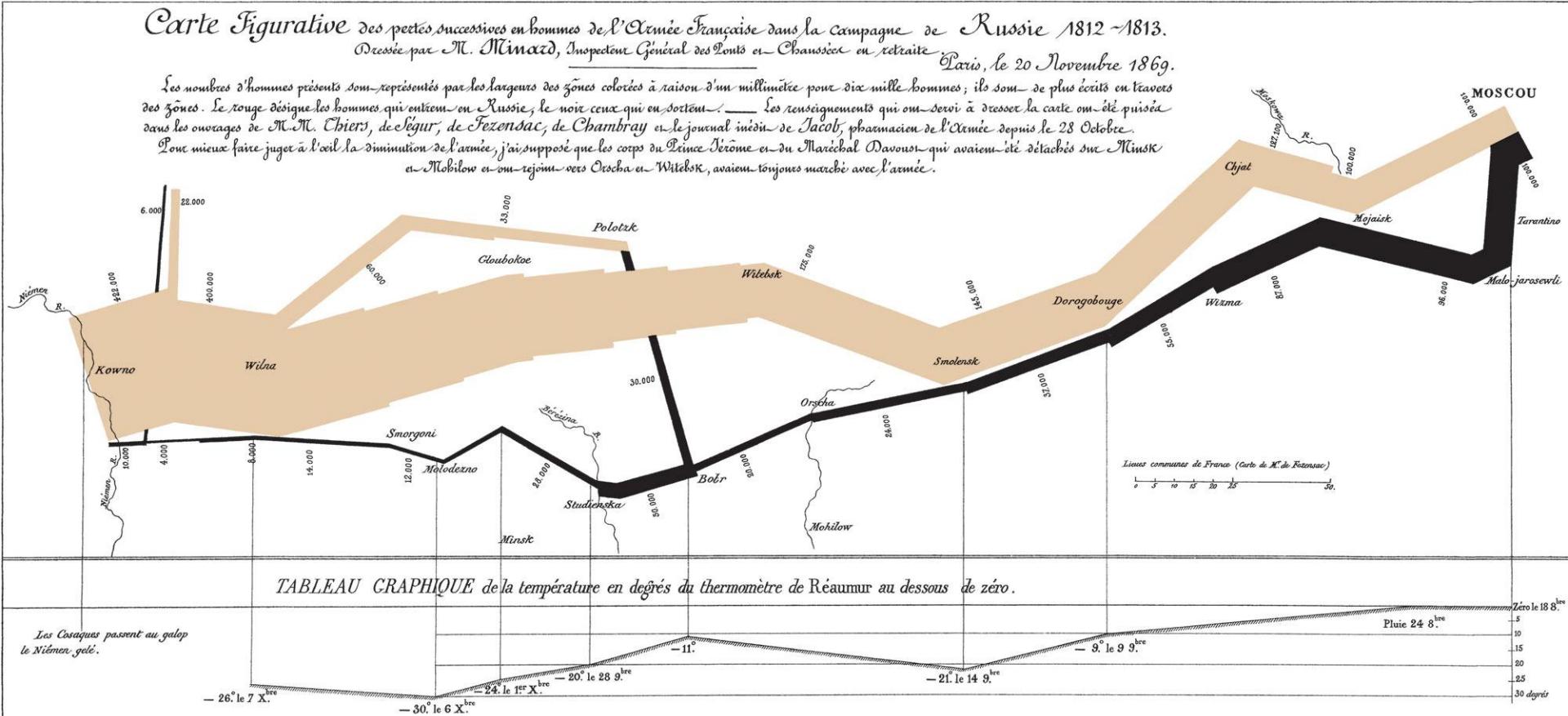

Oleksandr Romanko, Ph.D.

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

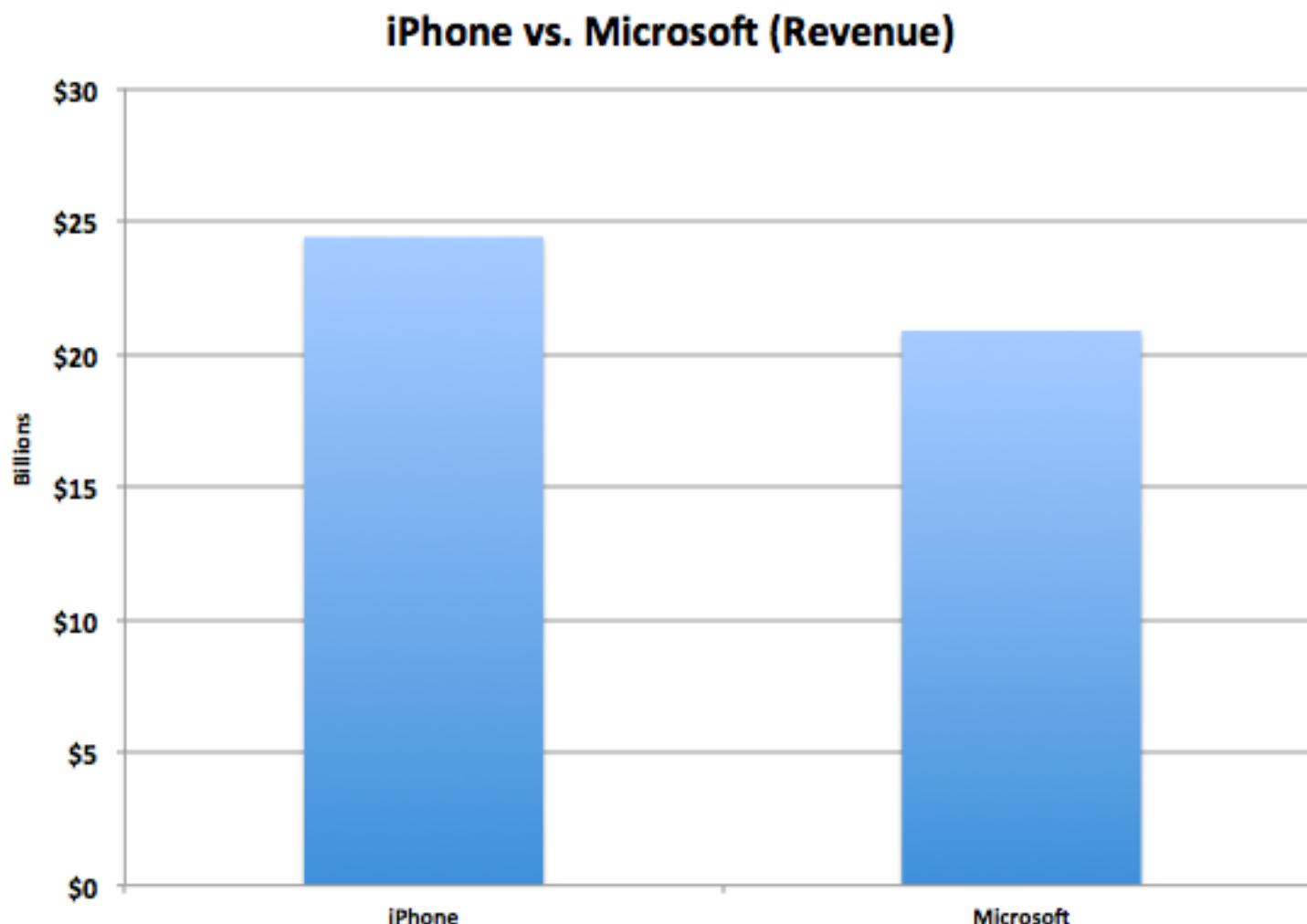
MIE1624H – Introduction to Data Science and Analytics Lecture 6 – Visual Analytics

Visual analytics

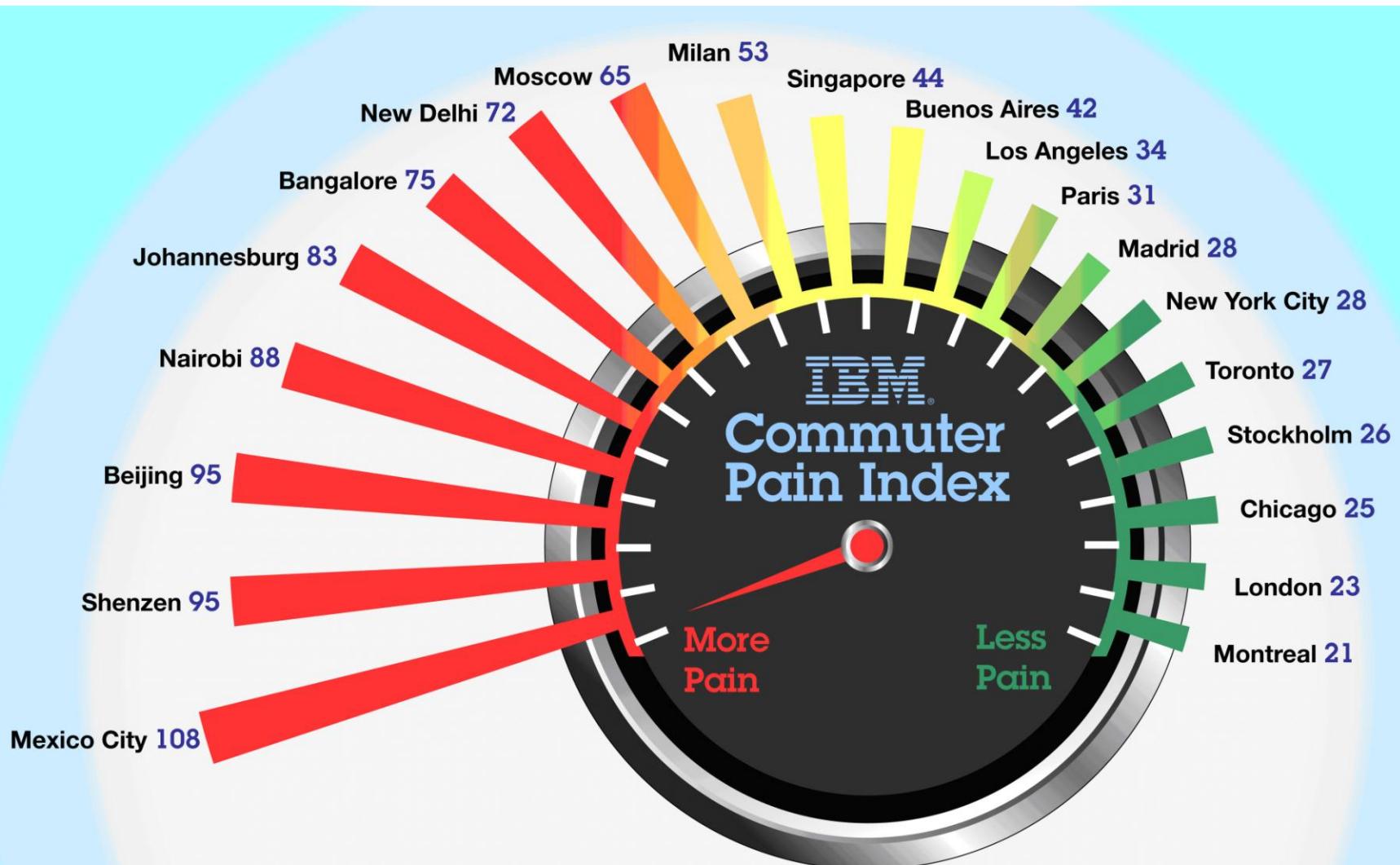
Visual statistics of the Napoleon Campaign: the Minard Map



