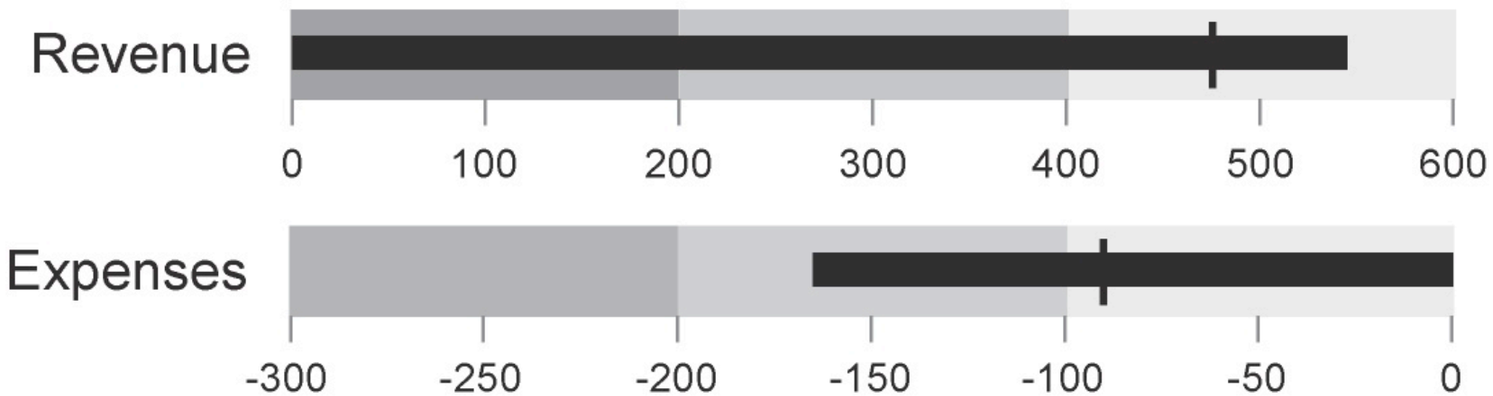
Points, rather than bars



When you want to narrow the quantitative scale such that it doesn't start at zero, you should substitute a data point for the bar, because bars should always start at zero. I've found that X's work well for representing the primary measure because they mark the value precisely (the center of the X) and even if the primary and the comparative measures overlap, one doesn't hide the other.

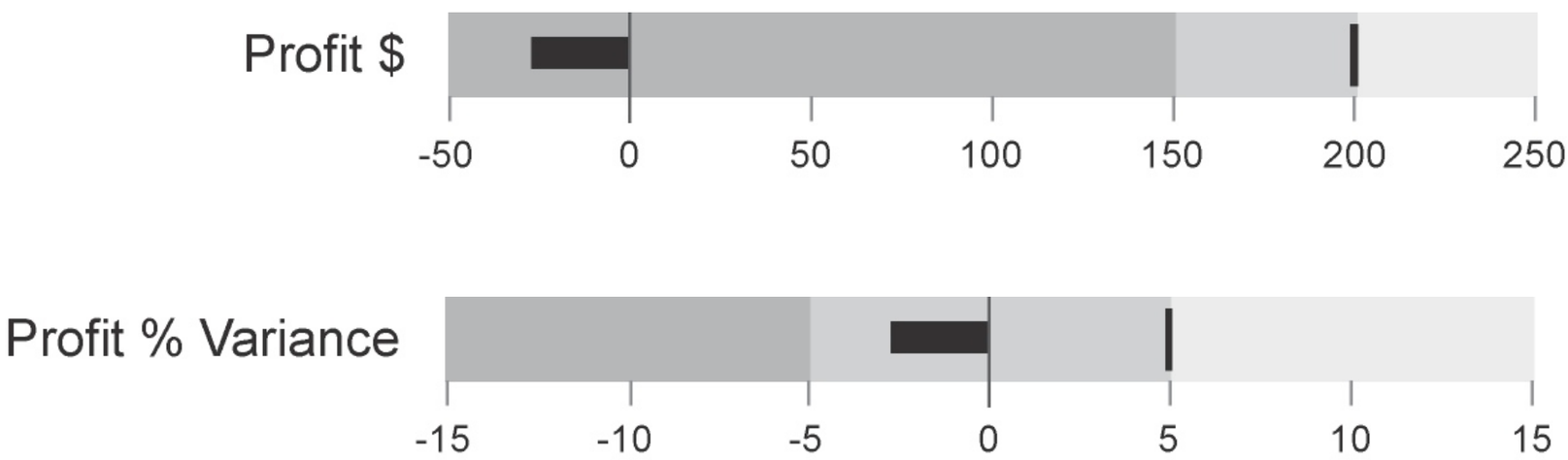
Mixture of graphs that are read differently





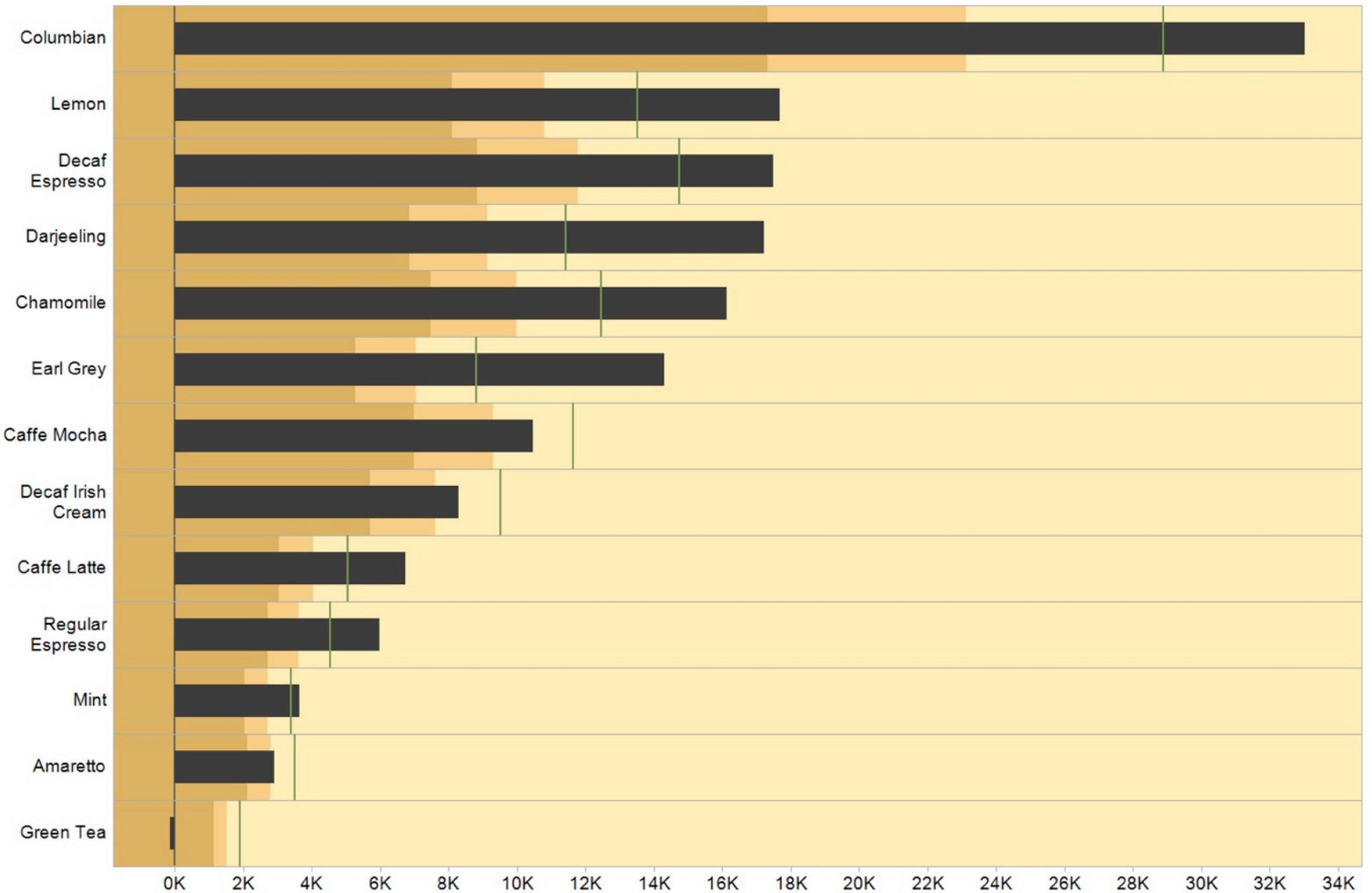
When a bullet graph is used to display a value that the intended audience thinks of as negative (that is, the higher the value the worse the situation), such as expenses, it should be designed in a way that makes this difference from the way most bullet graphs are read obvious. Two simple ways to do this is to (1) reverse the order of the qualitative ranges in the background, as illustrated in the top example, and (2) reversing the direction of the quantitative scale and bar, as illustrated in the bottom example.

Positive and negative values



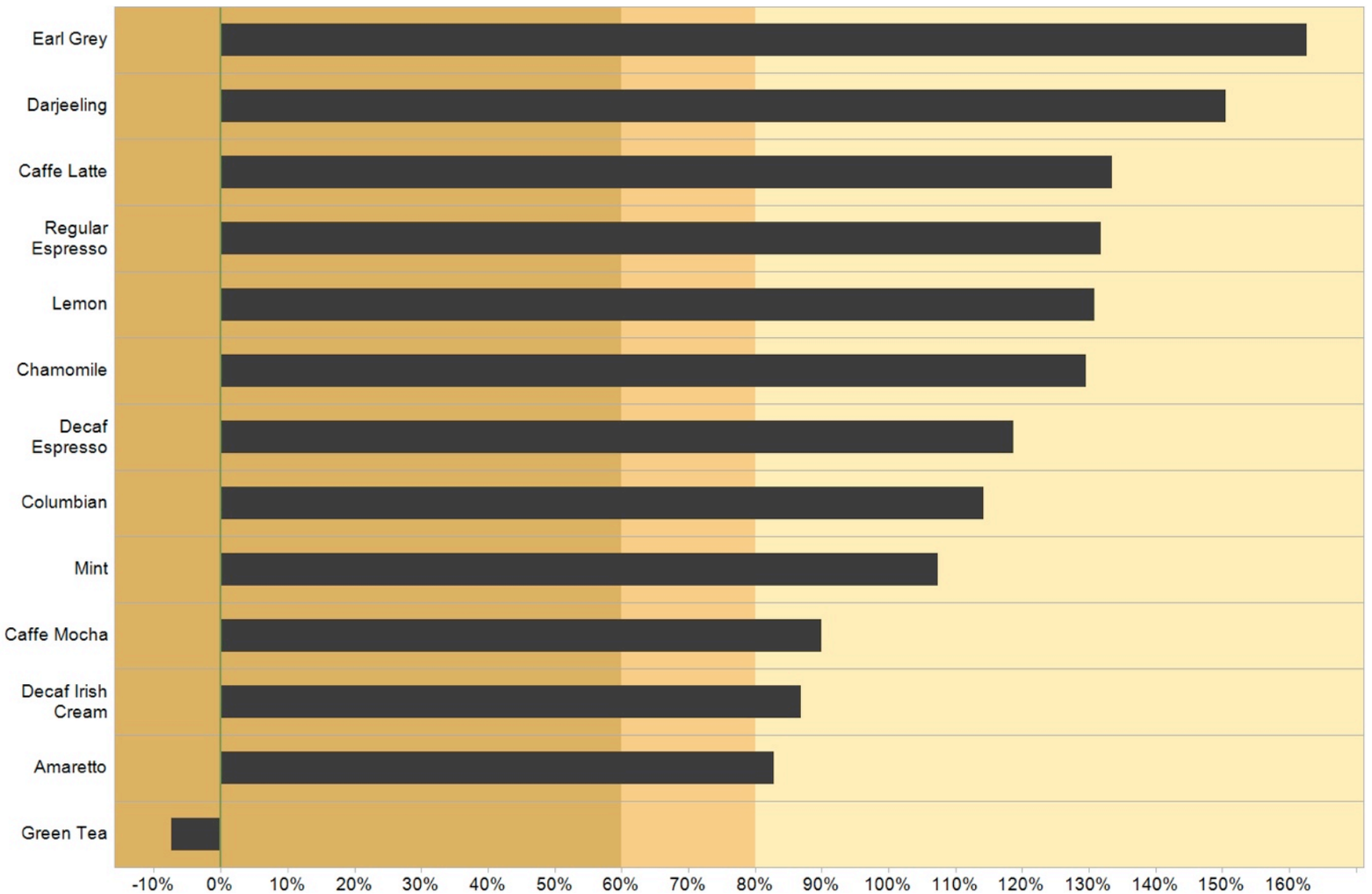
Sometimes bullet graphs must be designed to accommodate both positive and negative values, such as in the case of profits, which go negative when losses occur, as shown in the first example above. The second example illustrate another common practice: expressing a measure in terms of its variance to some comparative measure, such as a budget.

Series with independent qualitative ranges



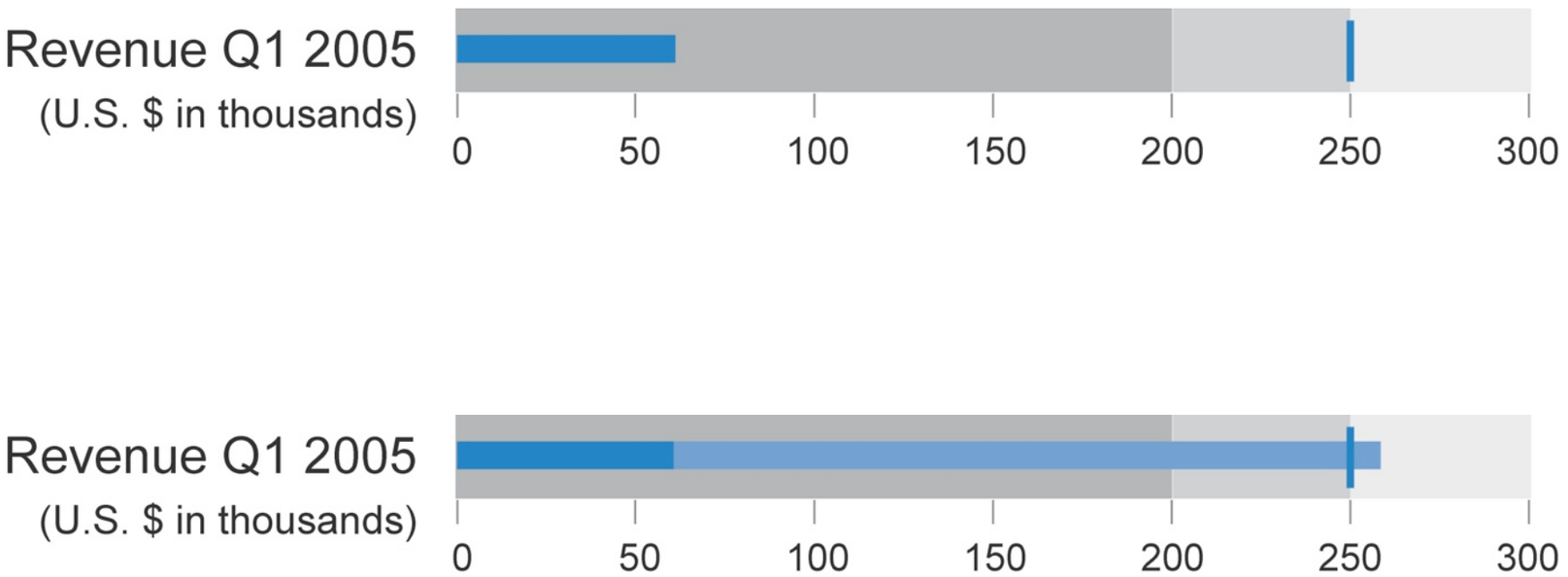
Bullet graphs can be arranged as a series of small multiples. In this example, each product has a different target for profits, which results in each bullet graph having independent qualitative ranges. This arrangement works well if you want to remain aware of target differences.

