

---

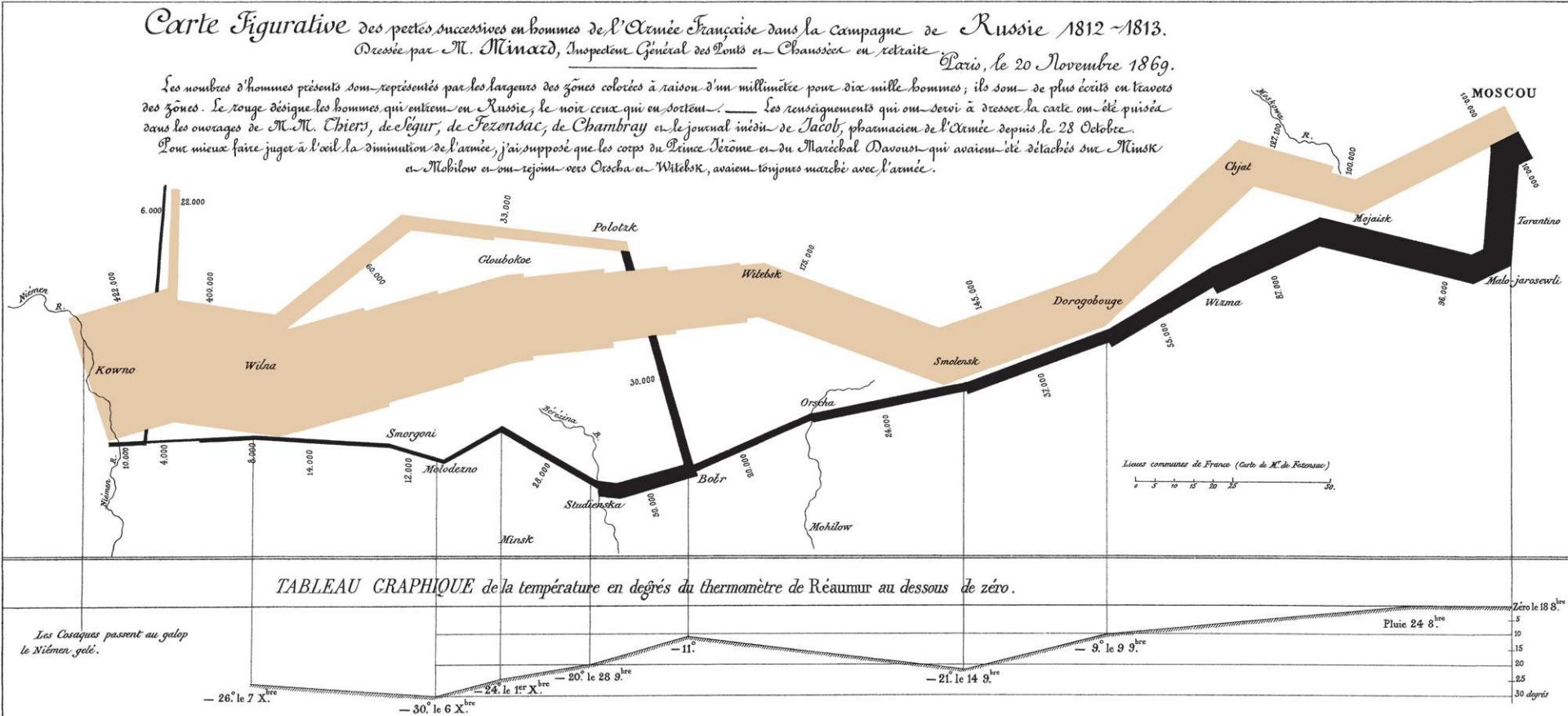
**Oleksandr Romanko, Ph.D.**

Senior Research Analyst, Risk Analytics, Watson Financial Services, IBM Canada  
Adjunct Professor, University of Toronto

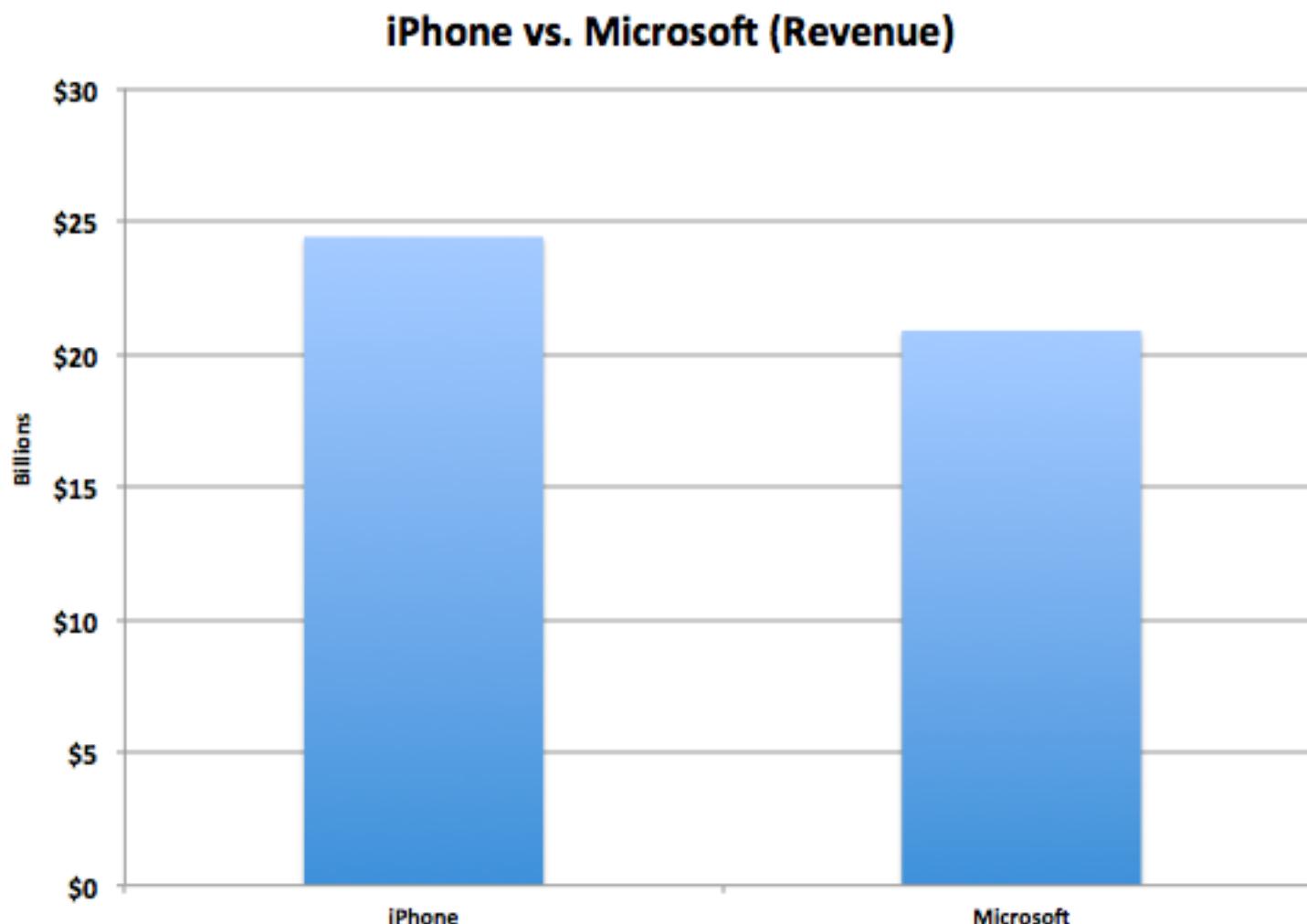
# **MIE1624H – Introduction to Data Science and Analytics Lecture 6 – Visual Analytics**

# Visual analytics

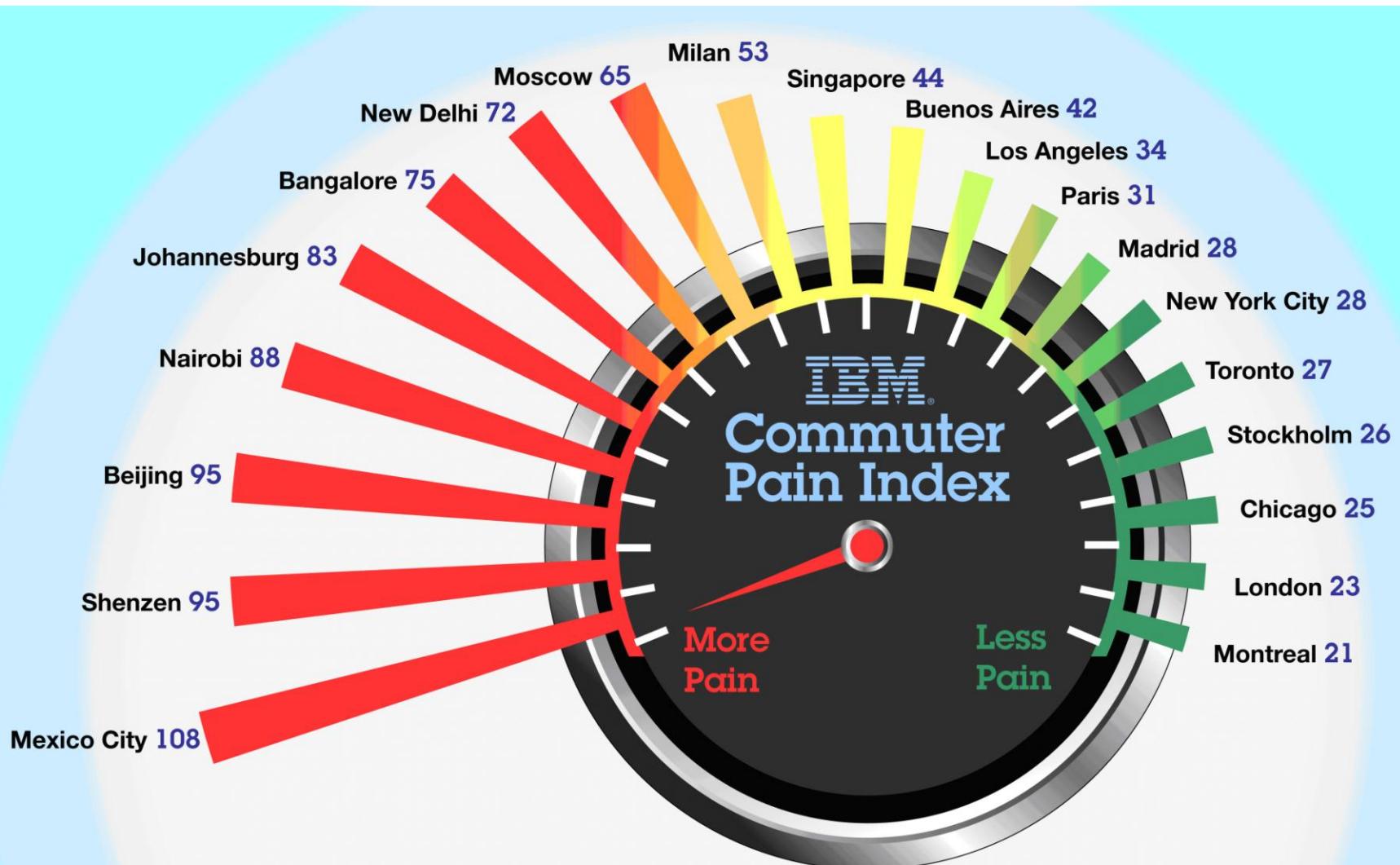
## Visual statistics of the Napoleon Campaign: the Minard Map



