Big Data Analytics

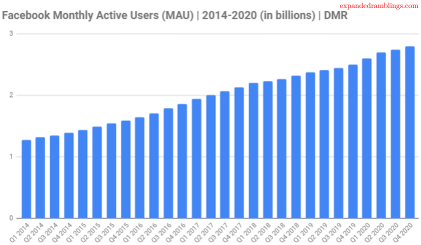
- Big Data Generation and Growth
- What is Big Data
- Importance of Big Data Analytics
- Industries benefiting from Data Analytics
- Sources of Data (people, machines, organizations)
- Aspects of Bigness (The 5 V's of big data)
- Types of Data (table, text, multimedia, stream, sequence, graphs)
- The Analytics Process (preprocessing, analytics, visualization)

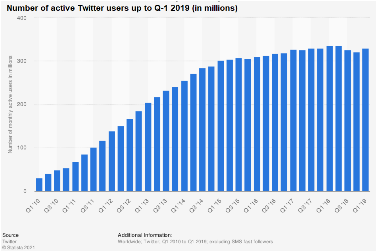
Imdad ullah Khan

Big Data Generation and Growth

- Data has been generated at an exploding rate in recent years
- Organizations collect trillions of bytes of information about their customers, suppliers, and operations every day
- Large pools of data is being captured, communicated, aggregated, stored, and analyzed by businesses, academia, and governments
- Individuals with smartphones on social network sites are continuously fueling the exponential growth of multimedia data

Big Data Generation and Growth





Big Data Generation and Growth

Where data comes from?

- Internet users generate about 2.5 quintillion bytes of data each day[1]
- In 2018, internet users spent 2.8 million years online[2]
  - Social media accounts for 33% of the total time spent online [2]
- In 2019, there were 2.3 billion active Facebook users
- Twitter users send nearly half a million tweets every minute[1]
- By 2020, every person will generate 1.7 megabytes in just a second[1]
- By 2020, there will be 40 trillion gigabytes of data (40 zettabytes)[3]
- 90% of all data has been created in the last two years [4]

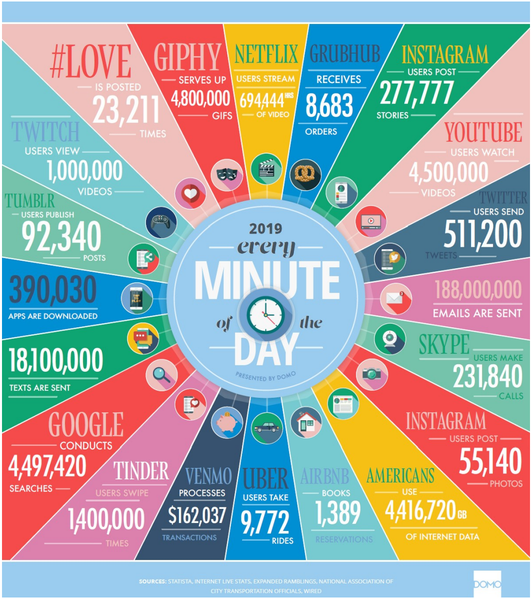
[1] Domo report (a company with data analytic platform for businesses)

[2] Global Web Index report (a company with big data analytic platform)

[3] EMC (Dell EMC provides big data solutions)

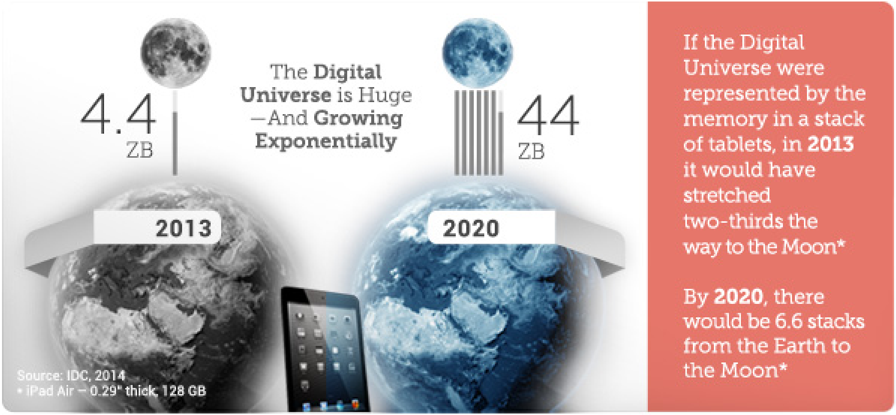
[4] IBM

Big Data Generation and Growth



SOURCES: STATISTA, INTERNET LIVE STATS, EXPANDED RAMBLINGS, NATIONAL ASSOCIATION OF CITY TRANSPORTATION OFFICIALS, WIRED

Big Data Generation and Growth



The **Digital Universe** is Huge —And **Growing Exponentially**

If the Digital Universe were represented by the memory in a stack of tablets, in **2013** it would have stretched two-thirds the way to the Moon*

By **2020**, there would be 6.6 stacks from the Earth to the Moon*

Source: IDC, 2014
* iPad Air – 0.29" thick, 128 GB

- 90% of all data has been created in the last two years [5]

[5] IBM

What is Big Data

- **"Big data"**: datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze

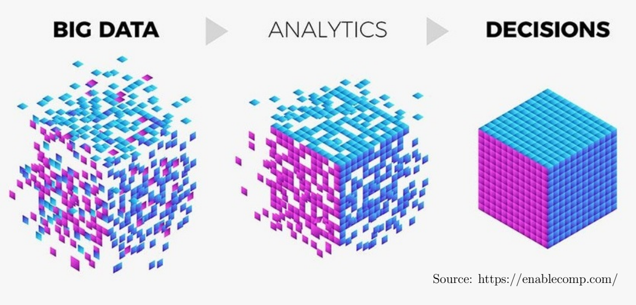
- As technology advances over time, the size of datasets that qualify as big data will also increase