Series with common scales



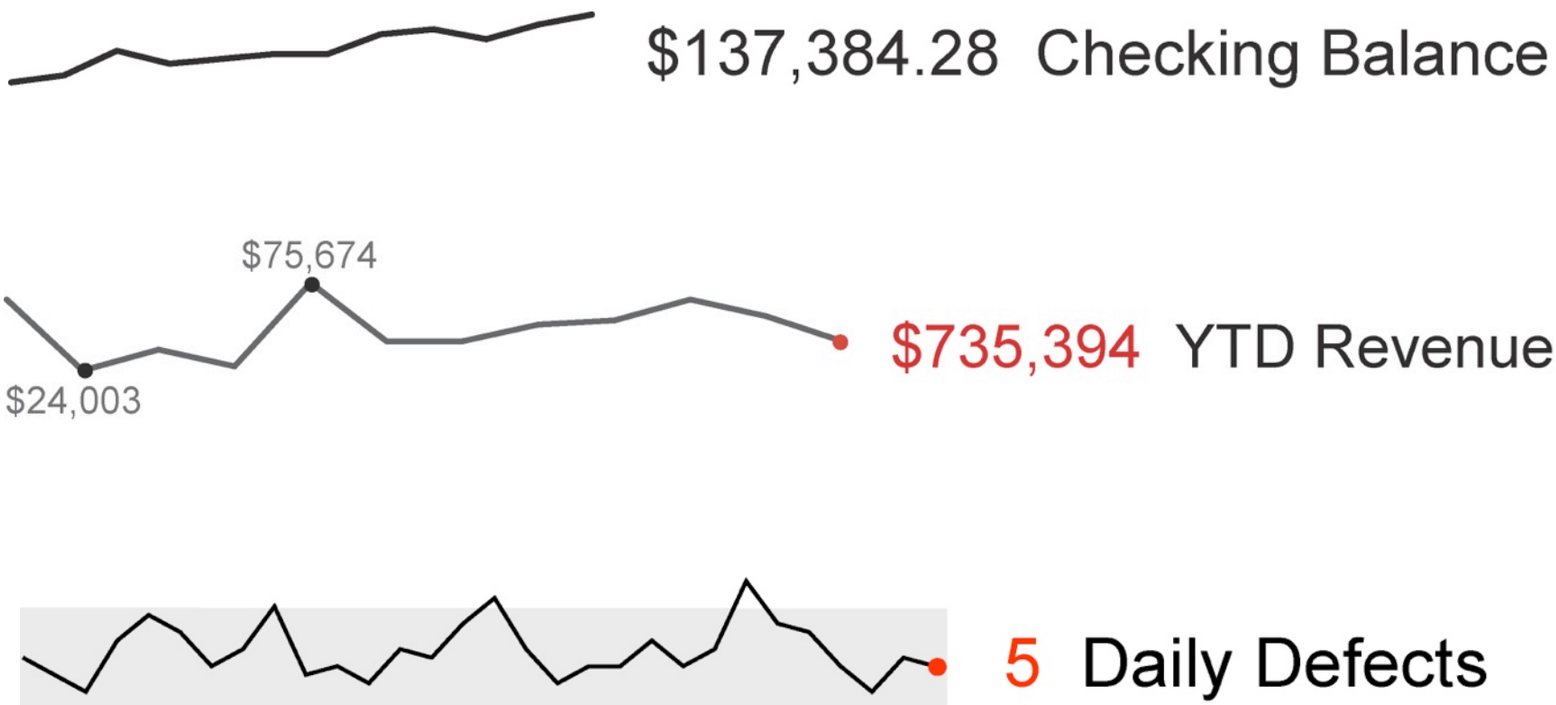
In this series of small multiples of the same profit per product information, the products have common qualitative ranges, because profits are being expressed as percentage variance to target. Although this version removes information about the different targets, it is much easier to use as a quick means of comparing profit performance among these products.

Projections for comparison to future target



You can use bullet graphs to project performance in relation to a future target. Whenever you compare a current measure to a future target, such as revenue as of January 15th compared to a Quarter 1 target, you can easily see how far you are from the target, but not if you are doing well today compared to that future target, which could still be weeks or even months away. This is true whether you are using a bullet graph, or any other graphical means to display this information. This shortcoming in the usefulness of the comparison can be overcome somewhat by adding a projection of where you'll be at the end of the period of time that is relevant to the target. The bottom bullet graph above splits the revenue measure into two segments: 1) the actual measure as of today, and 2) the projected measure of revenue based on current performance. This provides a rich display that tells you not only how far along you are on the path to the future target, but also how well you're doing today in relation to that target.

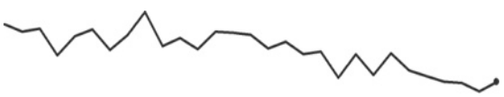
Sparklines



Data visualization expert Edward Tufte invented the sparkline. It is ideal for dashboards as a means to display an historical trend leading up to the current measure, providing useful context in very little space. Although sparklines lack a quantitative scale, a sense of scale can be provided by labeling the lowest and highest values along the line, as shown in the second example above. As the third example illustrates, sparklines can also be effectively used to show historical measures compared to a target, norm, or threshold, such as the comparison to an acceptable number of defects per day in a manufacturing process.

Sparklines are richer than trend arrows.

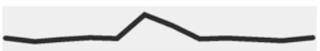
Revenue $86,864



Revenue $86,864

People commonly use simple up or down trend arrows to display the direction in which a measure is moving, but they are often ambiguous. In looking at the Revenue measure above, it isn't necessarily obvious if the upwards trend arrow indicates that revenue is trending upwards overall for the year, the quarter, the month, or just since yesterday. A sparkline, however, is not ambiguous, because it displays the entire period of history across which a sense of the trend applies.

Sparkline containers

Past 12 Months	Metric	Value
	Revenue	$913,394
	Profit	$193,865
	Avg Order Size	$5,766
	On Time Delivery	94%
	New Customers	1,247
	Cust Satisfaction	4.73 / 5
	Market Share	19%

Past 12 Months	Metric	Value
	Revenue	$913,394
	Profit	$193,865
	Avg Order Size	$5,766
	On Time Delivery	94%
	New Customers	1,247
	Cust Satisfaction	4.73 / 5
	Market Share	19%

I’ve found that it sometimes helps to provide subtle containers for sparklines, because without them our perception of the slope and pattern of a sparkline can be skewed by the slope of the sparkline below it. Here I’m illustrating two simple containers: a light background fill color (left) and a light border (right).

Icons

- Alert
- Up/Down Indicator
- On/Off Indicator

Avoid using too many icons.

In this context the term icon refers to a small, simple image that represents a particular meaning.

- **Alerts** are used to flag information as important or in need of attention. You can include variations of color to indicate different degrees of importance or urgency. It is best to use a distinct color for alerts, because people are able to search for and find a target color on a display faster than any other visual attribute.

  One general finding from these saccadic selectivity studies is that if the display items have, among other features, clearly distinguishable colors, then participants' eye movements tend to be guided by the target color. For example, Williams and Reingold (2001) used target items of particular color, shape, and orientation, and three groups of additional display items; each of them sharing exactly one of those three features with the target. By attributing each saccadic endpoint to its nearest display item, it was found that saccadic selectivity for the target color was about 70%, whereas it was only about 15% for shape and orientation.

  (Y. Xu, E. C. Higgins, M. Xiao, M. Pomplun. Cognitive Science 31, 2007, page 878)
- **Up/Down indicators** are used to indicate that a measure is greater than or less than another measure (for example, a prior measure in time to indicate that it has gone up or down).
- **On/Off Indicators** are used to indicate that a data item belongs to a particular group or status (current item in a schedule, featured product, etc.).

Text

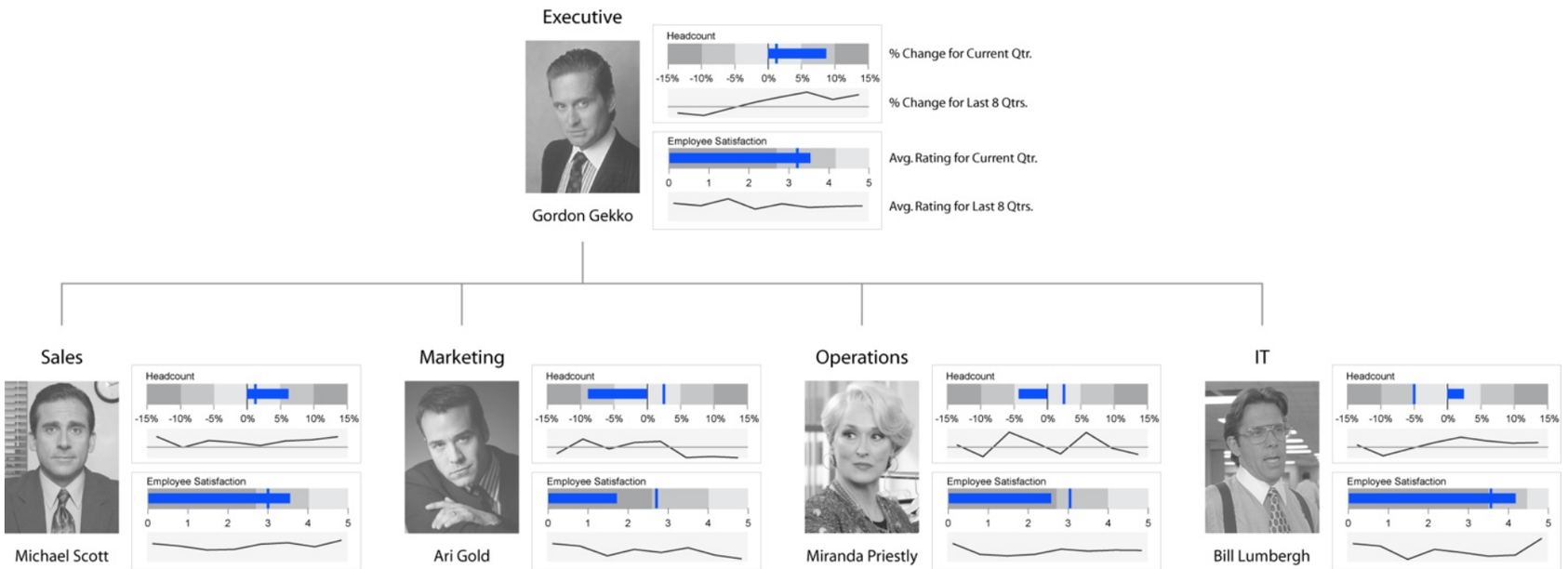
YTD Revenue $384,899

Note: All monetary amounts are expressed in U.S. dollars.

Text is used to verbally encode data (for example, text values in a table) or to label, explain, or instruct.

Image containers

Image containers are simply used to display images (bmp, jpeg, gif, tiff, etc.). (Note: Images are sometimes useful on dashboards, but this photo of my cat Tuna definitely is not a good example. She is adorable, though, isn't she?)



An example of useful images on a dashboard might involve photos of the heads of various departments, arranged in organization chart fashion, on a dashboard that is used by the Director of Human Resources.

Drawing objects

Line

Arrow

Rectangle

- **Lines** are used to rules (for example, to underline one or more items) or as connectors (for example, to connect separate entities in a diagram).
- **Arrows** are used as pointers (for example, to highlight particular data items) or as directional connectors (for example, to suggest a reading sequence or the direction of flow).
- **Rectangles** are used to highlight or group data items by drawing a border around them or to represent entities or processes in a diagram.
- **Ovals** are used highlight or group data items by drawing a border around them or to represent entities or processes in a diagram.

