



Lisbon School
of Economics
& Management
Universidade de Lisboa

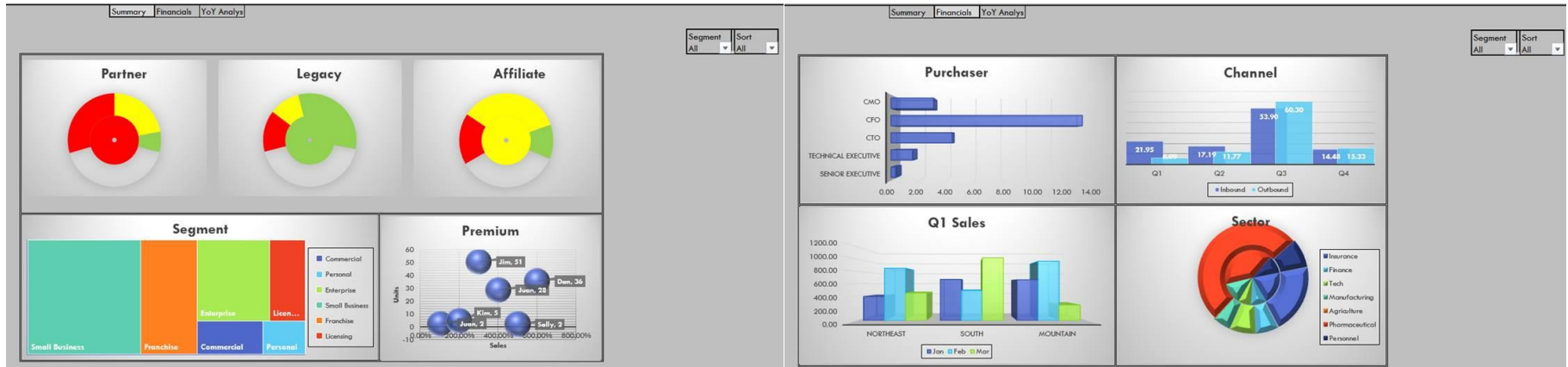


Carlos J. Costa

DASHBOARDS AND DATA VISUALIZATION

Telling a Story using data

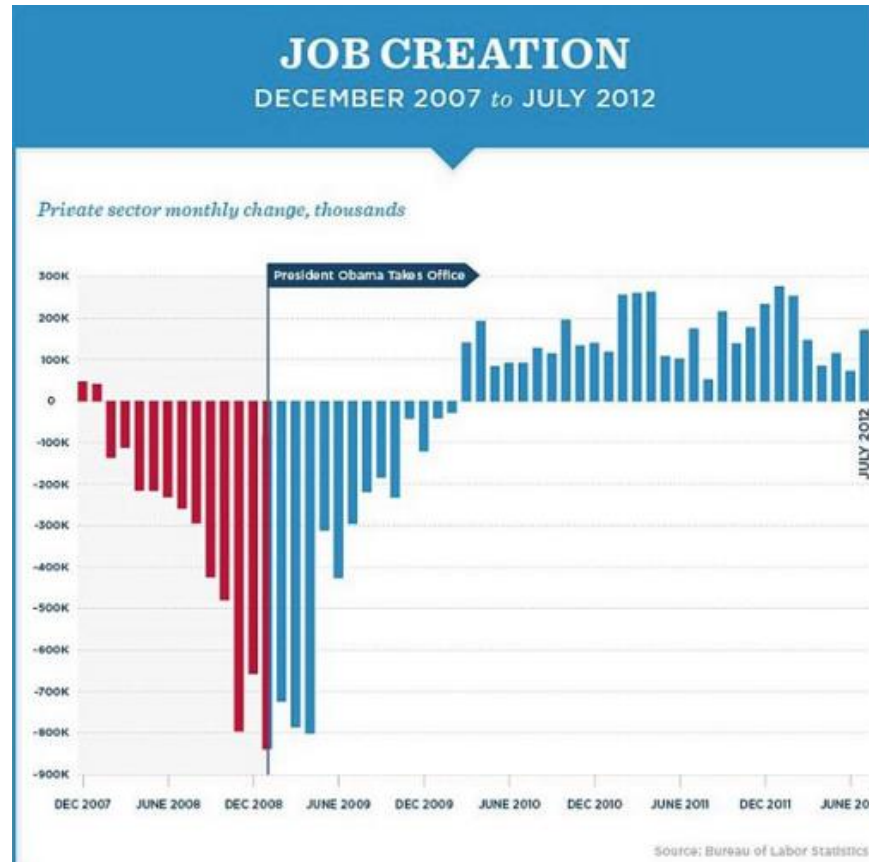
- Some reports have problems



- Shadows and 3D sometimes are noise
- Colour schema
- Character fonts
- Not the more adequate graphs

What is telling a story with data?

- For a visual to work, they need to tell the story the author intended.



Source: Bureau of Labor Statistics | Nathan Yau

What is telling a story with data?

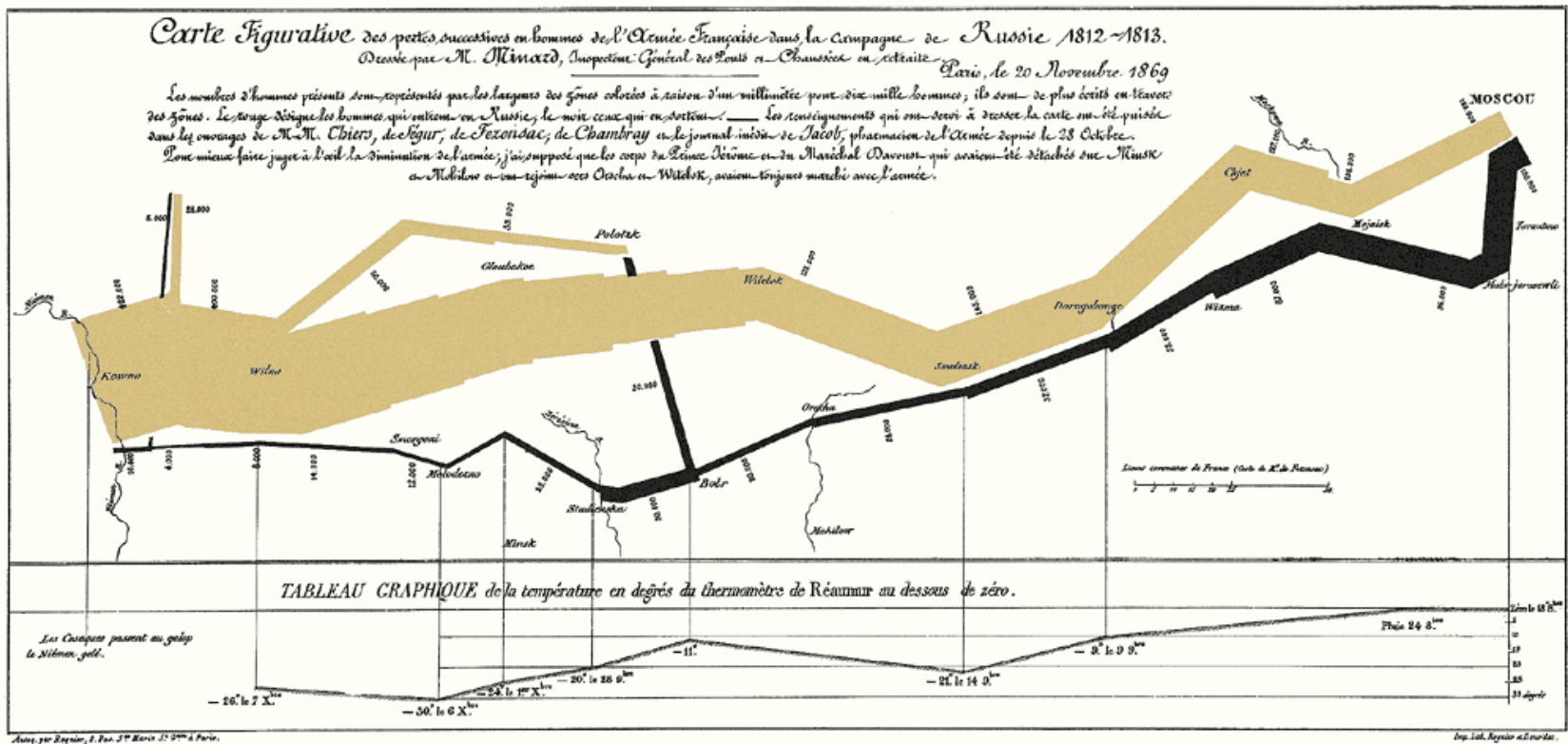
- Are there other ways to tell a great story through data?



