



VRIJE  
UNIVERSITEIT  
BRUSSEL

# Information Visualisation *Dashboards*

Prof. Beat Signer

Department of Computer Science  
Vrije Universiteit Brussel

[beatsigner.com](http://beatsigner.com)





# Opsview Monitor

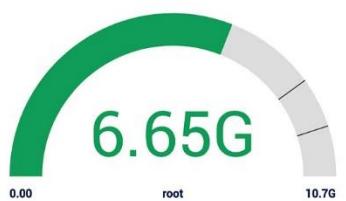
opsview 

**Initial Dashboard**

**HOST GROUP TREE MAP** (Opsview)

Auto-discovery	75 localhost hosts	Test host group
Auto-discovery	75 localhost hosts	Test host group
Monitoring Servers	Monitoring Servers	Monitoring Servers
Network	Network	Network

**DISK SPACE**

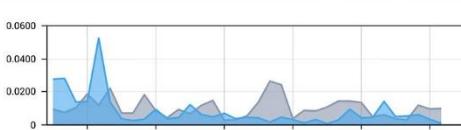


6.65G / 10.76G

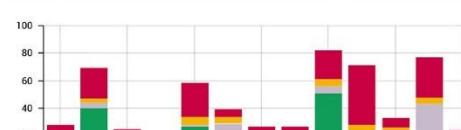
**EVENT TABLE**

TIME	STATUS	EVENT
Today 11:08	WARNING	PerfTest4467 :: AEF-QA-ServiceChe...
Today 11:00	WARNING	PerfTest4403 :: AEF-QA-ServiceChe...
Today 11:01	UP	image-builder.os.opsview.com
Today 11:05	UNKNOWN	PerfTest4428 :: AEF-QA-ServiceChe...
Today 11:01	UNKNOWN	PerfTest4470 :: AEF-QA-ServiceChe...
Today 11:11	OK	PerfTest4475 :: AEF-QA-ServiceChe...
Today 11:00	OK	PerfTest4467 :: AEF-QA-ServiceChe...

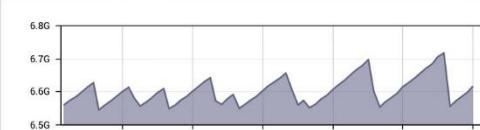
**CONNECTIVITY**



**EVENT GRAPH**



**PERFORMANCE GRAPH**



**CPU STATS**



**PERFORMANCE GAUGE**



**BSM SERVICE**



COMPONENT	AVAILABILITY	STATUS	OPERATIONAL DETAIL
GoldCollect...	0.00%	Failed	8 of 9 Host(s) failed
TestComp1	100.00%	Operational	All Hosts failed

COPYRIGHT OPSVIEW LTD

[https://commons.wikimedia.org/wiki/File:Opsview\\_Monitor\\_6.0\\_Dashboard.jpg](https://commons.wikimedia.org/wiki/File:Opsview_Monitor_6.0_Dashboard.jpg)



# What is a Dashboard

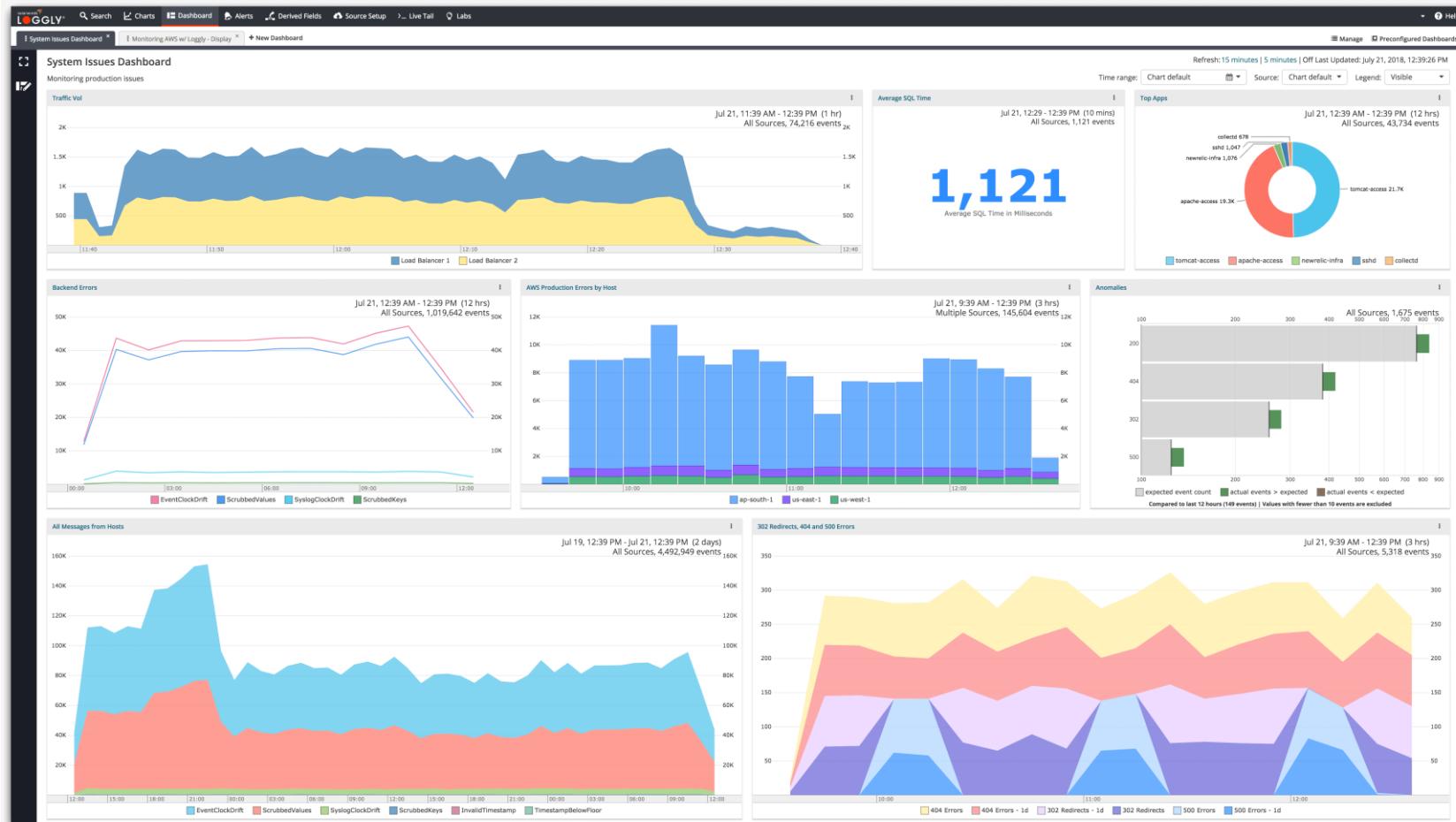
A *dashboard* is a *visual display of the most important information* needed to achieve one or more *objectives*; consolidated and arranged on a *single screen* so the *information can be monitored at a glance*.

Stephen Few, *Dashboard Confusion*, Intelligent Enterprise, March 2004





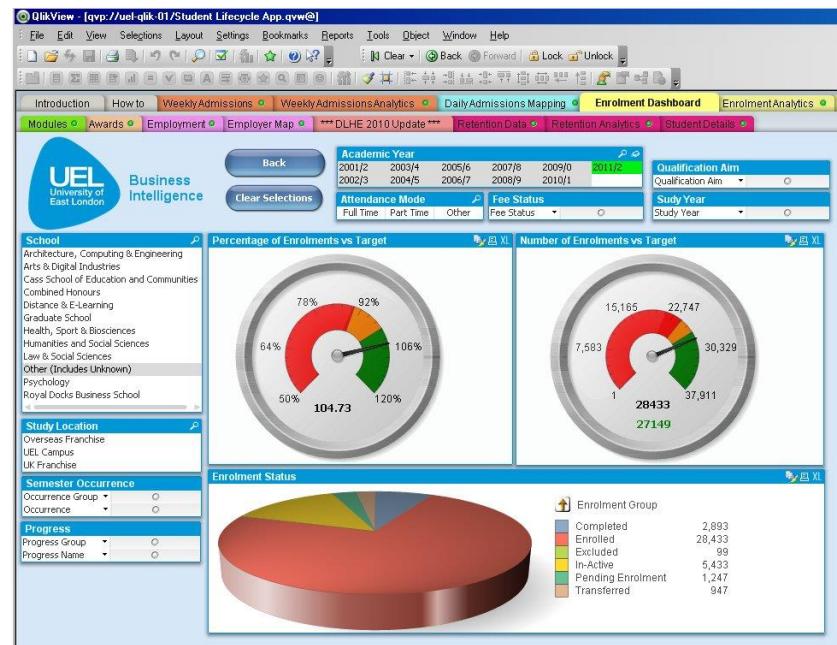
# Log Analysis





# Dashboards Are Visual Displays

Combine text and graphics,  
with an *emphasis on*  
**graphics**, as graphical  
presentations communicate  
information with greater  
efficiency and richer  
meaning than text alone.