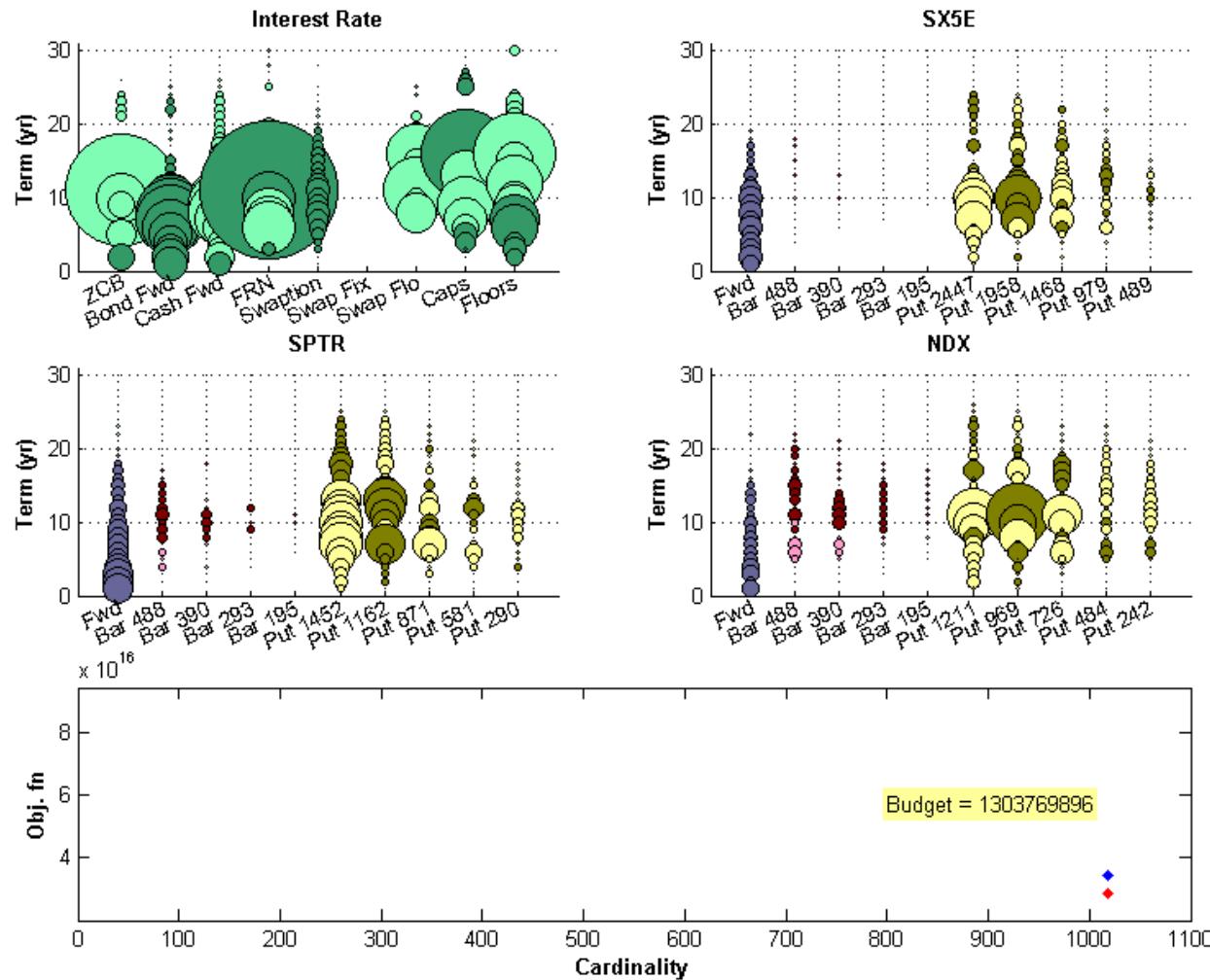
Visual analytics



Visual analytics



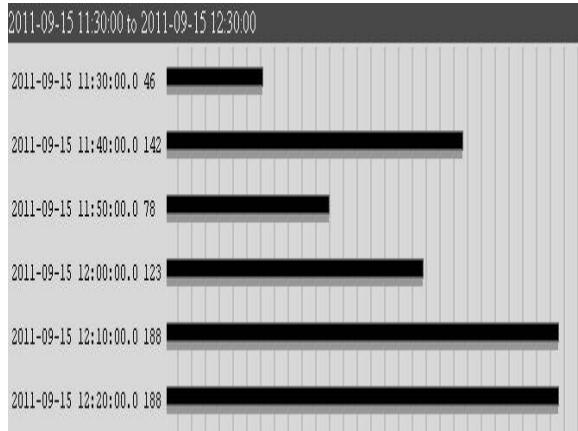
Visual analytics – portfolio



Historical visualization



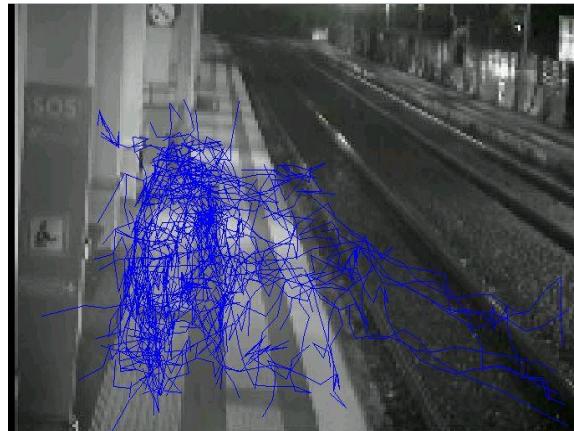
Activity Histogram



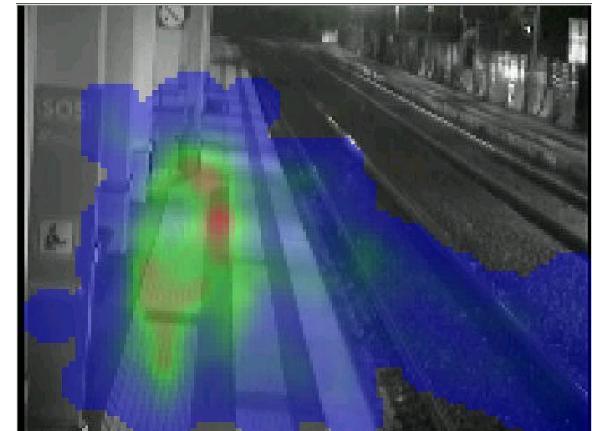
Distribution of events over time



Track Summary

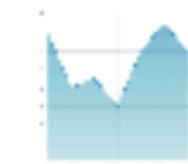


Show tracks of all objects returned from search



How long objects spent in different places

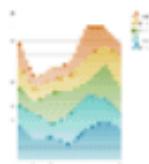
Visualization types



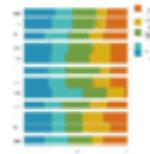
Area (Straight)



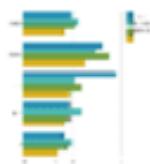
Area (smooth)



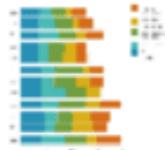
Area - Stacked (Strai...



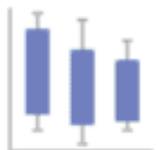
Bar - 100 Percent St...



Bar - Clustered



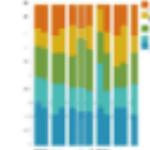
Bar - Stacked



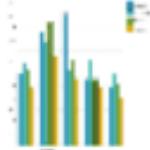
Box plot



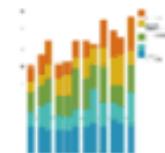
Bubble Chart



Column - 100 Percent...



Column - Clustered



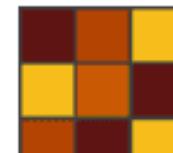
Column - Stacked



Donut



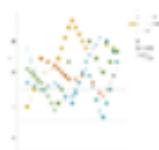
Gantt



Heatmap



Line (smooth)



Line (straight)



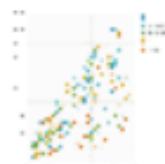
Network diagram



Network with Bubbles



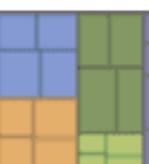
Pie



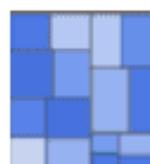
Scatter



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

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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.



Highest Pay

Executive Pay in 2008

	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.

The Quad: Previewing the Women's Final Four

Big East Goes South
Michigan State defeated Connecticut and North Carolina beat Villanova to reach the championship game in Detroit.