- The definition varies by sector, depending on the kinds of available software tools and sizes of datasets in a particular industry

- With those caveats, big data in many sectors today will range from a few dozen terabytes to multiple petabytes (thousands of terabytes)

Data Analytics

- Data: Set of values of qualitative or quantitative variables
- Information: Meaningful or organized data
- Data Analytics: The process of examining data in order to draw and communicate useful conclusions about the information it contains



Source: https://enablecomp.com/

Big Data Analytics: Market

Data Analytics: Then and Now

- Data Analytics has been around for years
- Even in 1950's, businesses were using basic analytics (manual examination) on data (essentially numbers in a spreadsheet) to uncover insights and trends
- New tools and technologies bring speed and efficiency in techniques
- Today, businesses analyze data and can identify insights for immediate decisions
- The ability to work faster and stay agile gives organizations a competitive edge they did not have before

Why is Big Data Analytics Important

Organizations analyze data

- to identify new opportunities
- to gain insights that lead to smarter business decisions
- to identify methods for more efficient operations
- to maximize larger revenues and higher profits
- to keeps customers satisfied

Top three factors businesses got the most value in

- Cost reduction
- Faster, better decision making
- New products and services

Cost reduction
BIG DATA ANALYTICS
Faster, better decision making
New products & services

Why enterprises use Big Data Analytics

Companies are using big data analytics for all types of decisions

The Evolution of Decision Making:
How Leading Organizations Are
Adopting a Data-Driven Culture

A REPORT BY **HARVARD BUSINESS REVIEW ANALYTIC SERVICES**

Sponsored by

sas THE POWER TO KNOW.

Harvard Business Review

What enterprises use Big Data Analytics for

- Competitor Analysis
  - Online traffic to websites and related social media
- Market Analysis
  - Trends and market segment analysis
- Productivity Enhancement
  - Analyze employees tracking data
- Cost Cutting
  - Reduce energy bills, optimize routes, predict demands, process efficiency and automation[6]
- Targeted Marketing
  - Analyze purchasing history and target the right people for a product
- Improved Customer Relations
  - Analyze customer feedback and make adjustments

[6] Forbes (01/08/2016) Big Data Analytics' Potential to Revolutionize Manufacturing Is Within Reach

Industries Benefiting from Big Data Analytics

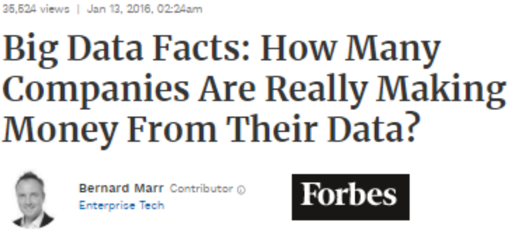
- Retail: Advertising, Targeted marketing, recommendation system, customer loyalty, inventory management, demand prediction
- Banking and Financial: Customer loyalty and churn, fraud detection, risk assessment
- Brands: 66% brands use data analytics for product and service launch, appropriate timings
- Logistics and Transportation: Fleet management, maintenance needs, drivers risk assessment, real time tracking
- Health Care: Efficiency in healthcare operations, predictive analytics, outbreak prediction, immunization strategy

Google's AI system can beat doctors at detecting breast cancer

By Hanna Ziady, CNN BUSINESS January 2, 2020

- Government & Utility Companies: Surveys & census, development planning, health, education, energy supply & demand management

Industries Benefiting from Big Data Analytics

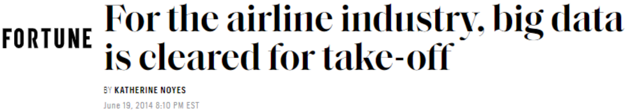


35,624 views | Jan 13, 2016, 02:24am

Big Data Facts: How Many Companies Are Really Making Money From Their Data?

Bernard Marr Contributor ⓘ
Enterprise Tech

Industries Benefiting from Big Data Analytics



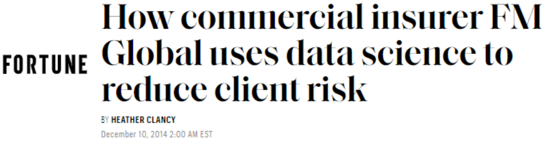
FORTUNE

For the airline industry, big data is cleared for take-off

BY KATHERINE NOYES

June 19, 2014 8:10 PM EST

Industries Benefiting from Big Data Analytics



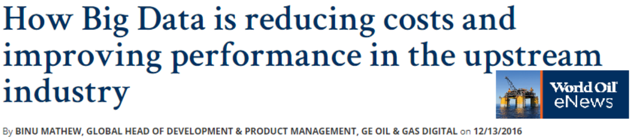
FORTUNE

How commercial insurer FM Global uses data science to reduce client risk

BY HEATHER CLANCY

December 10, 2014 2:00 AM EST

Industries Benefiting from Big Data Analytics

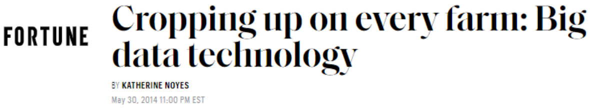


How Big Data is reducing costs and improving performance in the upstream industry

World Oil eNews

By BINU MATHEW, GLOBAL HEAD OF DEVELOPMENT & PRODUCT MANAGEMENT, GE OIL & GAS DIGITAL on 12/13/2016

Industries Benefiting from Big Data Analytics



FORTUNE

Cropping up on every farm: Big data technology

BY KATHERINE NOYES

May 30, 2014 11:00 PM EST

Industries Benefiting from Big Data Analytics

FORTUNE

Bright lights, big cities, bigger data

BY SHALENE GUPTA

October 31, 2014 3:42 AM EST

Industries Benefiting from Big Data Analytics

FORTUNE

Can Big Data cure cancer?

