Big Data Analytics

Introduction

2019

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France

UNIVERSITÉ DE STRASBOURG

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BUSINESS SCHOOL

Agenda

Big Data

- **Data Concept**
  - Data
  - Information
  - Knowledge
- **Big Data Concept**
  - Volume
  - Variety
  - Velocity
  - Veracity
- **Big Data Life Cycle**
  - Data Acquisition
    - Multi-Channels
    - Internet of Things
    - Cloud/Grid Computing
  - Data Storage
    - Data Base
    - Data Warehouse
    - Data Lake
    - Data Security

Analytics

- **Concept**
- **Types**
  - Traditional Analytics
    - Business Intelligence (BI)
    - OnLine Analytical Processing (OLAP)
  - Advanced Analytics
    - Artificial Intelligence
    - Data Mining
    - Machine Learning

Big Data Analytics

- **Concept**
- **Role**
- **As a field**
- **Technically**
- **Big Data Analytics Life Cycle**
  - Data Processing
    - Hadoop
    - MapReduce
  - Data Quality
- **Big Data Analytics Project**
- **Technological and Social Mutations**
- **In Management**
  - Applications
    - Predictive Management
    - Prediction in Unstructured BPM
    - Marketing/Sales Compliance
    - Supply Chain Advanced Risk Management
    - Supply Chain Predictive Risk Management

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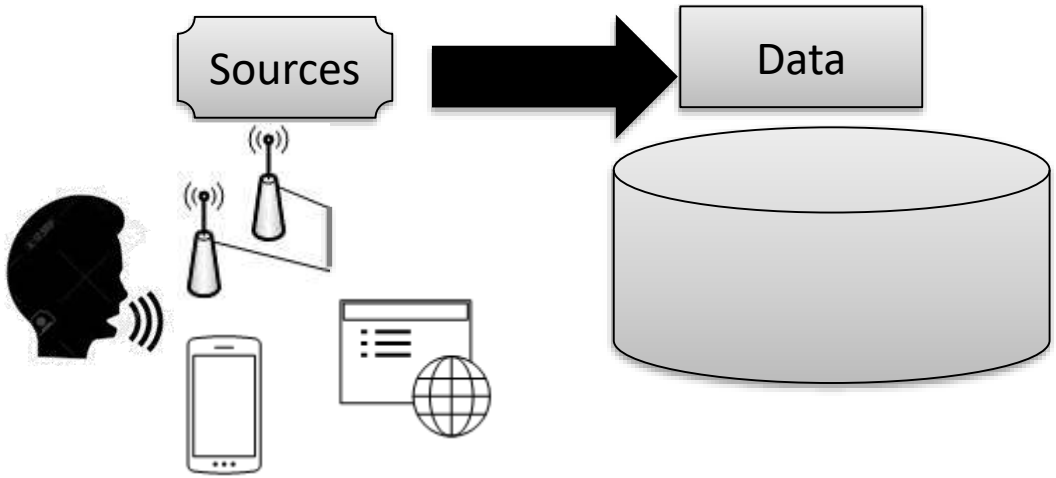
What is ‘Data’ ?!

5min to answer…

Data

Are the raw facts (or descriptions of facts) that were taken, observed, recorded, agreed, such as words, numbers, observations, surveys, etc.

- Data are unprocessed facts, figures, schemas, etc.
- In Information Systems (Computerized), Data is the input in the computer system.
- Data doesn't have a meaning !



Data

- 2 kinds of Data :
  - **Qualitative:** textual or symbolic
  - **Quantitative:** numerical

	Quantitative	Qualitative
Concept/Definition	Valuated facts	Describted facts
Methodology	Collected by measurement tools	Collected by observation
Analysis	Performed by statistical and numerical methods	Perfomed by specific adapted methods of classification, quantification, etc.
Results	Reported through statistic methods	Reported through a specific format/language