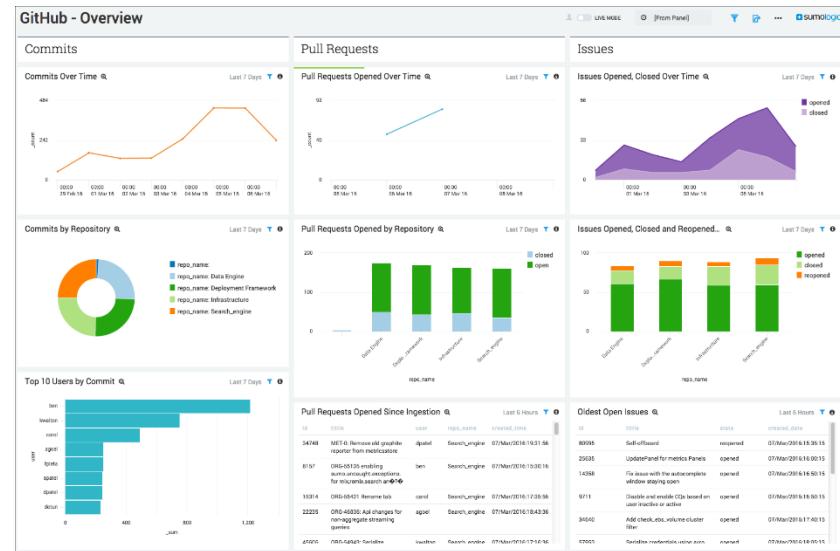




# Dashboards Display Information Needed to Achieve Objectives

Dashboards offer *access* to a collection of *information* that is not otherwise related, often *coming from diverse sources* related to various business functions.

- required information is often a set of *Key Performance Indicators (KPIs)*



# Dashboards Should Fit on One Screen

The *information* must be entirely available without effort, so it can all be *seen at a glance*.

- no scrolling should be necessary
- no moving between multiple views (screens)
- depending on objective information might be refreshed in real time

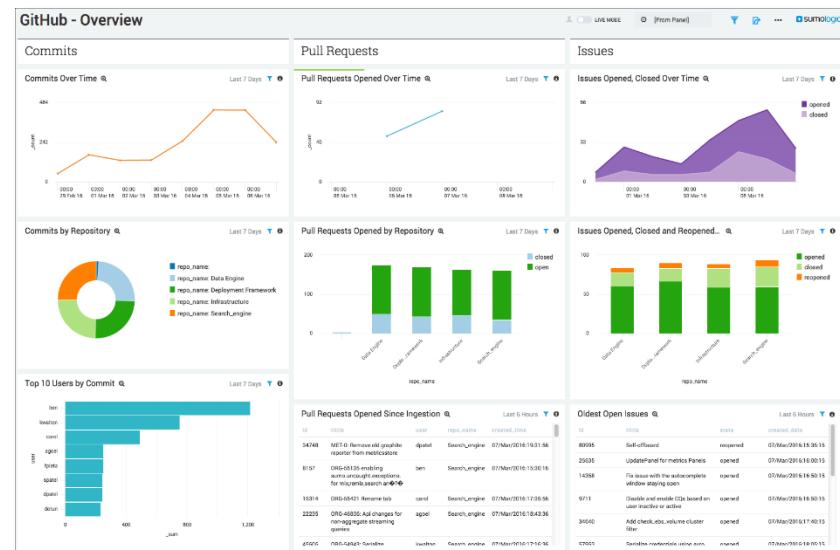


# Dashboards Are Used to Monitor Information at Glance

Information presented in a dashboard is in the form of *summaries* or *exceptions*.

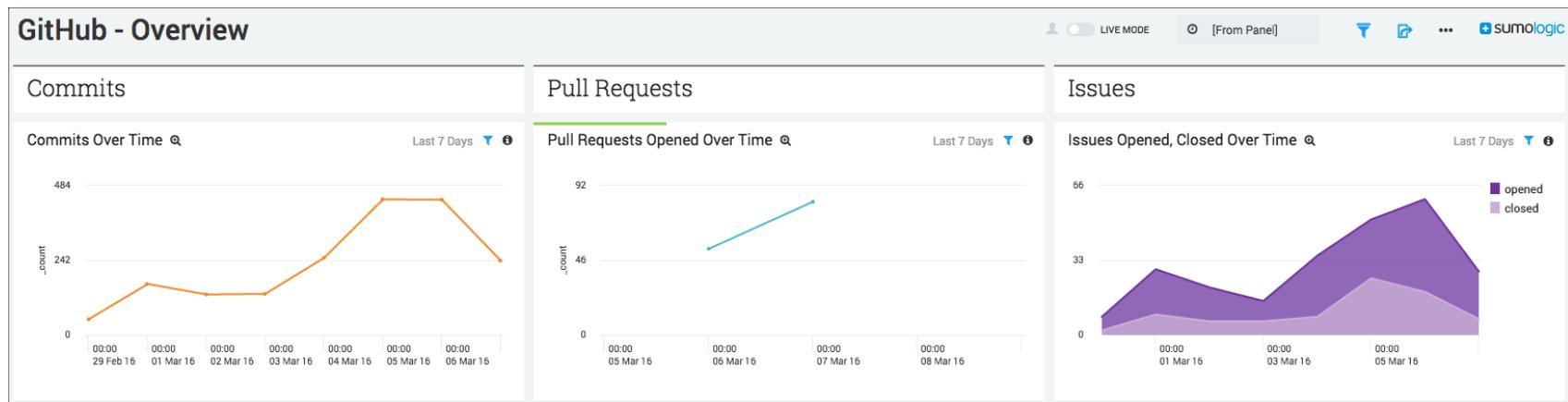
**Main goal:** *show* what requires attention

**Secondary goal:** offer details needed to take action





# Dashboards Have Small, Concise, Clear and Intuitive Display Mechanisms



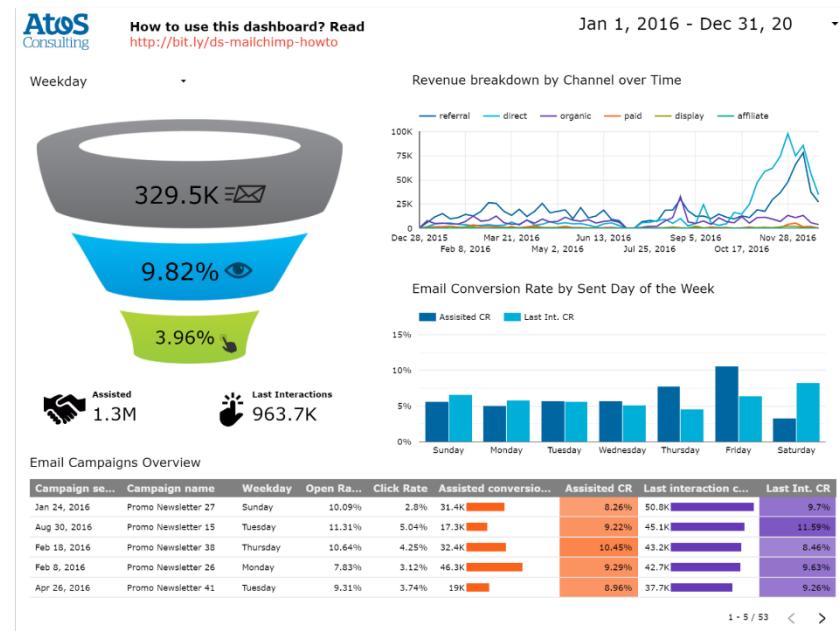
Display mechanisms (visualisations) that do not require much screen space

Choose the visualisation that is better suited for your needs

- line charts, gauges, thermometer, traffic signals

# Dashboards Are Customised

Displayed *information* must be *tailored* to the *requirements* of a person, group or function