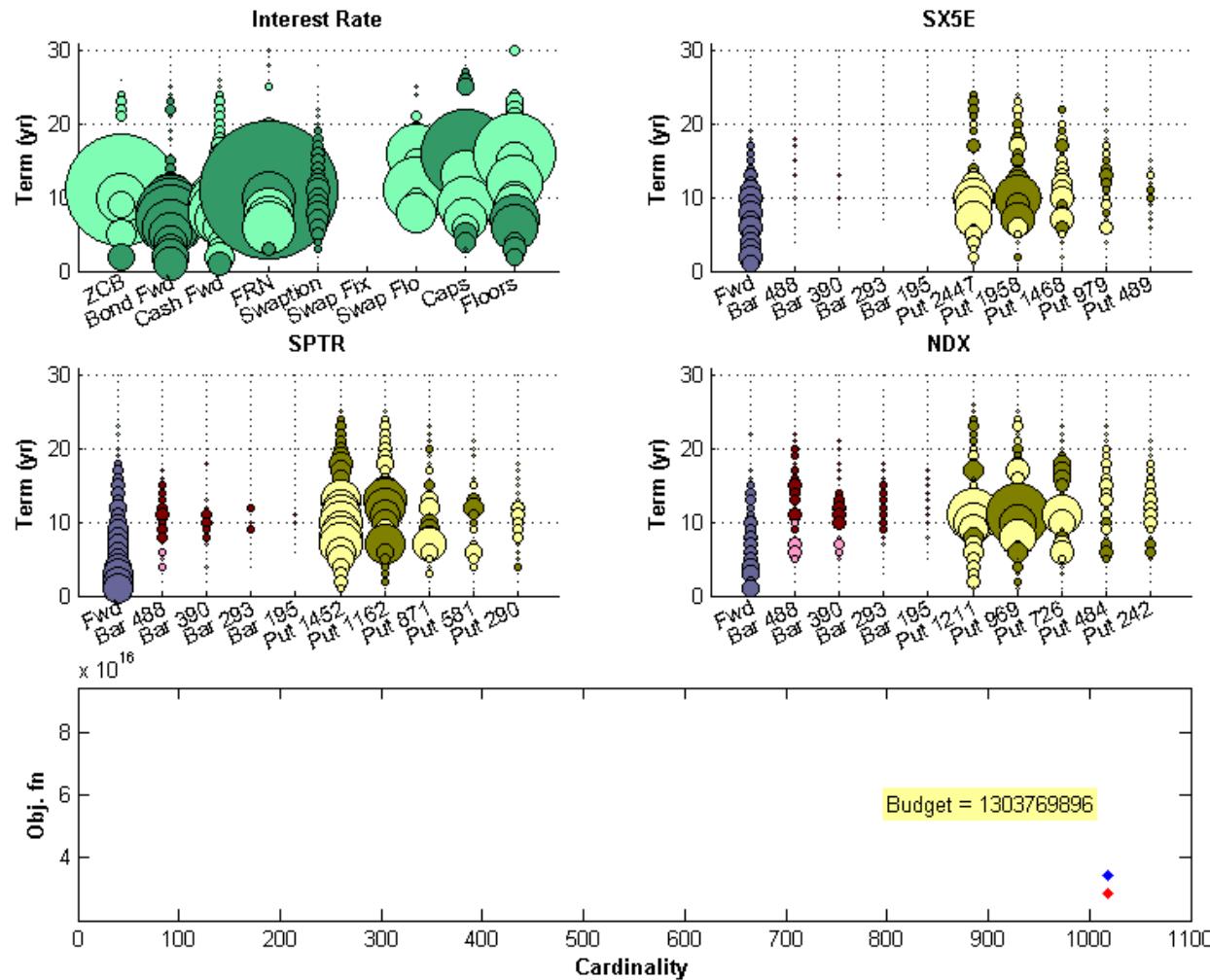
# Visual analytics



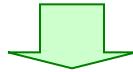
# Visual analytics



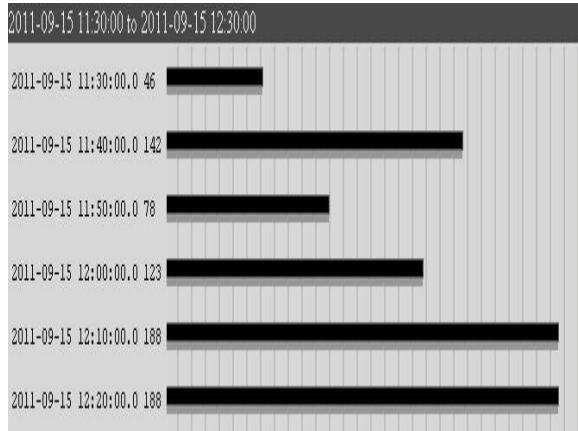
# Visual analytics – portfolio



# Historical visualization



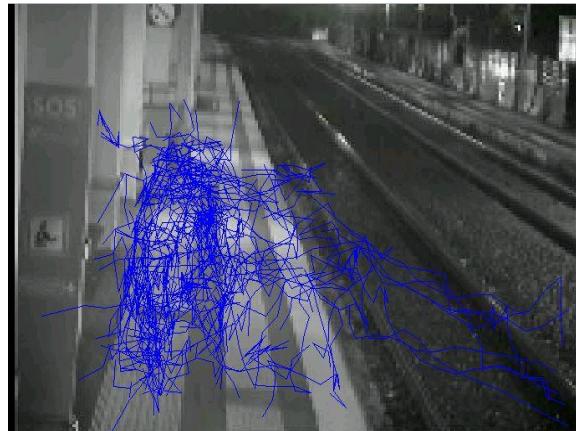
Activity Histogram



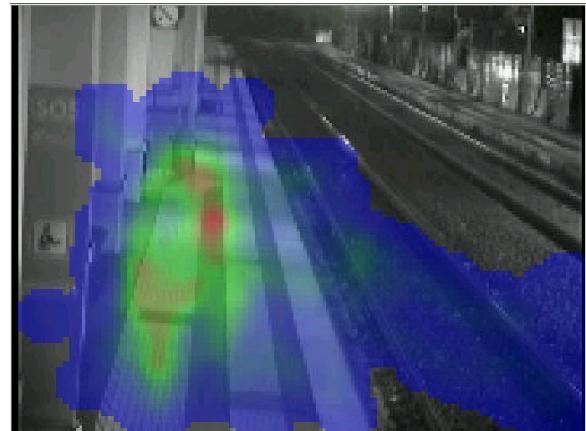
Distribution of events over time



Track Summary

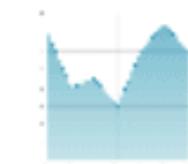


Show tracks of all objects returned from search



How long objects spent in different places

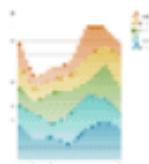
# Visualization types



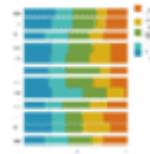
Area (Straight)



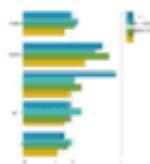
Area (smooth)



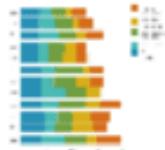
Area - Stacked (Strai...



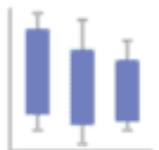
Bar - 100 Percent St...



Bar - Clustered



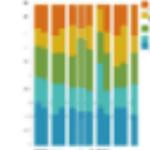
Bar - Stacked



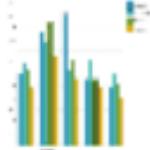
Box plot



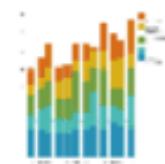
Bubble Chart



Column - 100 Percent...



Column - Clustered



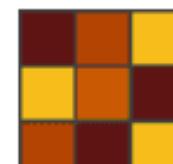
Column - Stacked



Donut



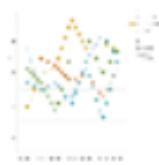
Gantt



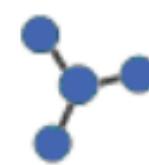
Heatmap



Line (smooth)



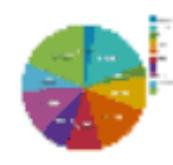
Line (straight)



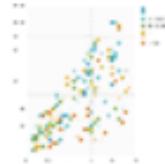
Network diagram



Network with Bubbles



Pie



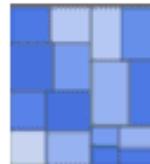
Scatter



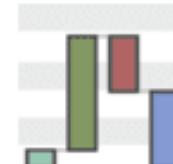
Tag Cloud



Treemap by category



Treemap by value



Waterfall chart

# Visualization formatting

## Visual Encoding Properties and Best Uses

Visual Encoding		Properties		Best Uses			
Example	Encoding	Ordered	Useful values	Quantitative	Ordinal	Categorical	Relational
	position, placement	yes	infinite	Good	Good	Good	Good
1, 2, 3; A, B, C	text labels	optional (alphabetical or numbered)	infinite	Good	Good	Good	Good
	length	yes	many	Good	Good		
	size, area	yes	many	Good	Good		
	angle	yes	medium/few	Good	Good		
	pattern density	yes	few	Good	Good		
	weight, boldness	yes	few		Good		
	saturation, brightness	yes	few		Good		
	color	no	few (< 20)			Good	
	shape, icon	no	medium			Good	
	pattern texture	no	medium			Good	
	enclosure, connection	no	infinite			Good	Good
	line pattern	no	few				Good
	line endings	no	few				Good
	line weight	yes	few		Good		





# Visual Grids

# Layout grid

Welcome to TimesPeople  
What's this?

TimesPeople Lets You Share and Discover the Best of NY...

8:37 PM Get Started No, thanks

HOME PAGE TODAY'S PAPER VIDEO MOST POPULAR TIMES TOPICS

Get Home Delivery Log In Register Now

SEARCHING FOR THE LOWEST FARE? STOP.  
Continental Airlines

# The New York Times

Sunday, April 5, 2009 Last Update: 8:09 PM ET

CONTINENTAL.COM. LOWEST FARE GUARANTEED.  
Continental Airlines

Try the new Global Edition. International news from a global perspective. Switch to Global Edition >

Search Try Our EXTRA Home Page

Get Home Delivery Personalize Your Weather

Lowe's

Switch to Global Edition ,

JOBs  
REAL ESTATE  
AUTOS  
ALL CLASSIFIEDS

WORLD  
U.S.  
POLITICS  
N.Y./REGION  
BUSINESS  
TECHNOLOGY  
SPORTS  
SCIENCE  
HEALTH  
OPINION  
ARTS  
Books  
Movies  
Music  
Television  
Theater  
STYLE  
Dining & Wine  
Fashion & Style  
Home & Garden  
Weddings/  
Celebrations  
TRAVEL  
Blogs  
Cartoons /  
Humor  
Classifieds  
Corrections  
Crossword/

**Experts Call North Korean Missile Launch a Failure**  
By WILLIAM J. BROAD 17 minutes ago

Some experts said the test under the North Korean campaign to come across as a fearsome adversary able hurl deadly warheads halfway around the globe.

Read Comments (296)

**Obama Calls on U.N. to Punish North Korea Over Rocket**  
By HELENE COOPER and DAN BILEFSKY 6:46 PM ET

A meeting of the Security Council ended without any action in response to North Korea's missile launch, despite a call from President Obama for a quick response.



**Executive Pay in 2008**

**Highest Pay** PREV NEXT

	PER DAY	PER YEAR
Sanjay K. Jha Motorola	\$286,152	\$104.4 mil.
Lawrence J. Ellison Oracle	231,777	\$84.6 mil.
Robert A. Iger Walt Disney	139,925	\$51.1 mil.
Kenneth I. Chenault American Express	117,130	\$42.8 mil.