Source: The Gap minder foundation, BBC, Youtube.com

Image Source: <http://img.youtube.com/vi/jbkSRLYSojo/0.jpg>

What is telling a story with data?



What is telling a story with data?

- Tufte (2001) classifies Napoleon's March to Moscow, a drawing made by Charles Joseph Minard in 1869, as one of the most effective graphic illustrations ever created.
- "Minard's presentation tells a rich, flowing story" Tufte, 2001.
- The chart, which depicts the losses of Napoleon's army during its 1812 invasion of Russia, begins on the left-hand side with 442,000 men *en route* to Moscow.
- The black line, which moves in the reverse direction, signifies its retreat and the horrific losses.

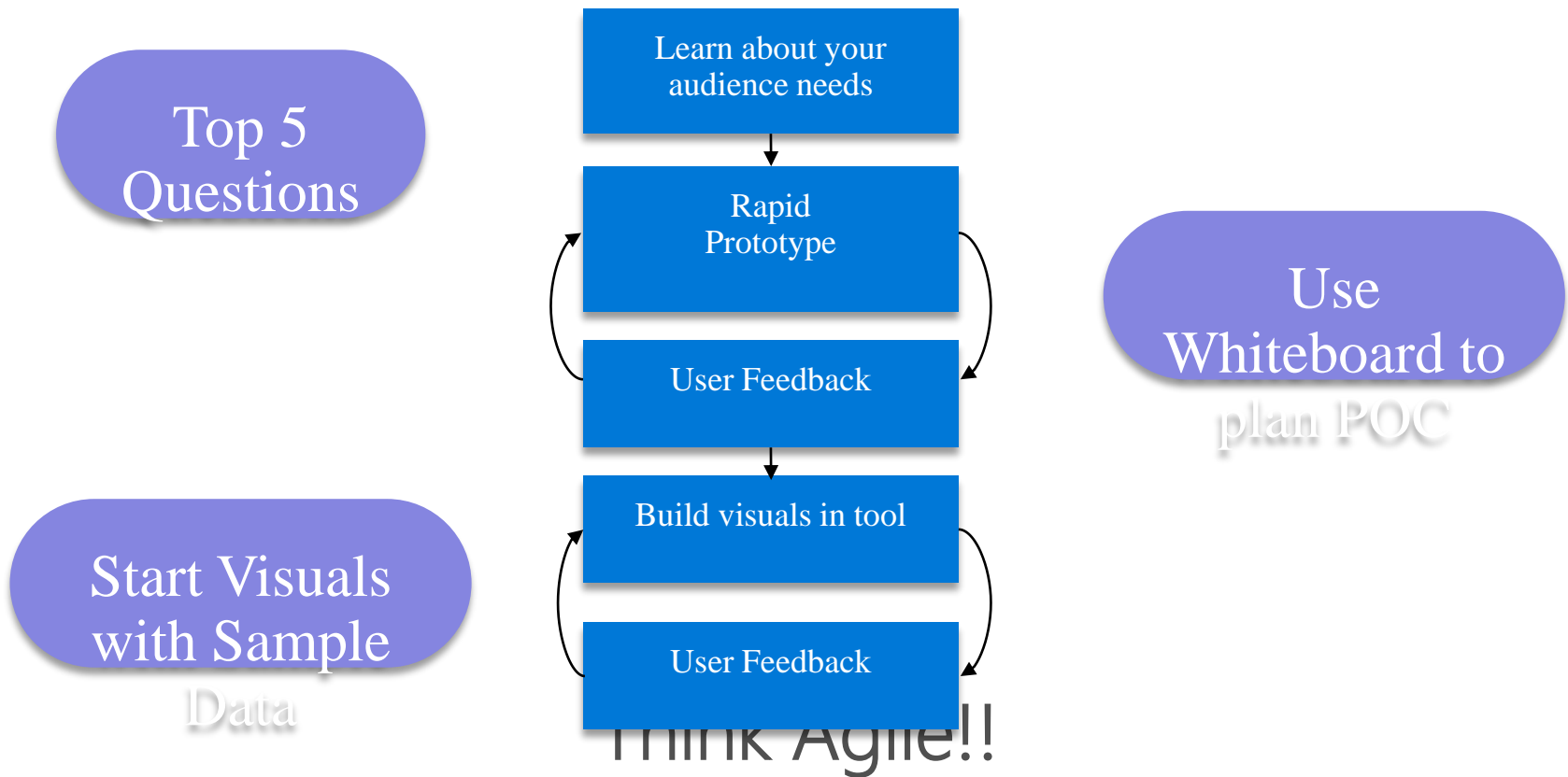
Effective graphical display

Excellence in statistical graphics consists of complex ideas communicated with clarity, precision and efficiency. Graphical displays should:

- show the data
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production or something else
- avoid distorting what the data has to say
- present many numbers in a small space
- make large data sets coherent
- encourage the eye to compare different pieces of data
- reveal the data at several levels of detail, from a broad overview to the fine structure
- serve a reasonably clear purpose: description, exploration, tabulation or decoration
- be closely integrated with the statistical and verbal descriptions of a data set.

Tufte (2001)

What is behind Data visualization?



What is a Dashboard?

What is a Dashboard?