BY MIGUEL HELFT

July 24, 2014 4:31 PM EST

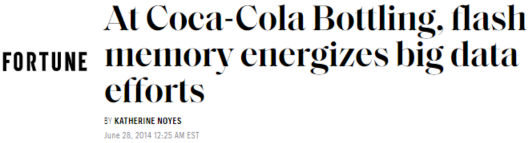
Industries Benefiting from Big Data Analytics

Can smart sensor systems anticipate and avoid danger?

Kate Pisa, CNN

Updated 1508 GMT (2308 HKT) January 21, 2020

Industries Benefiting from Big Data Analytics



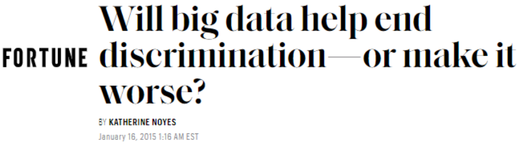
FORTUNE

At Coca-Cola Bottling, flash memory energizes big data efforts

BY KATHERINE NOYES

June 28, 2014 12:25 AM EST

Industries Benefiting from Big Data Analytics



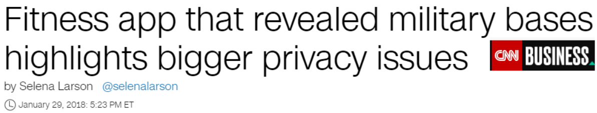
FORTUNE

Will big data help end discrimination—or make it worse?

BY KATHERINE NOYES

January 16, 2015 1:16 AM EST

Industries Benefiting from Big Data Analytics

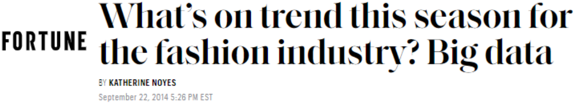


Fitness app that revealed military bases highlights bigger privacy issues CNN BUSINESS

by Selena Larson @selenalarson

January 29, 2018: 5:23 PM ET

Industries Benefiting from Big Data Analytics



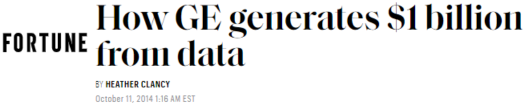
FORTUNE

What's on trend this season for the fashion industry? Big data

BY KATHERINE NOYES

September 22, 2014 5:26 PM EST

Industries Benefiting from Big Data Analytics



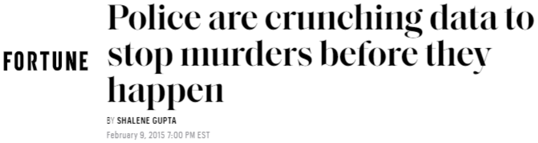
FORTUNE

How GE generates $1 billion from data

BY HEATHER CLANCY

October 11, 2014 1:16 AM EST

Industries Benefiting from Big Data Analytics



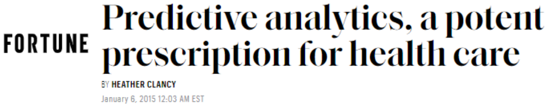
FORTUNE

Police are crunching data to stop murders before they happen

BY SHALENE GUPTA

February 9, 2015 7:00 PM EST

Industries Benefiting from Big Data Analytics



FORTUNE

Predictive analytics, a potent prescription for health care

BY HEATHER CLANCY

January 6, 2015 12:03 AM EST

Big Data Analytics - Market

- 12% - the rate of increase for big data and business analytics use from 2018 to 2019 [7]

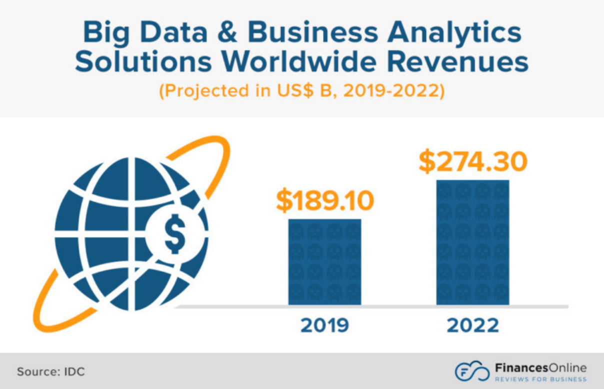
- $189.1 billion – projected worldwide revenues for big data and business analytics solutions for 2019 [7]

- $274.3 billion – projected worldwide revenues for big data and business analytics solutions by 2022 [7]

- 13.2% - projected compound annual growth rate (CAGR) of big data and business analytics within the five-year period, 2018-2022 [7]

[7] International Data Corporation (IDC) - Big data analytics company

Big Data Analytics - Market



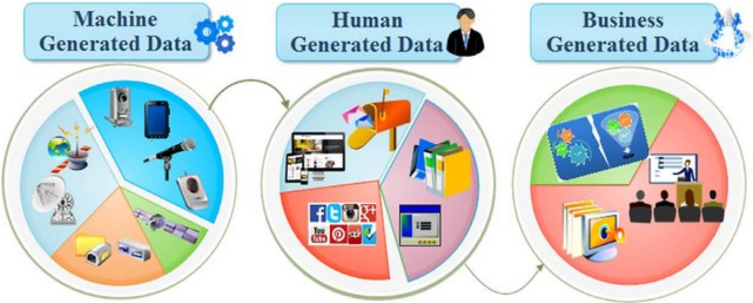
Big Data & Business Analytics Solutions Worldwide Revenues

(Projected in US$ B, 2019-2022)

Source: IDC

Sources of Big Data

Sources of Big Data



ELSEVIER

Information Processing & Management

Volume 54, Issue 5, September 2018, Pages 758-790

A survey towards an integration of big data analytics to big insights for value-creation