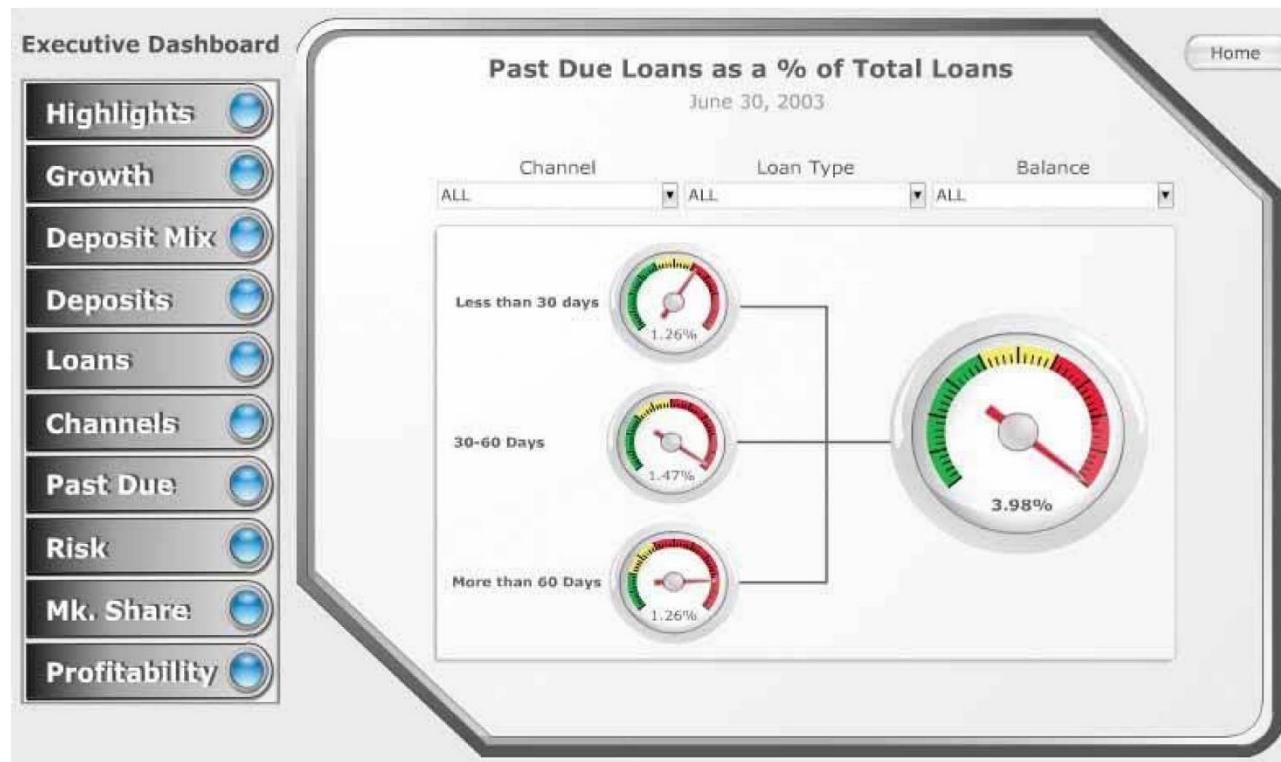


# 13 Common Mistakes in Dashboard Design

1. Exceeding the boundaries of a single screen
2. Supplying inadequate context for the data
3. Displaying excessive detail or precision
4. Choosing a deficient measure
5. Choosing inappropriate visualisation technique
6. Introducing meaningless variety
7. Using poorly designed visualisation technique
8. Encoding quantitative data inaccurately
9. Arranging data poorly
10. Highlighting important data ineffectively or not at all
11. Cluttering display with useless decoration
12. Misusing or overusing colour
13. Designing an unattractive visual display



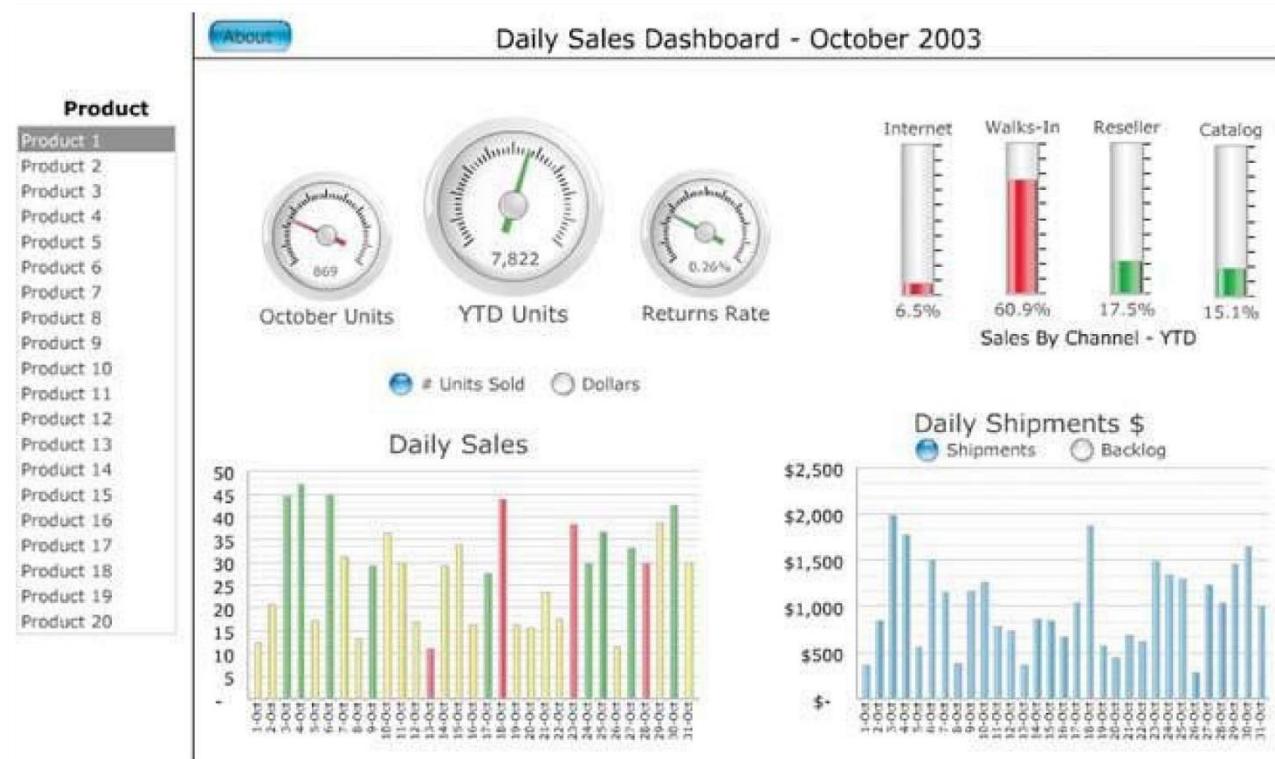
# Exceeding Boundaries of a Single Screen



- Fragmenting data into separate screens
  - separated into discrete screens



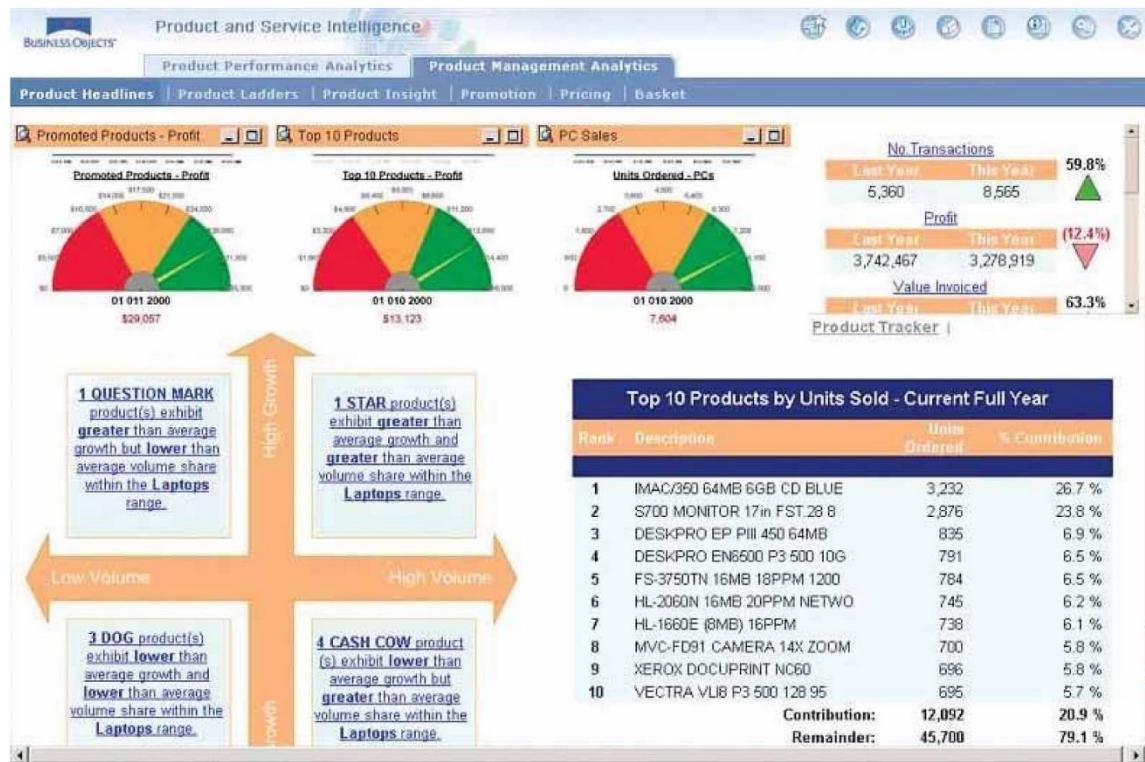
# Exceeding Boundaries of a Single Screen...



- Fragmenting data into separate screens
  - separated into instances of a single screen



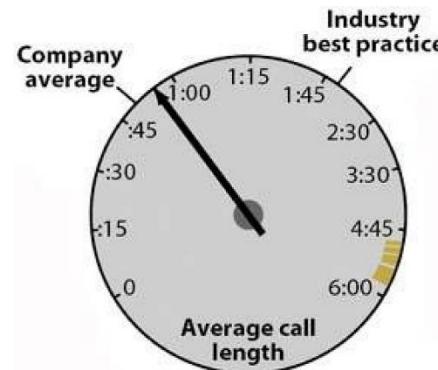
# Exceeding Boundaries of a Single Screen...



- Requiring scrolling
  - assume that anything requiring scrolling to see is less important



# Supplying Inadequate Context for the Data



- there is no point of reference to compare presented data
- colour of handles to indicate good or bad
- Add context if it provides real value
  - more is not always better



# Displaying Excessive Detail or Precision

The screenshot shows the CELEQUEST™ software interface. The top navigation bar includes 'Activity Server', 'Account Setting', 'Help', 'Signed in as zaphod', and 'Sign Out'. The left sidebar has a 'Navigation Tree' with 'Dashboards' expanded, showing 'All Dashboards', 'Quality Yield Analysis', and 'Bookmarked Dashboards'. The main area displays 'Active Alert Messages' with a table showing alerts from March 15, 2004, at various times. Below this are three charts: 'Board Yield Barchart', 'Board Yield Change Barchart', and 'Tests Breakdown Pie'. The bottom section shows a 'Board Yield Table Summary' with a table of yield data for various products. Red boxes highlight the alert table and the last two rows of the yield table.