Brackets: Men | Women

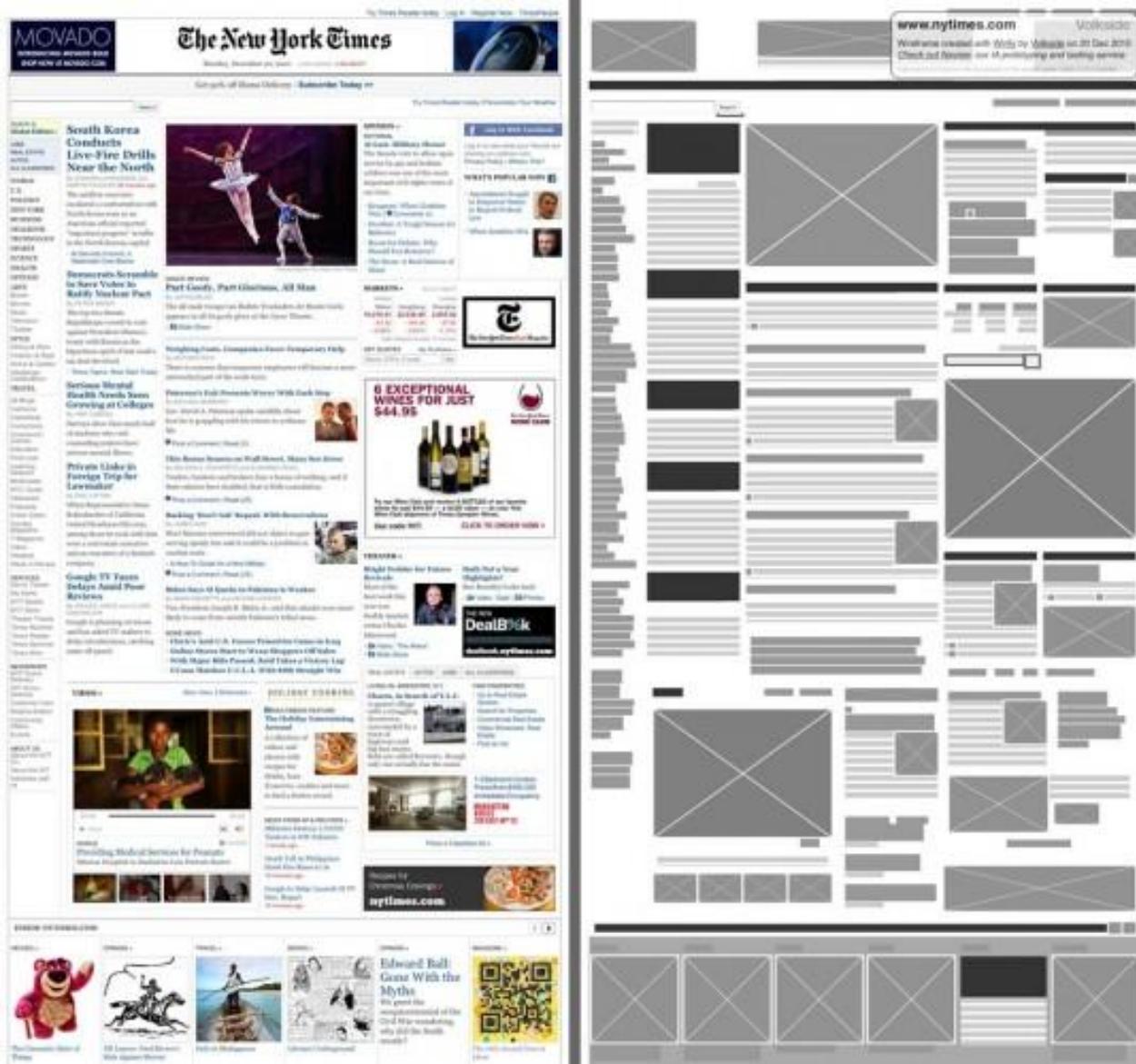
BUSINESS »

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-wolf-avenue.com

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

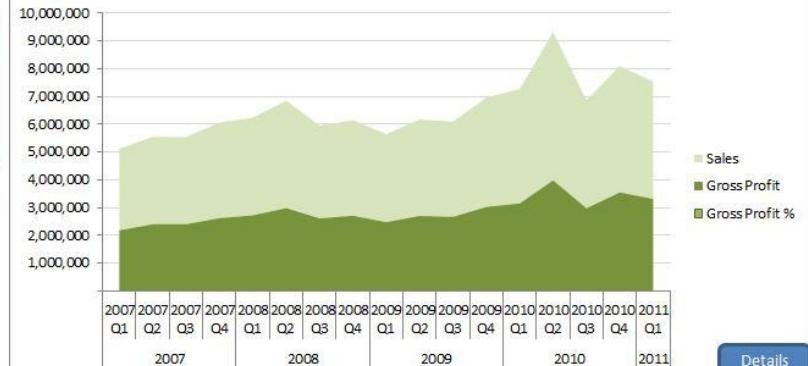
- CORPORATE - Corporate G...
- EVENTS - Events and Trad...
- SPORTS - Sports & Activities

Global Dimension 2

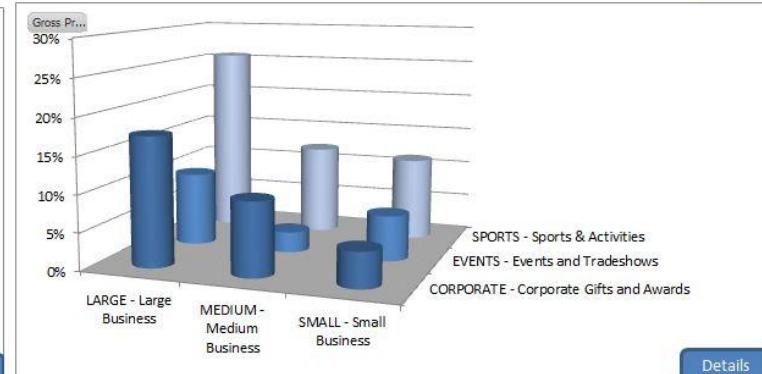
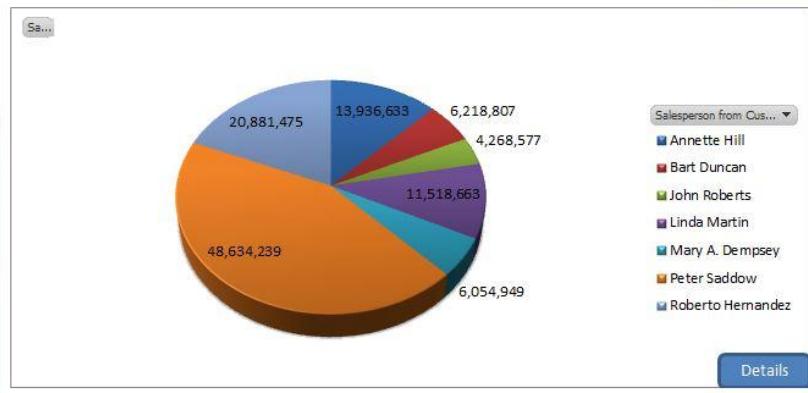
- LARGE - Large Business
- MEDIUM - Medium Business
- SMALL - Small Business

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

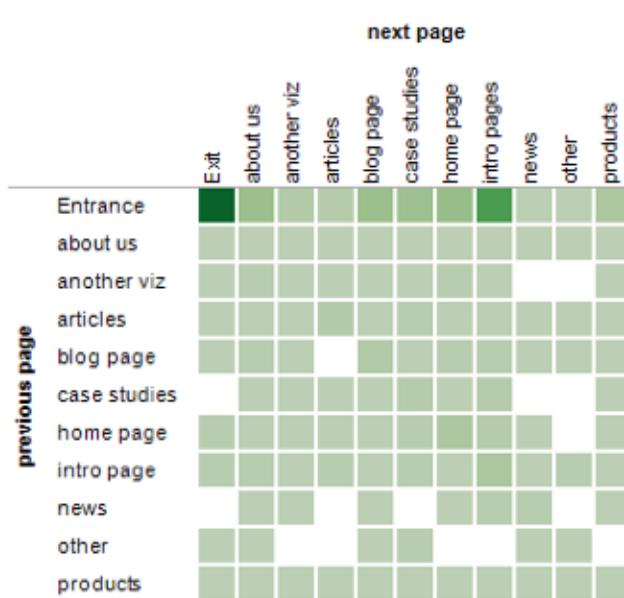
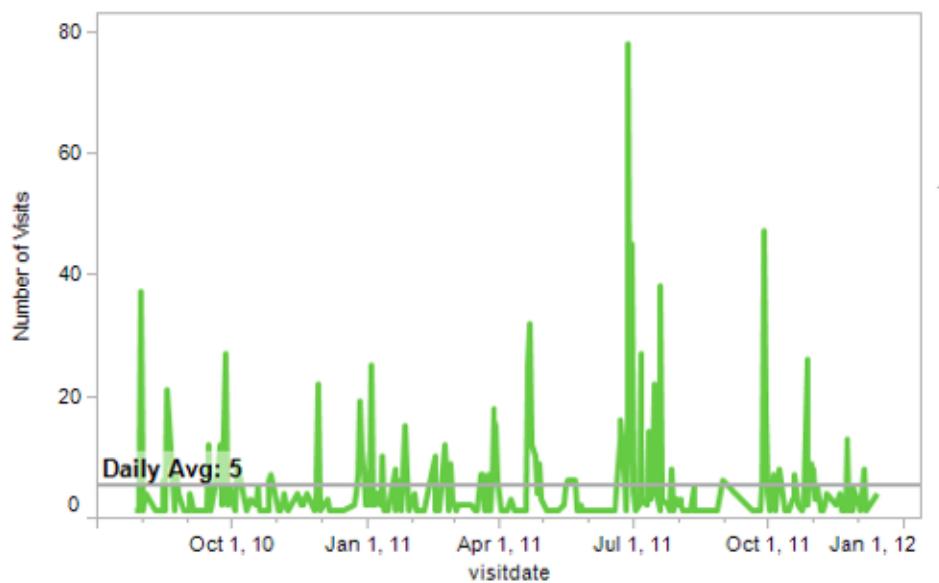
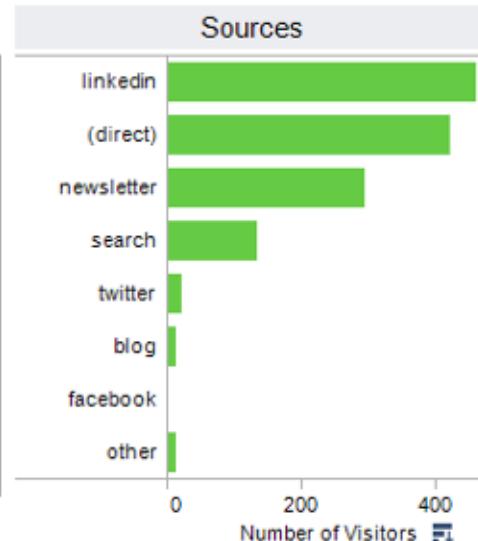
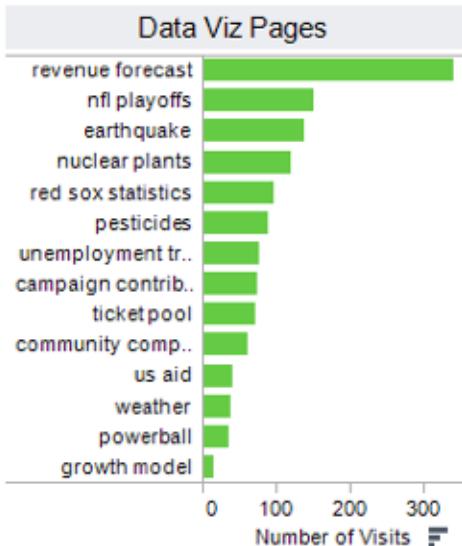
Item Category	
Awards & Recognition	Bags & Totes
Caps & Hats	Clocks & Watches
Corporate Gifts	Electronics
Mugs & Drinkware	Unknown