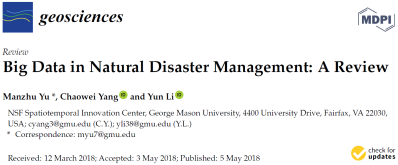
Mandeep Kaur Saggi, Sushma Jain

Sources: Machine Generated Data

- Biggest source of big data
- Temperature sensors, GPS navigator, Satellite imagery, Apps,
- Increasing number of smart devices, IoT
- A 12 hours flight produces 84TB of data, sensors, temperature, pressure, accelerometer, turbulence
- Smart City, Smart Transportation
- Think about the volume of video data collected at Lahore Safe City Authority Control Room
- Generally, such data is unstructured

Sources: People Generated Data

- Blogs, social network posts, keywords search, photo sharing, pictures, emails, ratings and reviews
- Daily facebook data 30+ PB > All US Academic libraries (2 PB)
- Companies use 12PB/day Twitter data for sentiment analysis around their products
- Could be used for disaster management, e.g. to identify and measure affected areas and channel resources



geosciences

MDPI

Review

Big Data in Natural Disaster Management: A Review

Manzhu Yu *, Chaowei Yang and Yun Li

NSF Spatiotemporal Innovation Center, George Mason University, 4400 University Drive, Fairfax, VA 22030, USA; cyang3@gmu.edu (C.Y.); yli38@gmu.edu (Y.L.)
* Correspondence: myu7@gmu.edu

Received: 12 March 2018; Accepted: 3 May 2018; Published: 5 May 2018

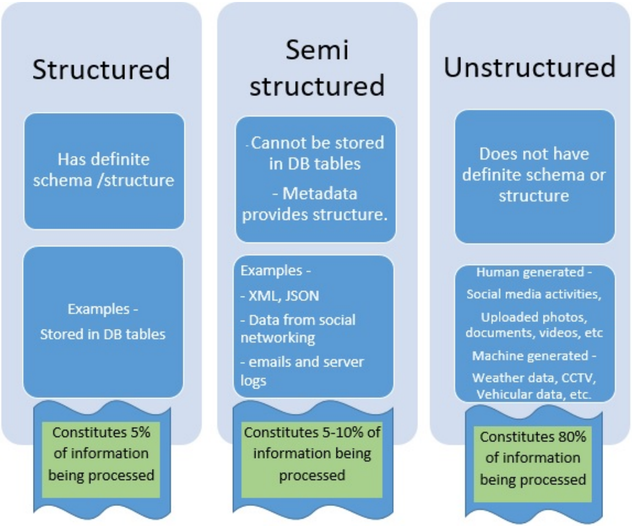
check for updates

- Typically unstructured, or at best semi-structured such as emails, where the header has somewhat of a structure, except in few cases such as filling up a survey form
- Generally more text: 500 million tweets per day

Sources: Organization Generated Data

- LUMS Students Data, ESPN Cricinfo, TCS shipment tracking data
- Governments open data, Stock Records, Banks, e-Commerce
- Medical Records
- Optimize routs and optimal scheduling can save 50m by reducing each drivers route by one mile
- Combine Walmart sales data with Twitter sentiment analyses or events to launch a new product
- Estimate demands
- Fraud Detection
- Highly Structured Data

Categories of Data



Structured

Has definite schema /structure

Examples -

Stored in DB tables

Constitutes 5% of information being processed

Semi structured

- Cannot be stored in DB tables

- Metadata provides structure.

Examples -

- XML, JSON

- Data from social networking

- emails and server logs

Constitutes 5-10% of information being processed

Unstructured

Does not have definite schema or structure

Human generated -

Social media activities,

Uploaded photos, documents, videos, etc

Machine generated -

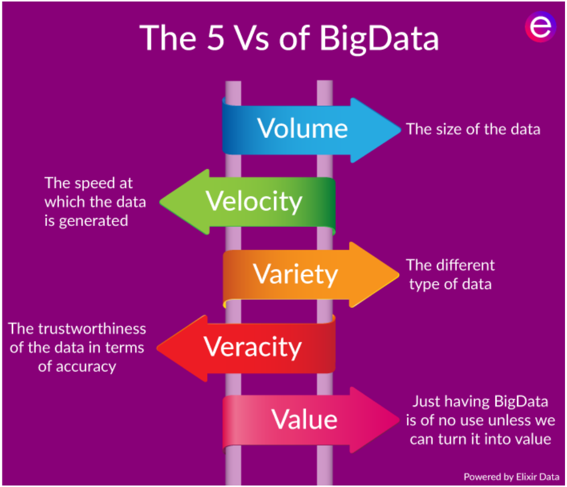
Weather data, CCTV, Vehicular data, etc.

Constitutes 80% of information being processed

The 5 V's of Data

Aspects of Big: The 5 V's

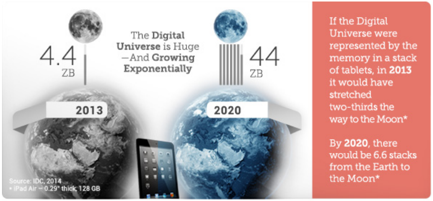
1. Volume
2. Velocity
3. Variety
4. Veracity
5. Value


The 5 Vs of BigData
Volume
The size of the data
Velocity
The speed at which the data is generated
Variety
The different type of data
Veracity
The trustworthiness of the data in terms of accuracy
Value
Just having BigData is of no use unless we can turn it into value
Powered by Elixir Data

Aspects of Big: The 5 V's – Volume

Volume: size, scale, dimensionality,

- 204m emails/minute, if an email is 100KB, see the volume



If the Digital Universe were represented by the memory in a stack of tablets, in **2013** it would have stretched two-thirds the way to the Moon*