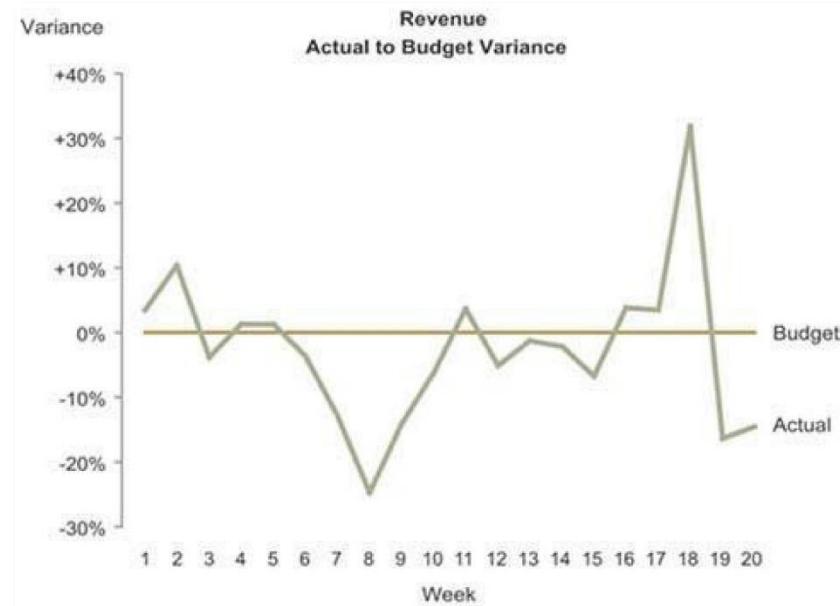
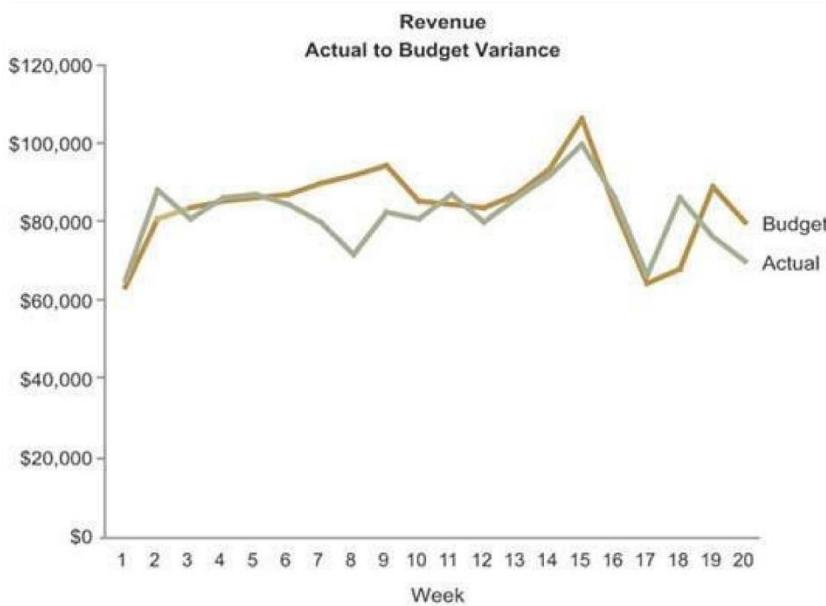
Subject	Importance	Alert Activated
8/16/2003 Yield Drop in ESS on 60-00...	Normal	03/15/2004 17:10:08
8/16/2003 Yield Drop on 60-0001663 ...	High	03/15/2004 17:10:08
8/13/2003 Yield Drop in ESS on 60-0002000...	Normal	03/15/2004 17:10:01
8/13/2003 Critical Component Failure (60-0...	High	03/15/2004 17:10:00
8/13/2003 Impacted Boards for 11-0000040...	High	03/15/2004 17:09:59
8/1/2003 Yield Drop in ESS on 60-000...	Normal	03/15/2004 17:09:46

PRODUCT_NUM	PRODUCT_DESC	YIELD_TODAY	YIELD_...	YIELD_...	YIELD_...	YIELD_...	YIELD_CHAN...	YIELD...
40-0000364-05	PCBA,ER05,AP7420	100.0000000000	100.0000	100.0000	100.0000	0.0000	0.0000000000	0.0000
60-0000720-01	ASSY,16 PORT CARD,SL,SW12000	89.4308943100	89.6000	98.0535	98.0535	-8.4535	-0.1691056900	-8.4535
60-0001624-06	ASSY,CP,FULL LENGTH	100.0000000000	100.0000	99.1549	99.1549	0.6451	0.0000000000	0.6451
60-0001663-03	ASSY, INNER BOX W/MB, SW3600	100.0000000000	100.0000	99.1111	99.1111	0.8889	0.0000000000	0.8889

- Avoid too much details or too precise measures
  - slows down the viewer without any benefits



# Choosing a Deficient Measure



Displaying actual and budgeted revenues separately fails to express the intended message

Representing the differences in terms of percentages emphasises a deviation from a target

- Deficient measure does not communicate in clearest way
  - measure can be accurate but not the best choice for message



# Choosing a Deficient Measure ...

- Make sure that the viewer knows
  - what is being measured
  - the units in which the measure is being expressed
- Which message most directly support the viewer's needs?
  - select the measure that most directly supports that message



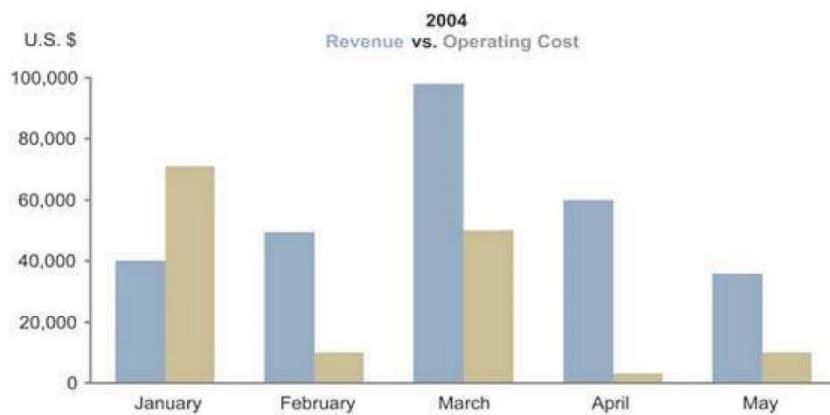
# Choosing Inappropriate Vis Technique

- Circles are a poor choice to represent unidimensional variables
  - problems with *visual perception*
- We simply cannot accurately compare areas
  - what about the operating cost of February and May?
    - costs in May seem higher than those in February while they are the same
    - revenues bubble in May is smaller which makes the enclosed operating costs seem bigger (optical illusion)





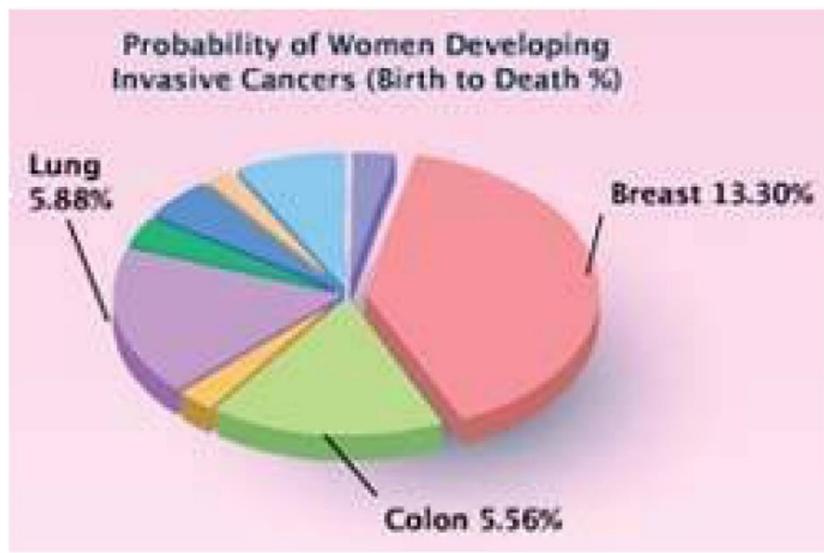
# Choosing Inappropriate Vis Technique ...



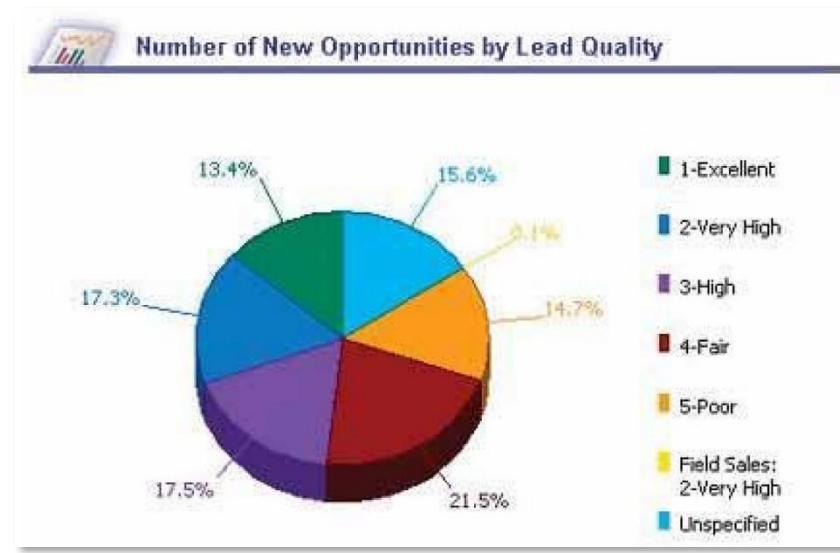
- A bar chart can represent this information efficiently and clearly



# Choosing Inappropriate Vis Technique ...



Do segments add up to 100%?