**INTERACTIVE GRAPHIC**  
**The Pay at the Top**  
A compensation research firm compiled data reflecting pay for 200 chief executives at 198 public companies that had revenue of at least \$6.3 billion. Related Article

New G.M. Chief Doesn't Rule Out Bankruptcy  
By A.G. SULZBERGER 1:56 PM ET

Fritz Henderson said he felt confident in General Motors

THIS LAND  
A Shop of Motley Flavors Is Gone, but Not All Is Lost  
By DAN BARRY 5:02 PM ET

When a fire

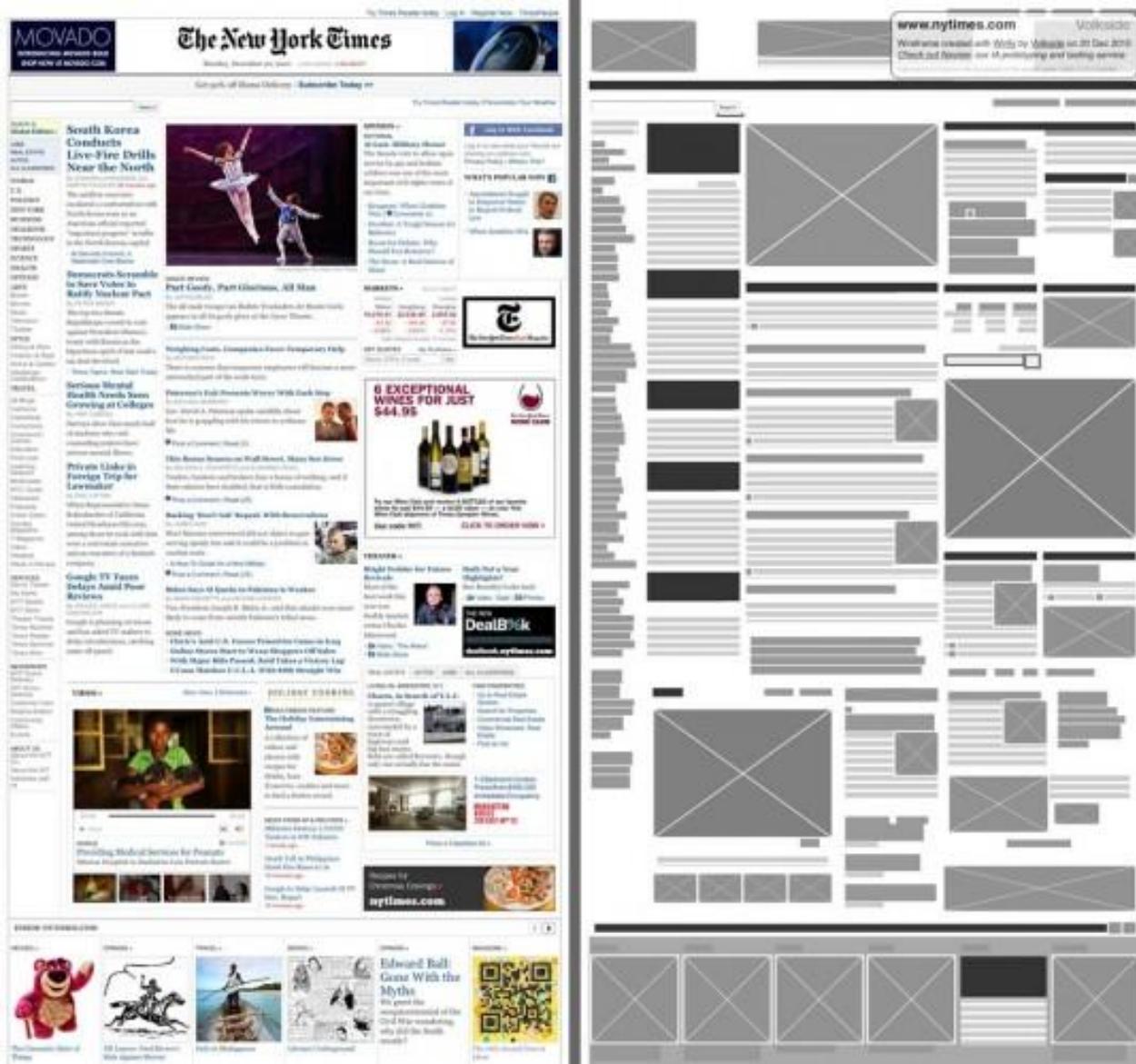
OPINION »  
Op-Eds: Obama's European Tour  
A. A. Gill: Class Lessons in England  
Christoph Peters: Back to Normal in Germany  
Amélie Nothomb: Envy in France

SPORTS »  
WOMEN'S TOURNAMENT  
After Passing on UConn, Appel Stands in Its Path  
Stanford junior Jayne Appel stands directly in the path of a perfect season for the No. 1 seeded Huskies.

BUSINESS »  
Executives Took, but the Directors Gave  
The corporate boards that approved steadily swelling paydays for C.E.O.'s are starting to come under scrutiny.

**The New York Times Small Business GO >**

# Layout grid





# Dashboards

# Dashboards – sales analytics

## Sales Dashboard

**Company**

- JetCorp, Belgium
- JetCorp, North America
- JetCorp, UK

**Year**

- 2007
- 2008
- 2009
- 2010
- 2011
- 2000

**Country**

- Germany
- Great Britain
- Iceland
- Netherlands
- Slovenia
- Spain
- Sweden
- Switzerland
- USA

**Global Dimension 1**

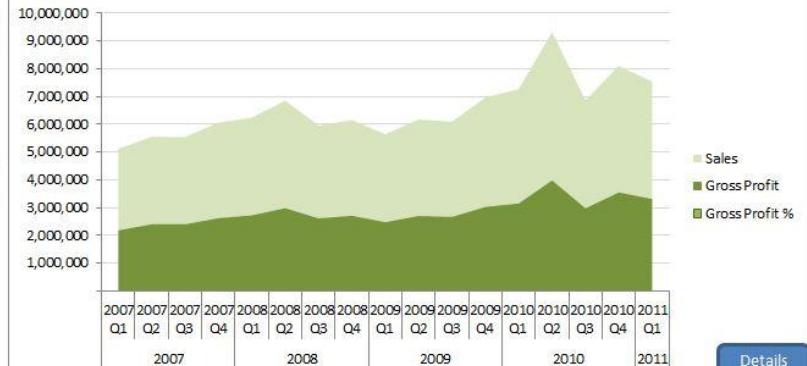
- CORPORATE - Corporate G...
- EVENTS - Events and Trad...
- SPORTS - Sports & Activities

**Global Dimension 2**

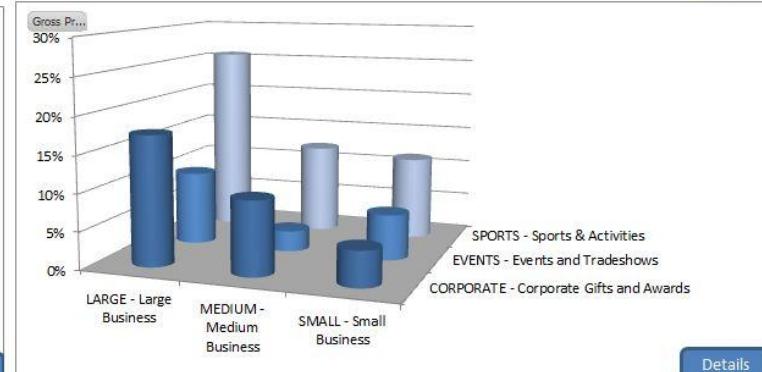
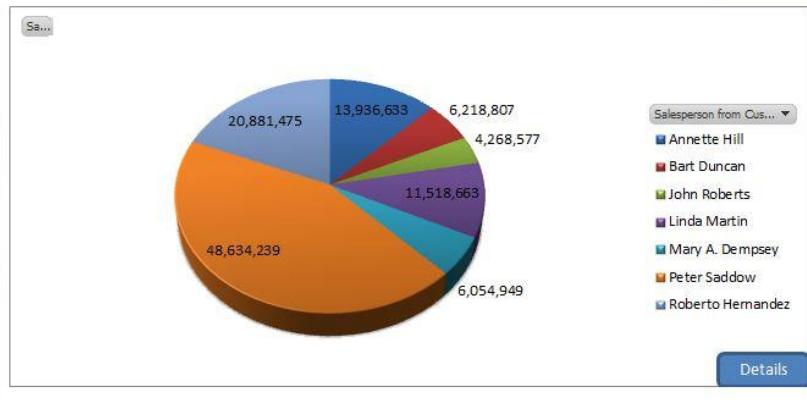
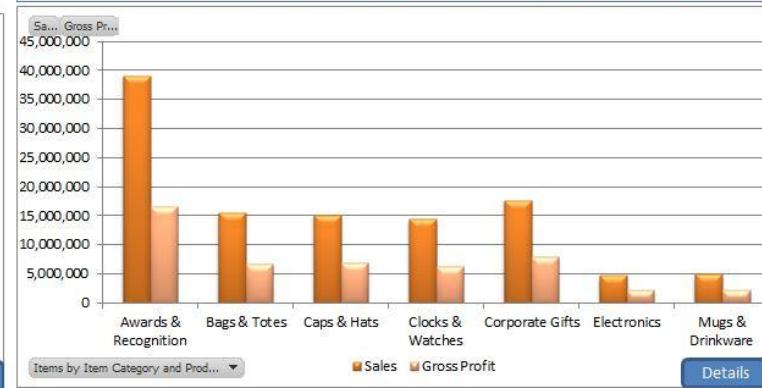
- LARGE - Large Business
- MEDIUM - Medium Business
- SMALL - Small Business

Salesperson from cust card	
Annette Hill	Bart Duncan
John Roberts	Linda Martin
Mary A. Dempsey	Peter Saddow
Roberto Hernandez	Unknown