By **2020**, there would be 6.6 stacks from the Earth to the Moon*

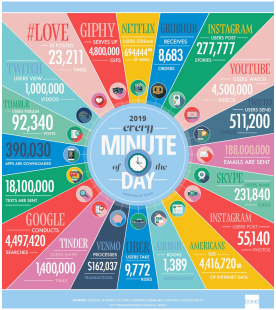
Source: IDC, 2014
* iPad Air – 0.29" thick, 128 GB

- Challenges: Acquisition, Storage, Retrieval, Processing Time
- Large dimensional data has more information, it is a blessing
- It is a also a big curse, dealing with large dimensions is a core topic in this course

Aspects of Big: The 5 V's – Velocity

Velocity: Speed of data is very high

- Number of emails, twitter messages, photos, videos etc. per second

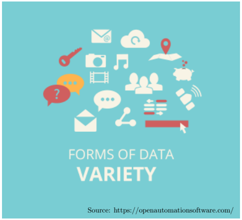


SOURCES: STATISTA, INTERNET LIVE STATS, EXPANDED RAMBLINGS, NATIONAL ASSOCIATION OF CITY TRANSPORTATION OFFICIALS, WIRED

- Late decisions implies missed opportunities
- Real time processing vs Batch Processing (end of the day)

Aspects of Big: The 5 V's – Variety

Variety: Structural variety, different formats, models



Source: https://openautomationsoftware.com/

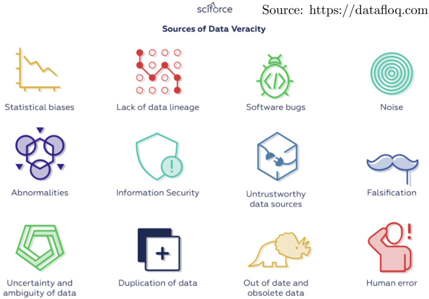
- Medium variety, audio, text, video,
- DBMS, files, traffic logs, XML, code
- Online vs Offline,
- Real time vs Intermittent data (another way data varies)
- Challenges: requirement of analytics, Semantic, how to interpret

Aspects of Big: The 5 V's – Veracity

Veracity: Quality of data

- Data could have many issues (biases, anomalies, inconsistent measurements and units, incomplete and duplicate records)
- Volatility in data, updated/outdated, changing trends/sentiments
- Trustworthiness and reliability of sources and generation/processing
- Fake news, rumours, fake likes, fake followers

Source: https://datafloq.com/



Aspects of Big: The 5 V's – Value

Value: Data can be turned into big value

- Data having no value is of no good to the company
- Should be able to meet strategic objectives
- Should amplify other technology innovations

5 Vs of Big Data: Value

The Economist Intelligence Unit report on surveying 476 executives

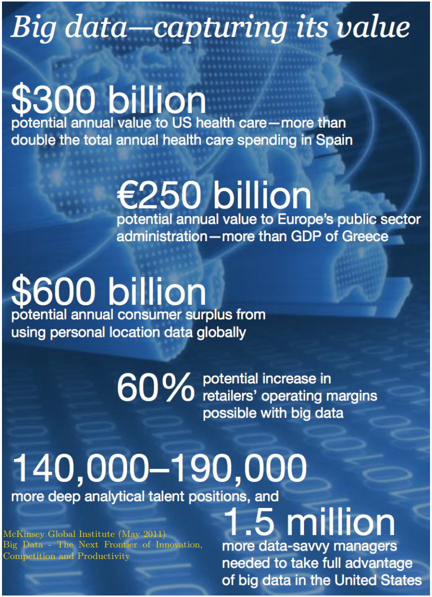
- 60% feel that data is generating revenue within their organizations
- 83% say it is making existing services and products more profitable
- 63% executives based in Asia said they are routinely generating value from data
- In the US, the figure was 58% and in Europe, 56%

35,524 views | Jan 13, 2016, 02:24am

Big Data Facts: How Many Companies Are Really Making Money From Their Data?

Bernard Marr Contributor
Enterprise Tech

5 Vs of Big Data: Value



Big data—capturing its value

$300 billion
potential annual value to US health care—more than double the total annual health care spending in Spain

€250 billion
potential annual value to Europe's public sector administration—more than GDP of Greece

$600 billion
potential annual consumer surplus from using personal location data globally

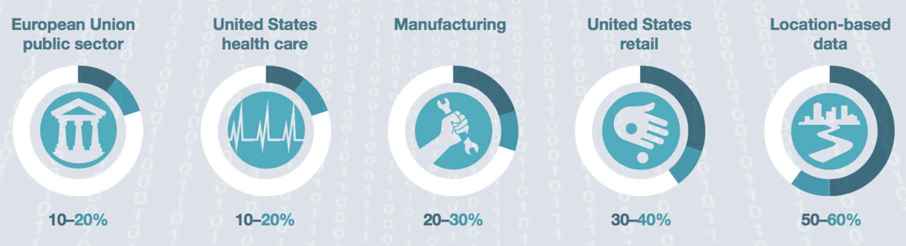
60% potential increase in retailers' operating margins possible with big data

140,000–190,000
more deep analytical talent positions, and

1.5 million
more data-savvy managers needed to take full advantage of big data in the United States

McKinsey Global Institute (May 2011)
Big Data - The Next Frontier of Innovation, Competition and Productivity