Are segments properly labelled?  
Does the colour schema make any sense?



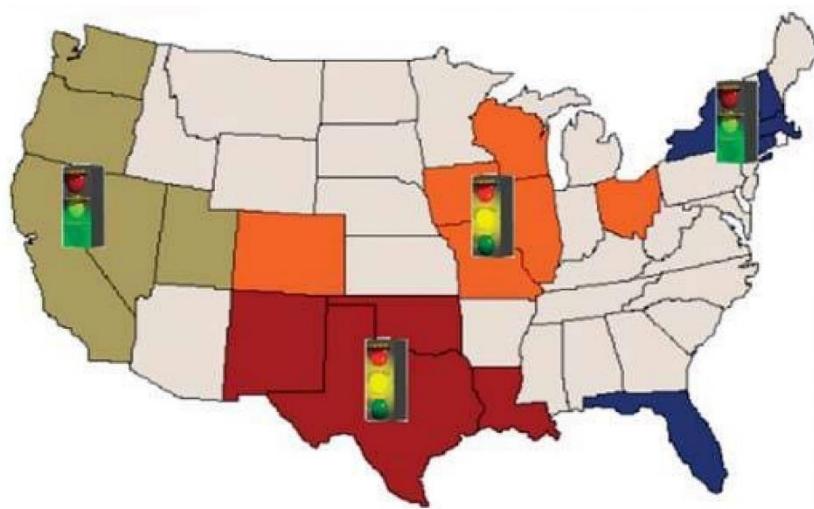
# Choosing Inappropriate Vis Technique ...



- A bar chart (even without different colours) makes the comparison way easier



# Choosing Inappropriate Vis Technique ...

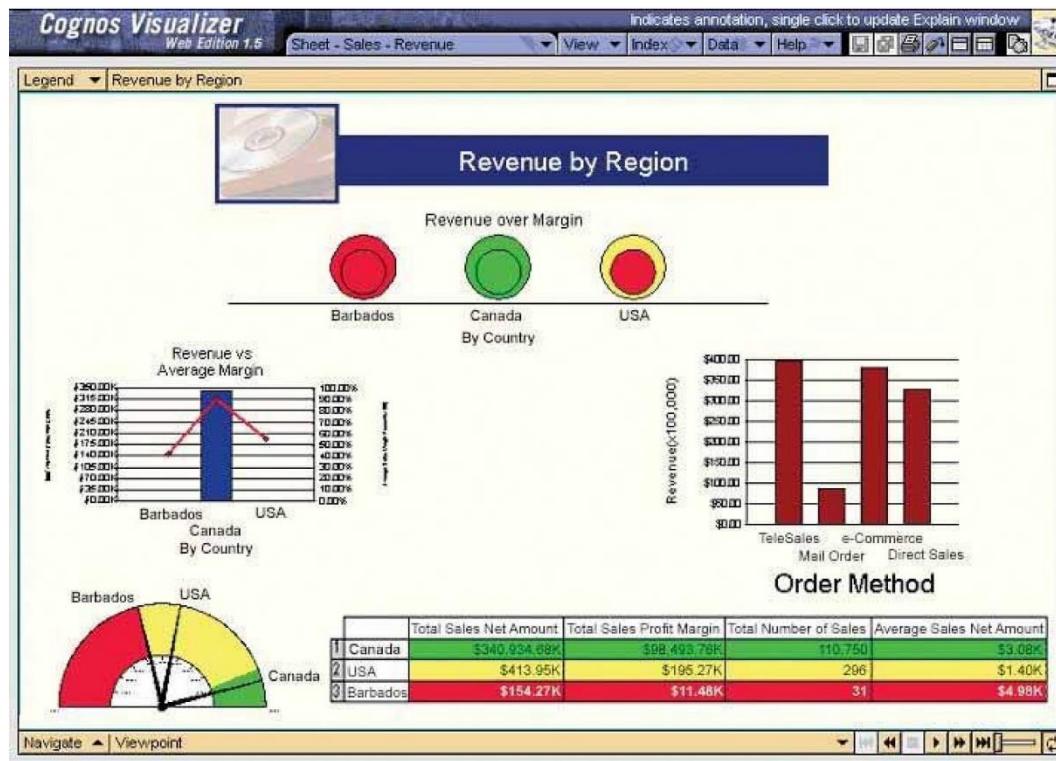


	Actual	Budget
East	\$87,398	\$78,950
West	\$132,931	\$119,850
South	\$50,846	\$49,100
Central	\$129,680	\$125,180

- Spatial (geographical) representation of the data does not have any added value



# Introducing Meaningless Variety

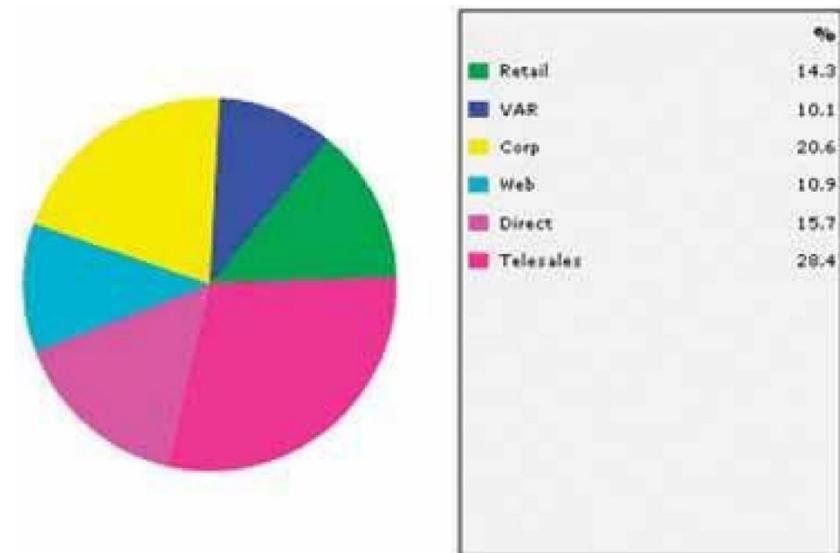


- *Unnecessary variety* requires a shift in perceptual strategy for each visualisation technique on the dashboard, resulting in *extra user time and effort*



# Using Poorly Designed Vis Techniques

- Legend provides the labels and values of the segments
  - forces back and forth eye-movements between the graph and the legend
  - waste of time and effort
- Random and inefficient order of slides and labels
  - ordering them by size would have provided useful information
- Bright colours of the pie slices produce sensory overkill
  - bright colours reserved for specific data that should "pop out"





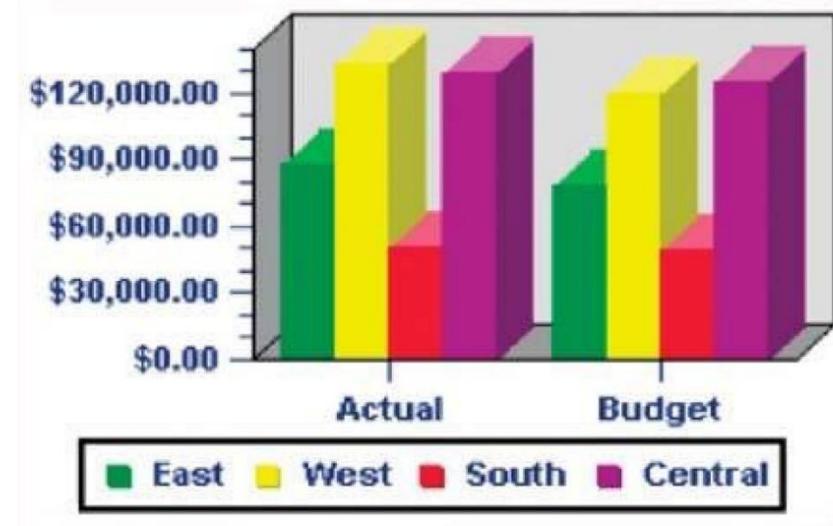
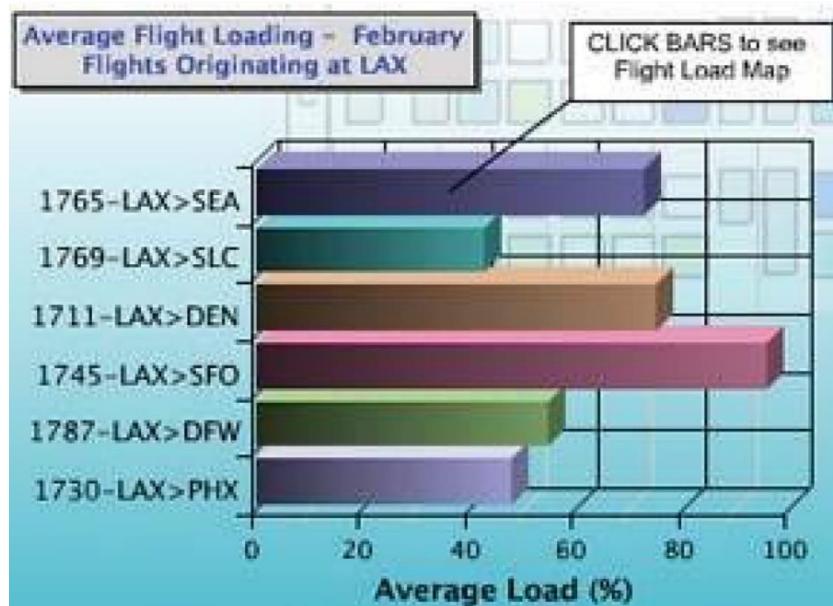
# Using Poorly Designed Vis Techniques ...