- **Data**

Example

~~Meaning~~ ~~What context ?~~ ~~Temperature of what ?~~

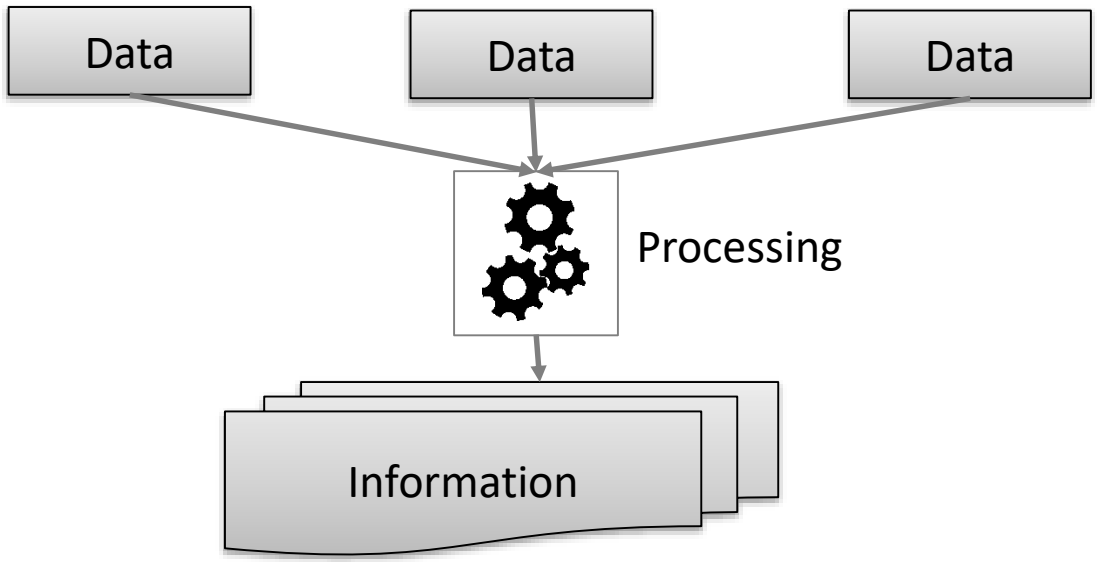
24°

Data

Information

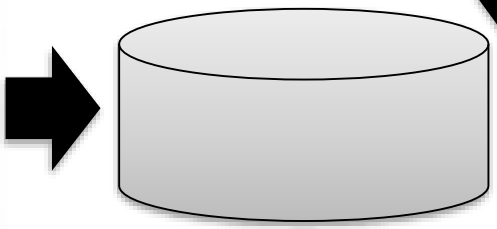
Is the raw fact that was taken, observed, recorded, agreed.

- Information is processed
- Processed Data become information.
- Information is based on Data