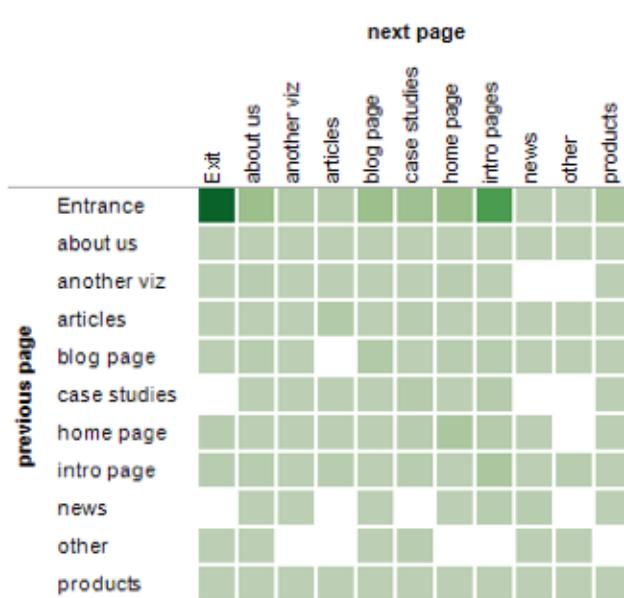
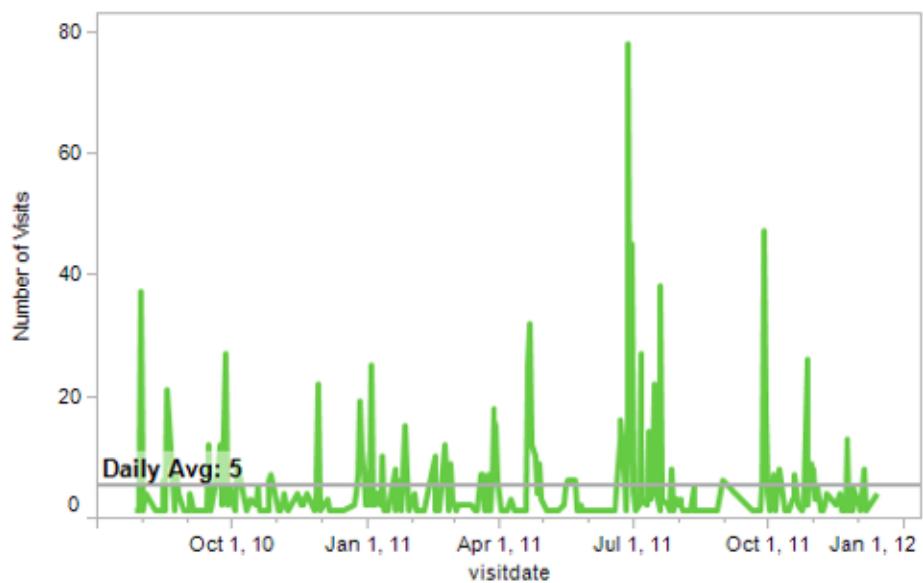
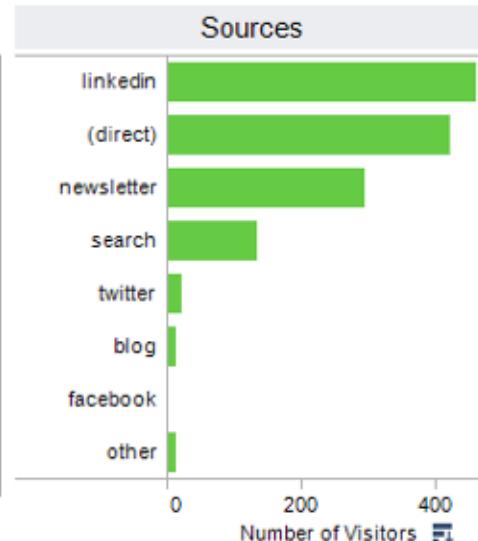
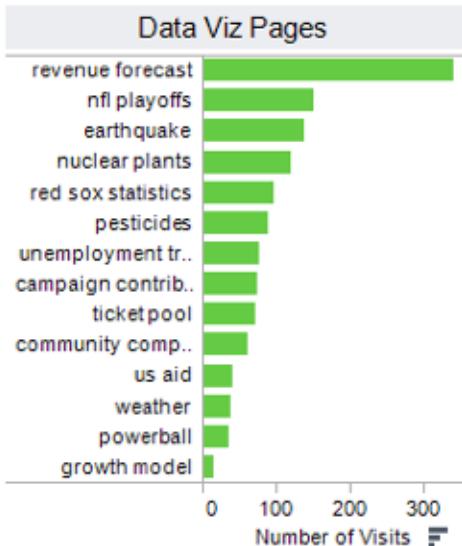
Item Category	
Awards & Recognition	Bags & Totes
Caps & Hats	Clocks & Watches
Corporate Gifts	Electronics
Mugs & Drinkware	Unknown



Product Group				
Emblems & Pins	Business Bags	Plastic	Sports Bags	Totes
Baseball Caps	Bucket Hat	Knit Hats	Visors	Clip-on
Desk Clocks	Stopwatches	Travel Clocks	Picture Frames	Headphones
MP3 Players	Speakers	Calculators	Computer Parts	Flashlights



# Dashboards – web-page analytics



# Dashboards – marketing analytics

IBM Digital Analytics Coremetrics Demo Site | Digital Analytics | My Profile | Admin | Help | Feedback | Support | Logout Welcome, aarikan@us.ibm.com

Find Report Actions

Dashboards Actions

- Standard Dashboards
  - Commerce Overview
  - Competitive Overview
  - Content Overview
  - Design Overview
  - Key Performance Indicators
  - Marketing Overview**
  - Real Time Overview

Workbook: Default Workbook \* Actions

Dashboard: Key Performance Indicators x Dashboard: Marketing Overview x Recently Used

Comments

### Marketing Overview

Marketing KPI Trends

Last 31 Days Ending 9/5/2013

	Yesterday	High / Avg. / Low
Sales	\$3,463,274.75	\$8,119,392.46 \$5,582,482.83 \$3,045,573.20
New Visitor %	87.72%	95.69% 86.23% 76.78%
Bounce Rate	44.80%	53.44% 48.66% 43.88%
Unique Visitors	18,500	20,313 16,912 13,511
Page Views / Session	9.53	12.10 10.68 9.27

Top Line Metrics

Sales Heatmap

4 Week Avg Ending 9/2/2013 - 9/8/2013

Conversion Trend

New Buyer % Trend

Top Marketing Programs

Yesterday | 9/5/2013

Vendor	Sales
google PPC	\$280K
Email_eMessage	\$180K
facebook	\$120K
X+1	\$80K
dotcom PPC	\$40K

Marketing Programs | By Vendor

Top Natural Search Keywords

Yesterday | 9/5/2013

Keyword / Search Engine	Sales	Orders
term not provided	\$66,399.59	
desk lamp	\$29,632.04	
leather office chair	\$22,854.82	
executive chair	\$21,303.33	
lamp	\$17,387.22	
desks	\$16,871.40	
student desk	\$16,454.05	
office chairs	\$15,780.02	
wood furniture	\$15,705.31	
coffee tables	\$15,694.51	

Reports Actions

Workbooks Actions

Manage

Guide Me

Messages (0) | 90232642 | About | © Copyright IBM Corporation 2010



# Spreadsheets vs. Visual Analytics

**HumanResources.cdd - IBM Cognos Insight**

**Open positions count by month**

Month	Customer Service	Customer Service Representative	Planned position count	Open positions
January	Customer Service	Customer Service Representative	248	265
February	Customer Service	Customer Service Manager	42	42
March	Finance	Accounting Clerk	188	189
April	Finance	Accounting Manager	42	42
May	Finance	Controller	42	42
June	Financial Analyst	63	67	4

**Days to fill open positions by recruiting type**

Recruiting Type	Professional Publication	National Newspaper	Local Newspaper	Internal	Employment agency	Website
Newspaper or Magazine	10	10	10	10	10	10
Local Newspaper	10	10	10	10	10	10
Internal	10	10	10	10	10	10
Employment agency	10	10	10	10	10	10
Website	10	10	10	10	10	10

**Samples | Employee expenses | Open positions**

**Employee expenses & performance**

**Employee Expenses:**

Organization	Total of Expense type	Benefits	Bonus	Pay	Training
Customer Service	393255.99	123319.53	29219.39	243987.27	
Human Resources	137403.79	247935.97	29219.39	243987.27	
Information Services and Technology	106674.62				
Marketing					
Production and Distribution					
Sales					
Employee name					
James Kent					
Jonathan Taver					
Maurice Hoffman					
Michelle Ogilvie					
Pasha Kana					
Alice Martin					
Andrew Roberts					
Dana Miles					
Helen Jones					
Bernard Lassus					
Tammy Shewmon					
Vittorio Rizzo					
Wu Gao					
Jules Dauphin					
Chiyo Yosoda					
Isamu Ashi					
Cyril Sodding					
Scott Brown					

**Samples | Employee expenses | Employee training | Open positions**

**Competitive Data Analysis**

**Future Chips Product Data**

Region	Product	Total of Month	2011-Jan	2011-Feb	2011-Mar	2011-Apr	2011-May	2011-Jun
Asia Pacific	Alpha	5,216,895	122,820	144,583	166,798	189,933	209,290	2

**Competitor Product Data**

Region	Product	Total of Month	2011-Jan	2011-Feb	2011-Mar	2011-Apr	2011-May	2011-Jun
Asia Pacific	Alpha	4,681,350	169,800	189,850	213,960	235,950	258,000	2

**Explore Point Example - Customer Return Default - IBM Cognos Insight**

**Locations of Returns**

**Customer and Product Details**

**Telecommunications in Industrialized Nations**

**Fixed telephone lines**

**Estimated Internet Users**

---

## Unique Capabilities

### 1 **Read and Write**

Change or add new data, simple import, no scripting

### 2 **Customize**

You are empowered to create, not just consume

### 3 **What-if Scenario Model**

Model new scenarios, test assumptions, optimize

### 4 **Plan**

Modify plans, budgets, forecasts accordingly

### 5 **Extend**

Predictive analytics, managed reporting, performance management

Don't just discover...  
Do something with it.

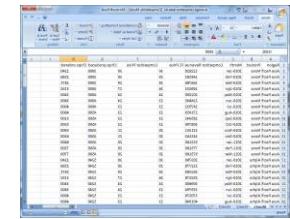
# How will it help you?

- A business analyst has to manage data from multiple sources.
- Data warehouses, spreadsheets, ERP systems
- The analyst can communicate high level findings but wishes to make the details more accessible and useful to business users

## Using Cognos Insight

- The Analyst can import files from local sources or corporate servers into Cognos Insight and create dashboards or plans that reflect the needs of individual or workgroup scenarios
- Allows business users further analyze the findings for themselves, using calculations, what-if, traffic lights
- Fast visualization selection for better understanding
- Focus on their particular areas of responsibility
- Share finding amongst colleagues
- No IT assistance

Microsoft Excel



Cognos Insight





# HR Analytics

# Visual resume



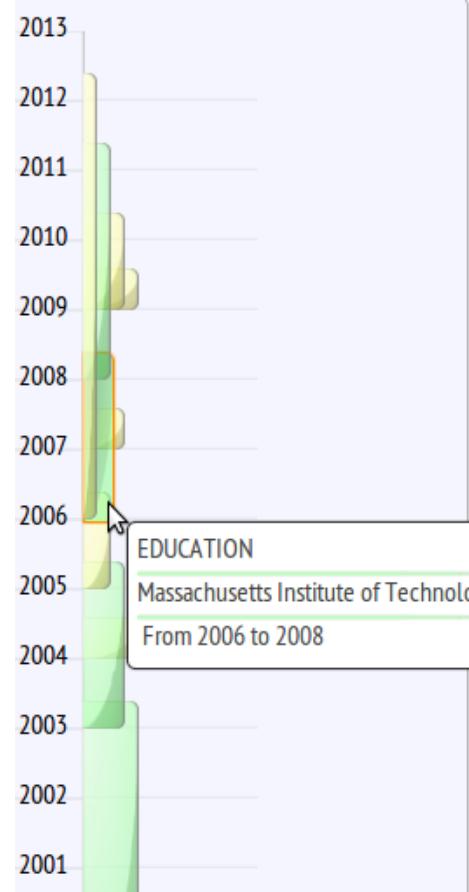
Pranav Mistry | [LinkedIn](#).

Research Assistant and PhD ca...