5 Vs of Big Data: Value



5 Vs of Big Data: Value

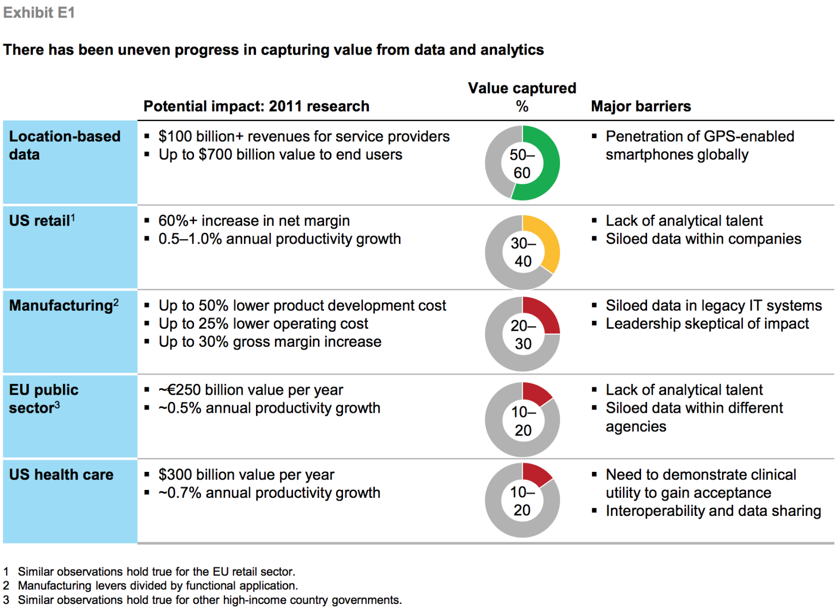


Exhibit E1

There has been uneven progress in capturing value from data and analytics

	Potential impact: 2011 research	Value captured %	Major barriers
Location-based data	▪ $100 billion+ revenues for service providers ▪ Up to $700 billion value to end users	50–60	▪ Penetration of GPS-enabled smartphones globally
US retail[1]	▪ 60%+ increase in net margin ▪ 0.5–1.0% annual productivity growth	30–40	▪ Lack of analytical talent ▪ Siloed data within companies
Manufacturing[2]	▪ Up to 50% lower product development cost ▪ Up to 25% lower operating cost ▪ Up to 30% gross margin increase	20–30	▪ Siloed data in legacy IT systems ▪ Leadership skeptical of impact
EU public sector[3]	▪ ~€250 billion value per year ▪ ~0.5% annual productivity growth	10–20	▪ Lack of analytical talent ▪ Siloed data within different agencies
US health care	▪ $300 billion value per year ▪ ~0.7% annual productivity growth	10–20	▪ Need to demonstrate clinical utility to gain acceptance ▪ Interoperability and data sharing

[1] Similar observations hold true for the EU retail sector.

[2] Manufacturing levers divided by functional application.

[3] Similar observations hold true for other high-income country governments.

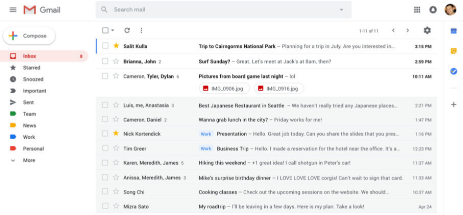
Types of Data

Types of Data

- Relational Data
- Text Data
- Multimedia Data
- Time Series Data
- Sequential Data
- Streams
- Graphs and Homogeneous Networks
- Graphs and Heterogeneous Networks

Types of Data: Text

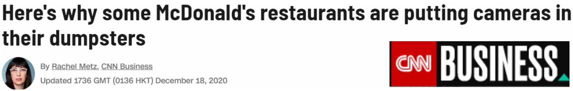
- blogs, webpages, tweets, documents, emails
- High dimensionality, vocabulary, information retrieval, natural language processing
- Latest search engine for Walmart.com uses text analysis, machine learning and even synonym mining to produce relevant search results. Wal-Mart says adding semantic search has improved online shoppers completing a purchase by 10% to 15%. "In Wal-Mart terms, that is billions of dollars,"



☐ ★ Salit Kulla	Trip to Cairngorms National Park – Planning for a trip in July. Are you interested in...	3:15 PM
☐ ☆ Brianna, John 2	Surf Sunday? – Great. Let's meet at Jack's at 8am, then?	2:59 PM
☐ ☆ Cameron, Tyler, Dylan 6	Pictures from board game last night – lol IMG_0906.jpg IMG_0916.jpg	10:11 AM
☐ ☆ Luis, me, Anastasia 3	Best Japanese Restaurant in Seattle – We haven't really tried any Japanese places...	2:21 PM
☐ ☆ Cameron, Daniel 2	Wanna grab lunch in the city? – Friday works for me!	1:47 PM
☐ ★ Nick Kortendick	Work Presentation – Hello. Great job today. Can you share the slides that you pres...	1:16 PM
☐ ☆ Tim Greer	Work Business Trip – Hello. I made a reservation for the hotel near the office. It's a...	12:23 PM
☐ ☆ Karen, Meredith, James 5	Hiking this weekend – +1 great idea! I call shotgun in Peter's car!	11:37 AM
☐ ☆ Anissa, Meredith, James 3	Mike's surprise birthday dinner – I LOVE LOVE LOVE corgis! Can't wait to sign that card.	11:33 AM
☐ ☆ Song Chi	Cooking classes – Check out the upcoming sessions on the website. We should...	10:37 AM
☐ ☆ Mizra Sato	My roadtrip – I'll be leaving in a few days. Here is my plan. Take a look!	Apr 24

Types of Data: Multimedia

- image, audio, video
- ‘Fast food and video’ company is training cameras on drive-through lanes to determine what to display on its digital menu board. When the lines are longer, the menu features products that can be served up quickly; when the lines are shorter, the menu features higher-margin items that take longer to prepare



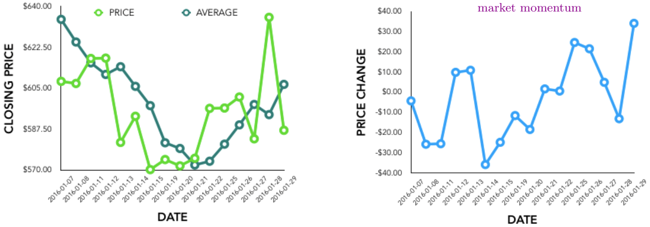
Here's why some McDonald's restaurants are putting cameras in their dumpsters