- # Information

Example



24° is
- The Temperature of weather
- In Strasbourg
- On 13/01/2019

Information

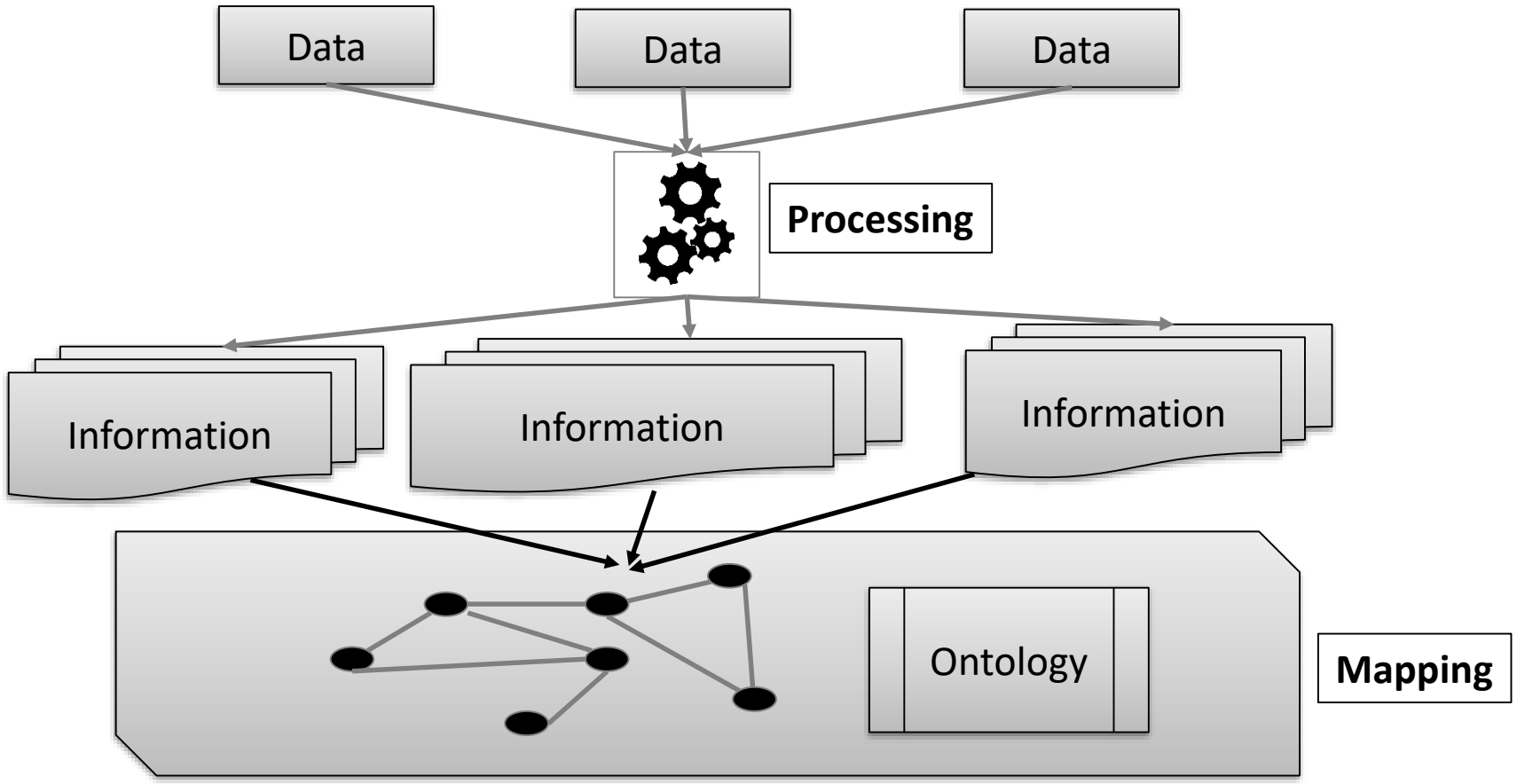
24°

Data

Knowledge

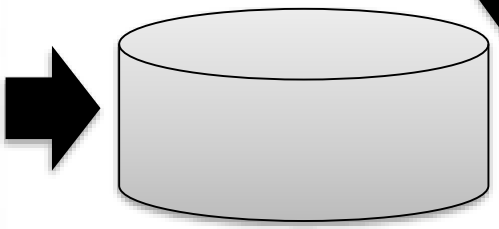
Is the set of relationships between information elements following an ontology

- Mapped information: how they are related, what is compound in what, where ?
- There is ontology (definition of meanings) that frame the set of information



- **Knowledge**

Example



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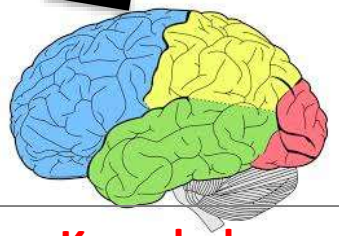


Knowledge

Decision:
Go out for a cruise

What is ‘Big Data’ ?!

5min to answer…

Big Data → Big Data Concept

Analytics

Analyze

Volume

Market

Management

Variety

Web

Facebook

Model

Definition

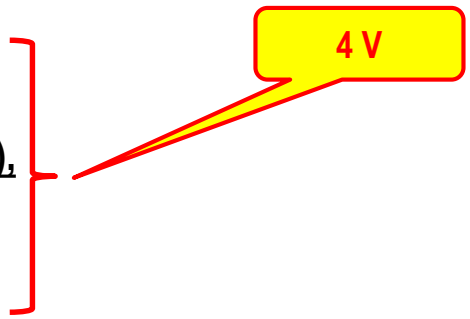
Big Data is the field that gathers all activities and functions of :

- **Acquisition** of Data,
- **Storage** of Data.

from multiple sources that cannot be processed by common and **traditional** systems (for example ERP, Excel, etc.).