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	24987.27	
Human Resources	137403.79	247935.97	12052.20	10674.62	
Information Services and Technology	86011.71	67865.87	1451.13	16694.71	
Marketing	75247.02	13569.14	9567.80	53110.08	
Production and Distribution	19826.24	3893.26	1198.28	15136.70	
Sales	74847.23	13497.08	5978.99	53371.16	

Employee Performance:

Employee Performance:

Sales performance with theme.cdd - IBM Cognos Insight

Sales Performance

Quarter	North America	Europe	South America	Total
Q1/2012	181,713.09	169,327.45	252,811.22	57,339.89
Q2/2012	181,055.11	161,507	213,447	40,396
Q3/2012	181,273.08	169,327.45	213,447	40,396
Q4/2012	181,273.08	169,327.45	213,447	40,396

Competitor Analysis Plan.cdd - IBM Cognos Insight

Competitive Data Analysis

Future Chips Product Data

Region	Total of Month	2011-Jan	2011-Feb	2011-Mar	2011-Apr	2011-May	2011-Jun
Asia Pacific	5,216,895	122,820	144,583	166,798	189,933	209,290	21

Competitor Product Data

Region	Total of Month	2011-Jan	2011-Feb	2011-Mar	2011-Apr	2011-May	2011-Jun
Asia Pacific	4,681,350	169,800	181,850	213,900	235,950	258,000	26

Explore Point Example - Customer Return Data.cdd - IBM Cognos Insight

Locations of Returns

Year	Quarter	Month	Country	State/Province	City
2011	Q1/2011	Jan-11	United States	Texas	Austin
2011	Q1/2011	Feb-11	United States	Texas	Houston
2011	Q1/2011	Mar-11	United States	Illinois	Chicago
2011	Q1/2011	Apr-11	United States	Illinois	Chicago
2011	Q1/2011	May-11	United States	Illinois	Chicago
2011	Q2/2011	Jun-11	United States	Illinois	Chicago
2011	Q2/2011	Jul-11	United States	Illinois	Chicago
2011	Q2/2011	Aug-11	United States	Illinois	Chicago
2011	Q2/2011	Sep-11	United States	Illinois	Chicago
2011	Q2/2011	Oct-11	United States	Illinois	Chicago
2011	Q2/2011	Nov-11	United States	Illinois	Chicago
2011	Q2/2011	Dec-11	United States	Illinois	Chicago
2011	Q3/2011	Jan-12	United States	Illinois	Chicago
2011	Q3/2011	Feb-12	United States	Illinois	Chicago
2011	Q3/2011	Mar-12	United States	Illinois	Chicago
2011	Q3/2011	Apr-12	United States	Illinois	Chicago
2011	Q3/2011	May-12	United States	Illinois	Chicago
2011	Q3/2011	Jun-12	United States	Illinois	Chicago
2011	Q3/2011	Jul-12	United States	Illinois	Chicago
2011	Q3/2011	Aug-12	United States	Illinois	Chicago
2011	Q3/2011	Sep-12	United States	Illinois	Chicago
2011	Q3/2011	Oct-12	United States	Illinois	Chicago
2011	Q3/2011	Nov-12	United States	Illinois	Chicago
2011	Q3/2011	Dec-12	United States	Illinois	Chicago
2011	Q4/2011	Jan-13	United States	Illinois	Chicago
2011	Q4/2011	Feb-13	United States	Illinois	Chicago
2011	Q4/2011	Mar-13	United States	Illinois	Chicago
2011	Q4/2011	Apr-13	United States	Illinois	Chicago
2011	Q4/2011	May-13	United States	Illinois	Chicago
2011	Q4/2011	Jun-13	United States	Illinois	Chicago
2011	Q4/2011	Jul-13	United States	Illinois	Chicago
2011	Q4/2011	Aug-13	United States	Illinois	Chicago
2011	Q4/2011	Sep-13	United States	Illinois	Chicago
2011	Q4/2011	Oct-13	United States	Illinois	Chicago
2011	Q4/2011	Nov-13	United States	Illinois	Chicago
2011	Q4/2011	Dec-13	United States	Illinois	Chicago

Smart_Planet_Insight_2002.cdd - Content

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.

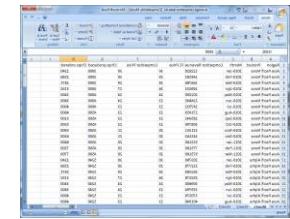
How will it help you?

- 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



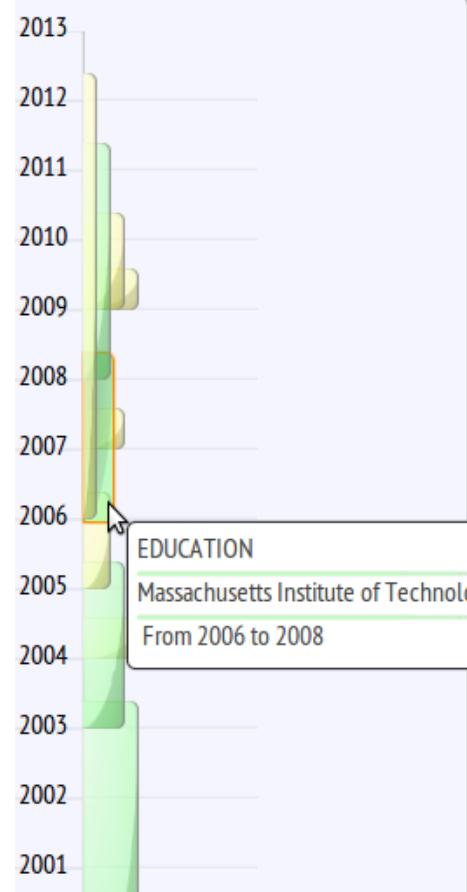
Pranav Mistry | [LinkedIn](#).