Research Assistant and PhD candidate at Media Lab, MIT

PREVIOUSLY

[Share](#) [+1](#) [Tweet](#) [Recommend](#)



## Experience

Visiting Researcher

0.2 Year(s) [JST ERATO Igaras...](#)

Research Intern

0.2 Year(s) [Microsoft Research](#)

Research Intern

0.1 Year(s) [Global Connecti...](#)

Research Assistant and PhD candidate

6 Year(s) [MIT Media Lab](#)

UX Researcher

1.2 Year(s) [Microsoft](#)

Intern in Incubation Team

0.2 Year(s) [Microsoft](#)

## Education

Massachusetts Institute of Technology

3 Year(s) [Massachusetts In...](#)

Massachusetts Institute of Technology

2 Year(s) [Massachusetts In...](#)

Indian Institute of Technology, Bombay

2 Year(s) [Indian Institute o...](#)

Gujarat University

4 Year(s) [Gujarat University](#)

## Skills

User Experience

System Design

Architecture

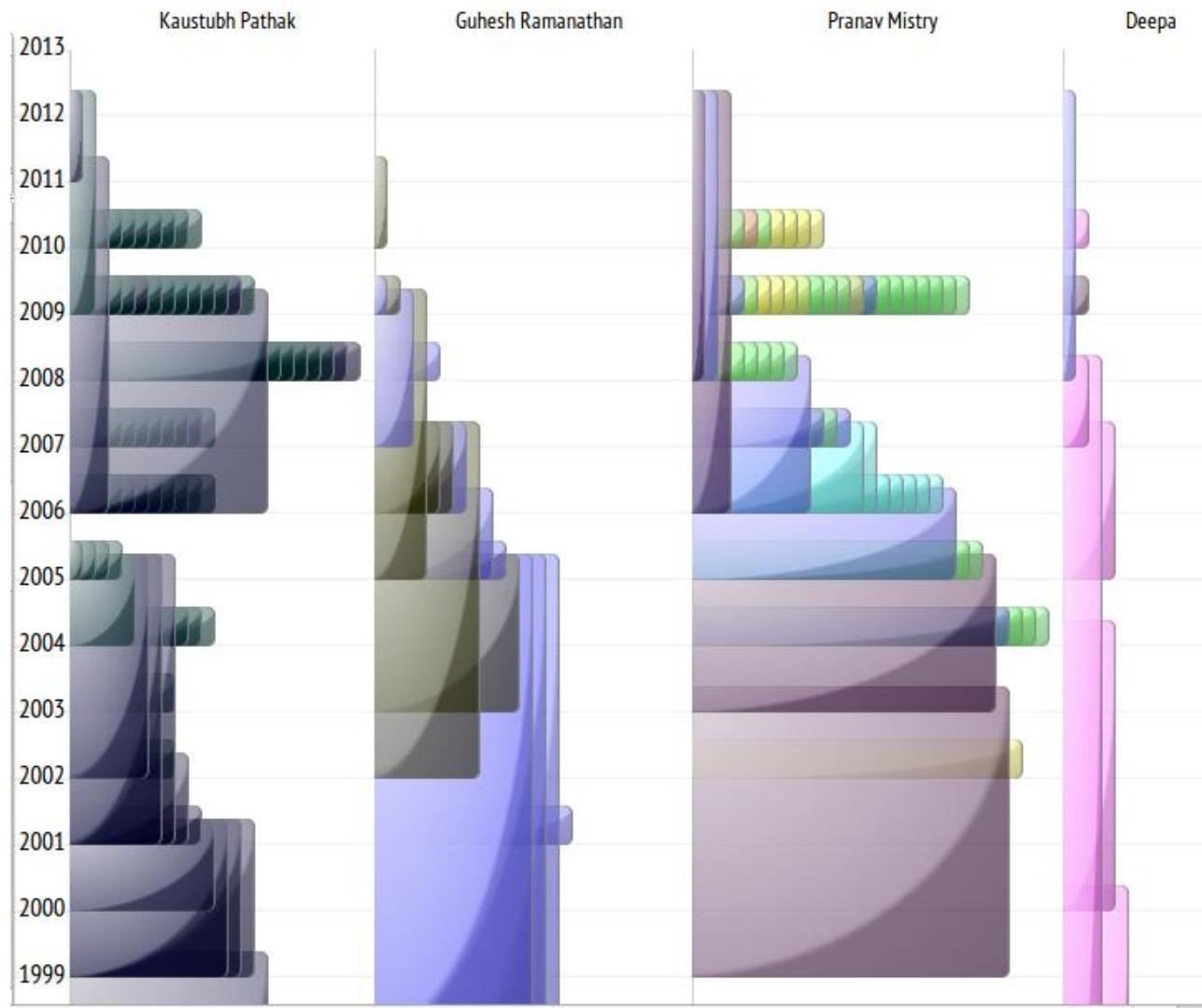
Human-computer Interaction

Prototyping

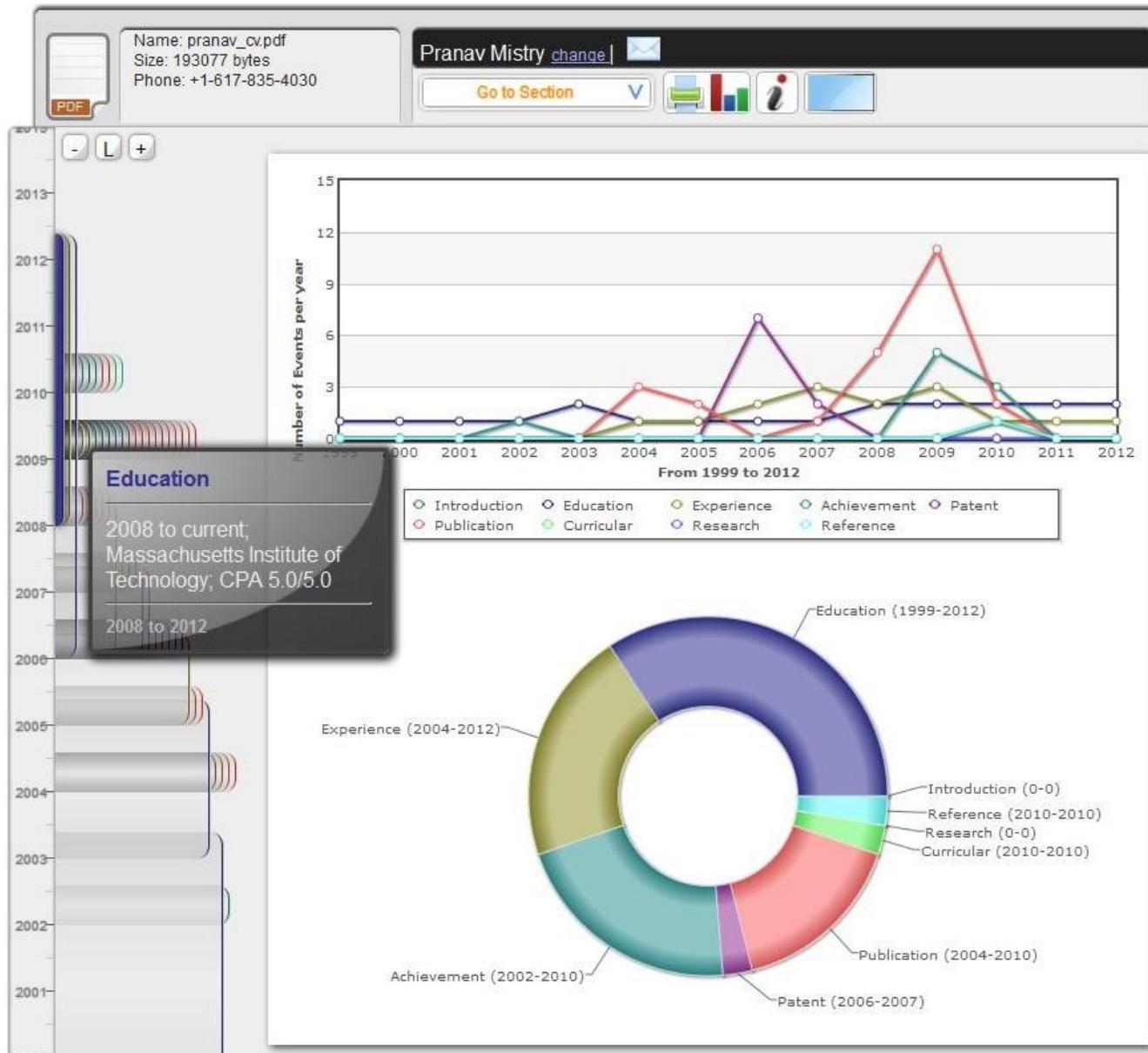


# Visual resume

Event-line with different sections, like Education, Experience, Projects, Achievements etc. (shown with different colors) and blocks representing an event for the corresponding section



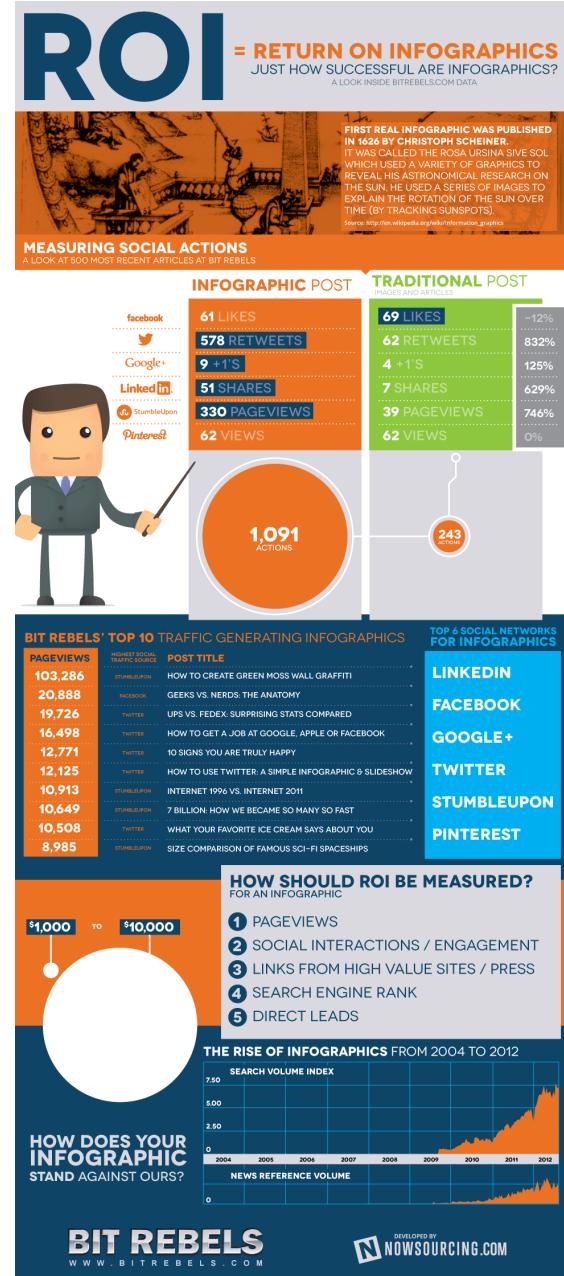
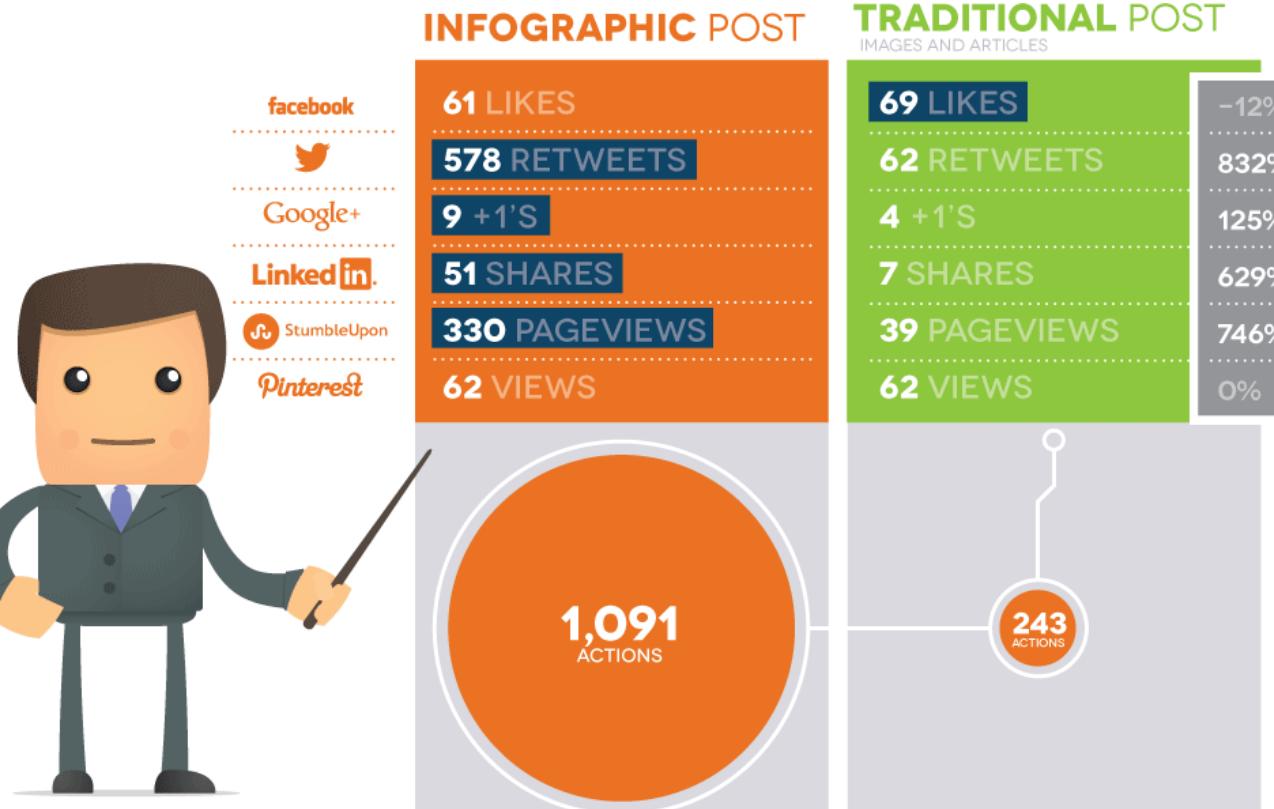
# Visual resume