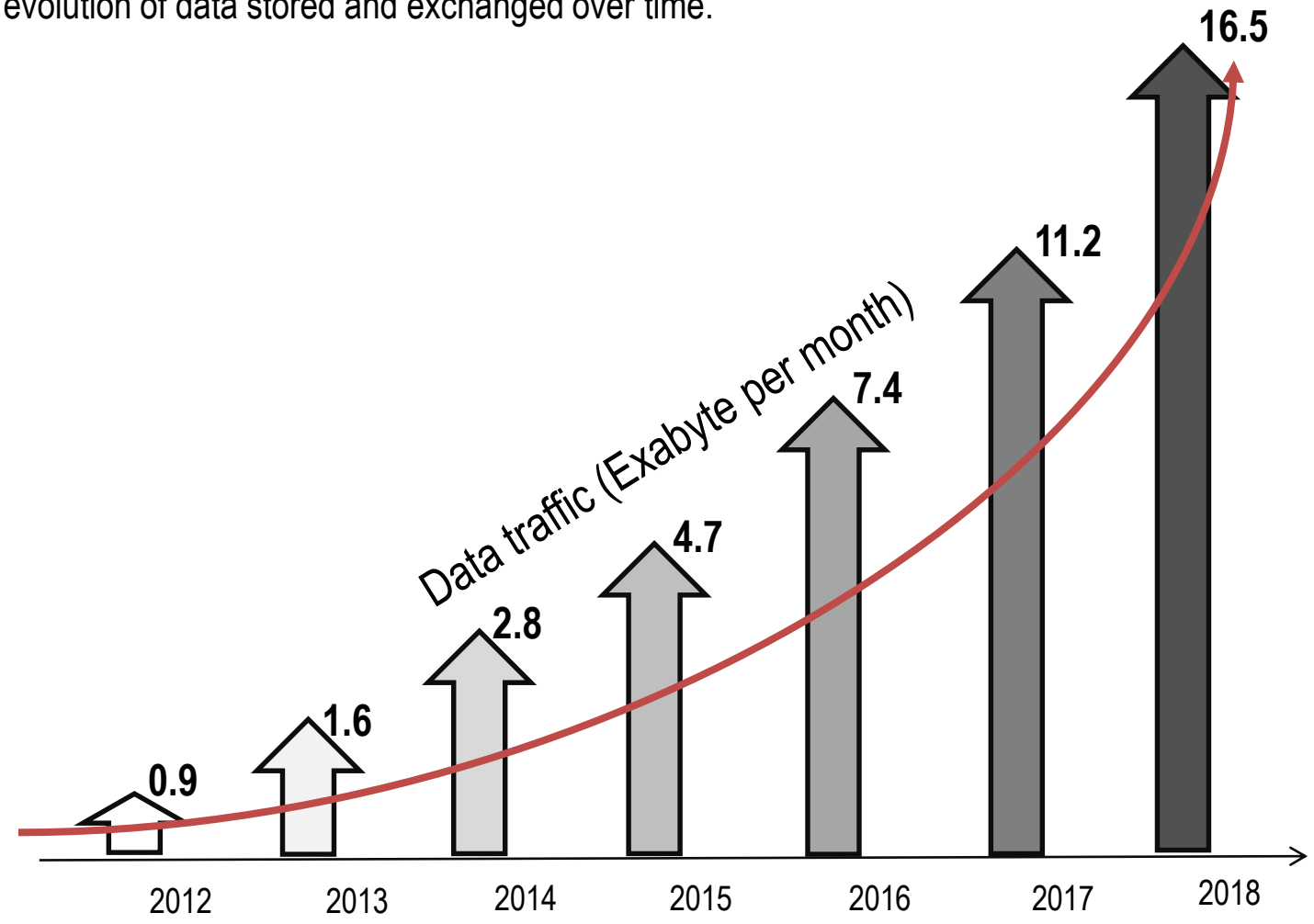
In Big Data, Data are :

- **Huge(Volume),**
- **hetereougenious (Variety),**
- **Dynamic (Velocity),**
- **Uncertain (Veracity).**



- **Volume**

The evolution of data stored and exchanged over time.



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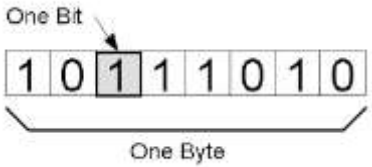