- Visual representation of the most relevant information needed to achieve one or more business objectives;
- Information presented in a consolidated and organized form on a single screen in order to be more easily monitored

Few, 2006



■ Last Year
 ■ Target Growth (40.00%)
 ■ Stretched Growth (100%)

- Owner**
- Andy Grant
 - Frank Cohen
 - James Bond
 - Brandon Armstrong
 - George Cohen
 - John Smith

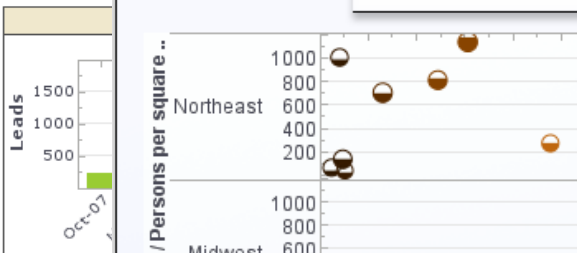
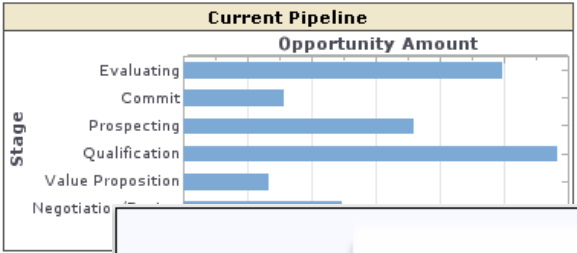
Exceptions

Exception	Count
Leads Inactive For 30 Days	0
Opportunities Past Close Date	56
Opportunities Inactive For 30 Days	59

Executive

Top Opportunities

ID	Name	Account	Amount
0067000000Dr	Commun Euro	Commun Europe	\$250,000.00
0067000000Dr	SpringShield -	SpringShield	\$249,480.00
0068000000Lx	GenAsi esign -	GenAsi esign	\$207,000.00
0067000000Dr	EquAll rated - I	EquAll rated	\$159,000.00
0067000000Dr	Aspied - Gener	Aspied	\$150,000.00
0067000000Dr	EquAll rated - I	EquAll rated	\$119,326.00
0067000000Dr	Foratas - Gene	Foratas	\$110,349.00



Census Visualization

Region / Persons per square

Households 2000

State

- Connecticut
- Illinois
- Indiana
- Iowa
- Kansas
- Maine
- Massachusetts
- Michigan
- Minnesota
- Missouri

Calendar

December 2008

Sun	Mon	Tue	Wed	Thu	Fri	Sat
30	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

Operational

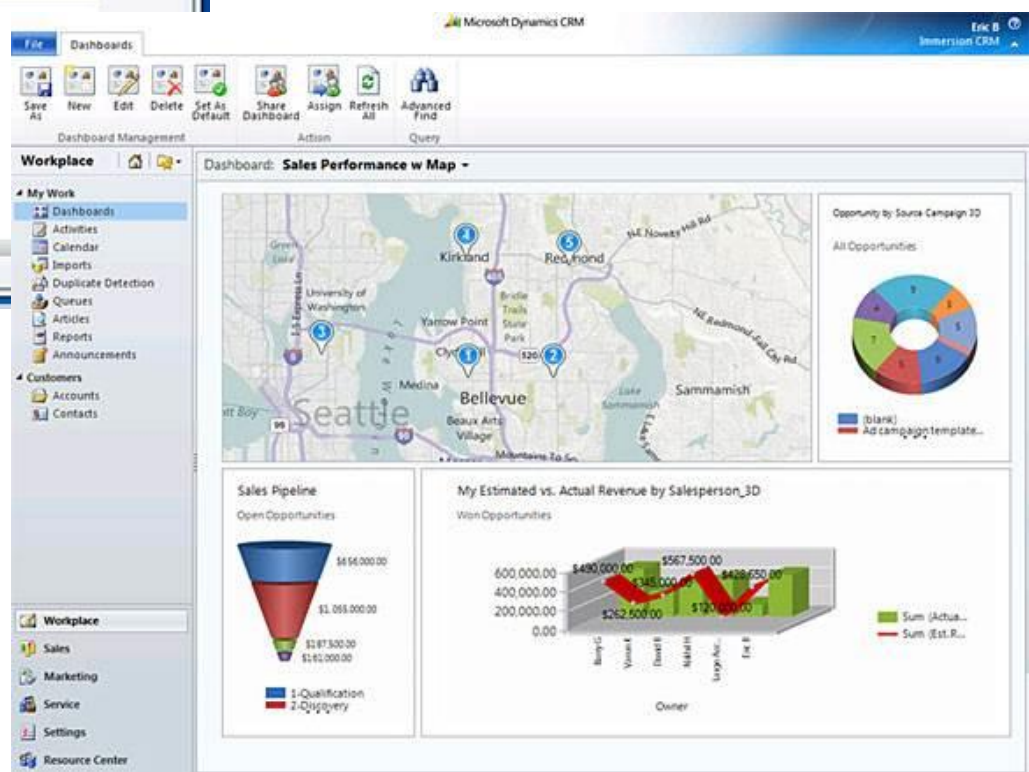
Fonte: https://www.inetsoft.com/products/business_dashboards_examples/





Oracle sales pipeline

Microsoft Sales Pipeline



Fonte: <http://searchcrm.techtarget.com/photostory/2240113011/CRM-user-interfaces-Sales-dashboard-examples/2/Microsofts-sales-dashboard>

WEATHER STATIONS (MULTIPLE SOURCES) 5

STATION	WIND SPEED	WIND GUSTS	DIRECTION	TEMPERATURE	HUMIDITY	RAIN TODAY	PRESSURE	FORECAST
CASA Office: Bloomsbury W1	8 mph	9 mph	SE ↘	11.5 °C	76%	0.0 mm	1027.9 mbar	Clear Night
Lambeth Meters: Brixton SW9	4.3 mph	4.3 mph	SW ↙	11.0 °C	83%	0.0 mm	1026.4 mbar	Clear Night
Hampstead NW3	3.6 mph	3.6 mph	S ↑	9.8 °C	84%	0.0 mm	1029.0 mbar	Clear Night

WEATHER (METAR) 848

London City Airport

Mostly clear **SW at 3 mph** **11 C**

FORECAST (YAHOO! WTH) 1748

Day	Temp	Condition
Mon	10 C	Mostly Clear
Tue	9 C	Partly Cloudy

TUBE LINE STATUS (TfL) 39

Bakerloo	Good Service
Central	Good Service
Circle	Good Service
District	Good Service
H & C	Good Service
Jubilee	Good Service
Metropolitan	Good Service
Northern	Good Service
Piccadilly	Good Service
Victoria	Good Service
W & C	Good Service
Overground	Good Service
DLR	Good Service

BIKE SHARING (TfL) 38

4.3 % Stations Full	4.9 % Stations Empty
7354 Bikes Available	430 Bikes or Docks Faulty

Available Bikes (last 24h)

IN SERVICE (TfL) 9

7197
London buses

378
Underground trains

AIR POLLUTION (DEFRA) 1748

µg/m³ TIME AVERG	OZONE	NO ₂	SO ₂	PM _{2.5}	PM ₁₀
Bloomsbury	13	38	4	9	10
Marylebone Rd	9	16	26	22	34
N Kensington	14	40	?	12	18

RADS (CASA) 1

CASA Office Desk ‡

6
cpm (uncalibrated)

RIVER LEVEL (PLA) 248

Thames (Tower Pier)

4.13
metres

STOCKS (YAHOO) 7

FTSE 100 Index

6552.34
+0.35 (0.01%)

RANDOM TRAFFIC CAMERAS (TfL) 10

Old Kent Rd/Asylum Rd

High St/Grosvenor Rd W Wickham

BBC LONDON NEWS (BBC) 48

Rigby killer 'a soldier of Allah' Mayor bike 'scaring' claim withdrawn Murder police found grave in garden Cameron praises 'towering' Mandela Police crackdown on pirate site ads Why do we value gold?