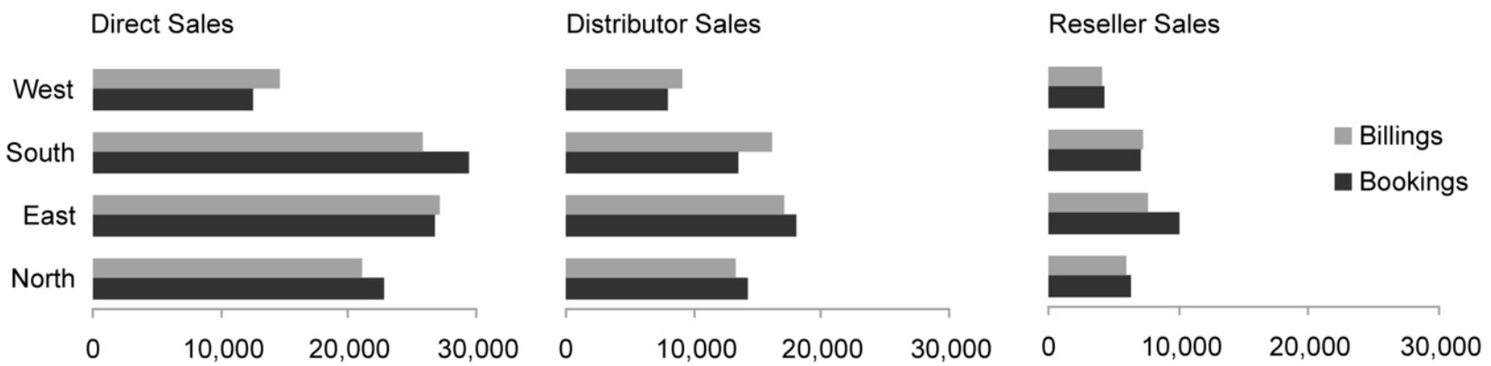
Organizers

Table

Department	Employee Count
Marketing	15
Human Resources	20
Info Systems	22
Finance	23
Sales	153
Manufacturing	235
Total	**468**

Spatial Map

Small Multiples

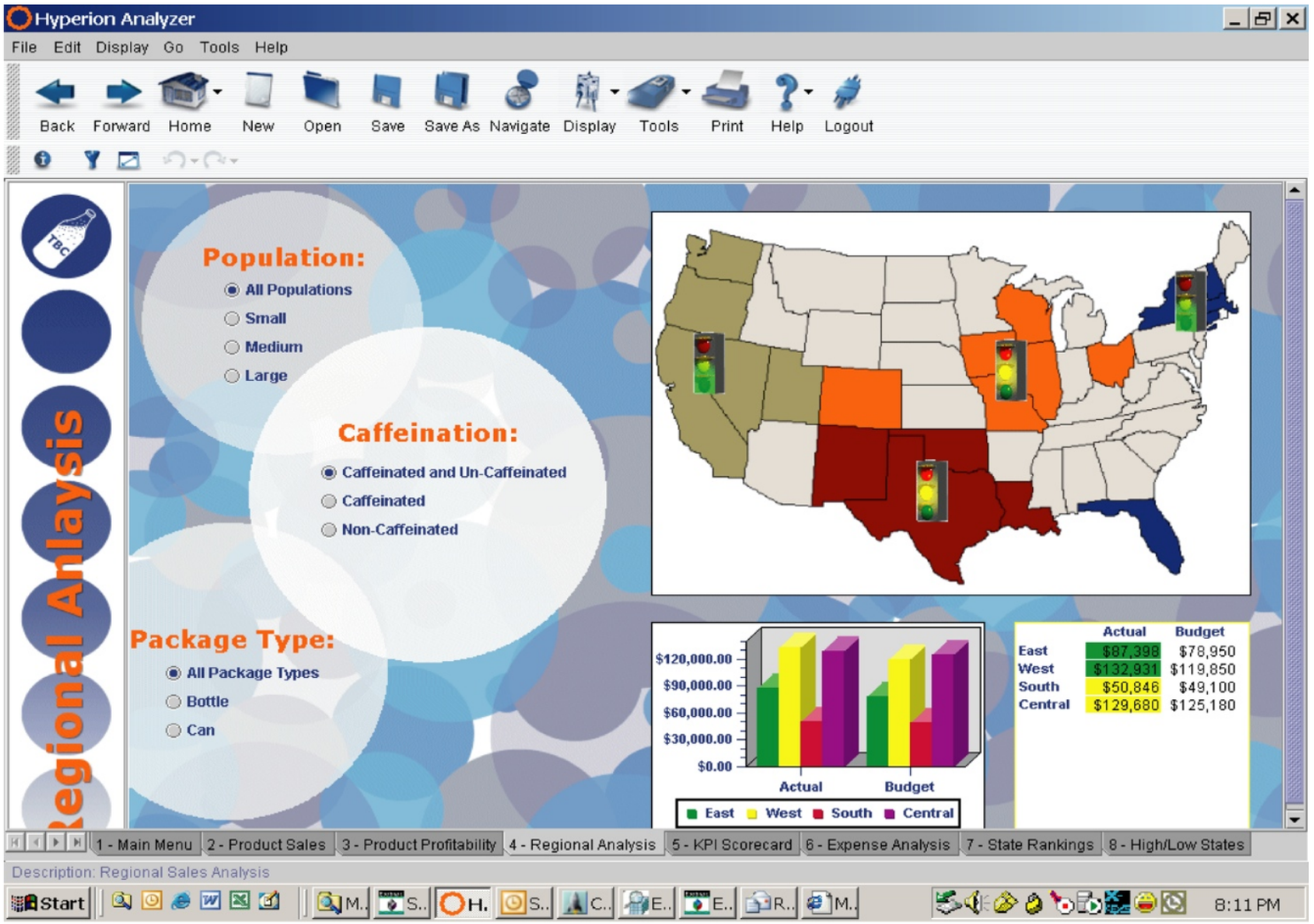


- **Tables** are used to organize any of the other display devices (text, images, graphs, etc.) into cells arranged as rows and columns.
- **Spatial Maps** are used to represent physical areas (for example, geographical regions or a the floor plan of a building) with irregular subdivisions, each of which can be addressed and manipulated separately.
- **Small Multiples** are used to arrange a series of small graphs vertically, horizontally, or in a matrix; graphs must be consistent, except that they each display a different subdivision of a category (time, region, product, etc.).

Visual design objectives

1. Eliminate clutter and distraction.
2. Group data into logical sections.
3. Highlight what's most important.
4. Support meaningful comparisons.
5. Discourage meaningless comparisons.

Eliminate clutter and distraction.



Given the small amount of information that actually appears on this dashboard, it is horribly cluttered. All three of the sections on the right half of the dashboard present the same basic information in different ways.

This dashboard communicates very little information, but is crammed full of visual content nonetheless. Very few of the pixels convey data. Everything that appears on the left half of the screen is either decorative or used for navigation or data filtering. The two graphs on the right (the bar graph and the geographical display with traffic lights) display the same data that appears in the table. It is sometimes useful to display the same data in multiple ways to emphasize different aspects, but these graphs don't do this effectively. Also, rendering the bars in the bar chart in 3D adds no value, but simply increases the amount of visual content that must be processed.

(Source: Website of Hyperion Solutions, Inc.)

Group data into logical sections.

How would you group these items?

- YTD revenue
- Customer satisfaction rating
- Revenue by product line
- Sales pipeline
- Top 10 customers YTD
- Market share compared to competitors
- Current quarter revenue
- Top 10 potential deals
- Revenue by sales region
- YTD profits
- Revenue history (rolling 12 months)

Keep the following considerations in mind when you determine how to arrange data on the screen:

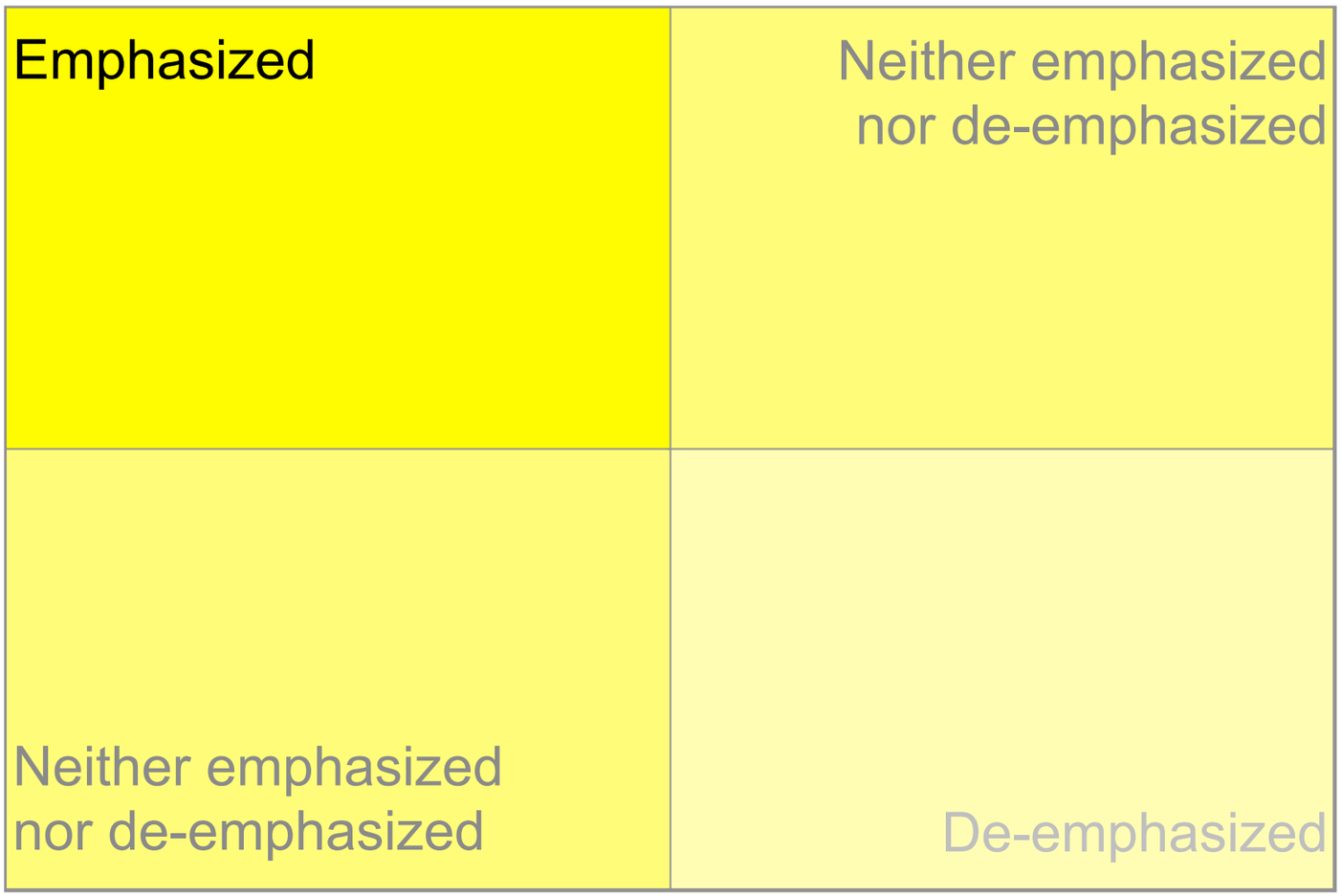
- Groups must match how the information is used.
- Groups are normally aligned with business functions and entities (sales, customers, and so on).
- Co-locate items belonging to the same group.
- Sometimes items belong together based on their importance to the task (for example, sometimes it makes sense to group the most important pieces of information together).
- Delineate groups using the least visible means (for example, through the use of white space).

Highlight what's most important.

- What's always important (static)
- What's important right now (dynamic)

Data that is most important and should therefore be highlighted fall into two categories: data that is always important and data that is important right now.

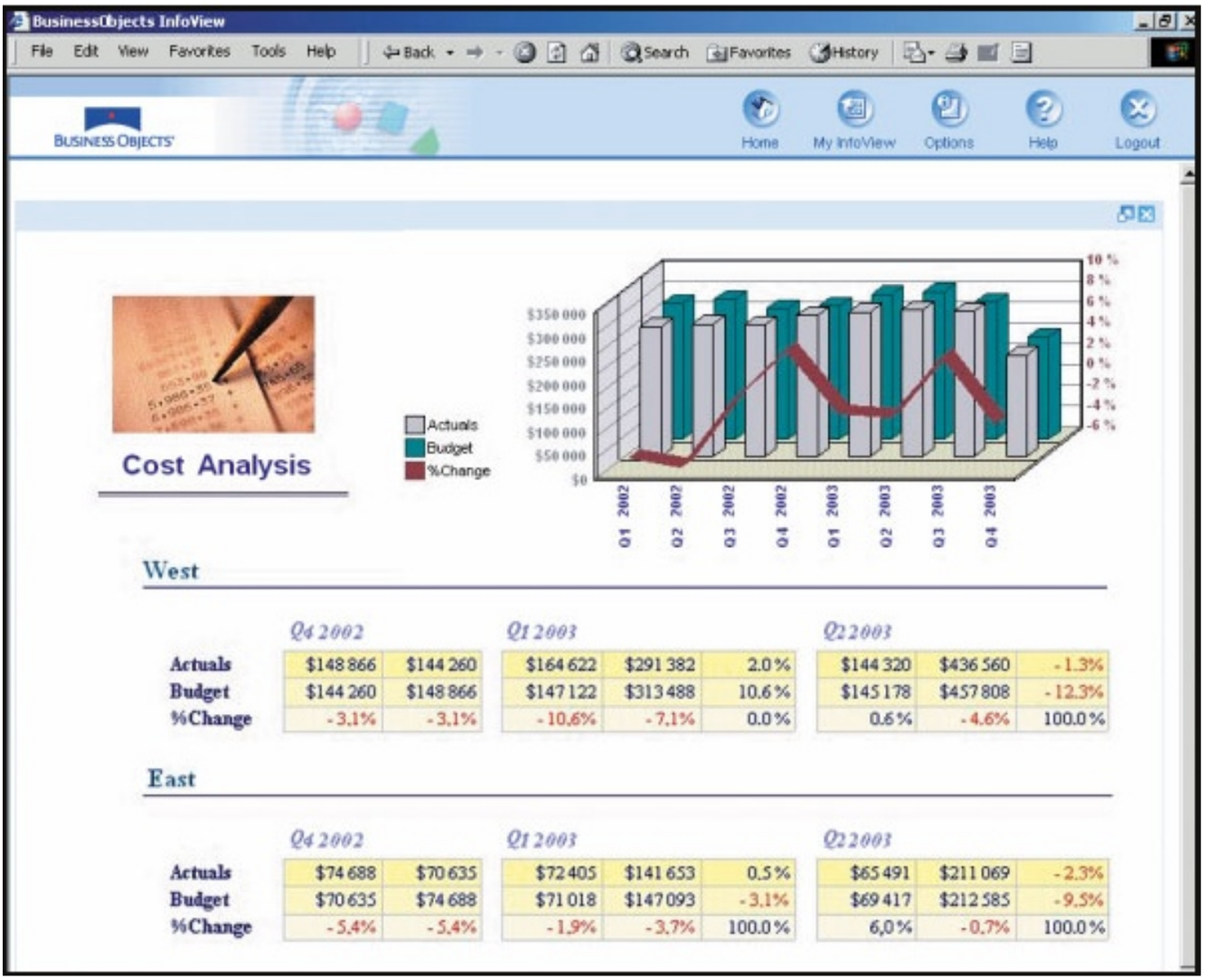
Screen real estate: location, location, location



When you design the layout and visual characteristics of a dashboard, you can direct the viewer's attention to particular information. Layout is generally static – it isn't going to change as the data changes – so you can only use it to focus attention on information that is generally most important. Focusing attention on data that is most important right now, perhaps because it is so bad it needs attention, is a separate matter involving separate techniques.

Research indicates that particular areas of a screen or page receive different levels of attention from readers: specifically the upper left. Location is the best means to highlight some information as generally more important than the rest.

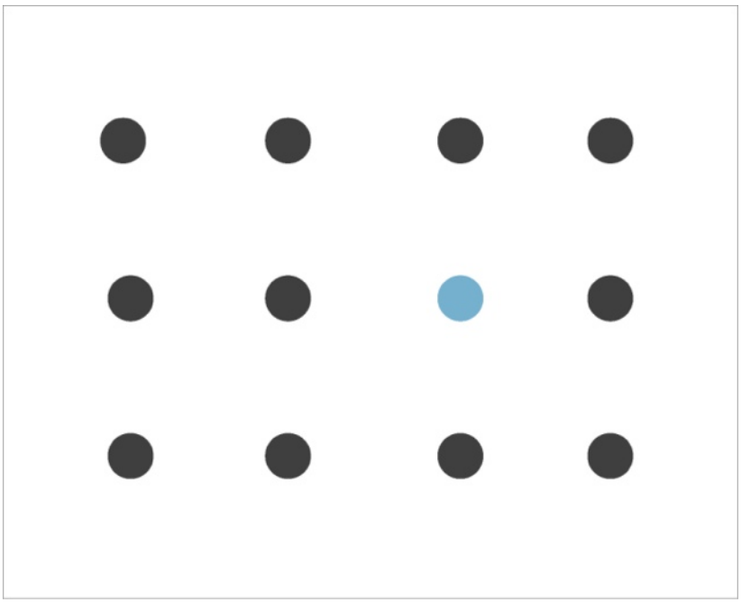
Highlight what's always important.