By Rachel Metz, CNN Business

Updated 1736 GMT (0136 HKT) December 18, 2020

Types of Data: Time Series

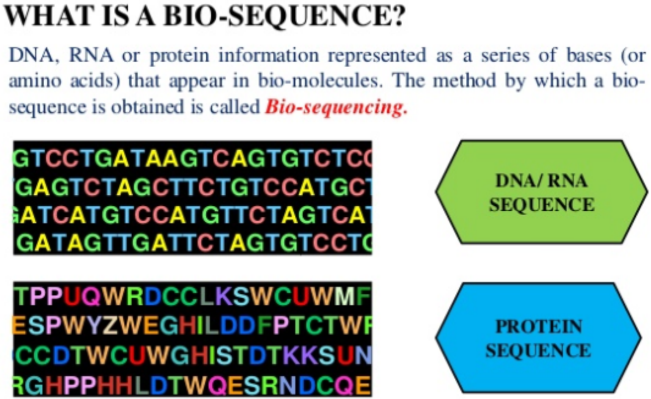
- Sequence of data points at equally spaced time intervals
- Sensor data, Stock market data, Forex rates, Temporal tracking (GPS), Smart Meters Data (AMI)
- Understanding the underlying forces and structure of observed data and fit a model to forecast, monitor or control
- Economic Forecasting, Sales Forecasting, Stock Market Analysis, Yield Projections, Process and Quality Control, Inventory Studies, Workload Projections, Census Analysis



Application of Time Series Analysis in Financial Economics by @Statswork https://link.medium.com/n3FJPzhIadb

Types of Data: Sequential Data

- Bio-sequences
- Discretized music and audio data
- Text



WHAT IS A BIO-SEQUENCE?

DNA, RNA or protein information represented as a series of bases (or amino acids) that appear in bio-molecules. The method by which a bio-sequence is obtained is called ***Bio-sequencing.***

GTCCTGATAAGTCAGTGTCTCC
GAGTCTAGCTTCTGTCCATGCT
ATCATGTCCATGTTCTAGTCAT
GATAGTTGATTCTAGTGTCCTG
DNA/ RNA SEQUENCE
TPPUQWRDCCLKSWCUWMF
ESPWYZWEGHILDDFPTCTWP
CCDTWCUWGHISTDTKKSUN
RGHPPHHLDTWQESRNDCQE
PROTEIN SEQUENCE

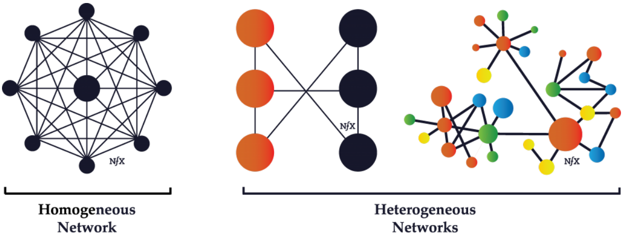
Source: Sijo Asokan (slideshare.net)

Types of Data: Streams

- Real time data
- Single pass algorithms/online algorithms
- Irreversible decisions
- Small memory algorithms

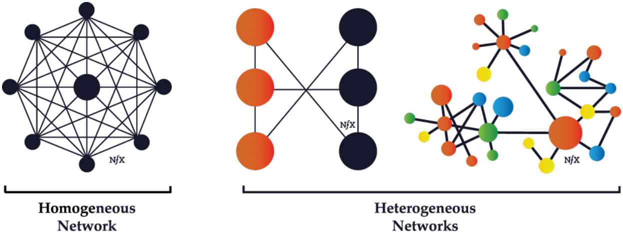
Types of Data: Graphs/Homogeneous Networks

- $G = (V, E)$, data items represented as graphs
- Could have similarity on edges
- Could have weights on vertices, edges or both
- Facebook, webgraph, twitter, co-authorship graphs (bibliometric), citation networks



Types of Data: Heterogeneous Networks

- Nodes represent different entities
- Authors and conferences



Data Analytics: Process and Tasks

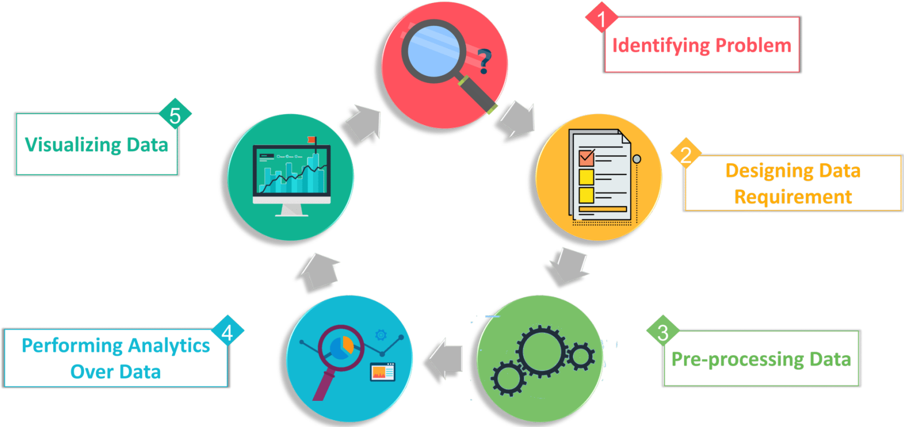
The Analytics Process

- Business Objective
  - Why we are seeking data analytics in the first place?
  - How can we reduce production costs without sacrificing quality?
  - What are some ways to increase sales with our current resources?
  - Do customers view our brand in a favorable way?
- Data Collection
  - What data is needed and available?
  - Identify sources of data and relevance of data
  - Are there enough instances, are all relevant features there?
  - Identify datasets, acquire and retrieve
  - Sources RDBMS, .txt, webservices (soup), RSS, tweets
  - Experiments, synthetic data generation, Survey