8 bits

X 1024

Byte

X 1024

KB

X 1024

MB

X 1024

GB

Volume

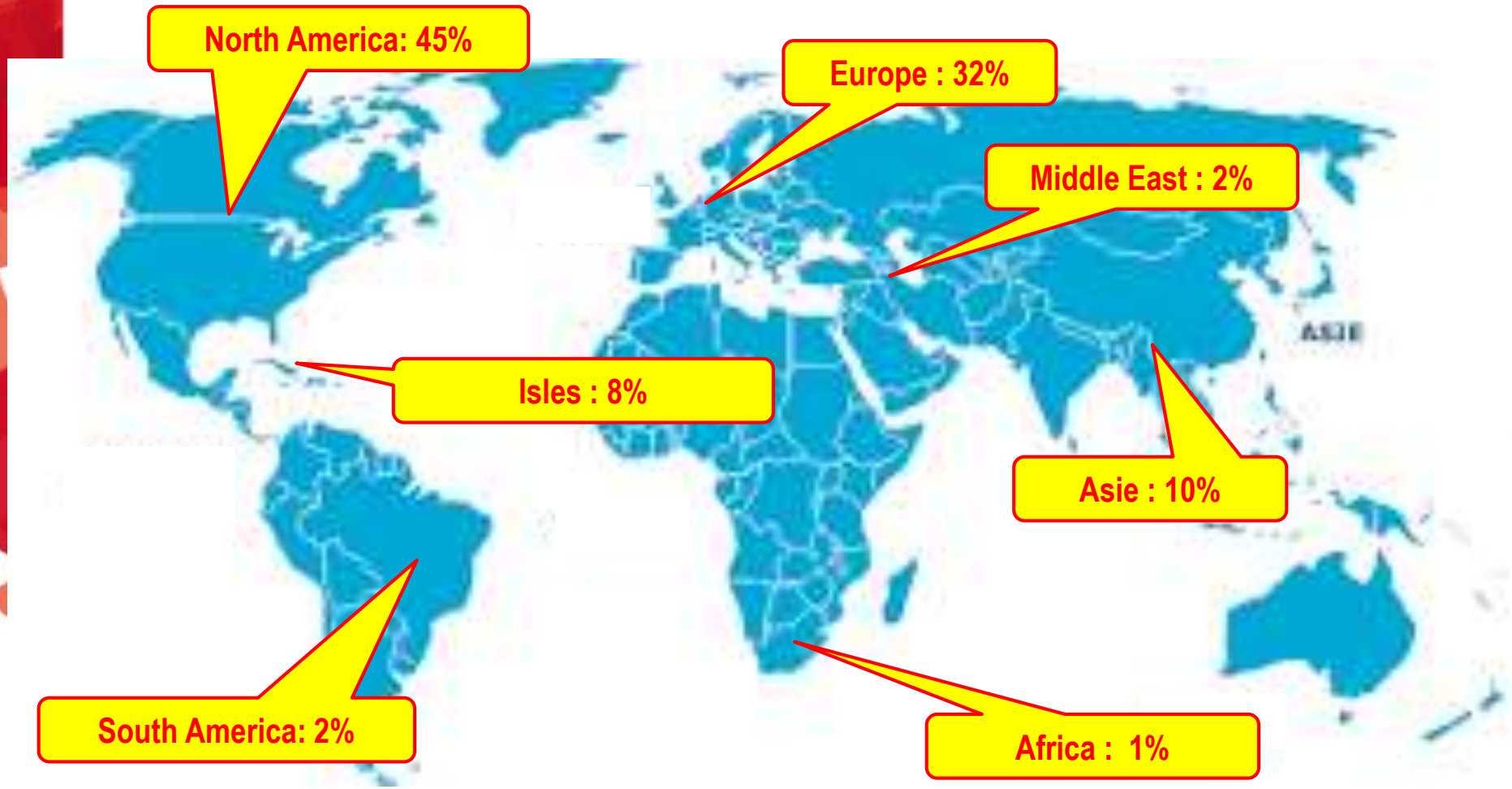
The evolution of data stored and exchanged over time.

- Data Measurement Units

Unit	Abbreviation	Decimal	Binary	Size
bit	b	0 or 1	0 or 1	1/8 of a byte
byte	B	8 bits	8 bits	1 byte
kilobyte	KB	$1{,}000^1$ bytes	$1{,}024^1$ bytes	1,000 bytes
megabyte	MB	$1{,}000^2$ bytes	$1{,}024^2$ bytes	1,000,000 bytes
gigabyte	GB	$1{,}000^3$ bytes	$1{,}024^3$ bytes	1,000,000,000 bytes
terabyte	TB	$1{,}000^4$ bytes	$1{,}024^4$ bytes	1,000,000,000,000 bytes
petabyte	PB	$1{,}000^5$ bytes	$1{,}024^5$ bytes	1,000,000,000,000,000 bytes
exabyte	EB	$1{,}000^6$ bytes	$1{,}024^6$ bytes	1,000,000,000,000,000,000 bytes
zettabyte	ZB	$1{,}000^7$ bytes	$1{,}024^7$ bytes	1,000,000,000,000,000,000,000 bytes
yottabyte	YB	$1{,}000^8$ bytes	$1{,}024^8$ bytes	1,000,000,000,000,000,000,000,000 bytes

- **Volume**

Distribution of Data centers around the world.