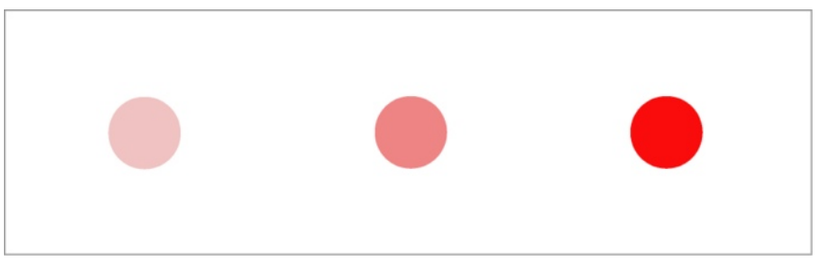


Take a moment to examine the dashboard shown above, paying particular attention to the use of the prime locations for emphasizing information. Has the designer has managed to focus attention on the right content?

(Source: Website of Business Objects.)

Highlight what’s important right now.



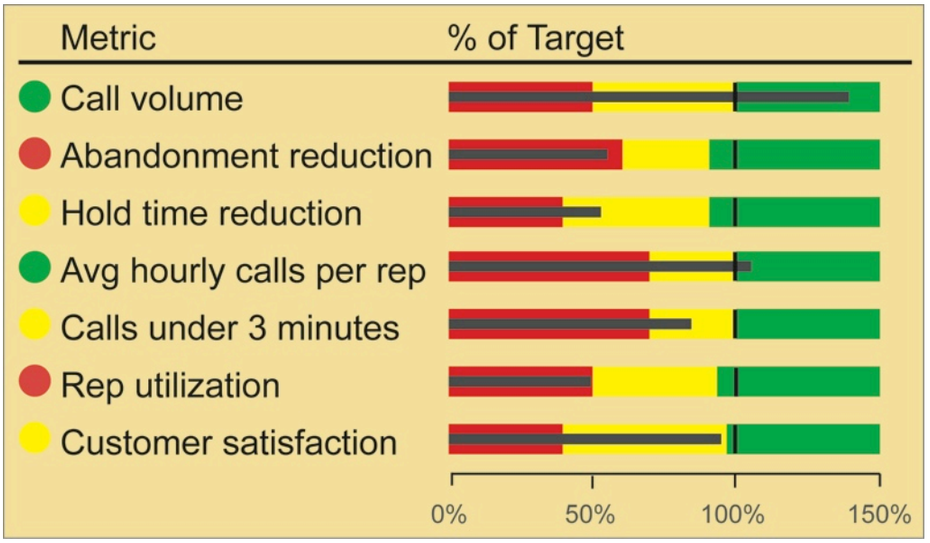


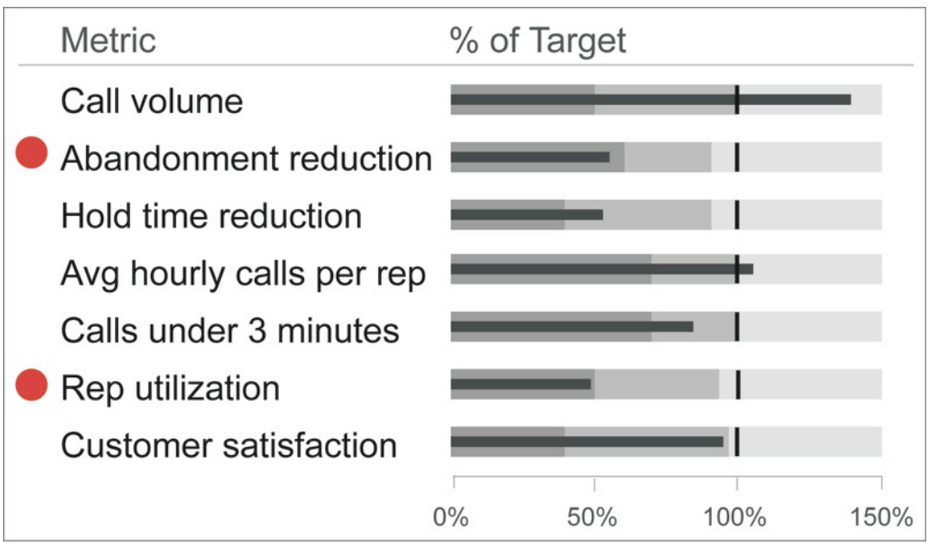
* YTD Revenue $283,304

If you want something to stand out from the rest, you can endow it with a visual attribute that contrasts with the rest of the display. Contrasts grab our attention and nag us to assign meaning to them. This is true of contrasts in any of the pre-attentive visual attributes (2-D location, size, shape, etc.), but especially true of color. Certain colors serve as powerful attention getters by convention, such as red, which suggests danger, alert, watch out, and other similar meanings in most western cultures. Red wouldn’t work, however, for the many people who suffer from the most common form of color blindness.

When you need to communicate varying levels of urgency, such as “This is extremely urgent” versus “This is important, but not quite as urgent”, the best visual mechanism involves the use of varying color intensities, rather than different colors.

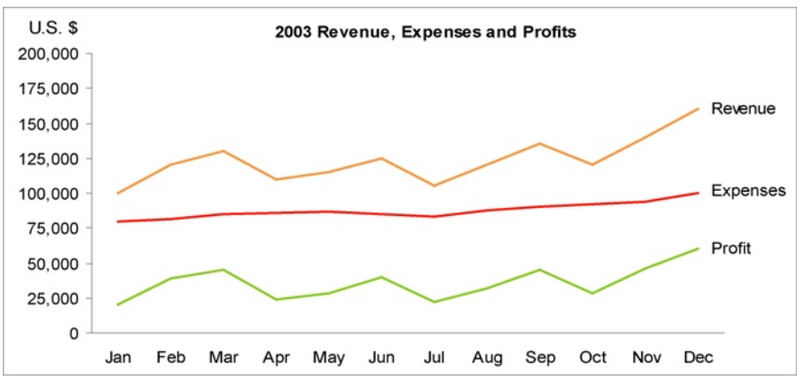
Two more visual attributes can also be used effectively to highlight particular data items dynamically: added marks and enclosure.

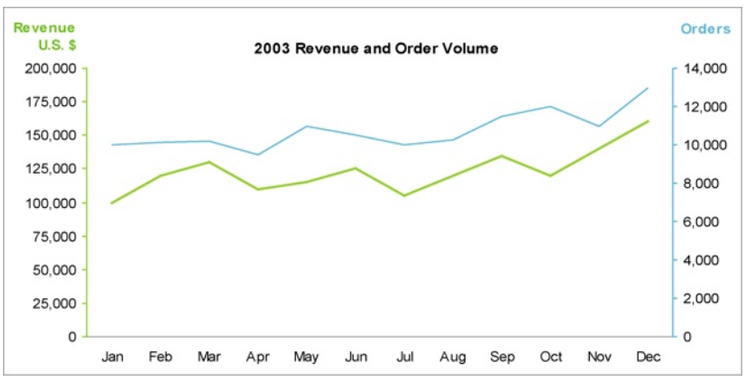




Color can highlight only when it isn’t overused.

Support meaningful comparisons.



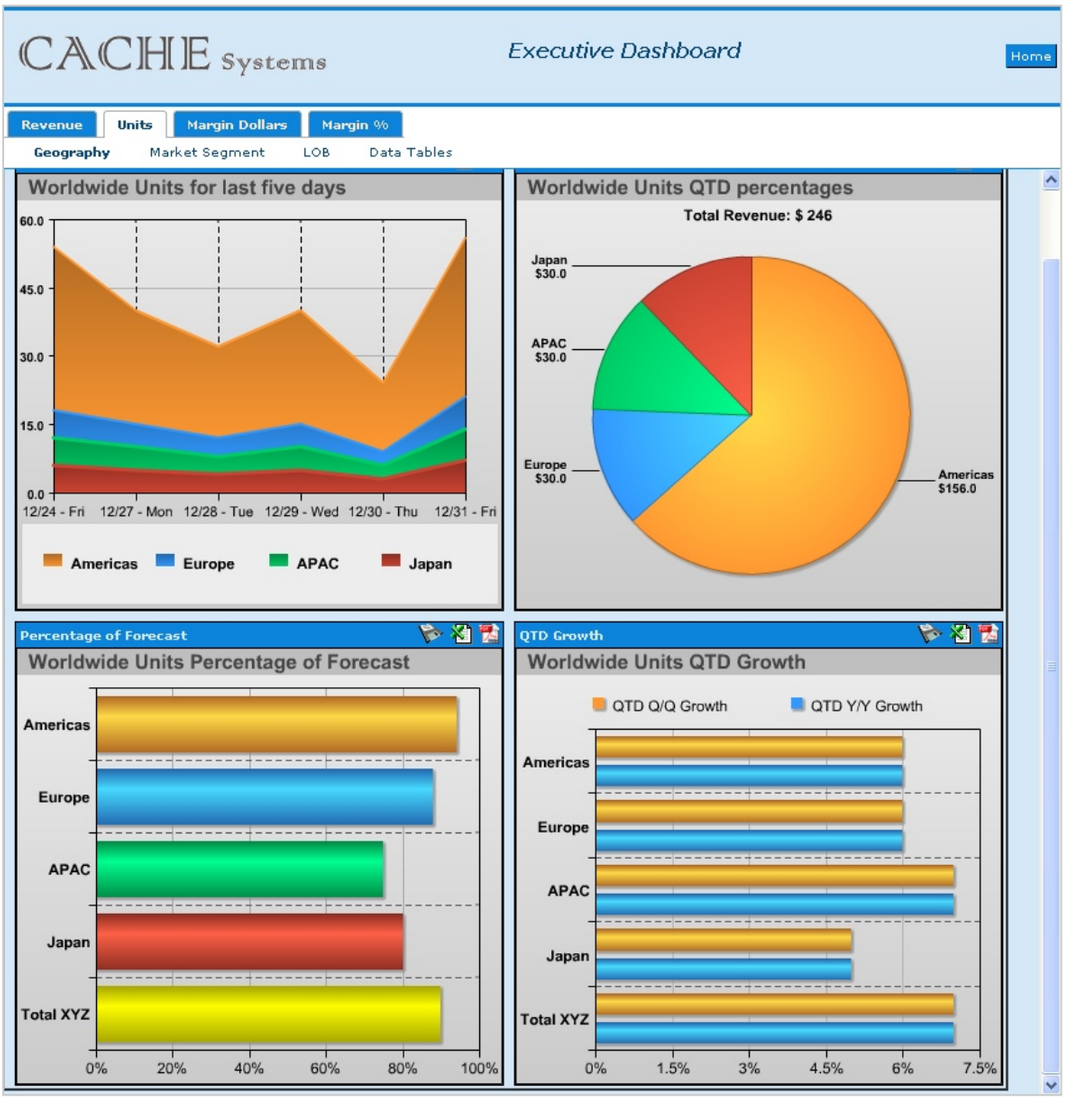


Product	Units Sold	Actual Revenue	% of Total	Forecast Revenue	% of Fcst
Product A	938	187,600	47%	175,000	107%
Product B	1,093	114,765	28%	130,000	88%
Product C	3,882	62,112	15%	50,000	124%
Product D	873	36,666	9%	40,000	92%
Product E	72	2,088	1%	50,000	4%
Total	6,858	$403,231	100%	$445,000	91%

Meaningful comparisons can be encouraged by doing the following:

- Combine in a single table or graph (if appropriate).
- Place items close to one another.
- Display using the same type of widget (if appropriate).
- Link items in different groups using a common color.
- Include comparative values (for example, ratios, percentages, or actual variances) whenever useful for clarity and efficiency.

Discourage meaningless comparisons.



Meaningless comparisons can be discouraged by doing the following:

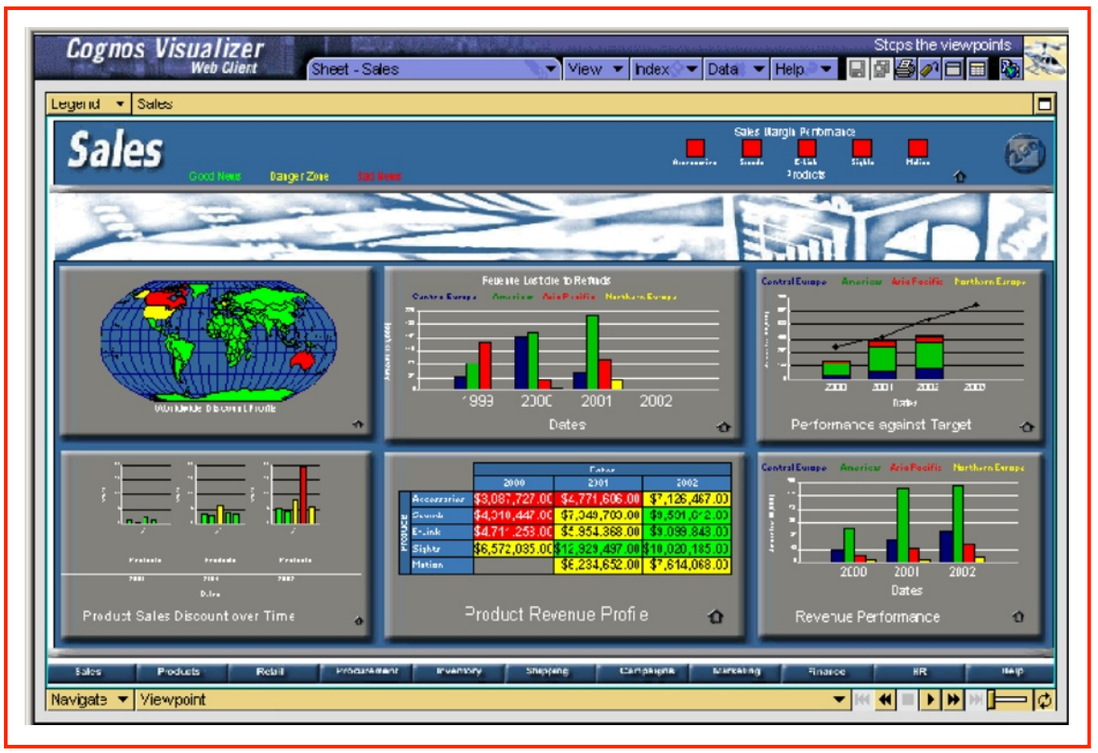
- Separate items from one another (if appropriate).
- Use different colors.
- Use different display widgets.