OPENSTREETMAP UPDATES (OSM) 248

Third attempt to name the terraced cottages around the Green. Revert my change to terraced cottages as they get rendered with wrong address. Added Tibet Foundation refining Name error.

ELECTRICITY (N.GRID) 29

Demand (Great Britain)

48211
MW

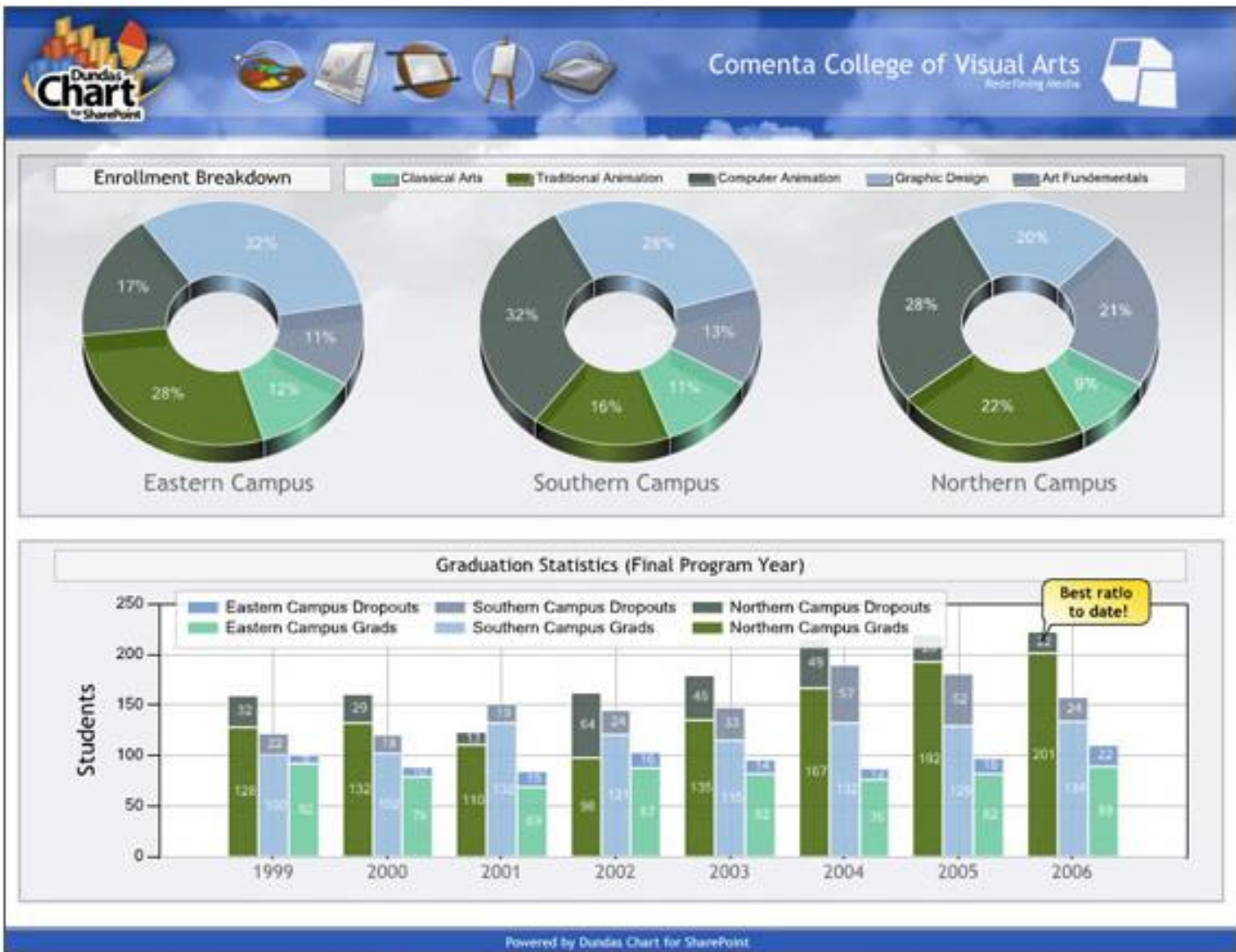
MOOD (LSE MAPPINESS) 38

8% unhappier than the long term average for here	13% happier than the whole country right now
---	---

TWITTER TRENDS FOR LONDON 198

MPs #NFL Christmas #Confident Xmas #ashes London
#RIPAlexTurner #12DaysofJonesDAY9 Waca

<https://www.matillion.com/insights/dashboard-examples-the-good-the-bad-and-the-ugly/>



Digital Dashboard, Education Metrics

<https://www.matillion.com/insights/dashboard-examples-the-good-the-bad-and-the-ugly/>

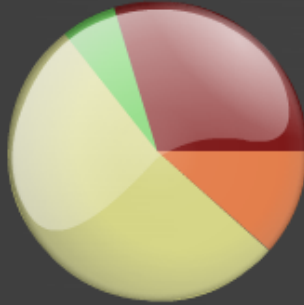
TIB At A Glance



Program Metrics

Statewide Project Inventory

Open



- Application
- Design
- Bid
- Construction
- Closeout

TIA UATA SCPP Total

Project Inventory Future Obligation Completed Projects

Active Projects

371

Rem. Commitment

\$339,003,068*

Completed (FYTD)

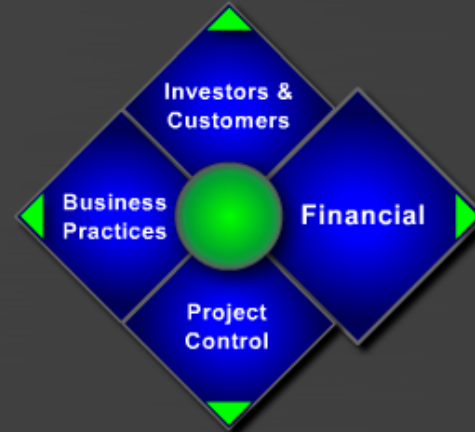
2

Under Construction

171

Agency Status

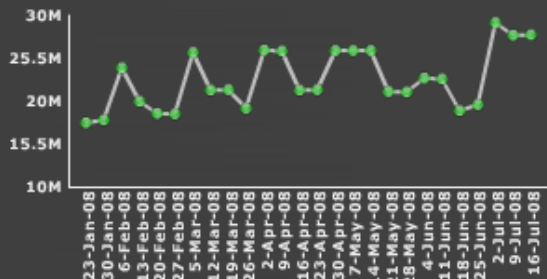
TIB Balanced Scorecard



Financial Health

Fund Balances

Open



TIA UATA SCPP Total

Fund Balances Project Expenditures Accounts Payable

TIA Fund Balance

\$15,204,017

UATA Fund Balance

\$8,842,294

SCPP Fund Balance

\$3,593,312

Transactions (MTD)