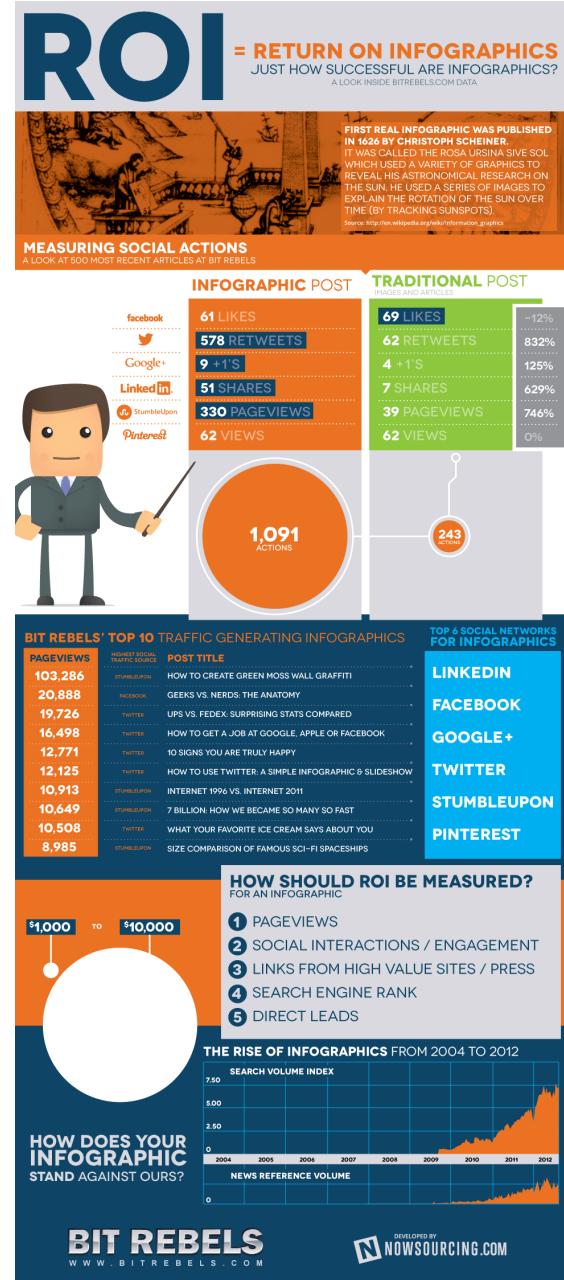
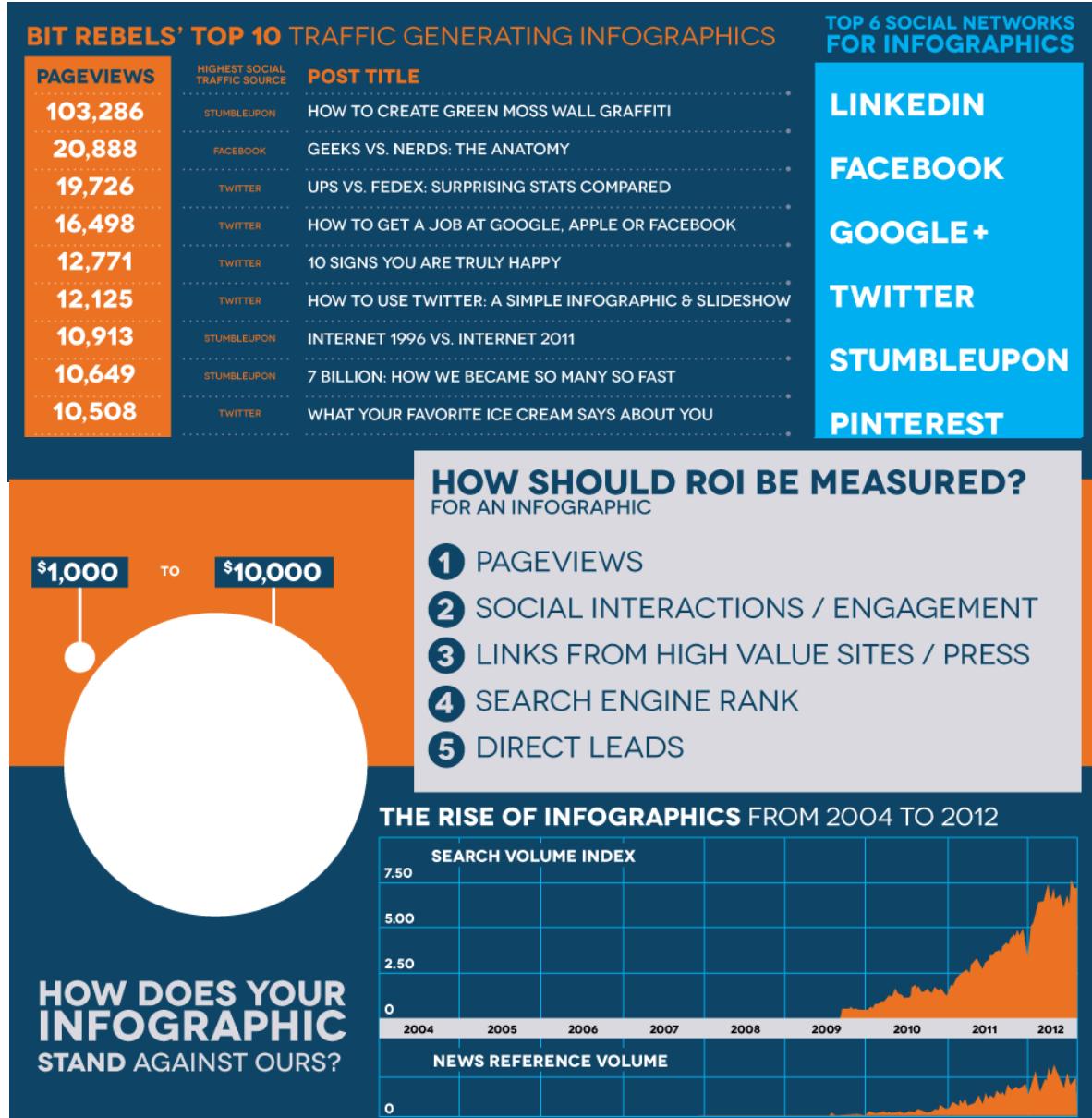