How good a job does the sample dashboard above do in discouraging meaningless comparisons?

(Source: Website of Corda Technologies.)

Design for aesthetic appeal.

Why bother?



Gack!

Pleasing displays are

- more enjoyable,
- which makes them more relaxing,
- which prepares you for greater insight and creative response.

The psychological and physiological benefits of aesthetically-pleasing design are nicely documented in Donald Norman's book *Emotional Design*.

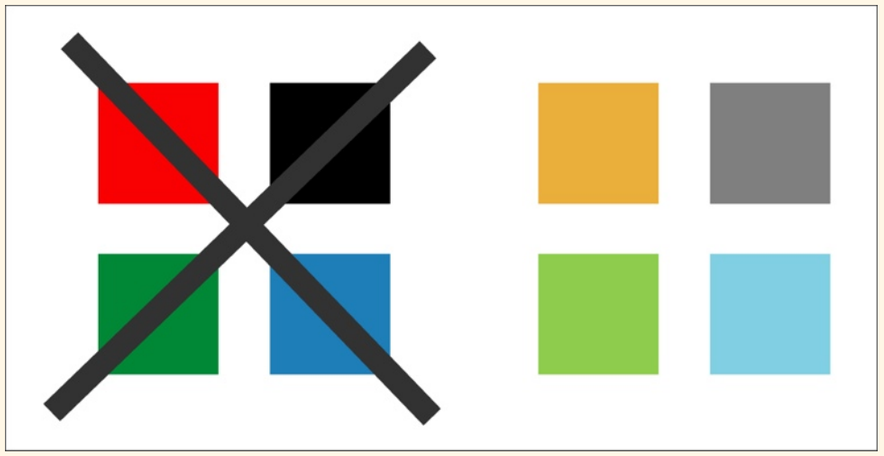
(Note: The dashboard image was found on the website of Cognos Incorporated.)

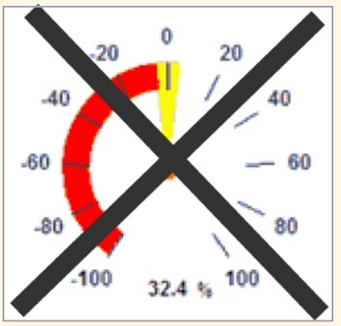
Principles of dashboard aesthetics

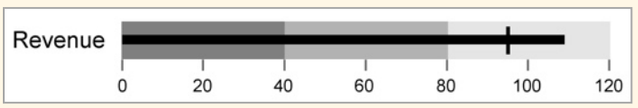
- Don’t add fluff!
- Attractively display the information itself.

Visual fluff is anything that doesn’t communicate or in some necessary way support the communication of useful data.

Aesthetic design practices







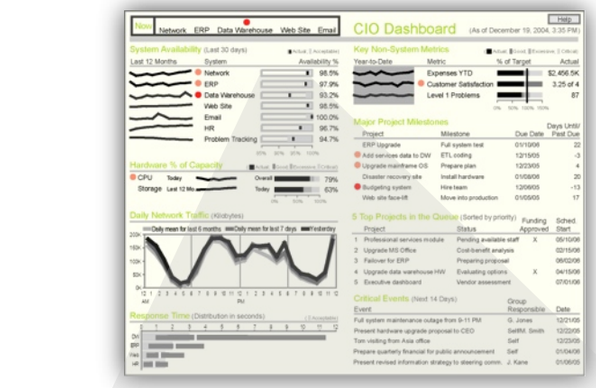
Fine Legibility		Poor Legibility	
Serif	Sans-Serif	Serif	Sans-Serif
Times New Roman	Arial	*Script*	**Gill Sans Ultra**
Palatino	Verdana	**Broadway**	Papyrus
Georgia	Tahoma	Old English	Tempus Sans ITC

The following guidelines will help you achieve a nice aesthetic without compromising the data:

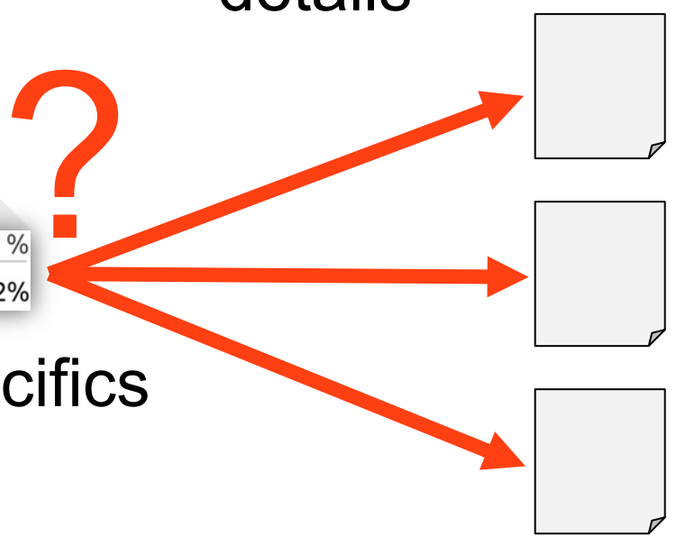
- Color
  - Keep bright colors to a minimum, using them only to make a few items stand out.
  - For most visual content, use light colors found in nature, giving them all the same value of lightness so that, even though they differ in hue, none stands out as more important than the others.
  - Use a light background other than pure white.
  - Do not fragment the screen by using different colors to separate different sections.
- Graphs and other graphics
  - Use the clearest images possible.
- Text
  - Stick with one font, or at most one for headings and one for all other text.
  - Use the clearest font possible.

Navigating to additional information

1. Scan the big picture



3. Link to supporting details



2. Zoom in on important specifics

As single-screen displays, dashboards do not always provide all the information needed to perform a job. They provide the initial view, which might need to be supplemented with additional information for more comprehensive understanding or response.

Dashboards can be designed for interaction. The most common types of dashboard interaction are:

- Drill-down into the details
- Slice to narrow the field

Dashboards can serve as launch pads for navigating to further information. When they are used for this purpose, keep the following principles in mind:

- Click the data itself
  - It's easy
  - It's intuitive
  - It saves space!
- Use consistent launch actions

Exercise

Practice designing an entire sales dashboard from scratch, which displays:

- YTD revenue
- Customer satisfaction rating
- Revenue by product line
- Sales pipeline
- Top 10 customers YTD
- Market share compared to competitors
- Current quarter revenue
- Top 10 potential deals
- Revenue by sales region
- YTD profits
- Revenue history (rolling 12 months)

The purpose of this exercise is to give you a chance to combine everything you've learned and put it to use. Take the scenario and data that you're given and design a complete dashboard.

SALES DASHBOARD - 19 December 2004

Performance

Good
Satisfactory
Poor

		Actual Q1	Actual Q2	Actual Q3	To Date Q4	Forecast Q4	Target Q4
Revenue Total		$ 154,057	$ 165,158	$ 199,738	$ 206,264	$ 225,205	$ 215,000
by Region	*North America*	$ 78,963	$ 78,138	$ 91,176	$ 91,441	$ 100,197	$ 107,500
	Europe	$ 30,811	$ 33,032	$ 39,948	$ 41,253	$ 45,374	$ 43,000
	Asia	$ 28,877	$ 37,472	$ 48,641	$ 52,944	$ 57,380	$ 39,775
	South America	$ 3,041	$ 3,435	$ 4,206	$ 5,035	$ 5,738	$ 5,375
	Middle East	$ 12,365	$ 13,081	$ 15,767	$ 15,592	$ 16,515	$ 19,350
by Product	*Cabernet*	$ 28,430	$ 30,228	$ 35,053	$ 38,728		$ 38,700
	Zinfandel	$ 13,876	$ 10,164	$ 17,876	$ 18,664		$ 19,350
	Merlot	$ 25,440	$ 24,977	$ 28,955	$ 28,865		$ 36,550
	Chardonnay	$ 68,634	$ 64,025	$ 104,063	$ 107,610		$ 98,900
	Sauvignan Blanc	$ 17,677	$ 35,763	$ 13,790	$ 12,398		$ 21,500
Profit		$ 31,999	$ 36,749	$ 42,431	$ 46,685		$ 53,750
Avg Order Size		405	421	435	449		430
Market Share		23%	20%	19%	17%		27%
Customer Satisfaction		3.18	2.95	2.82	2.67		3.29
On-Time Delivery		83%	73%	65%	68%		95%
New Customers		346	430	447	468		450

This and the next few slides are examples of dashboard solutions that were submitted in response to a data visualization competition that I judged for DM Review magazine in 2005. Every one of these examples fails to communicate in several significant ways. Using the dashboard design principles that you've learned, critique each of these dashboards, listing the reasons that they fail, and also the ways in which you believe they succeed.

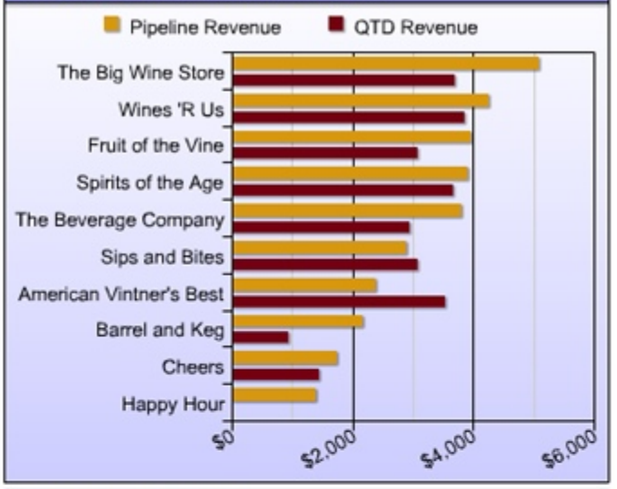
2004 Targets

Major Metrics

Poor
Satisfactory
Good

	Achievement Percentage Q1	Q2	Q3	Q4	Target %	Poor %
Revenue	103	99	109	96	90	< 60
Profit	85	88	92	87	80	< 60
Avg Order Size	101	103	104	105	75	< 50
Market Share	94	80	72	63	90	< 65
Customer Satisfaction	98	90	86	81	90	< 60
On-Time Delivery	90	78	69	72	90	< 60
New Customers	115	122	112	104	85	< 50

Top 10 Customers in the Pipeline



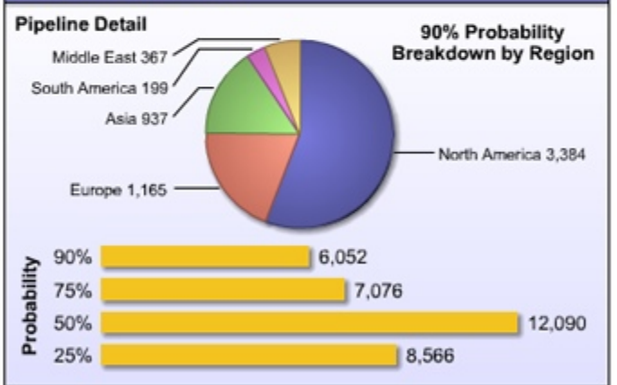
2004 Revenue Targets

by Product and Region

Poor
Satisfactory
Good

		Achievement Percentage Q1	Q2	Q3	Q4	Target %	Poor %
By Product	Cabernet	105	101	106	100	90	< 60
	Zinfandel	103	68	108	96	90	< 60
	Merlot	100	88	93	79	90	< 60
	Chardonnay	99	83	123	109	90	< 60
	Suavignan	118	214	75	58	90	< 60
By Region	North America	99	89	97	85	90	< 60
	Europe	103	99	109	96	90	< 60
	Asia	113	128	147	133	90	< 60
	South America	203	137	114	94	90	< 60
	Middle East	92	87	95	81	90	< 60

Pipeline and Trends

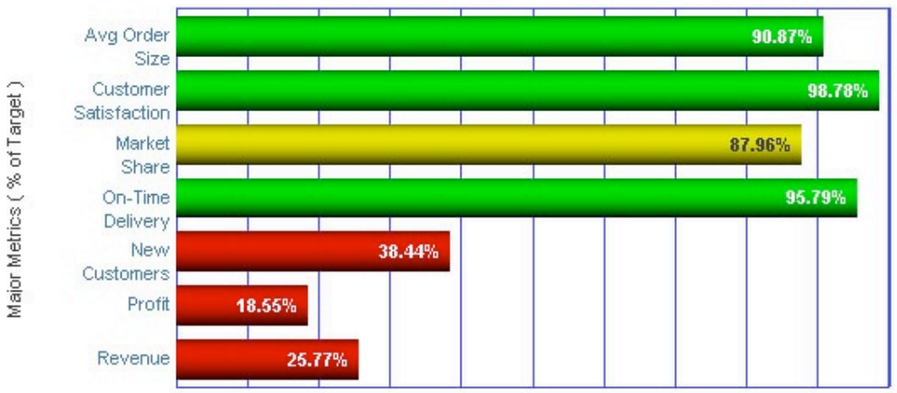


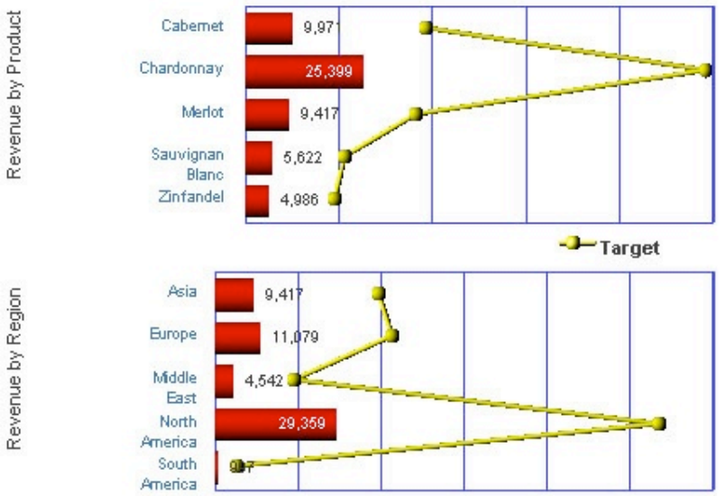
arcplan

Sales Dashboard

Cumulative Metrics	Oct	Nov	Dec
New Customers	0	0	173
Profit	0	0	9,971
Revenue	0	0	55,395

Q 4/2003 Q 1/2004 Q 2/2004 Q 3/2004 Q 4/2004





Top 10 Customers in the Pipeline	Pipeline Revenue	QTD Sales Revenue	YTD Sales Revenue
American Vintner's Best	2,389	3,535	75,396
Barrel and Keg	2,178	932	40,536
Cheers	1,738	1,457	58,008
Fruit of the Vine	3,972	3,068	73,332
Happy Hour	1,388	0	9,396
Sips and Bites	2,895	3,085	63,456
Spirits of the Age	3,903	3,680	77,604
The Beverage Company	3,799	2,956	62,796
The Big Wine Store	5,083	3,685	88,368
Wines 'R Us	4,263	3,865	82,044