23

Payments (MTD)

\$2,769,040.91

Sustainable Financial Management

- Account Balances
- Expenditures Vs. Revenue
- Payments Vs. Allotments
- Outstanding Payments

Fund Balances are as of 07/16/2008

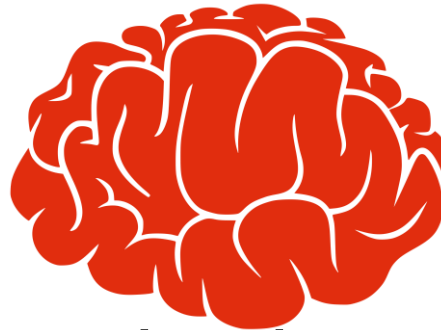
<https://www.matillion.com/insights/dashboard-examples-the-good-the-bad-and-the-ugly/>

Common Pitfalls in Dashboard Design

- Pitfall #1: Exceeding the Boundaries of a Single Screen
 - Pitfall #2: Supplying Inadequate Context for the Data
 - Pitfall #3: Displaying Excessive Detail or Precision
 - Pitfall #4: Expressing Measures Indirectly
 - Pitfall #5: Choosing Inappropriate Media of Display
 - Pitfall #6: Introducing Meaningless Variety
 - Pitfall #7: Using Poorly Designed Display Media
 - Pitfall #8: Encoding Quantitative Data Inaccurately
 - Pitfall #9: Arranging the Data Poorly
 - Pitfall #10: Ineffectively Highlighting What's Important
 - Pitfall #11: Cluttering the Screen with Useless Decoration
 - Pitfall #12: Misusing or Overusing Color
 - Pitfall #13: Designing an Unappealing Visual Display
- Few, 2006a

Science behind data Visualization

- Our Brains – that big red thing in the middle.



- We have learned to be very visual beings. We have three levels of memory to make things actual.

Iconic
memory

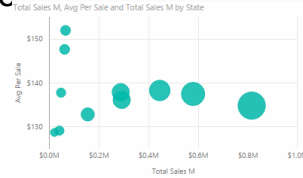
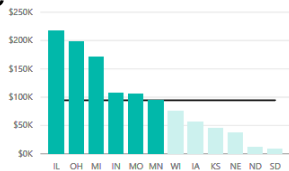
Short Term
memory

Long Term
memory

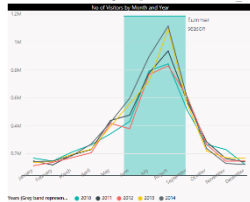
Science behind data Visualization

- Pre-cognitive attributes

- Very precise quantitative perception: 2D length and positioning



- Not very precise quantitative perception: width, size, intensity, blur



Sales was up 20% YoY



- Non-Quantitative Perception = Orientation, Form, Enclosure, Added Brands

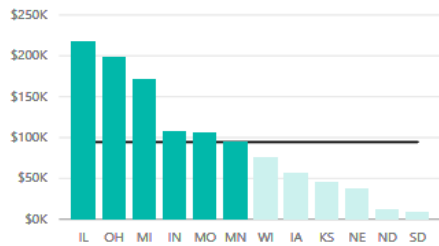
Region	Total Sales M	Sales YoY
South	\$1,566,447	10.66%
MidWest	\$992,456	5.42%
NorthEast	\$931,919	11.98%
Pacific	\$758,435	13.94%
Mountain	\$283,976	27.43%
	\$133	▼ -85.34%



Based upon Few, 2006b

Gestalt Principles

Proximity, Similarity



Continuity

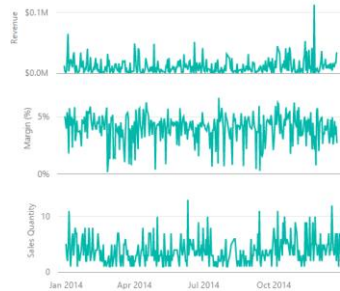
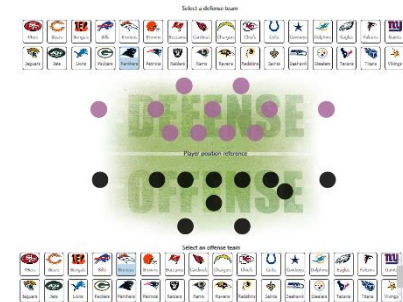


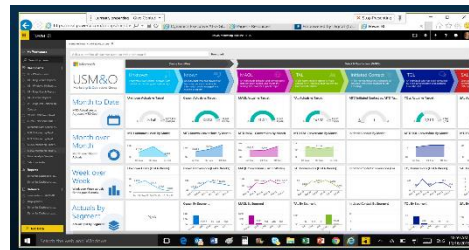
Figure and Ground



Enclosure, Symmetry



Continuity and Symmetry



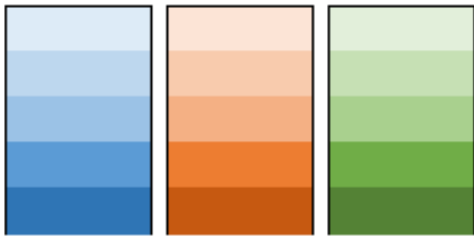
Visual Perception

- Organization of Visual perception
 - Colour
 - Shape
 - Spatial positioning
 - Movement

Few, 2006b

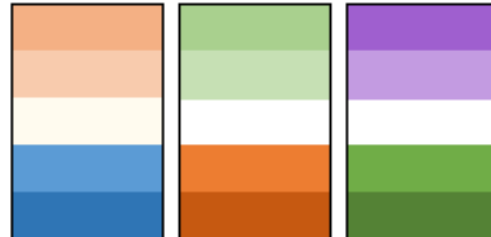
Art behind data visualization

- Types of Colours



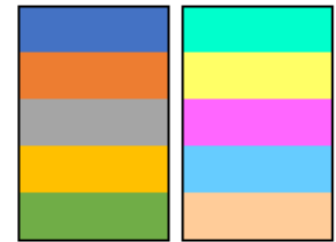
Sequential

There is a scale



Divergent

There are two
divergente spaces



Qualitative

There is no
longitudinal
organization/
order

Art behind data visualization

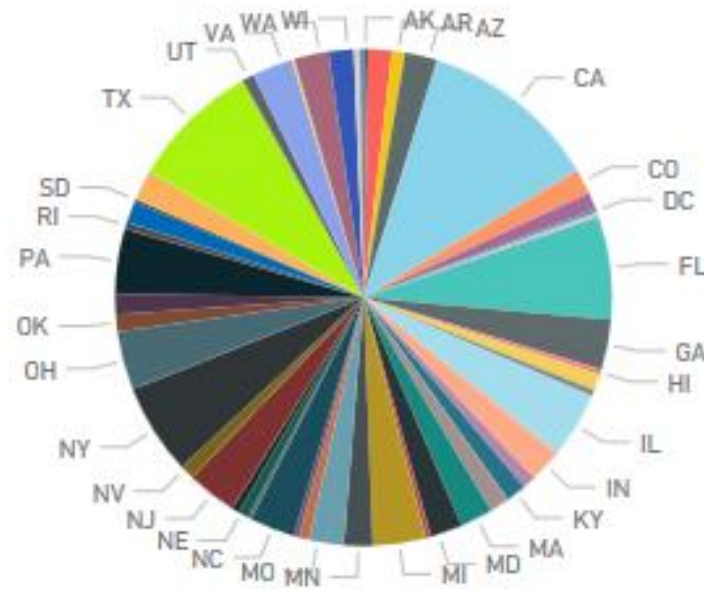
- **Important:**

- Do not have more than 3-5 colours in a single look (think short term memory)
- The eye can not differentiate more than 5 colours from the same hue
- Try to have a semantic meaning for the colours used (Red = Bad, Green = Good)