- **Volume**

Multiple Data centers around the world.

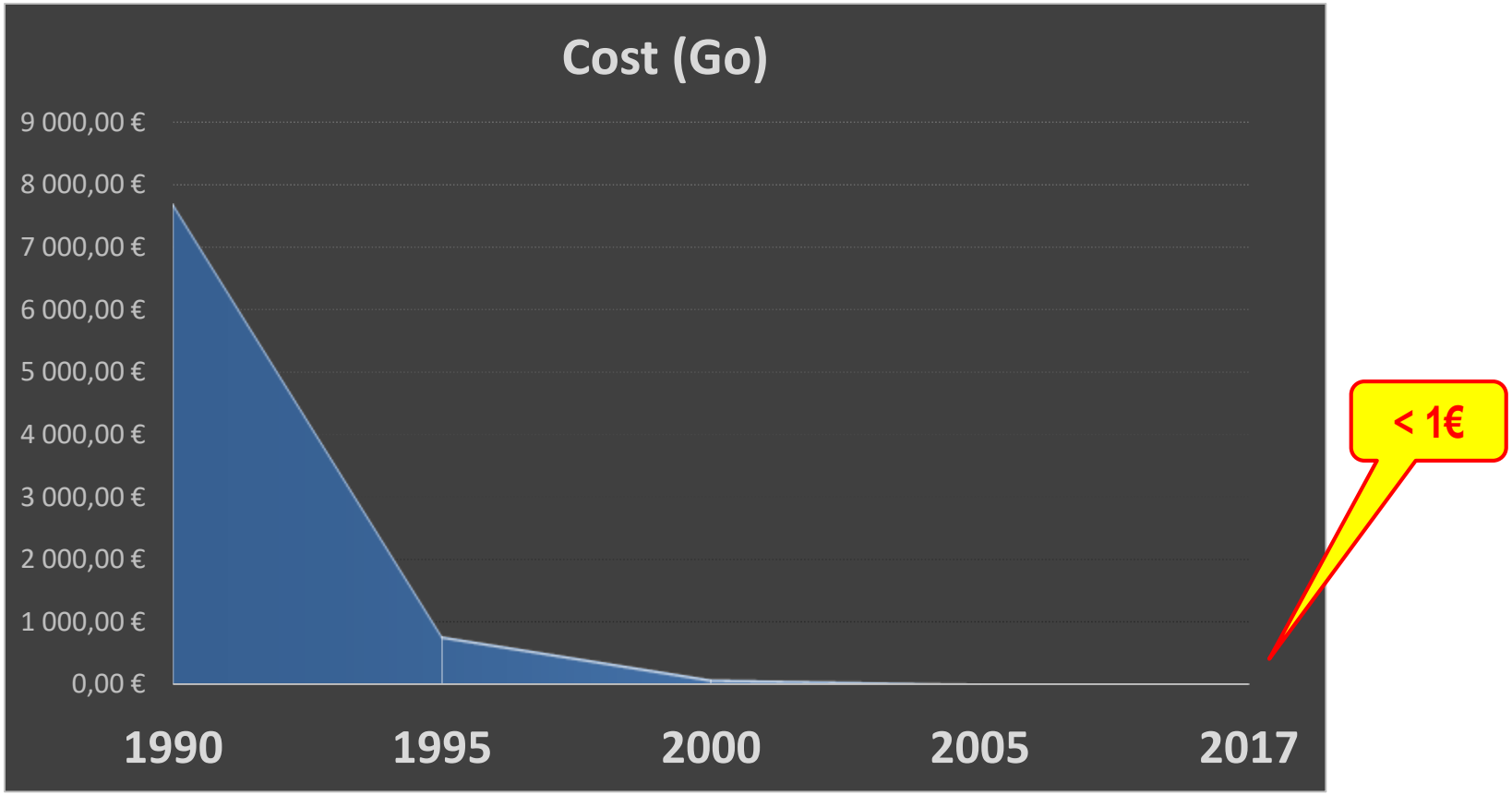
Data Center Utah (USA)