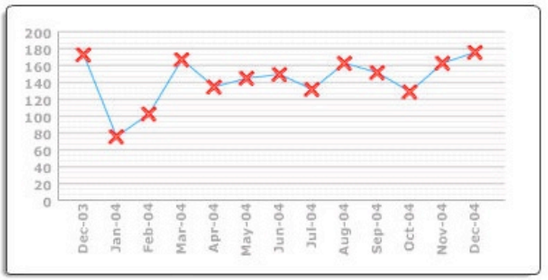
	Probability of Closing Sale			
Revenue by Region	25%	50%	75%	90%
Asia	2,760	3,648	1,439	937
Europe	1,273	2,955	1,702	1,165
Middle East	527	539	256	367
North America	3,505	4,592	3,384	3,384
South America	501	356	295	199

everybody on the same page

Monthly Performance

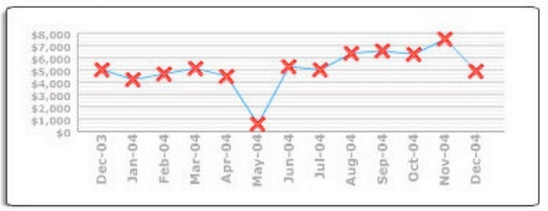
Major Metrics

- Revenue
- Profit
- Avg Order Size
- Market Share
- Cust Sat (1-5 scale)
- On-Time Delivery
- New Customers



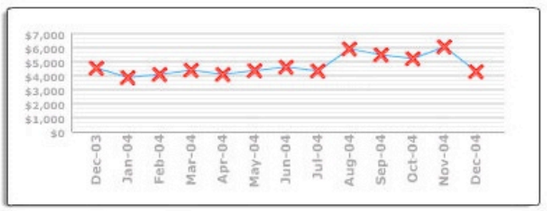
Revenue by Product

- Cabernet
- Zinfandel
- Merlot
- Chardon
- Sauv Blanc



Revenue By Region

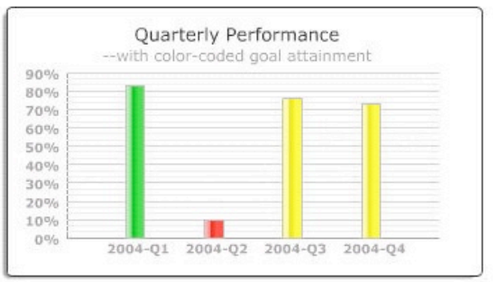
- N Amer
- Europe
- Asia
- S Amer
- Mid East



Quarterly Performance to Goal

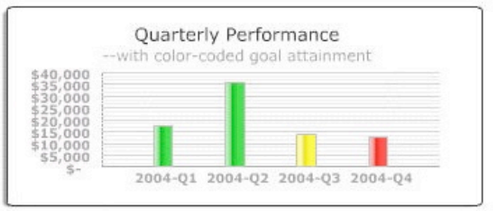
Major Metrics

- Revenue
- Profit
- Avg Order Size
- Market Share
- Cust Sat (1-5 scale)
- On-Time Delivery
- New Customers



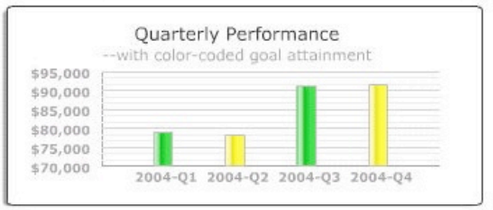
Revenue by Product

- Cabernet
- Zinfandel
- Merlot
- Chardonnay
- Sauv Blanc



Revenue By Region

- N Amer
- Europe
- Asia
- S Amer
- Mid East



Sales Pipeline Information

Sales Pipeline by Region for the Current Quarter to Date				
	Probability of Closing the Sale			
Revenue By Region	**90%**	**75%**	**50%**	**25%**
N Amer	$3,384	$3,384	$4,592	$3,505
Europe	$1,165	$1,702	$2,955	$1,273
Asia	$937	$1,439	$3,648	$2,760
S Amer	$199	$295	$356	$501
Mid East	$367	$256	$539	$527
Total Region Pipeline	**$6,052**	**$7,076**	**$12,090**	**$8,567**

Top 10 Customers in the Pipeline	Pipeline Revenue	QTD Sales Revenue	YTD Sales Revenue	Projected Year-End Sales
The Big Wine Store	$5,083	$3,685	$88,368	$93,451
Wines 'R Us	$4,263	$3,865	$82,044	$86,307
Fruit of the Vine	$3,972	$3,068	$73,332	$77,304
Spirits of the Age	$3,903	$3,680	$77,604	$81,507
The Beverage Company	$3,799	$2,956	$62,796	$66,595
Sips and Bites	$2,895	$3,085	$63,456	$66,351
American Vintner's Best	$2,389	$3,535	$75,396	$77,785
Barrel and Keg	$2,178	$932	$40,536	$42,714
Cheers	$1,738	$1,457	$58,008	$59,746
Happy Hour	$1,388	$-	$9,396	$10,784
Total Top Ten	**$31,608**	**$26,263**	**$630,936**	**$662,544**

Product or Region Revenue distribution

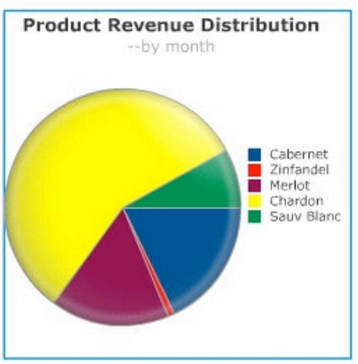
(Select a month from the appropriate list box.)

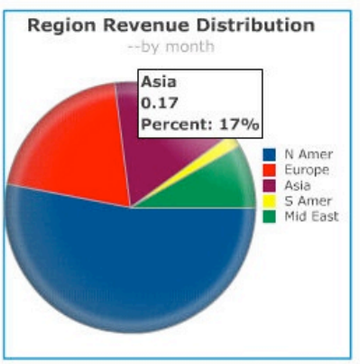
Product

- Mar-04
- Apr-04
- May-04
- Jun-04
- Jul-04
- Aug-04

Region

- Dec-03
- Jan-04
- Feb-04
- Mar-04
- Apr-04
- May-04

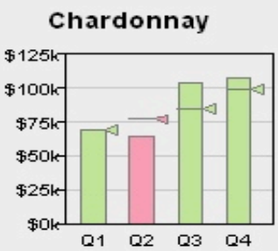


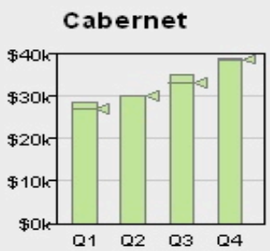


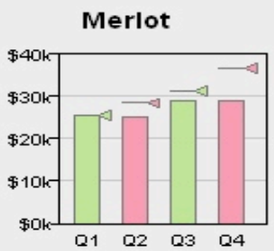
Sales Dashboard

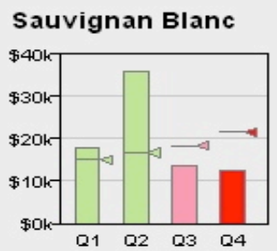
(All currency in US $)

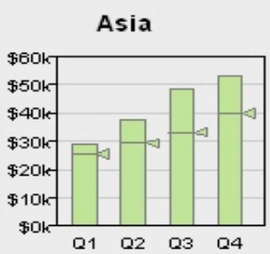
19dec2004

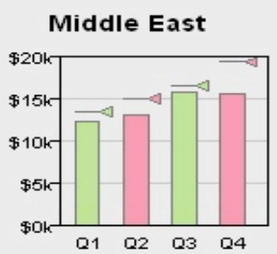


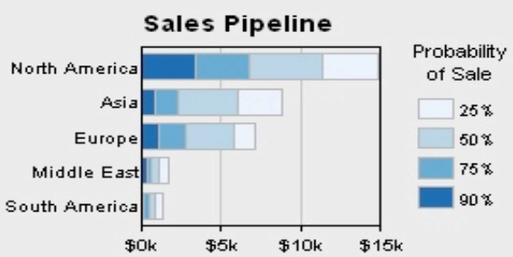


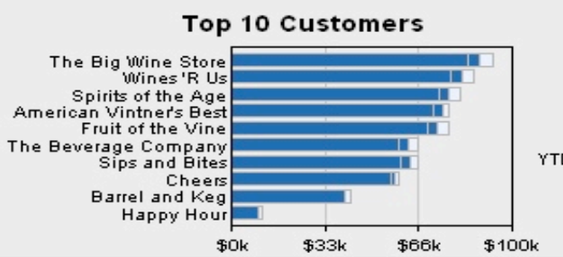








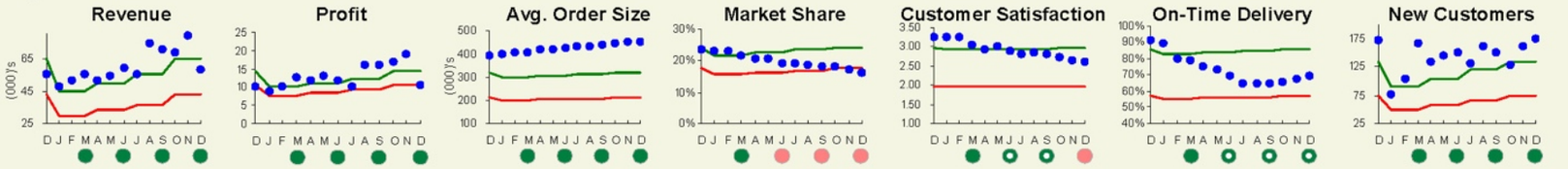




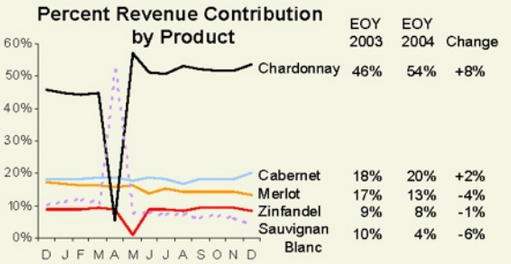
Sales Dashboard

December 2003 to December 2004

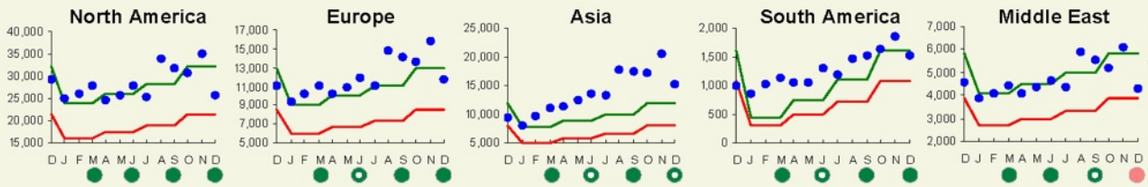
Major Metrics

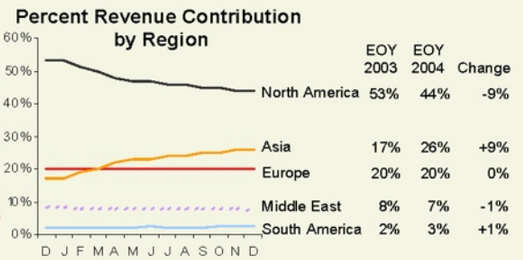


Revenue by Product



Revenue by Region





Top 10 Customers in the Pipeline

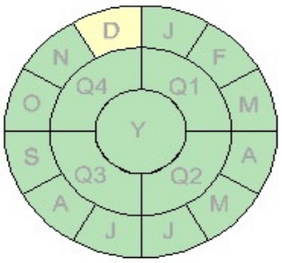
Customer	Pipeline Revenue	QTD Sales Revenue	YTD Sales Revenue
The Big Wine Store	5,083	3,685	88,368
Wines 'R Us	4,263	3,865	82,044
Fruit of the Vine	3,972	3,068	73,332
Spirits of the Age	3,903	3,680	77,604
The Beverage Company	3,799	2,956	62,796
Sips and Bites	2,895	3,085	63,456
American Vintner's Best	2,389	3,535	75,396
Barrel and Keg	2,178	932	40,536
Cheers	1,738	1,457	58,008
Happy Hour	1,388	0	9,396