Art behind data visualization

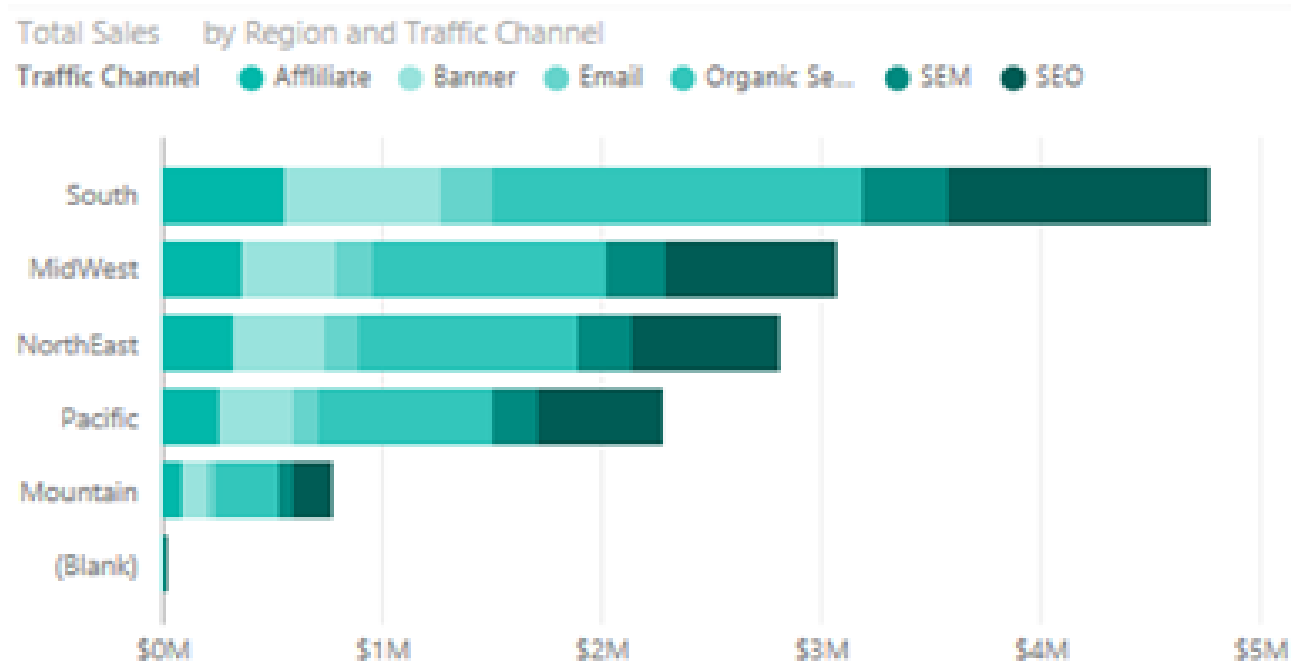
- Avoid:

Total Sales M by State



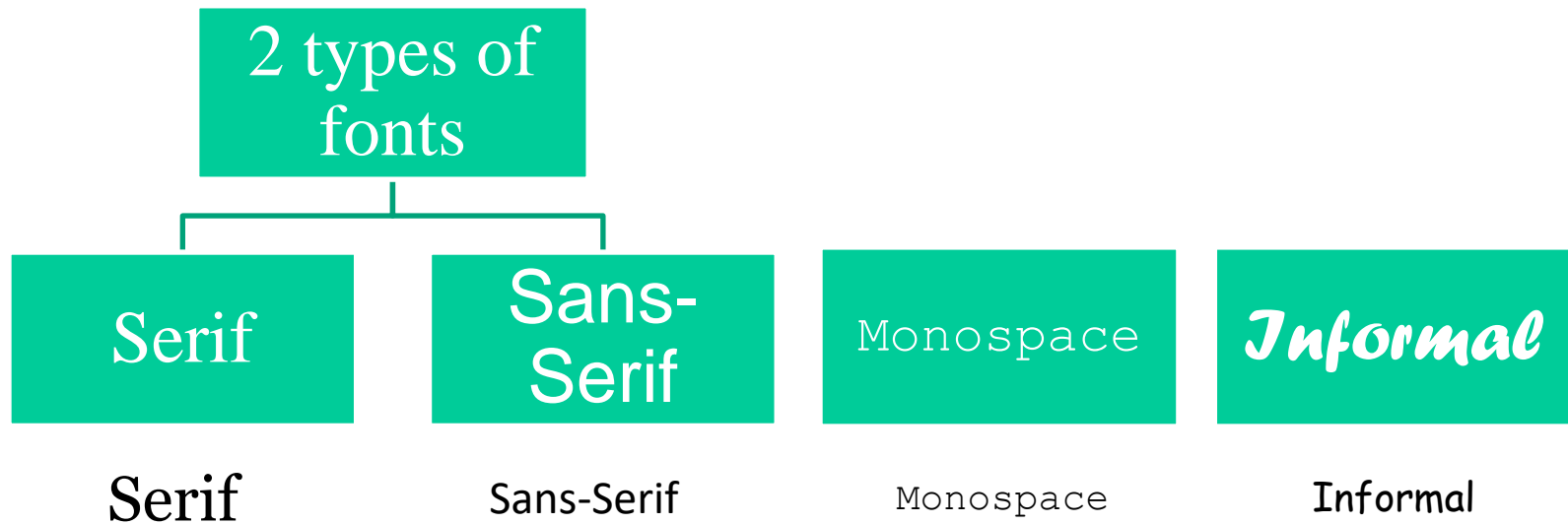
Art behind data visualization

- Avoid:



Art behind data visualization

Fonts



- Sans-Serif better for Digital Media in professional context
- Ex. Segoe, Calibri, Trebuchet