- Can you tell how much was sold in the Catalog category?
  - lack of delimiters between set of three digits (thousands, millions, etc.)
- Can you read every number on the scale used in every gauge?
  - numbers along the scales are positioned inside rather than outside the axis leading to some occlusion
  - text at the bottom of each meter obstructs the needle for measures near the bottom or top of the scale



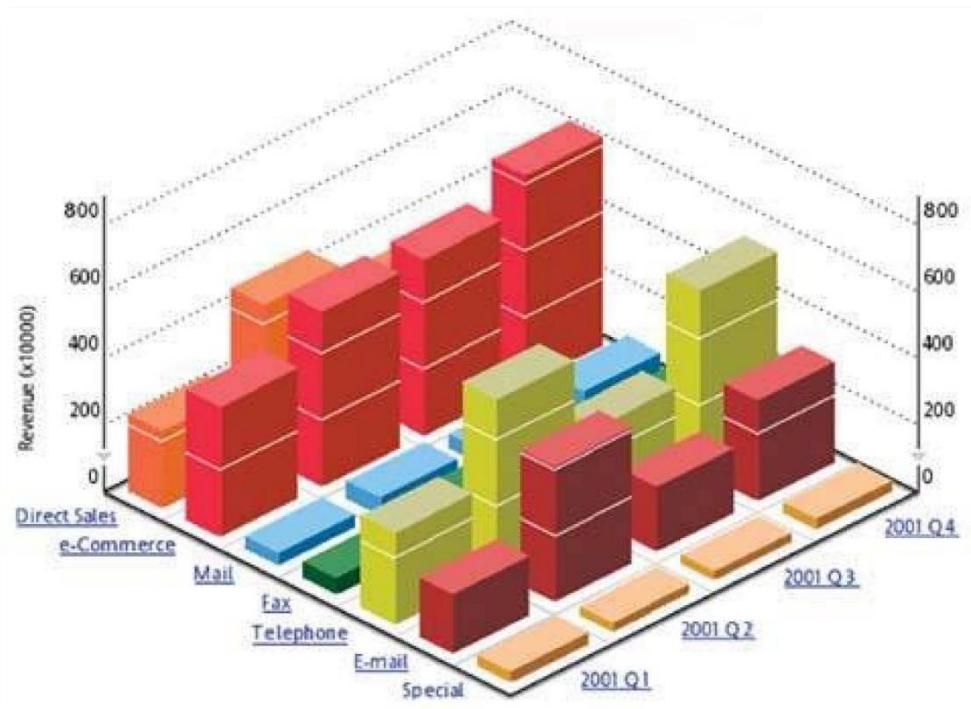
# Using Poorly Designed Vis Techniques ...



- Most important thing to remember is *to show the data*
  - maximise the *data-ink-ratio*
  - avoid chart chunk
  - avoid poor colour schemes



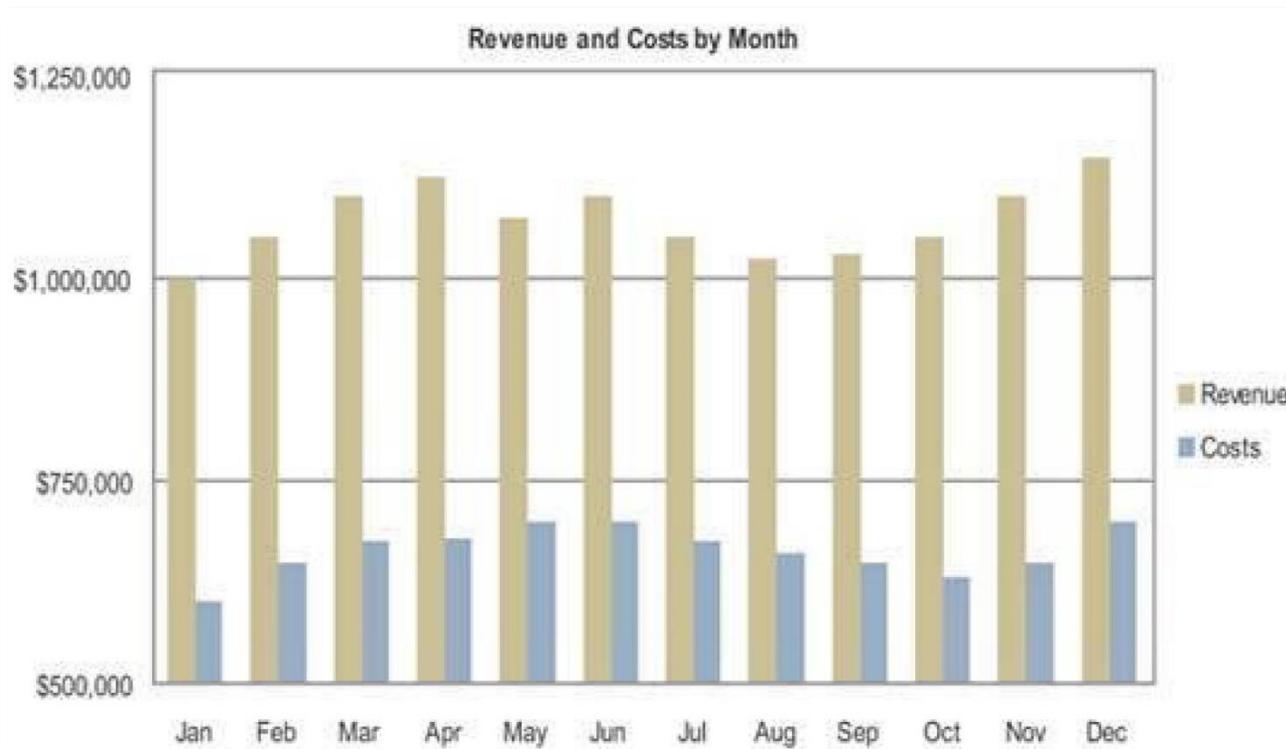
# Using Poorly Designed Vis Techniques ...



- Almost always avoid 3D-graphs for the presentation of business data
  - problem of occlusion



# Encoding Quantitative Data Inaccurately



- Wrong axis scales and other design issues
  - might easily lead to wrong conclusions



# Arranging Data Poorly



- Red band segments the space to an unnecessary degree



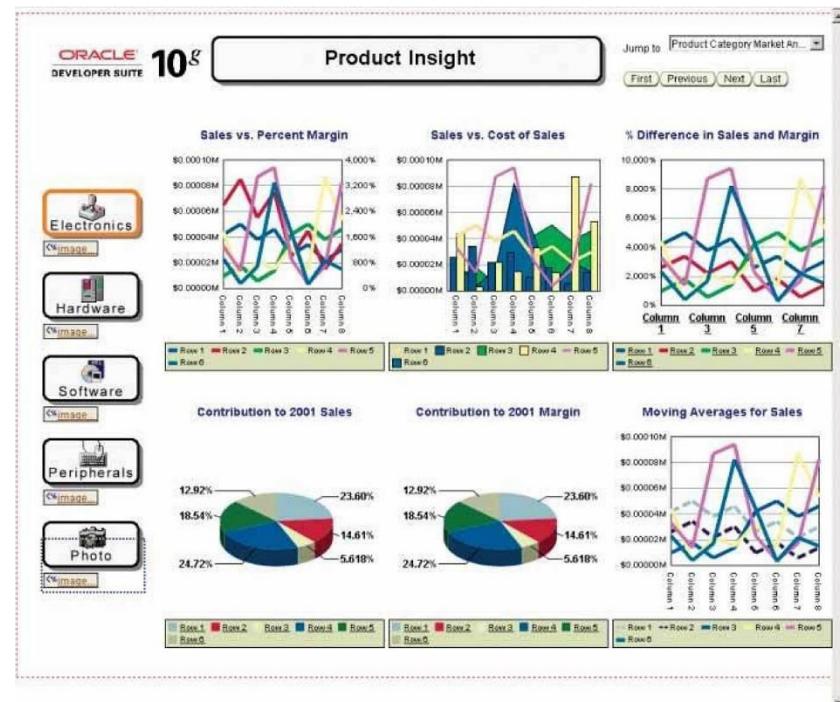
# Arranging Data Poorly ...