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

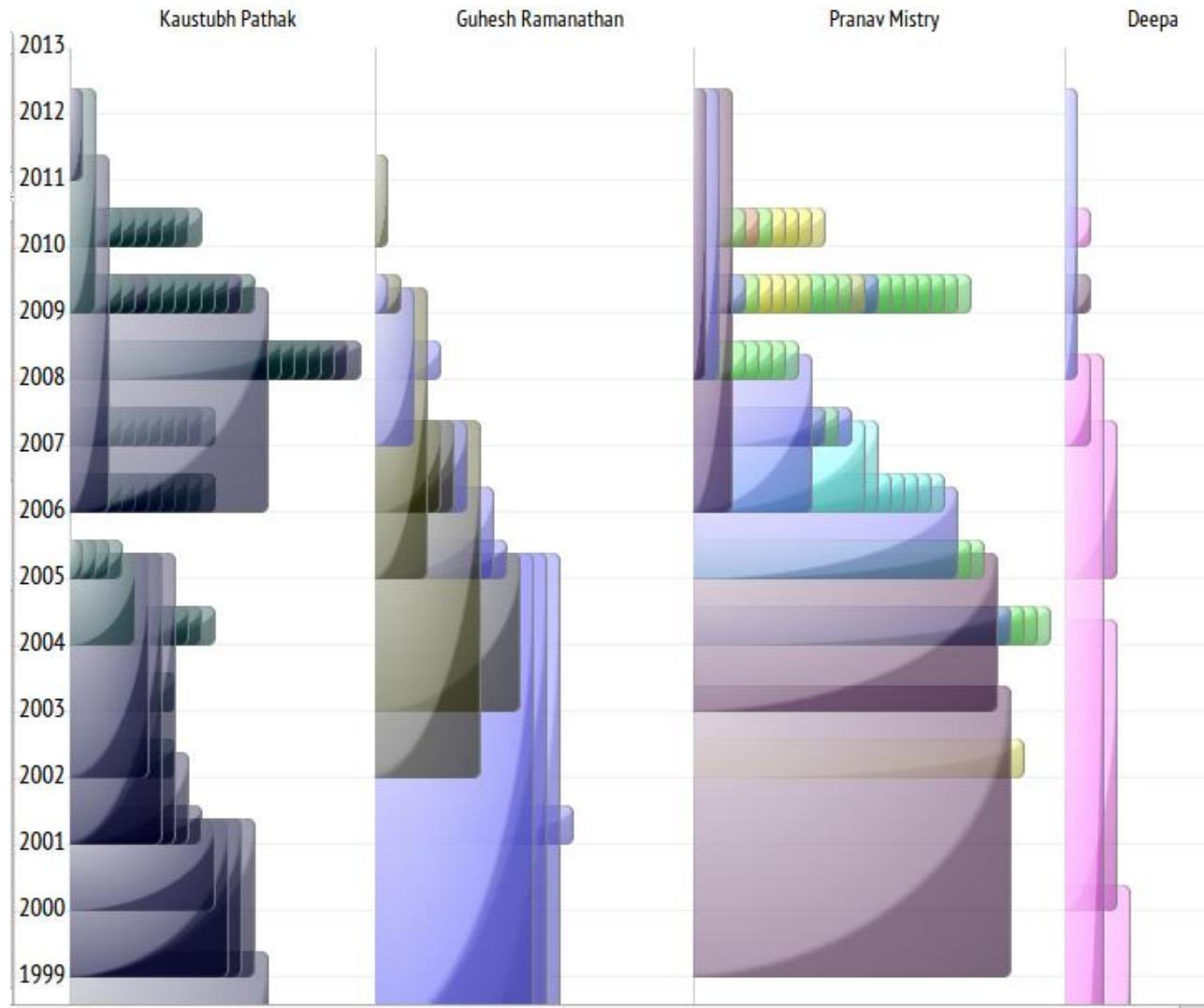
Human-computer Interaction

Prototyping

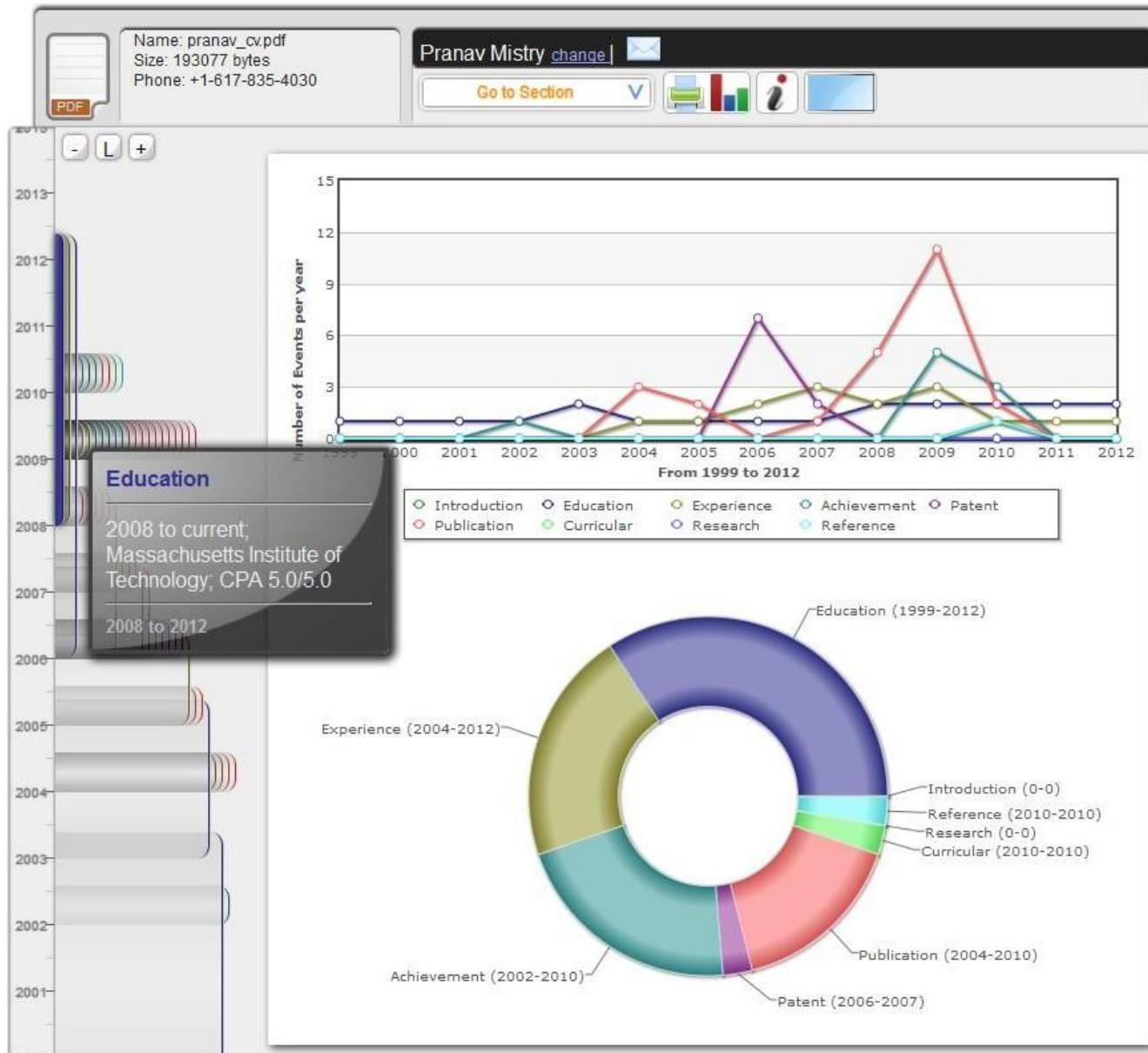


Visual resume

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



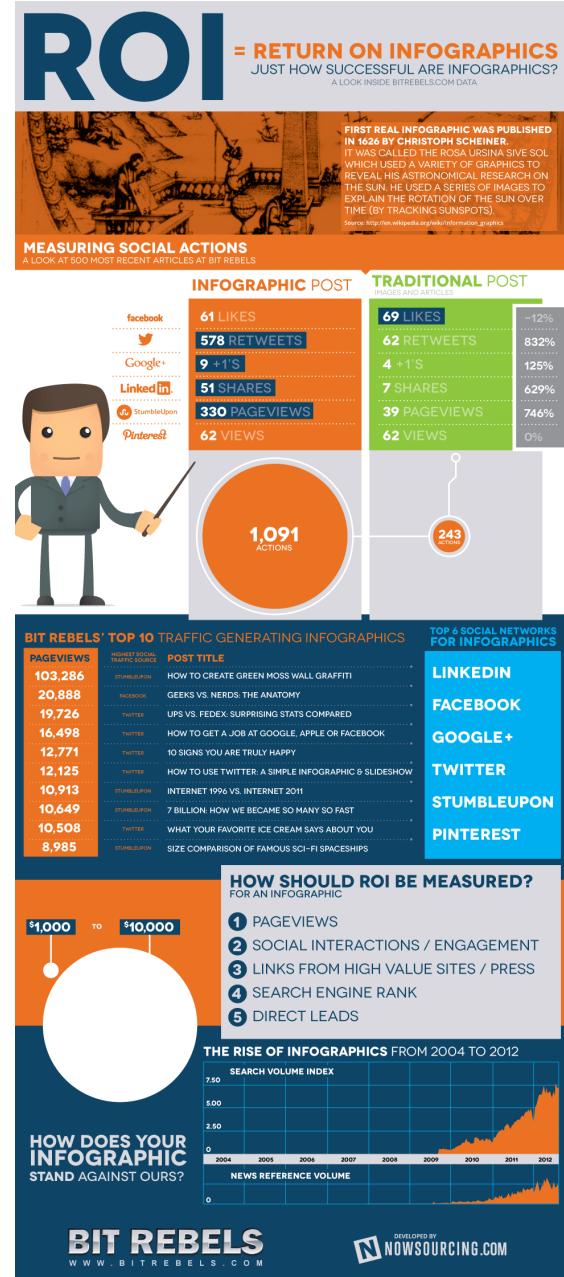
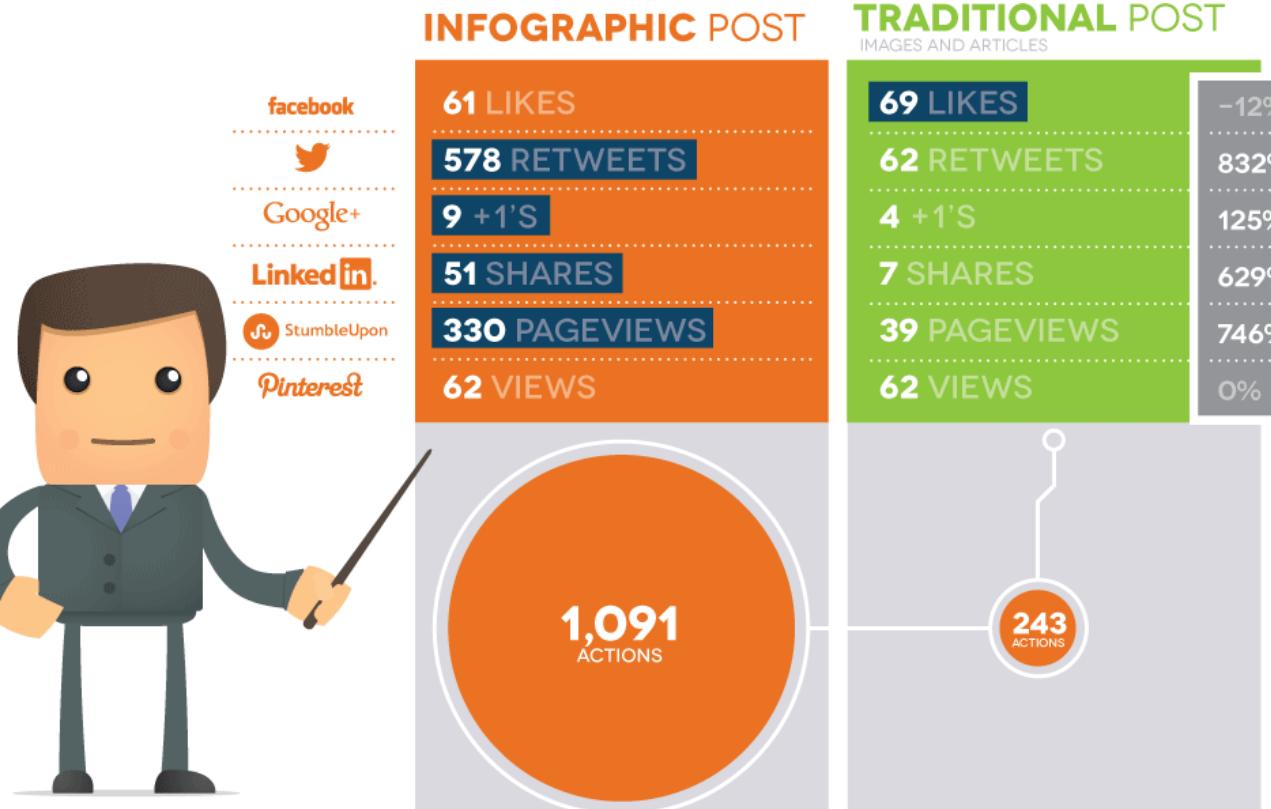
Visual resume