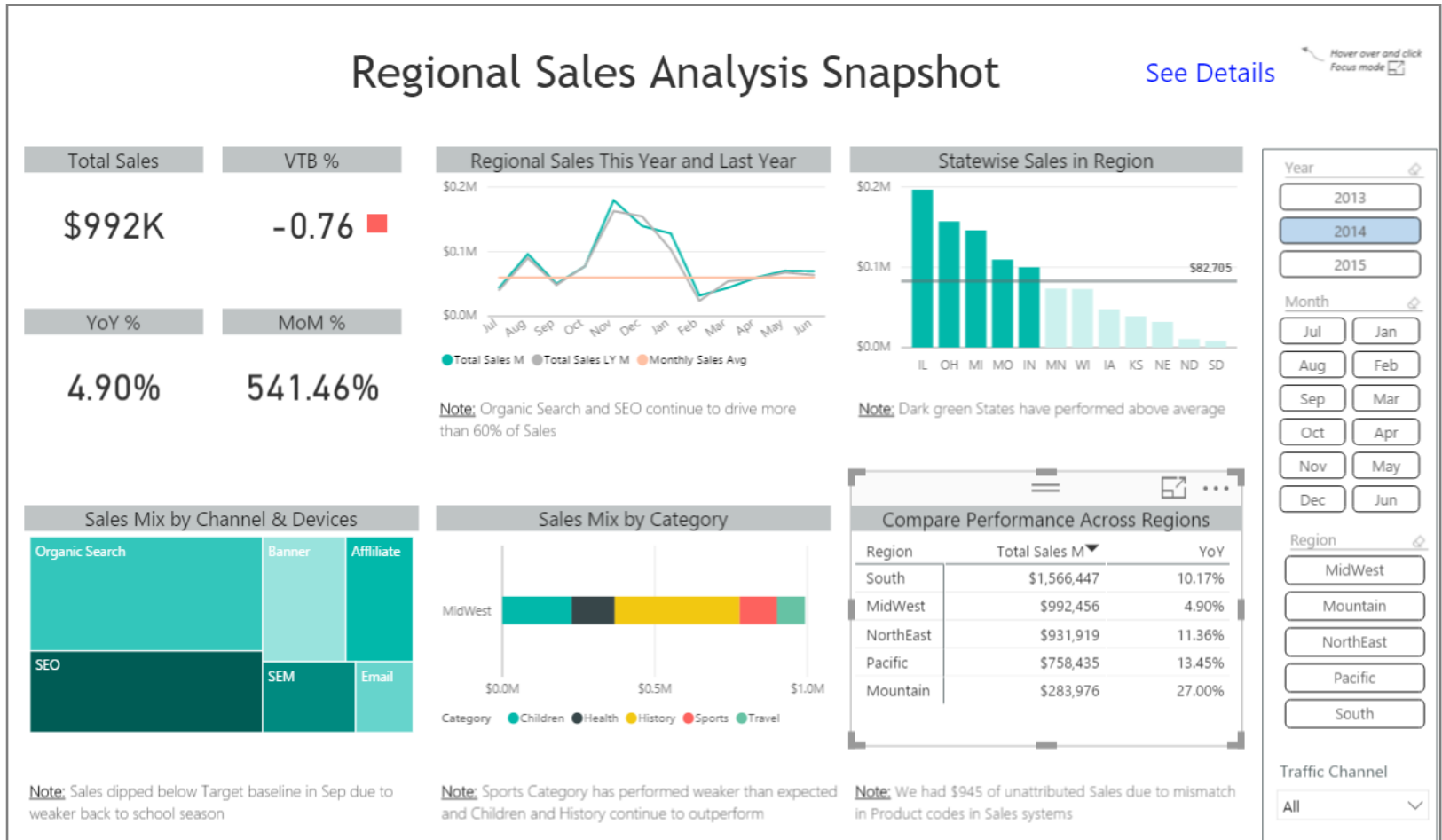
Art behind data visualization

- You can change the font weight using three techniques
 - Change the size:
 - Hi Power BI - Segoe UI Light 28
 - Hi Power BI - Segoe UI Light 24
 - Choice of different fonts with greater weight of the same family
 - Hi Power BI - Segoe UI (Body) 24
 - Hi Power BI - Segoe UI Light 24
 - Use bold
 - **Hi Power BI** - **Segoe UI Light 24 (Bolded)**
 - Hi Power BI - Segoe UI Light 24 (Non-Bolded)

Art behind data visualization

- Recommendations regarding the use of fonts:
 - Choose at most 2-3 font types / sizes on a report page / control panel
 - Choose a lighter weight font Ex. "Segoe UI Light" for
 - Axis
 - Important Data Tags
 - Text box
 - Non-titles
 - Use a larger weight font from the same family for titles instead of (bold) Ex. Segoe UI Bold

Characters and fonts



Main Challenges

- Main challenges:
 - Placing a large volume of useful and often unrelated information in a limited space
 - Be clear
 - Choosing the right information

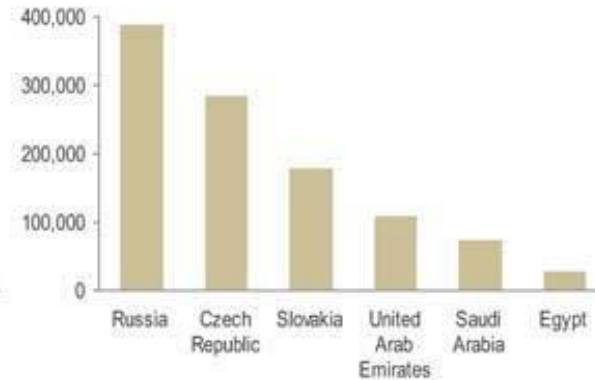
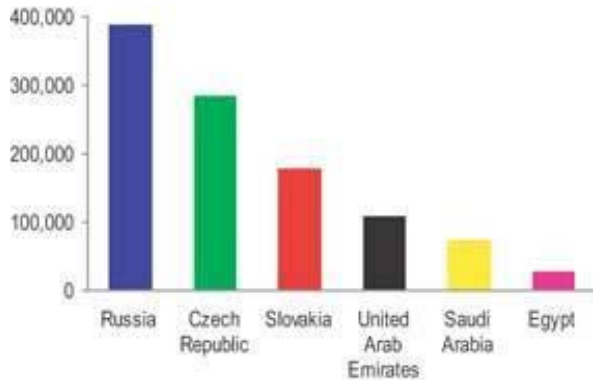
Few, 2006b

Main Challenges

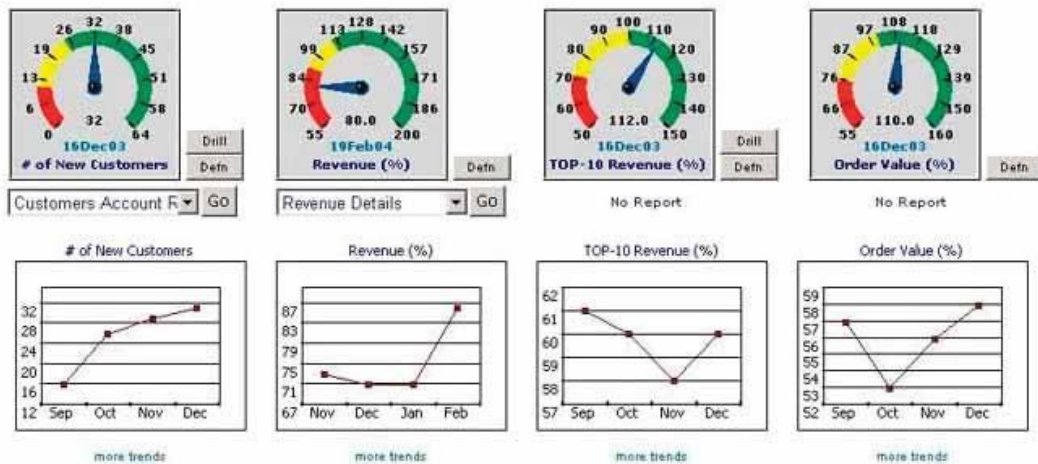
- Well-designed dashboards deliver information that:
 - It is exceptionally well organized
 - It is condensed, mainly in summaries and exceptions
 - It is specific and customized to audience needs and goals
 - Presented through concise means that communicate data and message clearly and directly