# Infographics

# Infographics

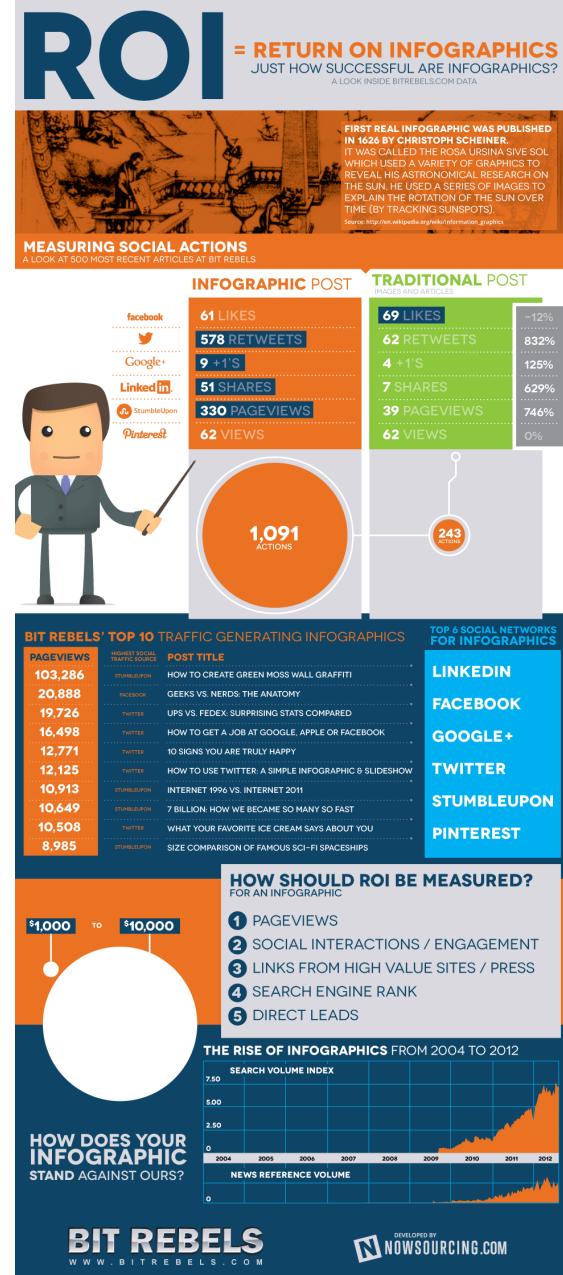


# Infographics



# Infographics

## MUSGO GRAFFITI



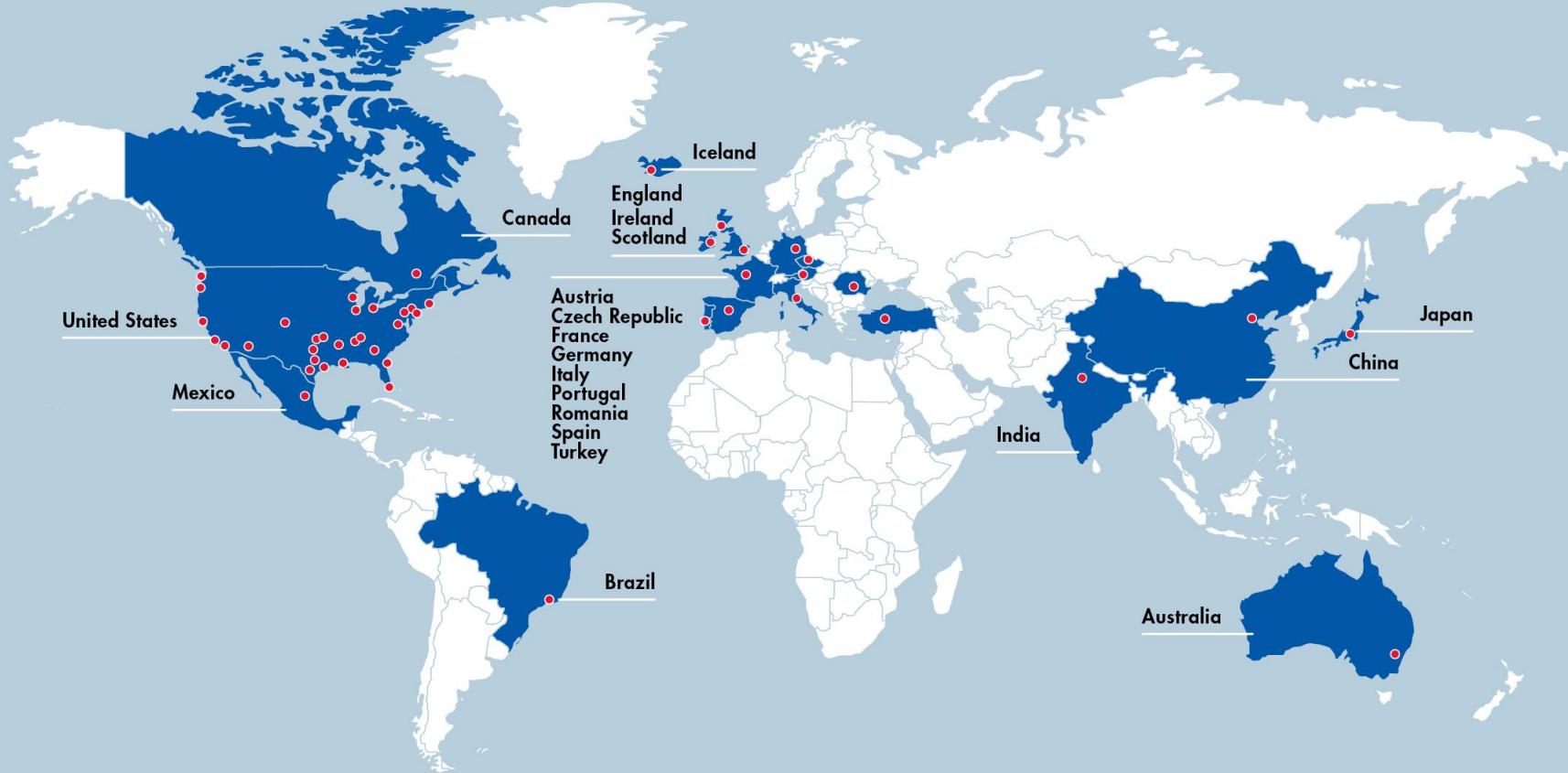


# Other Visualizations

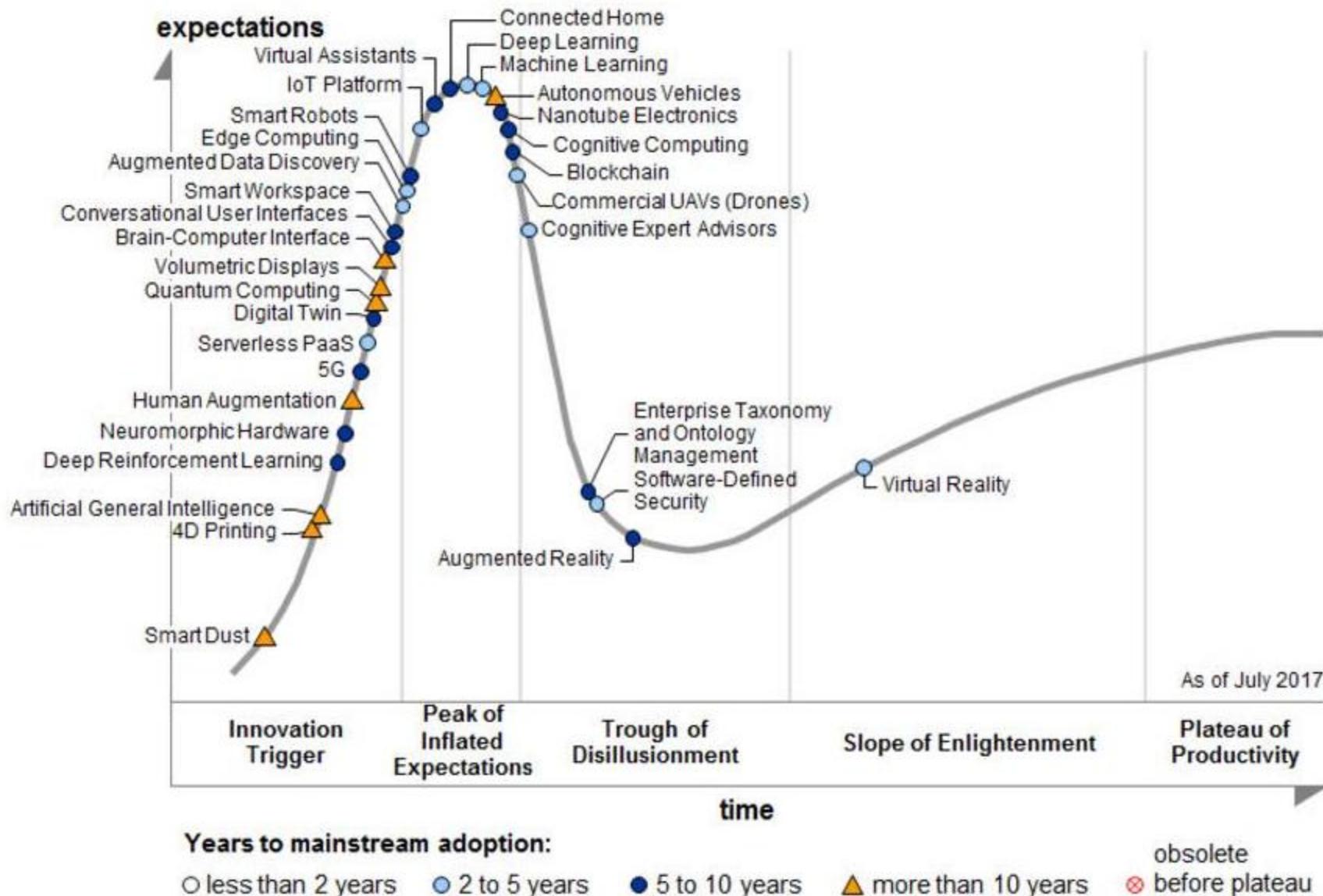
# Do you know what are your alumni doing?

## The Cox Alumni Network — Global Reach with a Local Touch

The strength and magnitude of our alumni network is a key attribute from which you'll reap a lifetime of benefits. With more than 40,000 alumni around the world, it's no surprise that *The Economist* ranks our alumni network 25th in the world for global breadth and effectiveness.



# Hype cycle for emerging technologies (2017)



\$2.50

\$2.00

↑  
Price of  
a gallon  
of gasoline

Annual average for  
regular grade,  
adjusted for inflation

Miles driven per capita each year →

5,000 mi.

6,000 mi.

7,000 mi.