The Analytics Process

- Data Preparation
  - Make the data ready for analytics
  - Exploratory Data Analysis Describe, Summarize, Visualize
  - Pre-process: Improve data quality, clean data, transformation, standardization, normalization
- Data Analysis
  - Apply analytical techniques
  - Supervised and unsupervised learning, Graph analytics
- Report and Deployment
  - Communicate results and findings, and apply conclusions to gain benefit

The Analytics Process



1 Identifying Problem

2 Designing Data Requirement

3 Pre-processing Data

4 Performing Analytics Over Data

5 Visualizing Data

Data Analytics Tasks and Methods

Data Analytics is the process

- to discover patterns in data
- to find relationships in data
- to (automatically) extract knowledge from data
- to summarize data in ways that are understandable and useful

Discovering knowledge form data often requires learning

Data Analytics Tasks and Methods

Descriptive Analytics

- Uncover patterns, correlations, trends & trajectories describing data
- Explanatory in nature
- Require post-processing to validate and explain the results
- Clustering/grouping the data or Detecting outliers (anomalies) in data

Predictive Analytics

- Predict value of a attribute based on values of other attributes
- Predicted attribute: Target/dependent/response variable
- Attributes used to predict: Predictor/explanatory/independent variables
- Classification: nominal target attribute (class labels)
- Regression: numeric target attribute

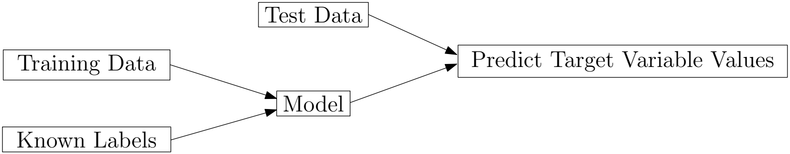
Data Analytics Taks

- Clustering: Partition data into meaningful groups
- Outlier Detection: Detect points that are unusual (unlike others)
- Classification: Assign (predefined) class labels to each object
- Regression: Find a function that models (continuous) target variable
- Association Analysis: Find patterns in data that describe relationships
- Recommendation: Predict an unknown rating based on known ratings
- Community Detection: Find (overlapping) communities of nodes in networks
- Centrality and Important nodes: Find important (or evaluate importance of) nodes in networks

Machine Learning for Data Analytics

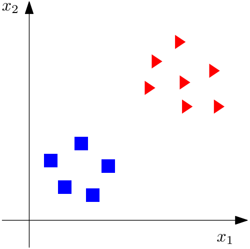
Supervised Learning

- For some data items the correct results (values of the target variable) are given (ground truth)
- We want to learn a model that generalizes i.e. the model is able to perform accurately on new/unseen/unlabeled data items
- Classification, where the target is a categorical attribute
- Regression, where the target is a continuous attribute

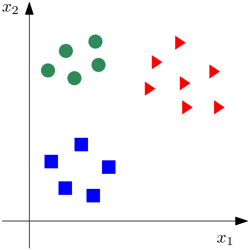


Machine Learning for Data Analytics

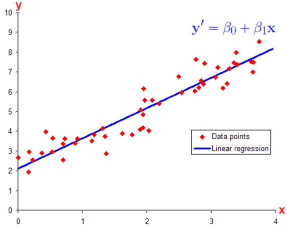
Binary Classification



Multi-Class Classification



Regression



Machine Learning for Data Analytics

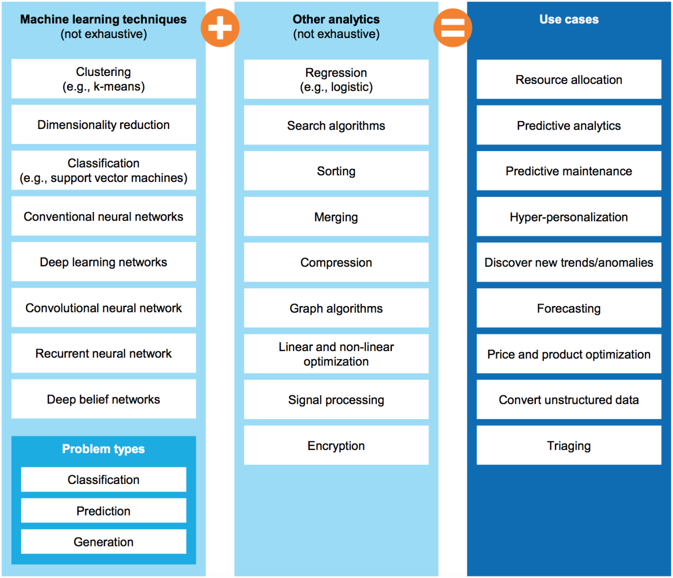
Unsupervised Learning

- No correct output is provided
- Learning and analytics is done using statistical properties of data

- Clustering
- Outlier detection
- Modeling the density of data
- Dimensionality reduction

Data Analytics Tasks and Methods

Machine learning can be combined with other types of analytics to solve a large swath of business problems



Machine learning techniques
(not exhaustive)

- Clustering (e.g., k-means)
- Dimensionality reduction
- Classification (e.g., support vector machines)
- Conventional neural networks
- Deep learning networks
- Convolutional neural network
- Recurrent neural network
- Deep belief networks

Problem types

- Classification
- Prediction
- Generation

+

Other analytics
(not exhaustive)

- Regression (e.g., logistic)
- Search algorithms
- Sorting
- Merging
- Compression
- Graph algorithms
- Linear and non-linear optimization
- Signal processing
- Encryption

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Use cases

- Resource allocation
- Predictive analytics
- Predictive maintenance
- Hyper-personalization
- Discover new trends/anomalies
- Forecasting
- Price and product optimization
- Convert unstructured data
- Triaging