Few, 2006b

Example of non-data pixels to be eliminated



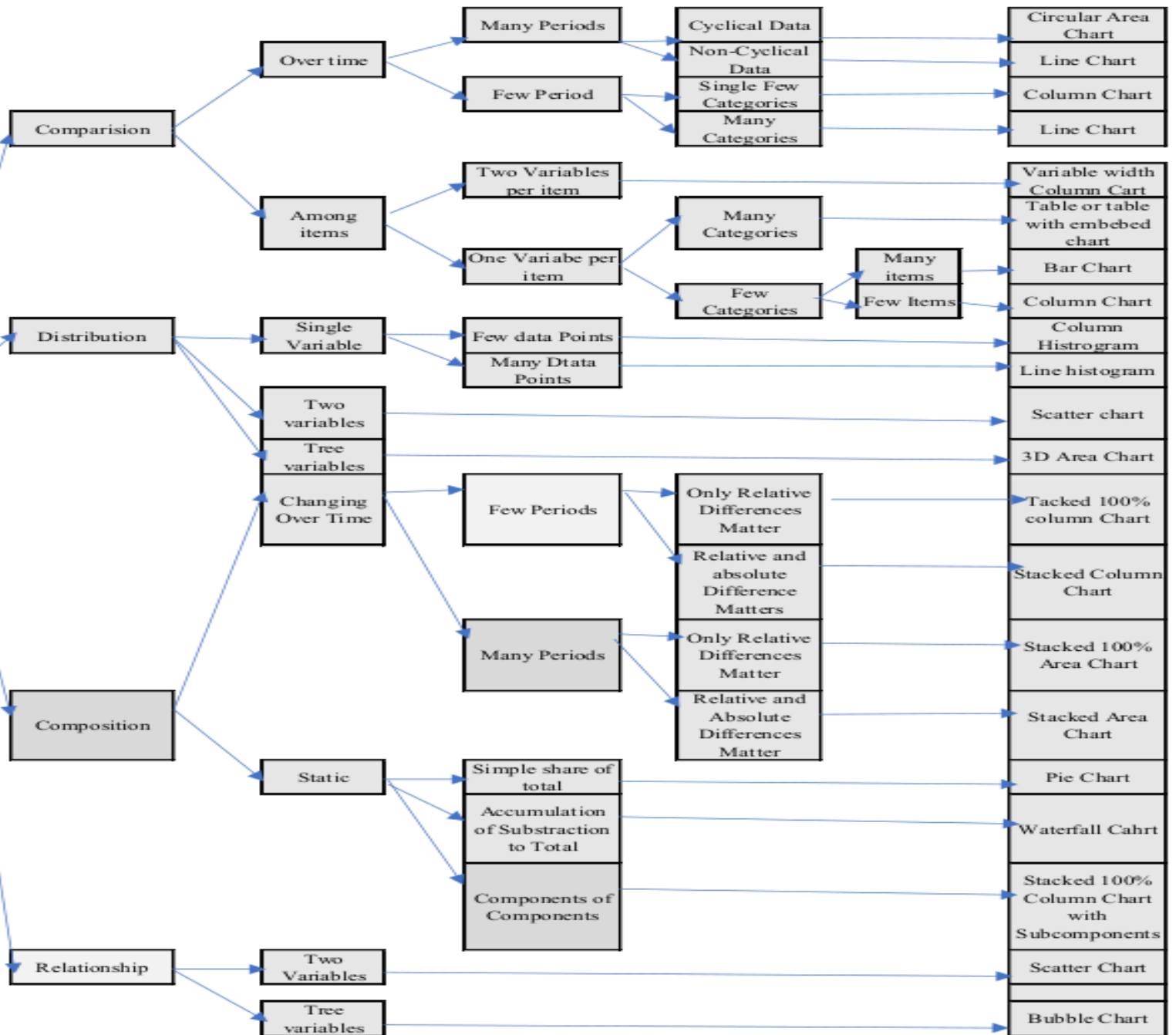
Colours have no meaning.



Borders are useless

Choosing the better graphics

What would you like to show?



Business Questions

1. What are my total sales for a selected year and region?
2. What are my total sales per year?
3. What is the gross profit per city of my country?
4. How are my sales by Channel, Device, Category for the selected Year?
5. How do my total sales and annual growth for the region compare to other regions?
6. What are my total sales for the selected year, month by categories?
7. How is my trend of 1 month per average sale for my categories? What is the minimum and maximum average per sale?

References

- Aparicio, M., & Costa, C. J. (2015). Data visualization. *Communication design quarterly review*, 3(1), 7-11.
- Costa, C. J., & Aparicio, M. (2019, September). Supporting the decision on dashboard design charts. In *Proceedings of 254th The IIER International Conference 2019* (pp. 10-15).
- Few, Stephen (2006a) *Common Pitfalls in Dashboard Design* by Principal, Perceptual Edge
[https://www.perceptualedge.com/articles/Whitepapers/Common_Pitfalls.pdf]
- Few, Stephen (2006b) *Information Dashboard Design* O'Reilly
- Kaplan, Robert S; Norton, D. P. (1993). "Putting the Balanced Scorecard to Work". *Harvard Business Review*, sept-oct.
- Microsoft, *Power BI Advanced Visualization and Storytelling Slides*
- Mintzberg, H. (1989). *Mintzberg on Management: Inside Our Strange World of Organizations*. Simon and Schuster.
- Laudon, Kenneth & Laudon, Jane (2012). *Management Information Systems – Managing the Digital Firm*, 12^a ed., Pearson, Harlow.
- Parmenter, David (2010) *Key Performance Indicators, Developing, Implementing, and Using Winning KPIs* Second Edition, John Wiley & Sons, Inc. New Jersey
- Tufte, Edward R (2001) *The Visual Display of Quantitative Information* (2nd ed.), Cheshire, CT: Graphics Press
- Tufte, Edward R (2001b) *Envisioning Information*, Cheshire, CT: Graphics Press
- Tufte, Edward R (1997), *Visual Explanations: Images and Quantities, Evidence and Narrative*, Cheshire, CT: Graphics Press
- Tufte, Edward R (2006), *Beautiful Evidence*, Cheshire, CT: Graphics Press
- Ware, Colin (2004) *Information Visualization: Perception for Design*, Second Edition. San Francisco: Morgan Kaufman.