- Lack of visual balance based on importance of data
  - top left (most prominent) use to display logo and controls
  - bottom right (least prominent) draws attention due to large amount of covered space
- Comparison between order size and profit tedious due to side-by-side rather than above-below arrangement
- Arrangement guideline
  - most important data must get the attention
    - make it "pop out" so it gets immediate attention
  - data that should be compared should be arranged and visually designed to encourage and support this comparison



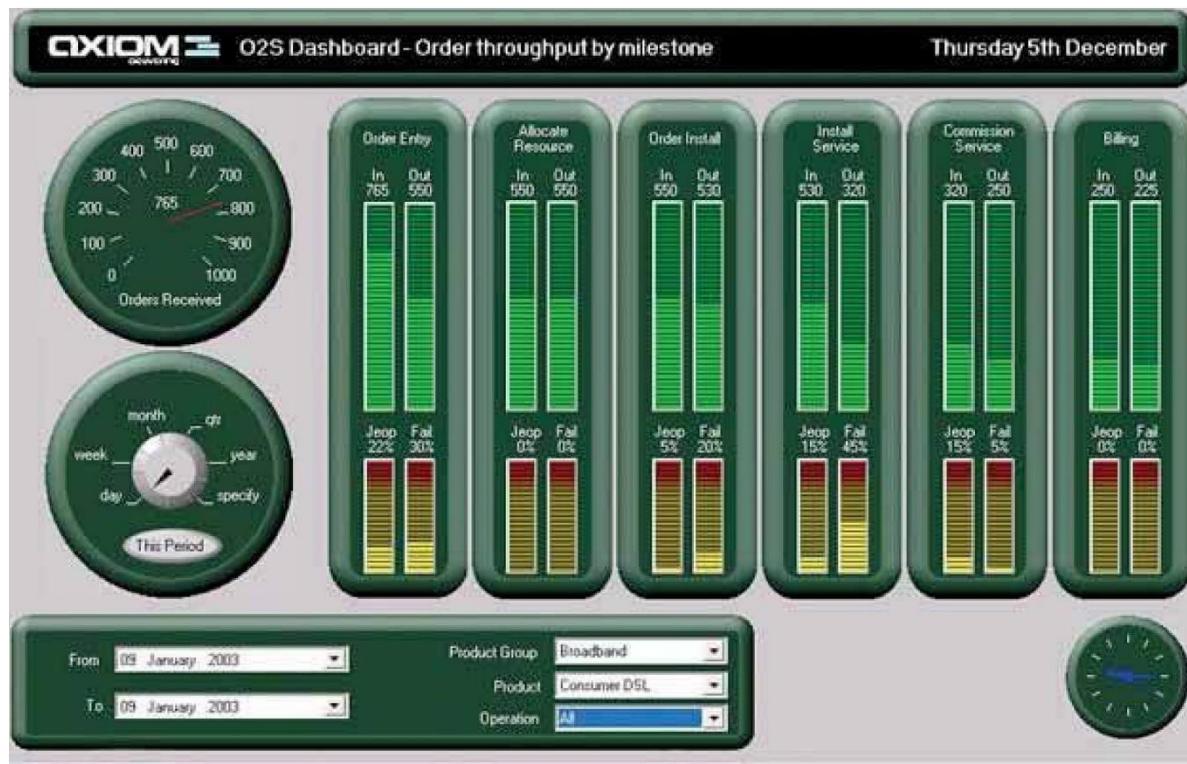
# Highlighting Important Data Ineffectively or Not at All

- Everything that deserves space on a dashboard is important, but not equally
  - a viewer's eyes should always be directed to the most crucial information first
  - navigation controls should not be emphasised





# Cluttering Display With Useless Decoration



# Cluttering Display With Useless Decoration

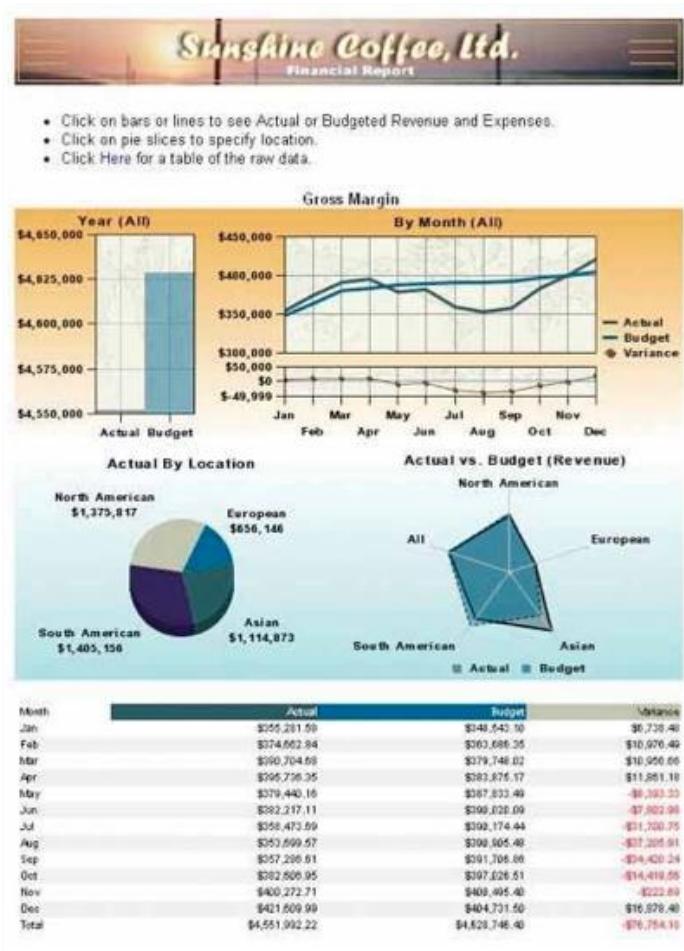




# Cluttering Display With Useless Decoration

## Problems in this Example?

- Logo and title eat up most valuable real estate across the entire top of the dashboard
  - if logo must be present (branding) make it small and place it out of the way
- Background gradient gets the attention
  - colour gradients with no real purpose (distracting)
- Maps in the background of the three upper graphs distract from the data





# Misusing or Overusing Colour





# Designing an Unattractive Visual Display

- *"Some dashboards are just plain ugly."* (Few, 2006)
  - when we see them, we are inclined to avert our eyes hardly the desired reaction to a screen that is supposed to be supplying us with important information
  - when a dashboard is unattractive, the viewer is put in a frame of mind that is not conducive to its use
  - dashboards should not be made pretty, but rather attractively display the data itself, without adding anything that distracts from or obscures it



# Strategies for Effective Dashboard Design

1. Condensing information with summaries and exceptions
2. Maximising the data-ink-ratio
3. Designing dashboards for usability/UX
  - organise information to support its meaning and use
  - make the viewing experience aesthetically pleasing



# Condensing Information

- Summarisation
  - represent a set of numbers (often a large set) as a single number
  - two most common summaries are sums and averages
- Exception
  - why make someone scan through hundreds of values when only one or two require attention?
  - we call these critical values exceptions



# Reducing Non-Data Ink

- Eliminate all unnecessary data-ink
  - eliminate graphics that provide decoration only (e.g. banners)
  - remove chart junk (grids, borders, backgrounds, 3D effects, ...)
- De-emphasise and regularise the remaining non-data ink
  - keep the weight of the lines to a minimum
  - grid lines and fill colours can be used in tables to distinguish some columns from others



# Reducing Non-Data Ink ...

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

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

- De-emphasise and regularise the non-data-ink that remains
- Do not vary the colour, weight or shape of non-data pixels that serve the same purpose



# Reducing Non-Data Ink ...

- What should we do with navigation and interaction controls?
  - buttons and selection boxes should not be given prominence as they do not display data
  - if they must exist, place them in an out-of-the-way location such as the bottom-right corner of the screen and mute them visually, so they will not compete with the data for attention



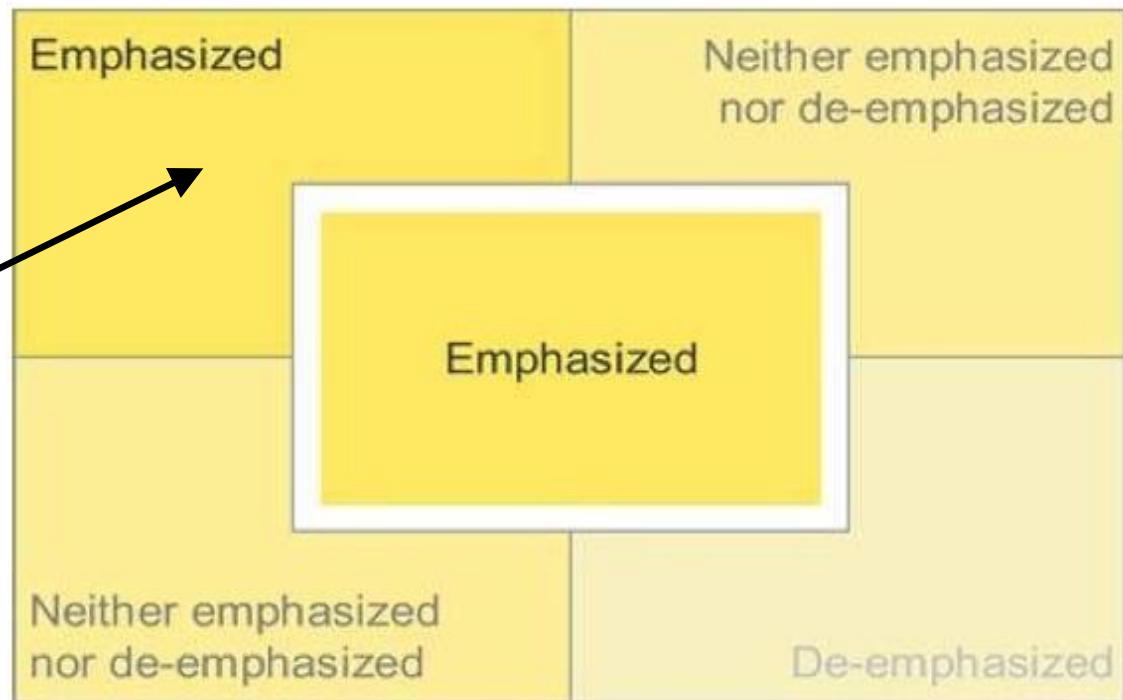
# Enhancing Data Ink

- Highlight the most important data-ink
  - information that is always important (static means of emphasis)
  - information that is only important at the moment (dynamic means of emphasis)