Sales Pipeline by Region

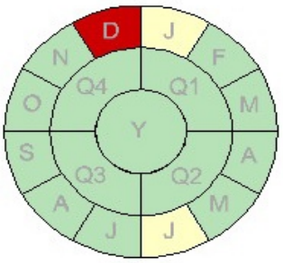
Open Cork Sales Dashboard

Last Update: December 19, 2004 3:01 PM EST

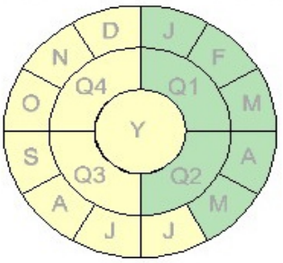
Revenue



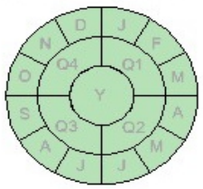
Profit



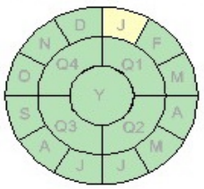
Customer Satisfaction



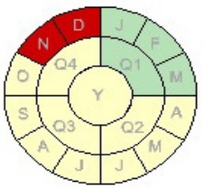
Avg Order Size



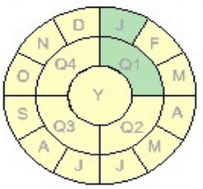
New Customers



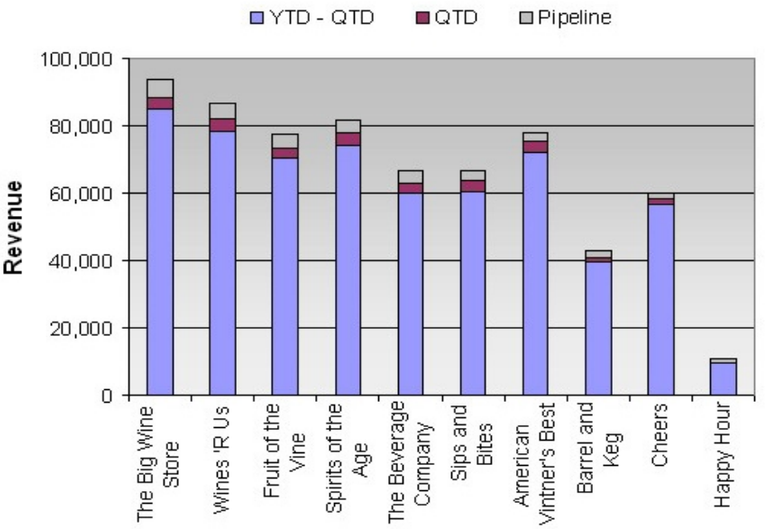
Market Share



On-TIme Delivery

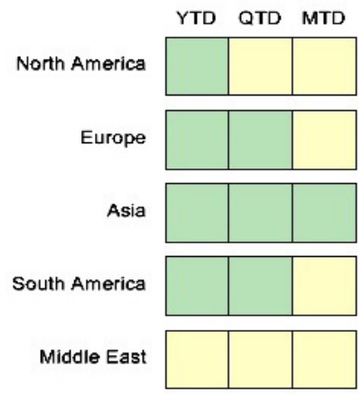


Sales Revenue By Customer

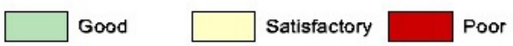


Revenue by Product

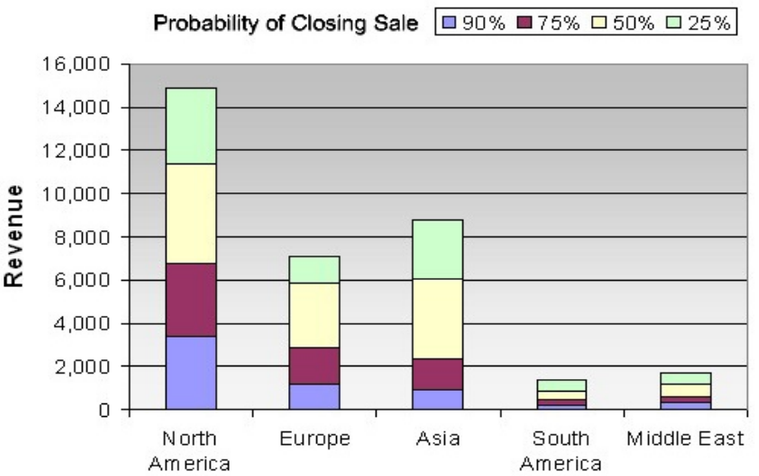
Revenue by Region



Relative to YTD, QTD, or MTD Target



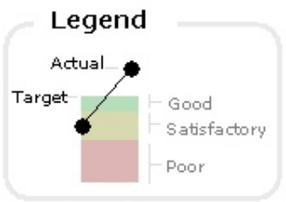
Q4 Sales Pipeline by Region

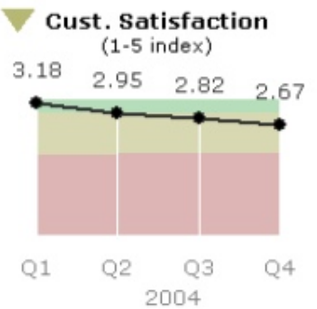


Sales Performance Dashboard

as of December 19th, 2004

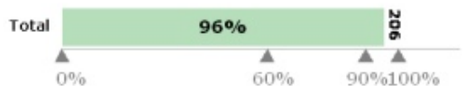
Major Metrics





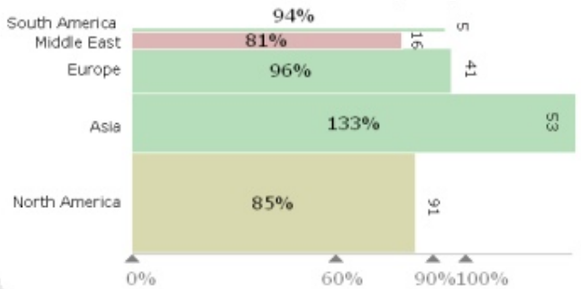
QTD Revenue Performance

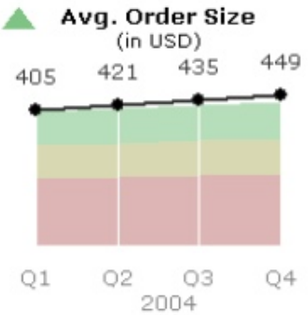
(% of target to date and sales in thousands of USD)

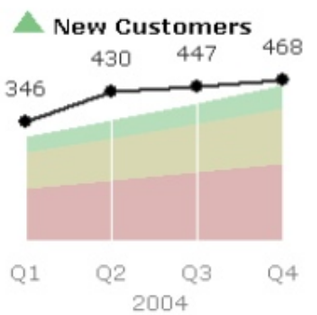


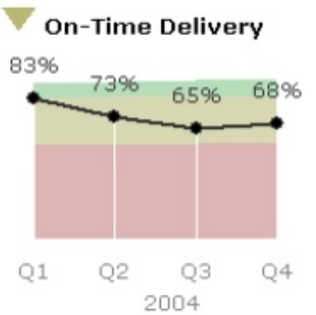
Revenue Performance by Product

Revenue Performance by Region





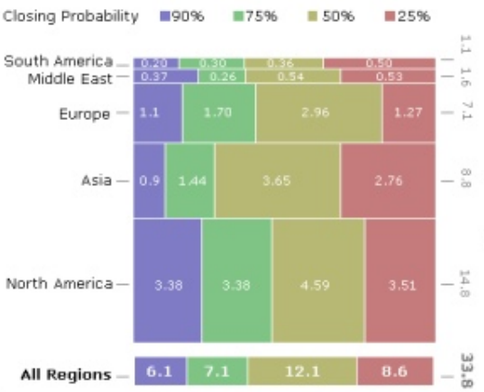




Sales Pipeline

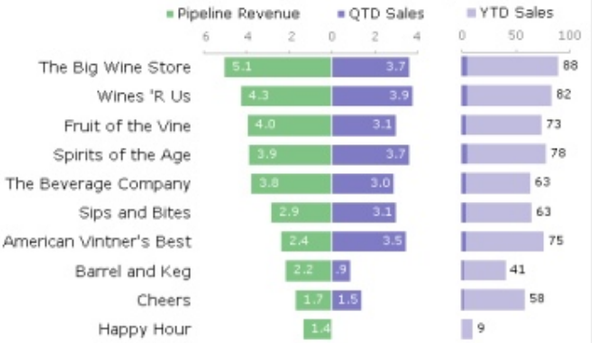
QTD Sales Pipeline by Region

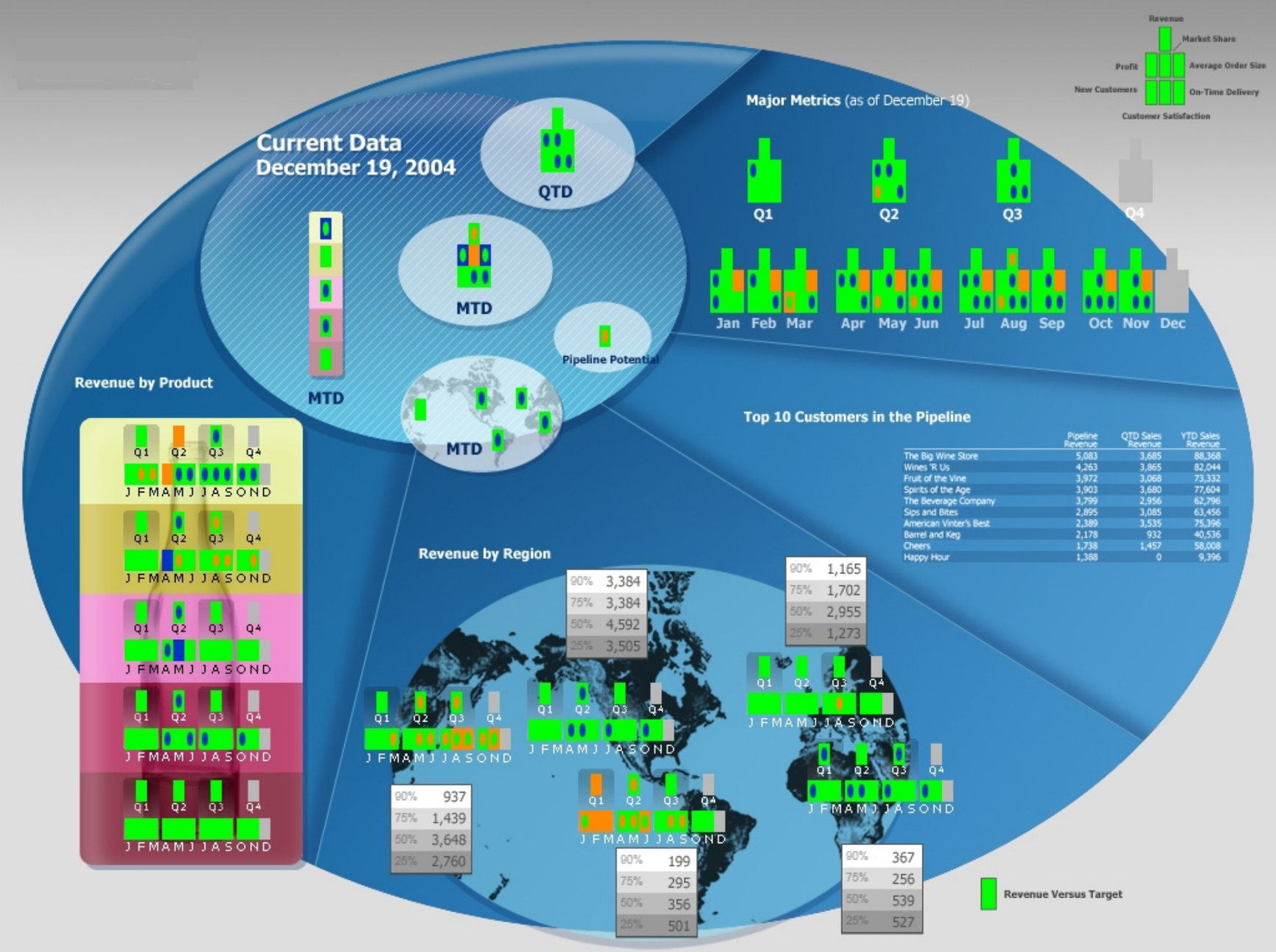
(in thousands of USD)

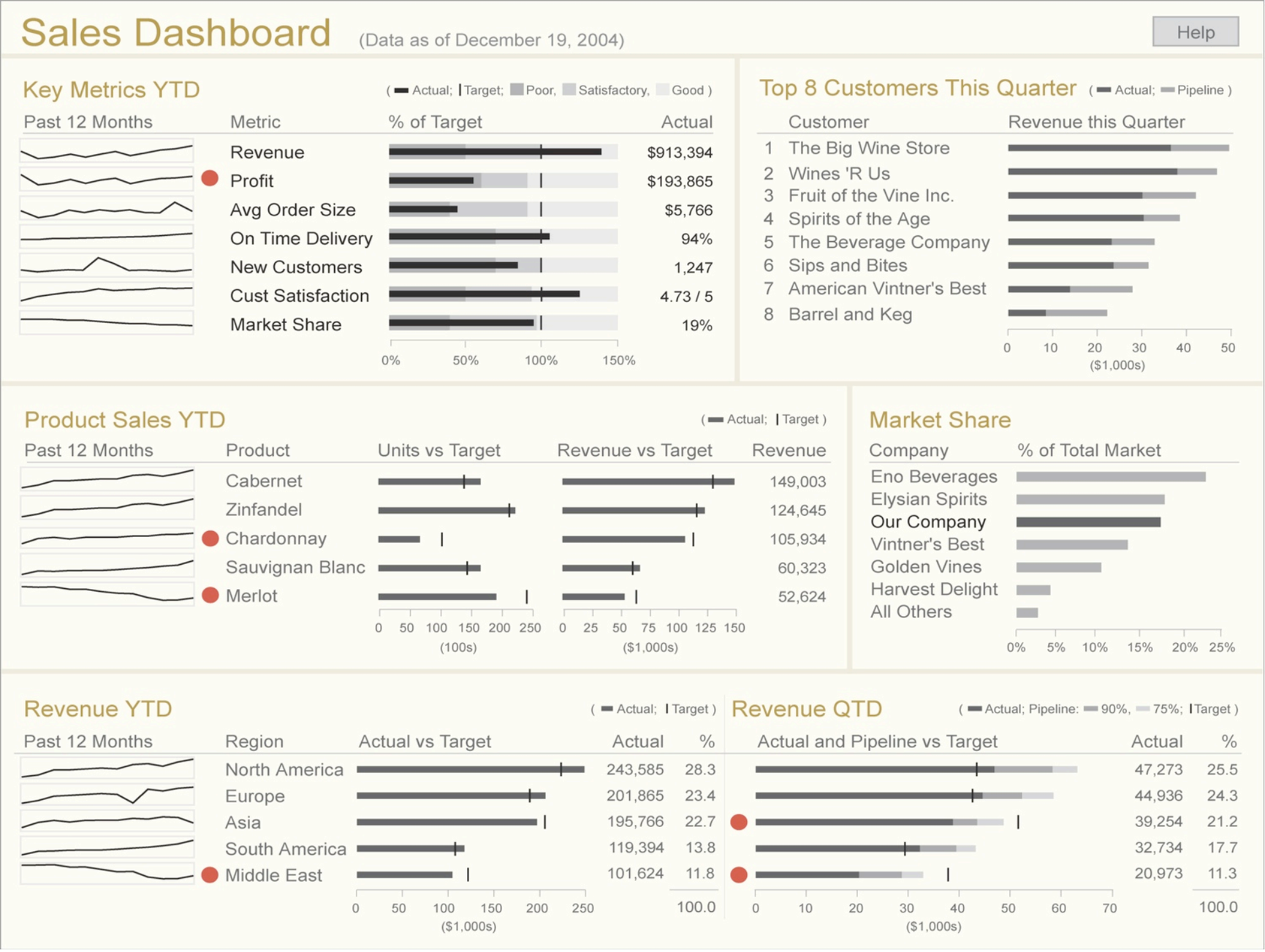


Top 10 Customers in the Pipeline

(in thousands of USD)