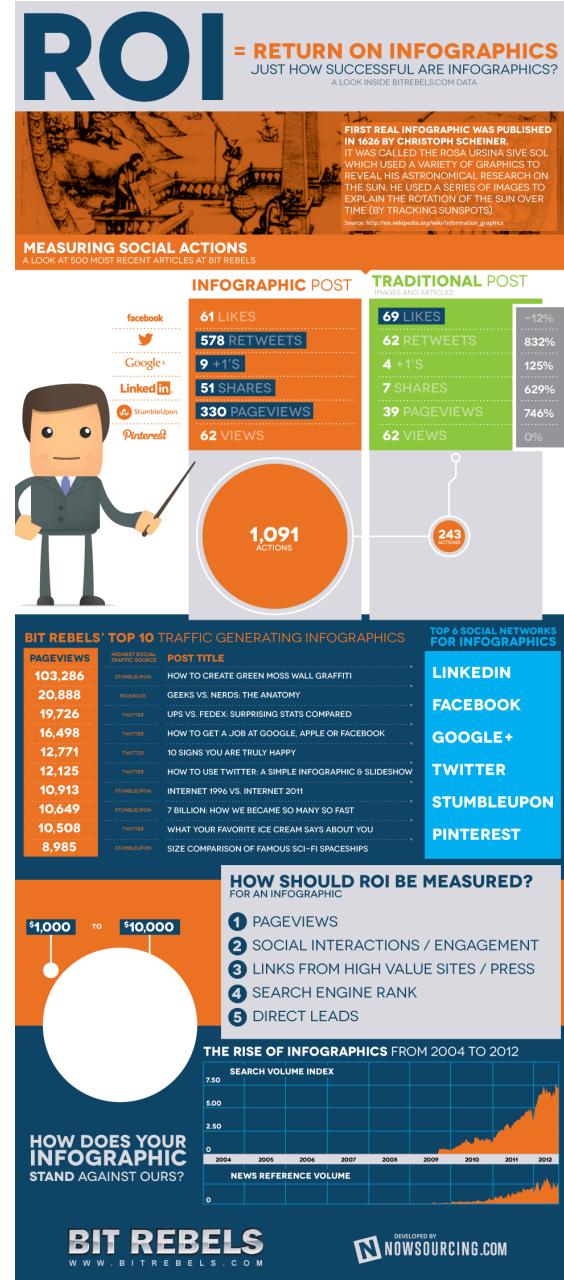
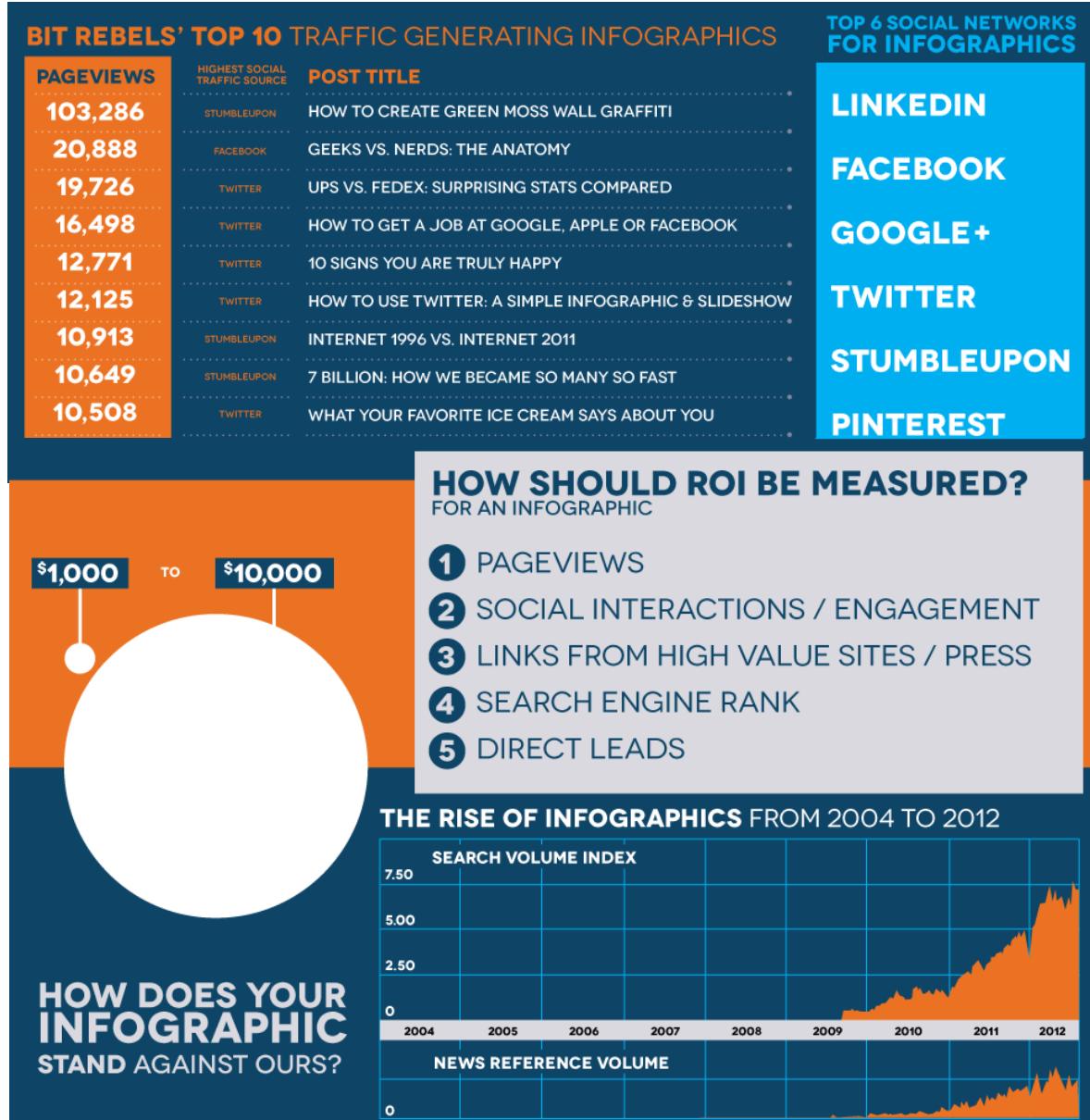