1956-72  
Cheap gas, longer commutes

1973-74  
The Arab oil embargo

1978-81  
Energy crisis

Cheap gas,  
longer commutes

The Arab  
oil embargo

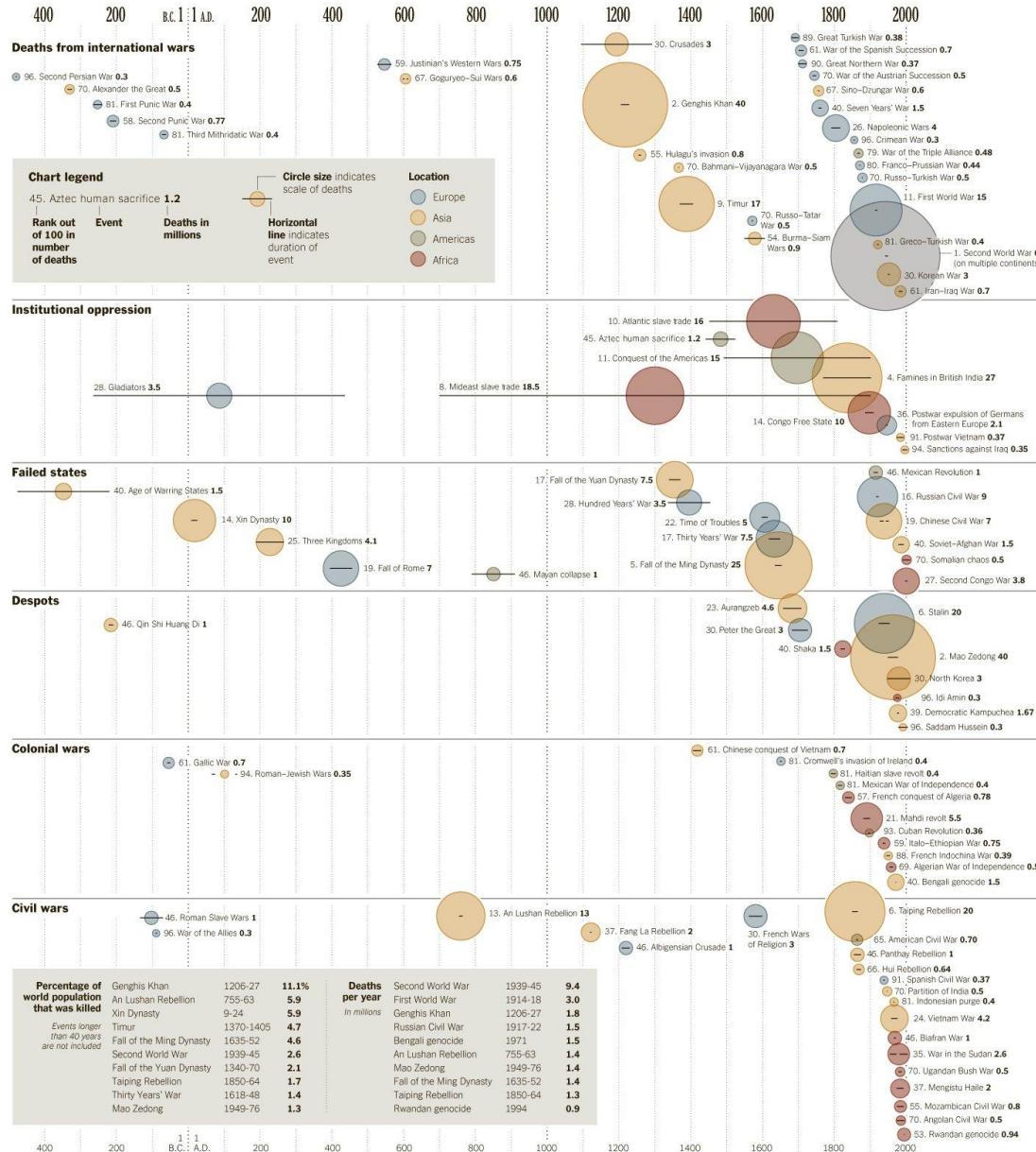
# Population Control, Marauder Style

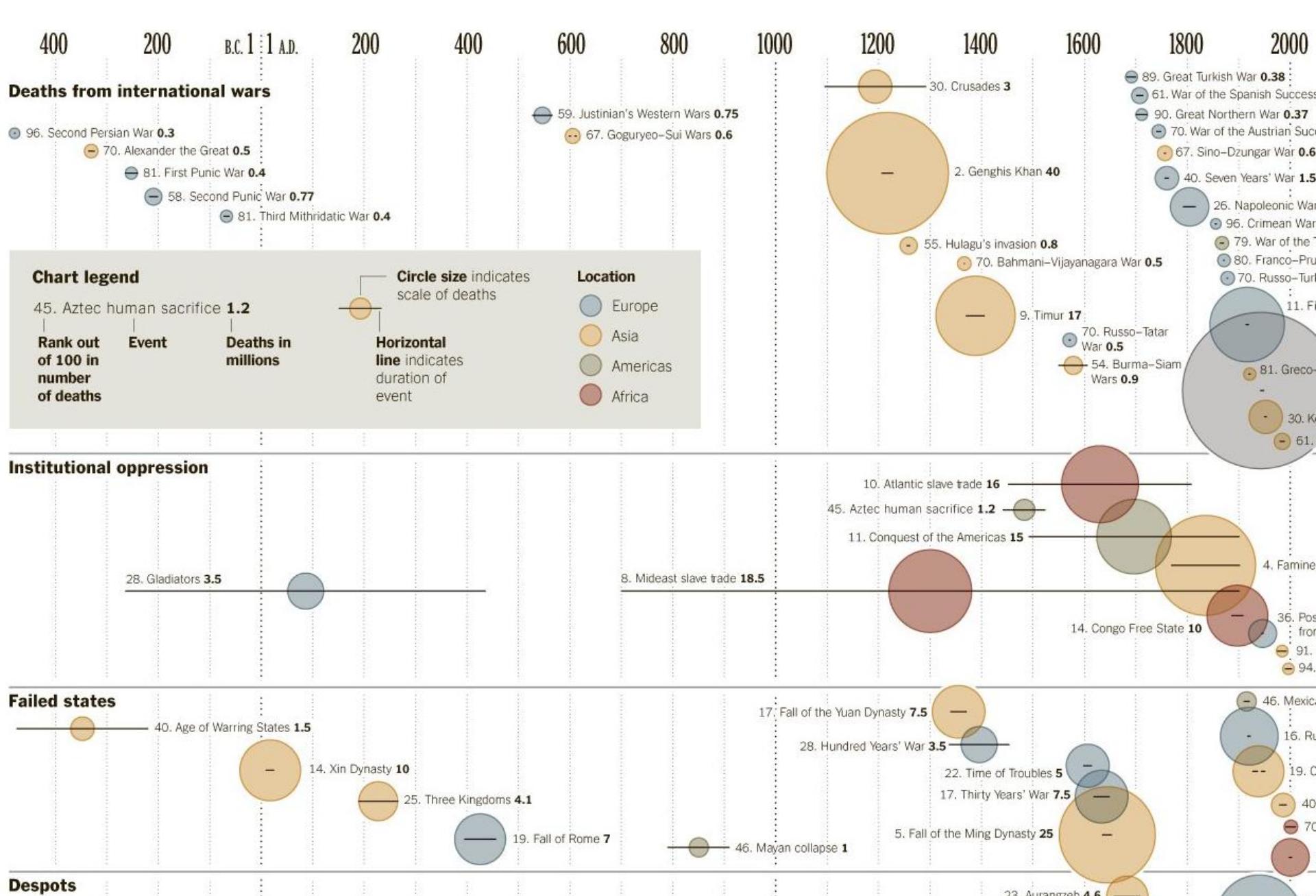
## Visual analytics

Last week, the United Nations announced that the world's population had reached seven billion, but there have been times when it headed in the opposite direction, and not in pleasant ways. The savagery of the Mongol conqueror Genghis Khan has topped the list of major events by far, at 11.1 percent of world blood upheavals in China — the An Lushan Rebellion and the collapse of the Xin Dynasty — each may have killed about 6 percent of humanity. Those are but 3 of the 100 worst atrocities in history, as catalogued by Matthew White in "The Great Big Book

of Horrible Things," an amusing (really) account of the murderous ways of despots, slave traders, blundering royals, gladiators and assorted hordes. Estimating the toll from such horrors is an inexact science, given war's nature and the mysteries of antiquity. But the "worst" are more plentiful in recent century, given that there were more people to kill and better ways to kill them on a grand scale. Even so, killings as a percentage of all humanity are probably declining. Below, the sweep of human brutality in a timeline.

BILL MARSH







# Watson Analytics

# Watson Analytics

Quick start intuitive interface

The screenshot shows the Watson Analytics interface. At the top, there's a navigation bar with 'Getting Started' selected, followed by 'Add Data', 'Recent Workbooks', and 'Open Workbook'. On the left, a 'WELCOME' section includes a 'Getting Started' button, a 'Add Data' button, and a 'Recent Workbooks' button. Below this, there's a 'Welcome to Watson Analytics!' message and a 'Explore our solutions by role' section with icons for Marketing, Sales, Finance, Operations, HR, IT, and Executive. A search bar at the top right contains the placeholder 'Enter a keyword to filter the list below, or to ask Watson a question about your data!'. The main area is divided into two main sections: 'Start from Data' and 'Start from a Story'. The 'Start from Data' section features three cards: 'EXPLORE YOUR DATA' (Tool icon, blue background), 'PREDICT AND EXPLAIN' (Tool icon, grey background), and 'FORECAST FUTURE VALUES' (Coming Soon, grey background). The 'Start from a Story' section displays a grid of 12 story cards arranged in four rows of three. Each card includes a title, a brief description, and a small thumbnail image. The cards are categorized by role: Marketing, HR, Executive, Sales, and others. A blue callout bubble on the left says 'Data discovery' pointing to the first card. A blue callout bubble on the right says 'Mobile-ready' pointing to the bottom-right card. A blue callout bubble at the bottom says 'Cloud-based agility' pointing to the bottom center.

X WELCOME

Getting Started Add Data Recent Workbooks Open Workbook

Welcome to Watson Analytics!

Explore our solutions by role

Marketing Sales Finance Operations HR IT Executive

Enter a keyword to filter the list below, or to ask Watson a question about your data!

Q

Start from Data

TOOL EXPLORE YOUR DATA

The easy, beautiful way to find the stories in your data

TOOL PREDICT AND EXPLAIN

Discover the drivers of behavior and results

COMING SOON FORECAST FUTURE VALUES

Lorem ipsum dolor sit amet, consectetur adipiscing.

Start from a Story

TUTORIAL GETTING STARTED WITH WATSON ANALYTICS

Take a tour of Watson Analytics!

MARKETING IMPROVE CAMPAIGN EFFECTIVENESS

Understand the drivers of campaign success

EXECUTIVE RETAIN YOUR TEAM

Identify high risk employees

TUTORIAL WORKING WITH DATA

Get more from your data with Watson Analytics

HR PREVENTING EMPLOYEE ATTRITION

Identify the causes of attrition before it's too late

SALES FIND PATTERNS IN WINS AND LOSSES

What combination of factors leads to a win?

HR SAMPLE TEXT SAMPLE TEXT

Get more from your data with Watson Analytics

MARKETING CUSTOMER PROFITABILITY

Drive more value from each customer relationship

SALES NEXT BEST OFFER FOR EXISTING CUSTOMERS

What should I offer (and to who) to sell more?

Natural language dialogue

Mobile-ready

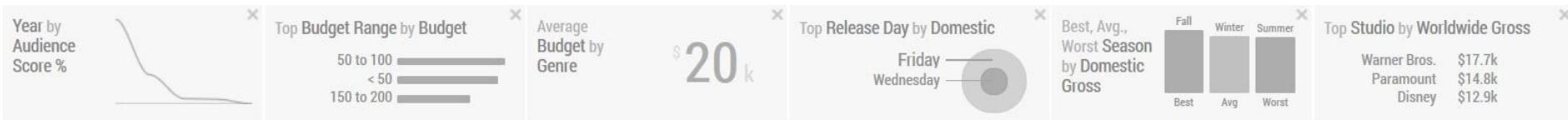
Cloud-based agility

# Watson Analytics

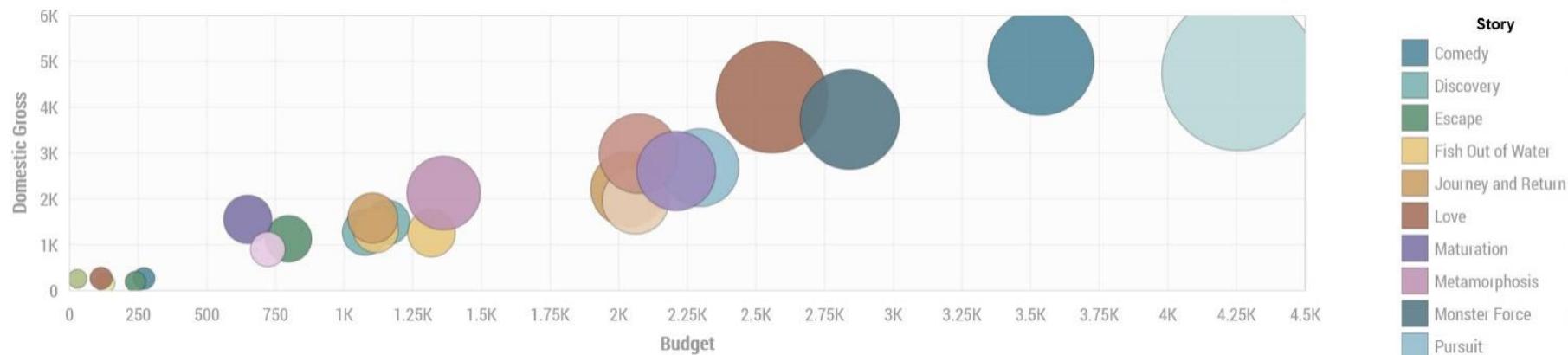
The screenshot displays the Watson Analytics platform with several key features highlighted:

- Data access and refinement:** A blue callout points to the "Analysis Detail" section, which shows statistics like "146 Input Fields were evaluated" and "60 Input Fields were potentially useful".
- Integrated social business:** A blue callout points to the top right corner of the interface.
- Intelligent automation:** A blue callout points to the "Predictive Model" section, which illustrates how multiple drivers (labeled 1-8) influence the "Sales" outcome.
- Guided analytic discovery:** A blue callout points to the bottom left, indicating the platform's ease of use ("Easier to Understand") and predictive power ("More Predictive").
- Report and dashboard creation:** A blue callout points to the right side of the interface, showing various charts and maps.
- Visual storytelling:** A blue callout points to the bottom right, highlighting the "What else is interesting about this field?" section which provides additional insights into data associations.
- Unified analytics experience:** A large blue callout at the bottom center summarizes the overall user experience.

# Watson Analytics



What is the relationship between **Budget** and **Domestic Gross** by **Story** ?



Story ▾

Budget ▾

Domestic Gr... ▾

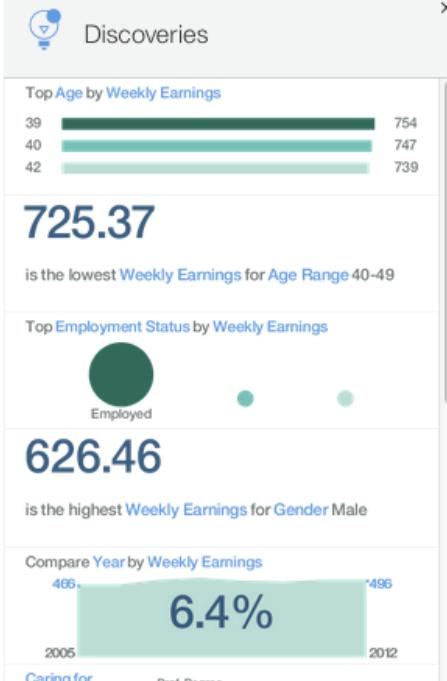
Worldwide G... ▾

# Watson Analytics

Discovery 1



What is the breakdown of **Weekly Earnings** by **Education Level** ?



Education Level



Weekly Earnings



Heat by

Rows

	Age Range	Education Level	Employment S...	Year	Gender	Age	Television	Housework	Socializing & R...	Weekly Earnings	Caring for Ch...
--	-----------	-----------------	-----------------	------	--------	-----	------------	-----------	--------------------	-----------------	------------------