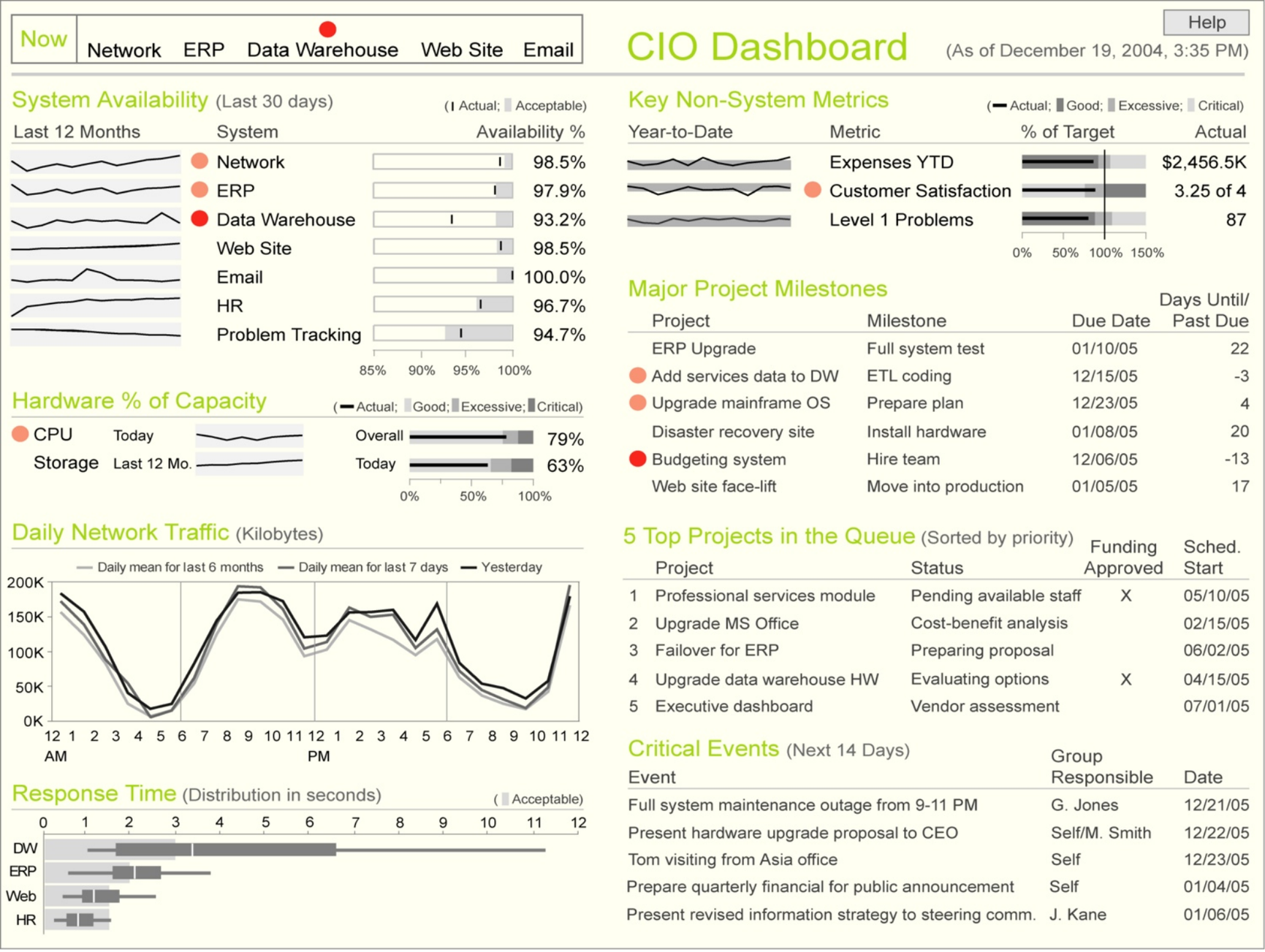

Revenue
Market Share
Profit
Average Order Size
New Customers
On-Time Delivery
Customer Satisfaction
Current Data
December 19, 2004
QTD
MTD
MTD
Pipeline Potential
MTD
Major Metrics (as of December 19)
Q1
Q2
Q3
Q4
Jan Feb Mar
Apr May Jun
Jul Aug Sep
Oct Nov Dec
Revenue by Product
Q1 Q2 Q3 Q4
J F M A M J J A S O N D
Top 10 Customers in the Pipeline
Pipeline Revenue
QTD Sales Revenue
YTD Sales Revenue
The Big Wine Store 5,083 3,685 88,368
Wines 'R Us 4,263 3,865 82,044
Fruit of the Vine 3,972 3,068 73,332
Spirits of the Age 3,903 3,680 77,604
The Beverage Company 3,799 2,956 62,796
Sips and Bites 2,895 3,085 63,456
American Vinter's Best 2,389 3,535 75,396
Barrel and Keg 2,178 932 40,536
Cheers 1,738 1,457 58,008
Happy Hour 1,388 0 9,396
Revenue by Region
90% 3,384
75% 3,384
50% 4,592
25% 3,505
90% 1,165
75% 1,702
50% 2,955
25% 1,273
90% 937
75% 1,439
50% 3,648
25% 2,760
90% 199
75% 295
50% 356
25% 501
90% 367
75% 256
50% 539
25% 527
Revenue Versus Target



We finish up now with an example of a well-designed dashboard. Notice the way that all of the principles that we've covered in this workshop have been combined to create a data-rich, yet simple and accessible sales dashboard.

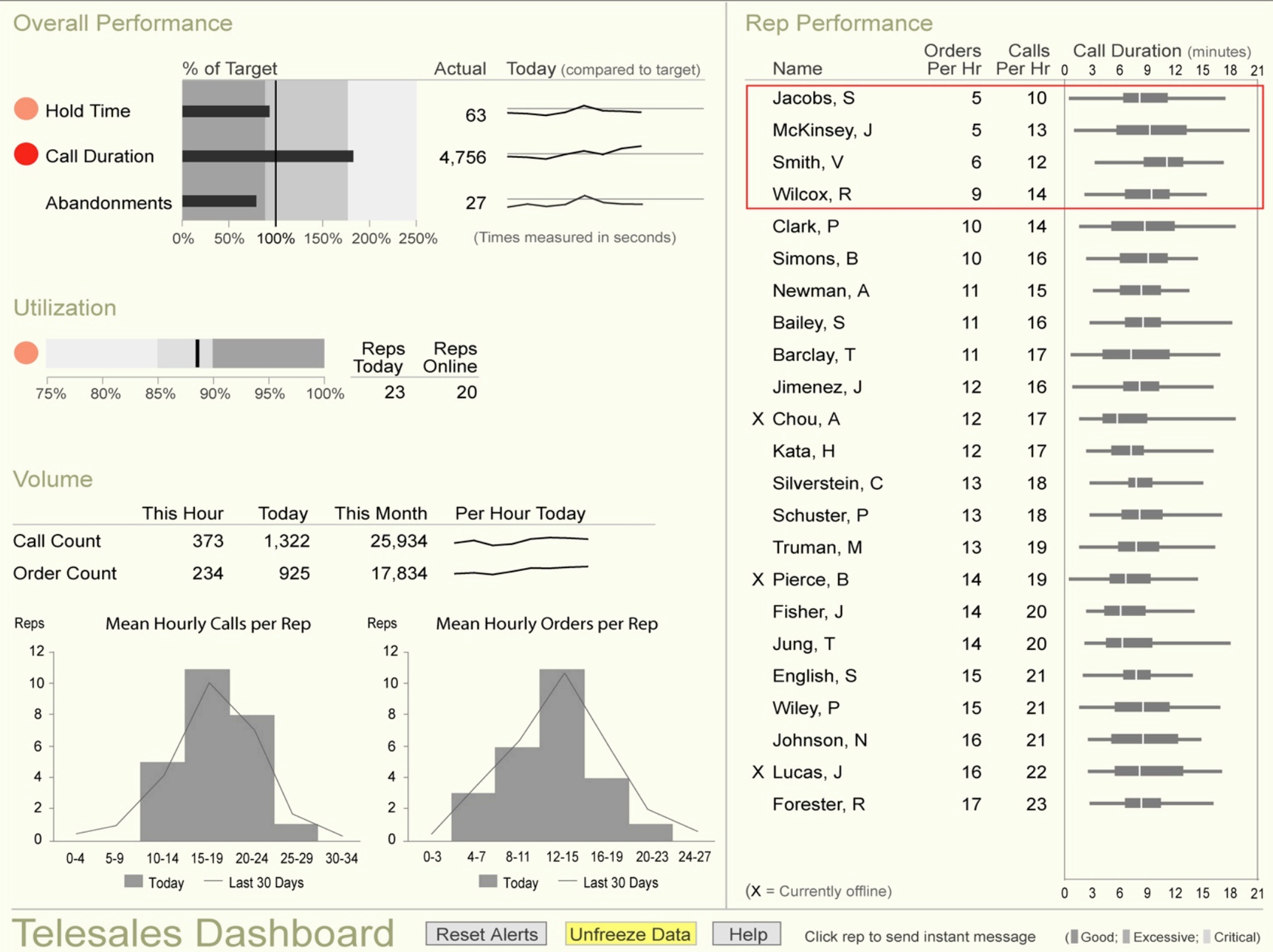
Notice the following characteristics:

- Color has been used sparingly.
- The prime real estate on the screen has been used for the most important data.
- Small, concise display media have been used to support the display of a dense set of data in a small amount of space.
- Some measures have been presented both graphically and as text.
- White space alone has been used to delineate and group data.
- The dashboard has not been cluttered with instructions and descriptions that will seldom be needed.



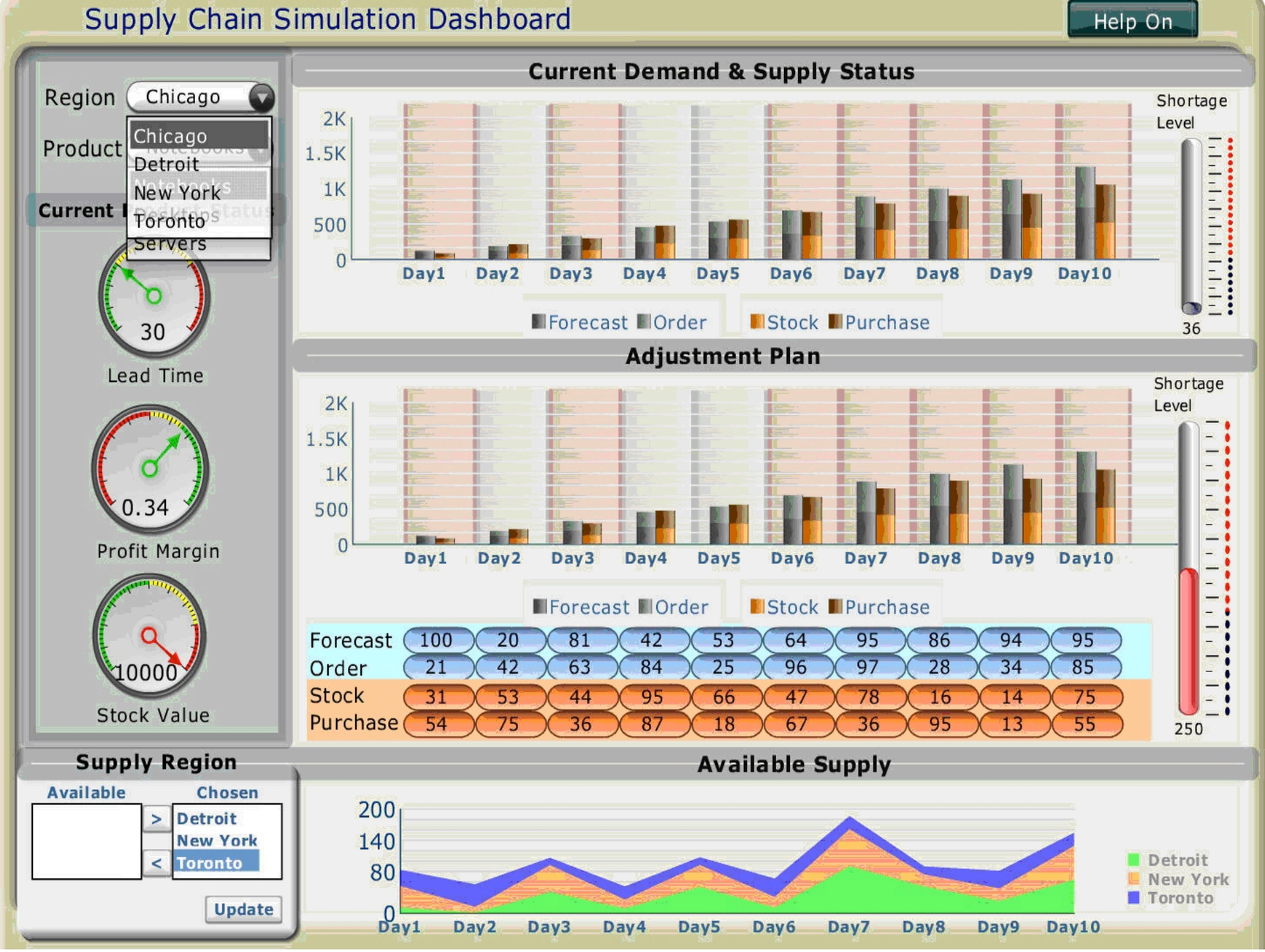
This CIO dashboard also illustrates the practices that we've learned in class.

One section of this dashboard—the upper-left corner—displays near real-time data. This section consists of a series of five alerts: one for each of the systems that the CIO might need to respond to immediately when a problem arises. The rest of this dashboard provides the CIO with information that is more strategic in nature. Notice that a great deal of contextual information has been provided to complement the measures—especially comparisons to measures of acceptable performance. This is the kind of context that could help the CIO easily make sense of these measures.



Here's dashboard that supports real-time monitoring of operational data. Because the telesales manager uses it to respond immediately to problems as they arise, it has been kept very simple. The primary metrics that he must vigilantly monitor are the length of time customers are waiting to connect with a sales representative, the length of time sales representatives are spending on calls, and the number of customers who are getting discouraged and hanging up while waiting to get through. Because of their importance, these three metrics are located in the upper-left corner of the dashboard and are extremely easy to read.

When problems arise, such as the lengthy hold times and excessively lengthy calls shown in this example, he must quickly determine the cause before taking action. This is when he would switch his focus to the performance of the individual sales representatives, which can be seen on the right side of the dashboard. Individuals are ranked by performance, with those performing poorly at the top and a red rectangle highlighting those who are performing outside the acceptable range.



Xcelsius Challenge Winner—you can do better

Already, with just one day of instruction, you should be able to design a dashboard that communicates much more effectively than this winning solution in Business Objects' 2006 Crystal Xcelsius Challenge competition.

I blogged about this winning solution to the Crystal Xcelsius Challenge, lamenting its high degree of fluff and low amount of information. One of my readers protested against my "harsh criticism."

> *I am not sure I agree with your rather harsh criticism of the Crystal Xcelsius product. Granted, it is "flashy" (pun intended) and can be abused by people who get too enamored with its array of visual options, but I would argue that it can be used to create dashboards that users do find valuable and informative. In our organization, we have created a few dashboards using Xcelsius that are very popular with their intended audience, simply because they convey important information in a simple and user-friendly way. Now, it is quite possible that they don't follow all data visualization best practices, but if the information is effectively conveyed (as judged by the recipients of that information), isn't that of utmost importance?*

I responded by inviting this reader to submit one of his dashboards to my Discussion Forum for inspection. He accepted my invitation and a collaboration began, resulting in the following revised opinion:

> *I have definitely come to appreciate many of the design limitations inherent in Xcelsius, limitations I was not aware of before. I am beginning to understand why Stephen is so critical of much of the dashboarding software—it is great at the razzle-dazzle, but is surprisingly constrained when it comes to enabling some basic good design principles.*