Infographics

Infographics

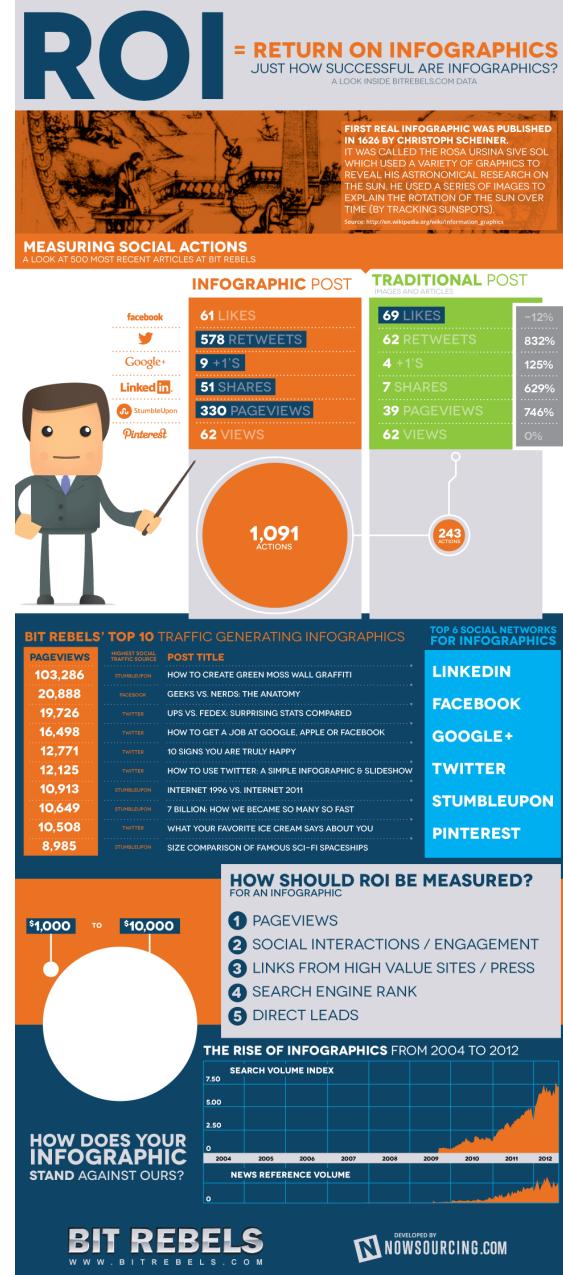


Infographics



Infographics

MUSGO GRAFFITI



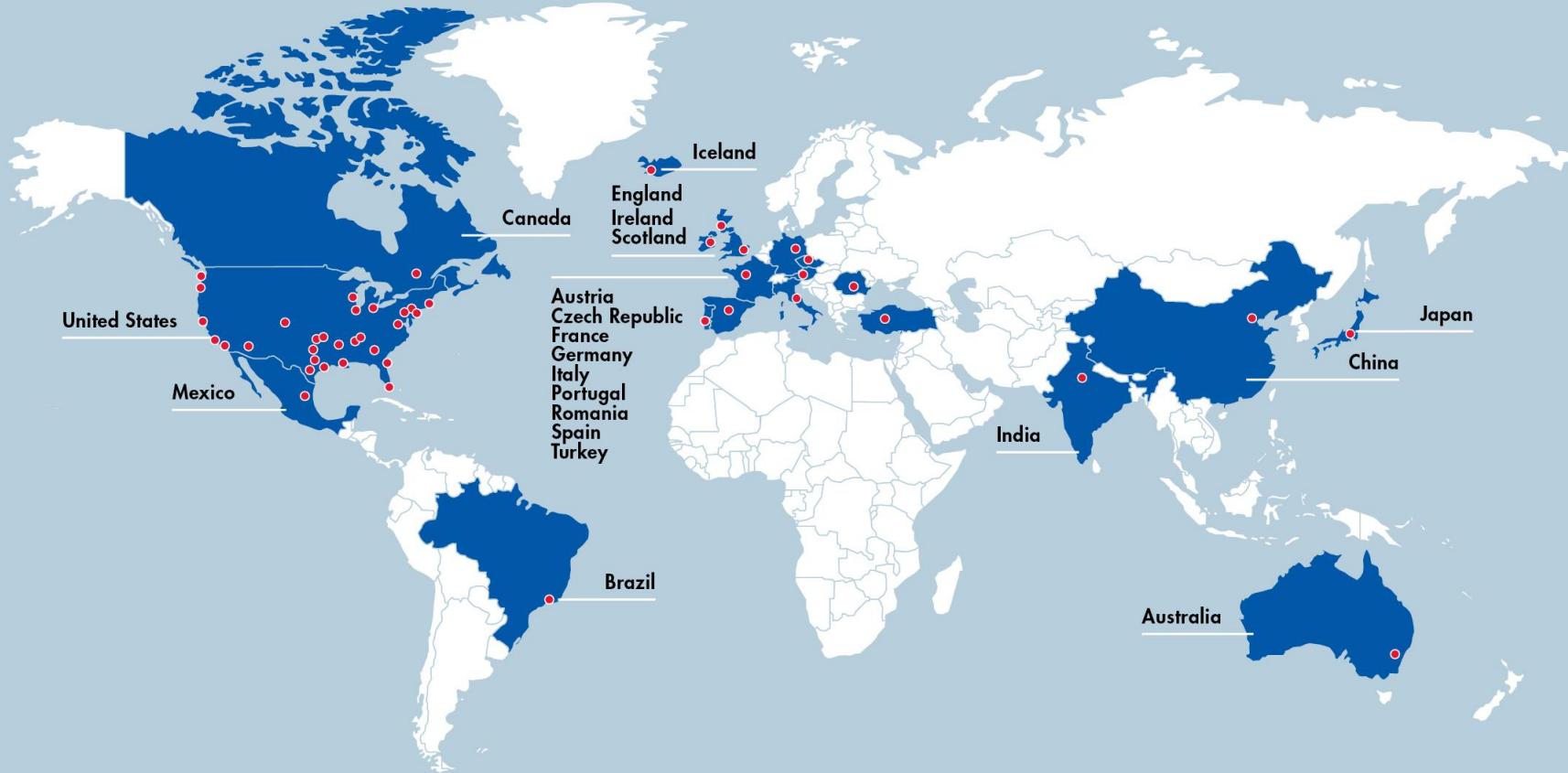


Other Visualizations

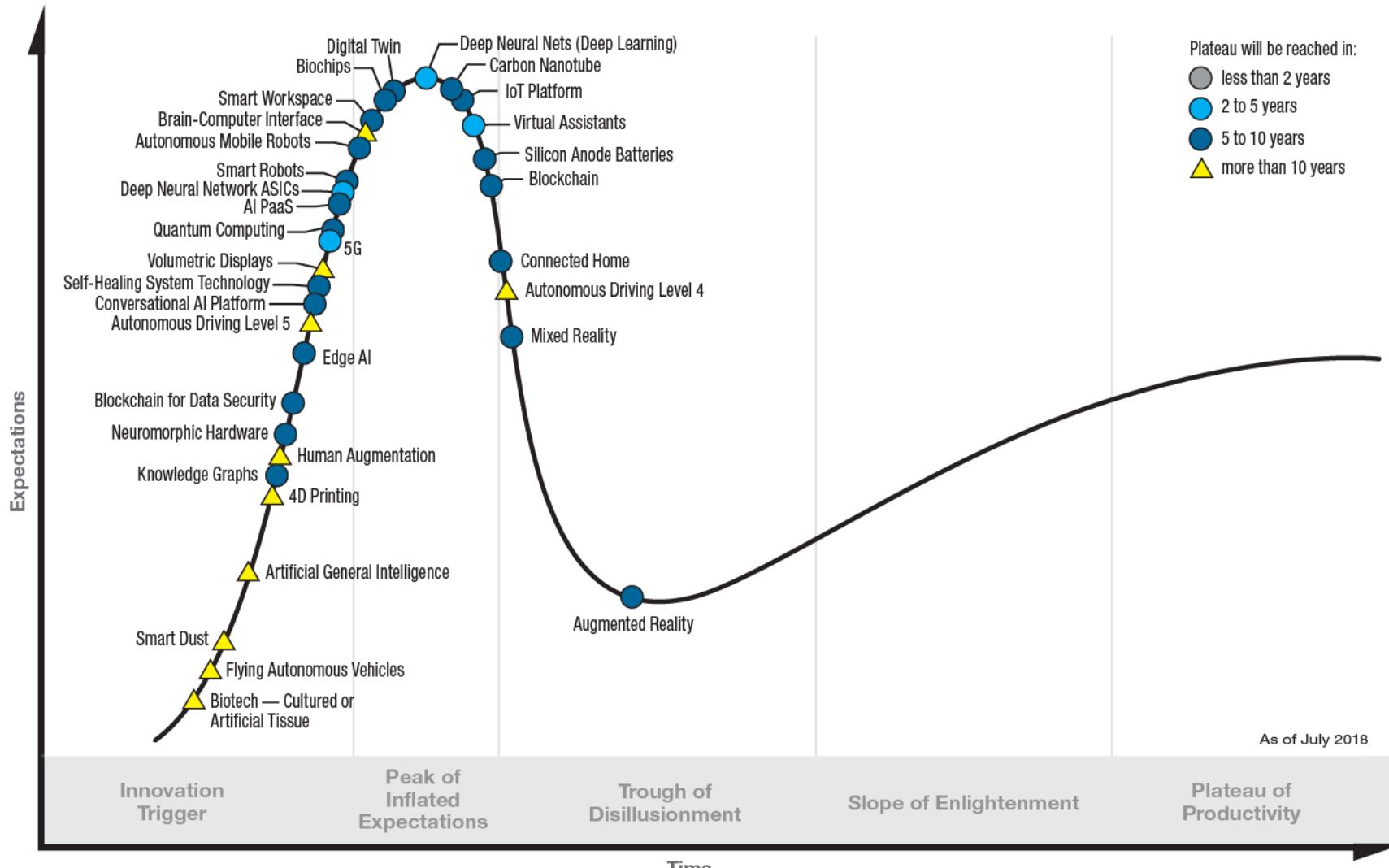
Do you know what are your alumni doing?

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 (2018)



\$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.