# Enhancing Data Ink ...

Never waste this valuable real estate by placing a company logo or controls for navigation or data selection here



- Different degrees of visual emphasis should be associated with different regions of a dashboard



# Organise Information to Support Its Meaning and Use

- Organise groups according to business functions, entities and use
- Co-locate items that belong to the same group
- Delineate groups using the least visible means
- Support meaningful comparisons
- Discourage meaningless comparisons



# Organise Information to Support Its Meaning and Use ...

Product	Units Sold	Actual Revenue	Region	Units Sold	Actual Revenue
Shirts	938	187,600	North	2,263	133,066
Blouses	1,093	114,765	South	1,920	112,905
Pants	3,882	62,112	East	1,303	76,614
Skirts	873	36,666	West	754	44,355
Dresses	72	2,088	Canada	618	36,291
Total	6,858	\$403,231	Total	6,858	\$403,231



Product	Units Sold	Actual Revenue	Region	Units Sold	Actual Revenue
Shirts	938	187,600	North	2,263	133,066
Blouses	1,093	114,765	South	1,920	112,905
Pants	3,882	62,112	East	1,303	76,614
Skirts	873	36,666	West	754	44,355
Dresses	72	2,088	Canada	618	36,291
Total	6,858	\$403,231	Total	6,858	\$403,231

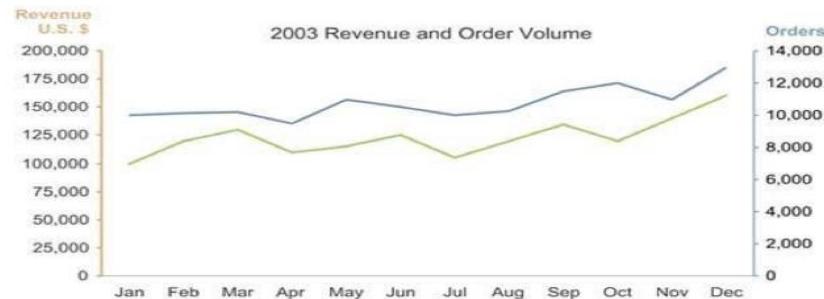
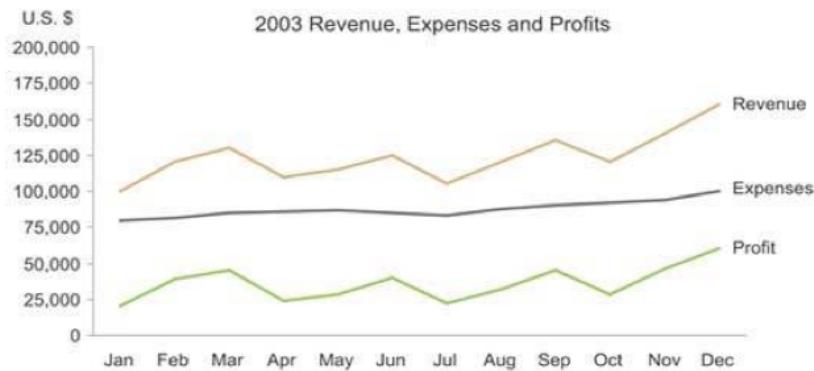
Channel	Units Sold	Actual Revenue	Warehouse	Units Sold	Actual Revenue
Direct	2,057	120,969	Virginia	2,537	149,195
Distributor	1,921	119,903	California	1,920	112,905
Reseller	1,783	104,840	Texas	1,372	80,646
OEM	1,097	64,519	Calgary	1,029	60,485
Total	6,858	\$403,231	Total	6,858	\$403,231

- Delineate groups using the least visible means (e.g. white space)



# Organise Information to Support Its Meaning and Use ...

- Support meaningful comparisons
  - combine items in a single visual encoding
  - place items close to one another
  - use brushing and linking
  - include comparative values (e.g. ratios, percentages, variances)
  - use of colour can support grouping and encourage comparisons





# Organise Information to Support Its Meaning and Use ...

- Discourage meaningless comparisons by separating items and using different colours
- In this example, some colour choices produce this unintended effect
  - different use of yellow colour (amber)
  - our natural inclination to link same colours is misleading



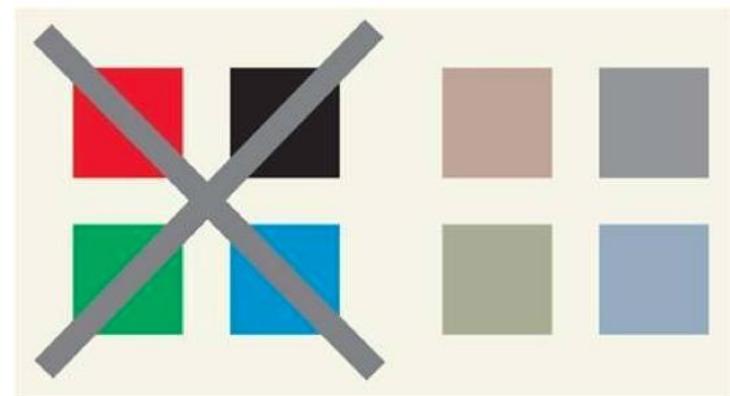
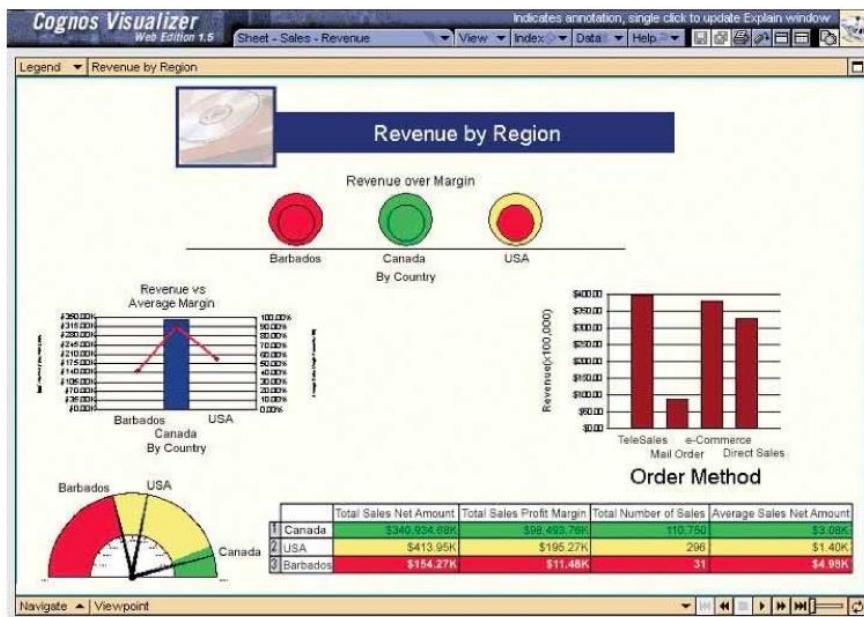


# Make Viewing Experience Aesthetically Pleasing

- Choose colours appropriately
  - keep bright colours to a minimum, using them only to highlight data that requires attention
  - Use less saturated colours such as those that are predominant in nature (e.g. colours of earth and sky), except for content that demands attention
  - use a barely discernible pale background colour other than pure white to provide a more soothing, less-contrasting background



# Make Viewing Experience Aesthetically Pleasing ...



- Choose colours appropriately



# Make Viewing Experience Aesthetically Pleasing ...

Fine legibility		Poor legibility	
Serif	Sans-Serif	Serif	Sans-Serif
Times New Roman	Arial	<i>Script</i>	<b>Gill Sans Vitra</b>
Palatino	Verdana	<b>Broadway</b>	Papyrus
Courier	Tahoma	<b>Old English</b>	Tempus Sans ITC

- Use legible fonts
  - decent font size
  - no ornaments, no fancy fonts
  - use a different font for headings
  - find out what works and stick with it throughout the dashboard

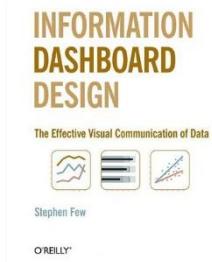


# Exercise 9

- Interaction with D3.js



# References



*Information Dashboard Design: The Effective Visual Communication of Data*, Stephen Few,  
O'Reilly Media (1st edition), January 2006,  
ISBN-13: 978-0596100162

- S. Few, *13 Common Pitfalls in Dashboard Design*, White Paper Perceptual Edge, 2006
  - [https://www.perceptualedge.com/articles/Whitepapers/Common\\_Pitfalls.pdf](https://www.perceptualedge.com/articles/Whitepapers/Common_Pitfalls.pdf)
- E. Nadelhoffer, *10 Best Practices for Building Effective Dashboards*, White Paper Tableau
  - <https://www.tableau.com/learn/whitepapers/10-best-practices-building-effective-dashboards>



# References ...

- Opsview Monitor, Opsview Inc
  - <https://www.opsview.com>
- Log Analysis, Loggly
  - <https://www.loggly.com>



VRIJE  
UNIVERSITEIT  
BRUSSEL

# Next Lecture

## *Case Studies and Course Review*