Cheap gas,
longer commutes

The Arab
oil embargo

1956-72

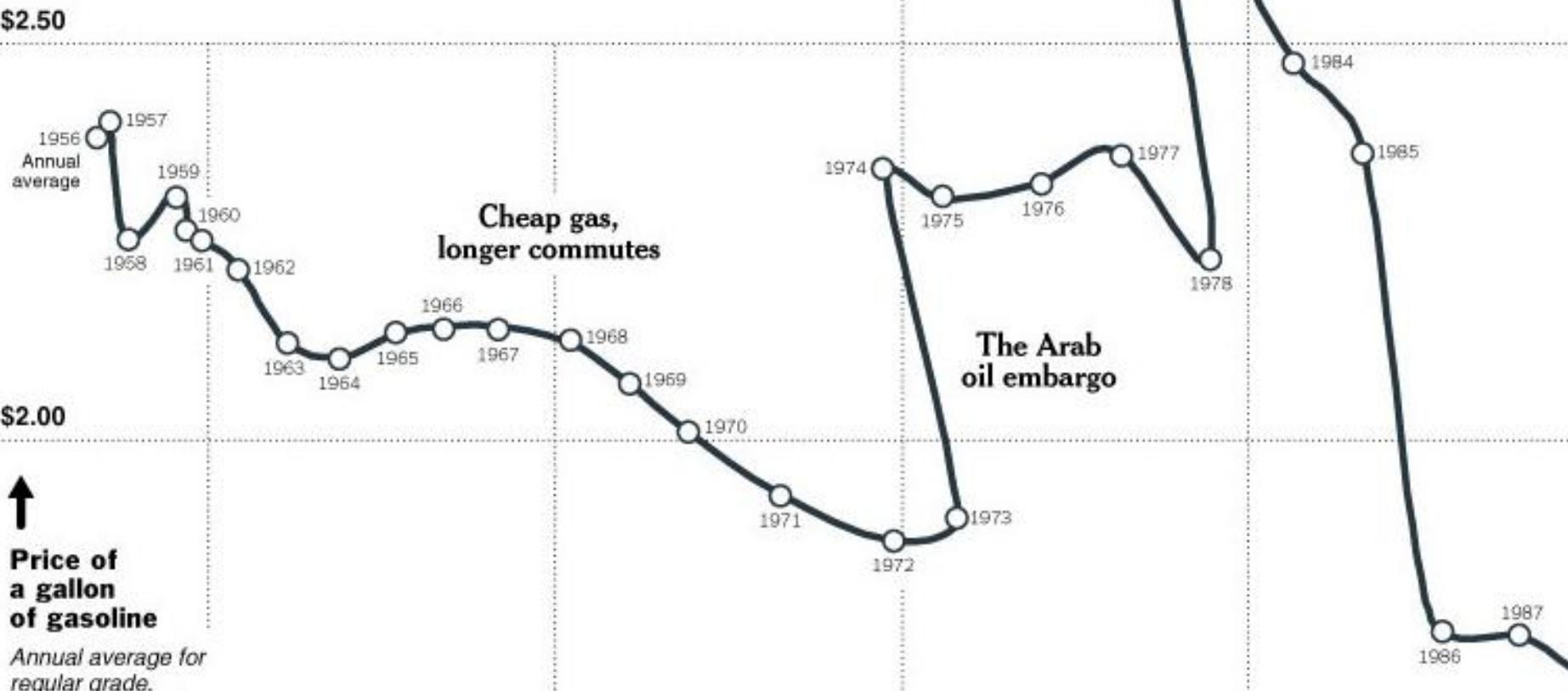
Cheap gas, longer commutes

1973-74

The Arab oil embargo

1978-81

Energy crisis



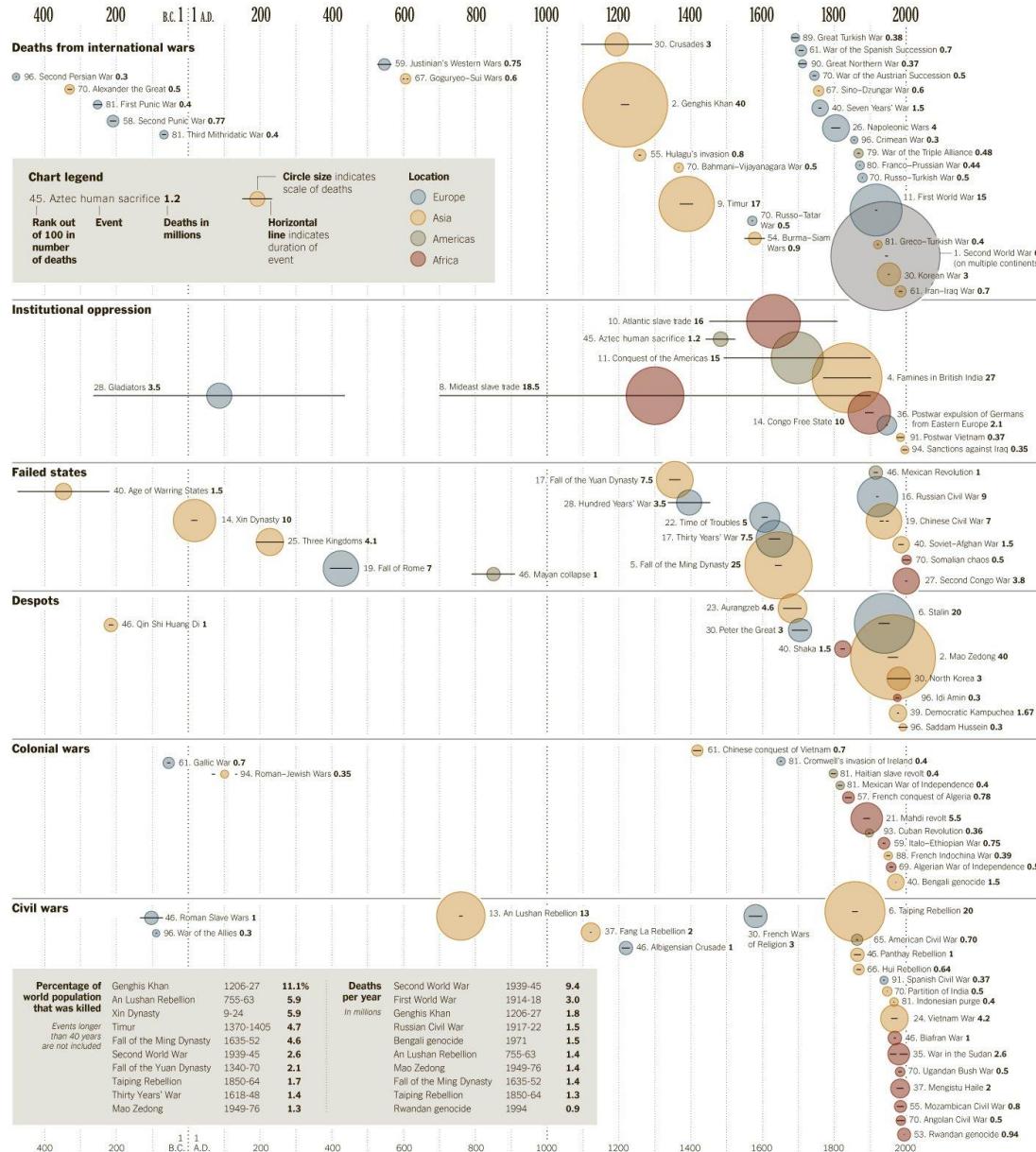
Population Control, Marauder Style

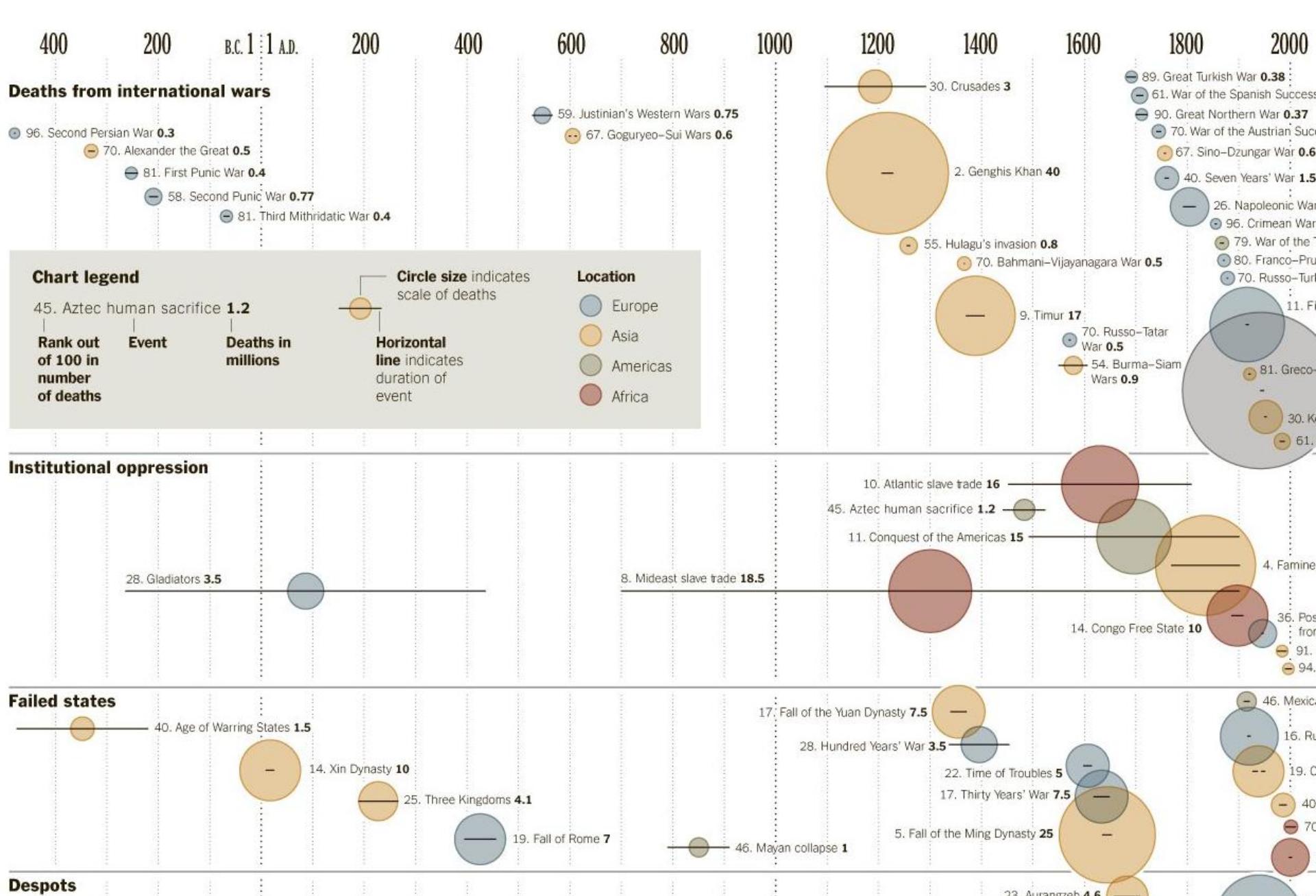
Visual analytics

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 8 percent of world population 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 'Data Discovery' section with 'EXPLORE YOUR DATA' and 'PREDICT AND EXPLAIN' tools, and a 'COMING SOON' section for 'FORECAST FUTURE VALUES'. In the center, there are two main sections: 'Start from Data' and 'Start from a Story'. The 'Start from Data' section features icons for 'TOOL EXPLORE YOUR DATA' and 'TOOL PREDICT AND EXPLAIN'. The 'Start from a Story' section displays a grid of 12 story cards categorized by role: Marketing, Sales, Finance, Operations, HR, and IT. Each card has a title, a brief description, and a small thumbnail image. A search bar at the top right contains a magnifying glass icon. A blue speech bubble in the top right corner says 'Natural language dialogue'. A blue speech bubble in the bottom right corner says 'Mobile-ready'. A blue speech bubble in the bottom left corner says 'Data discovery'.

Welcome to Watson Analytics!

Explore our solutions by role

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

Start from Data

Start from a Story

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

Lore ipsum dolor sit amet, consectetur adipiscing.

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?

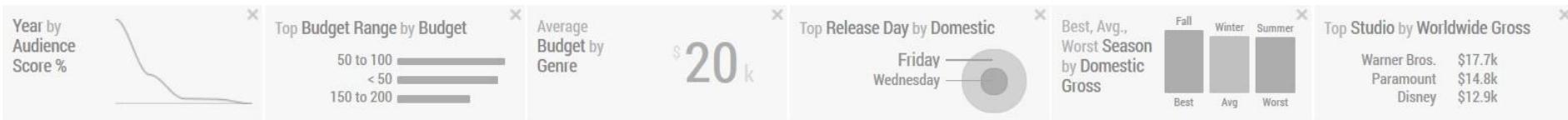
Cloud-based agility

Watson Analytics

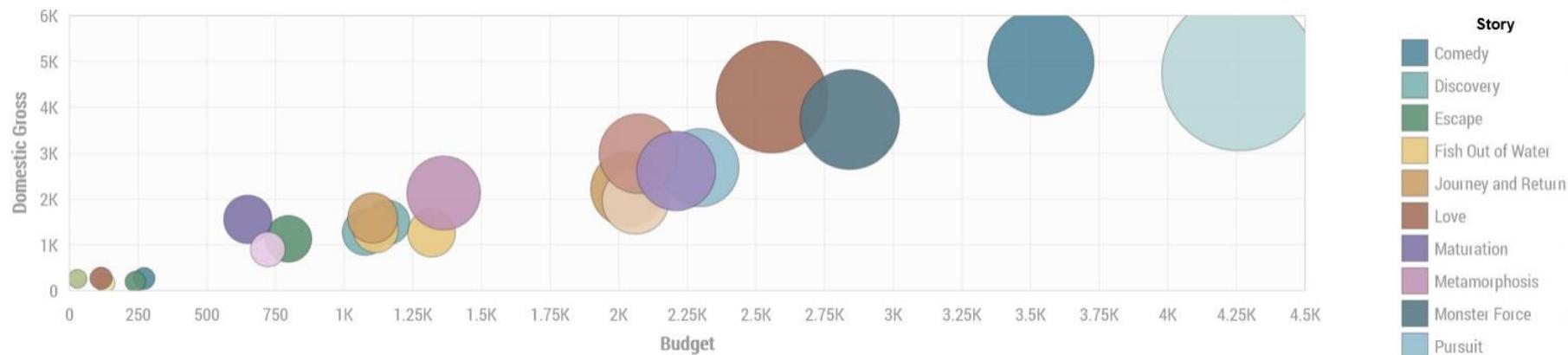
The screenshot displays the Watson Analytics interface with several key features highlighted:

- 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 ease of understanding the predictive model.
- 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.
- 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** ?

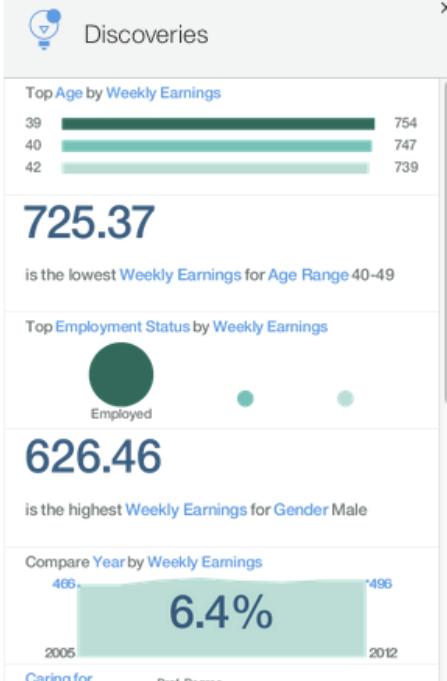


Watson Analytics

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 C...
--	-----------	-----------------	-----------------	------	--------	-----	------------	-----------	--------------------	-----------------	-----------------