Data Center Vitry (France)

Data Center Busan (South Korea)

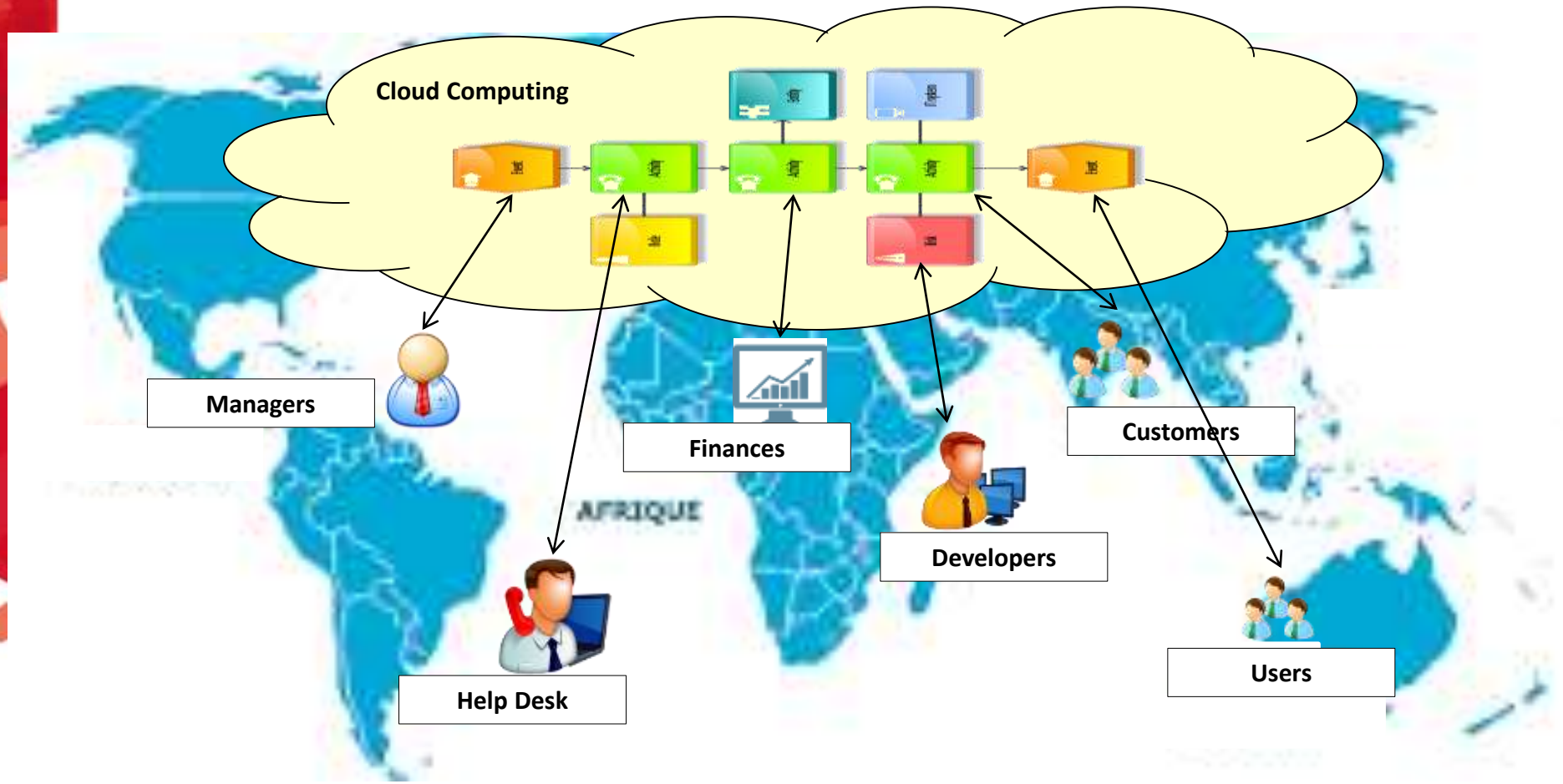
- **Volume**

Storage price decreasing.



- **Volume**

Virtualization.

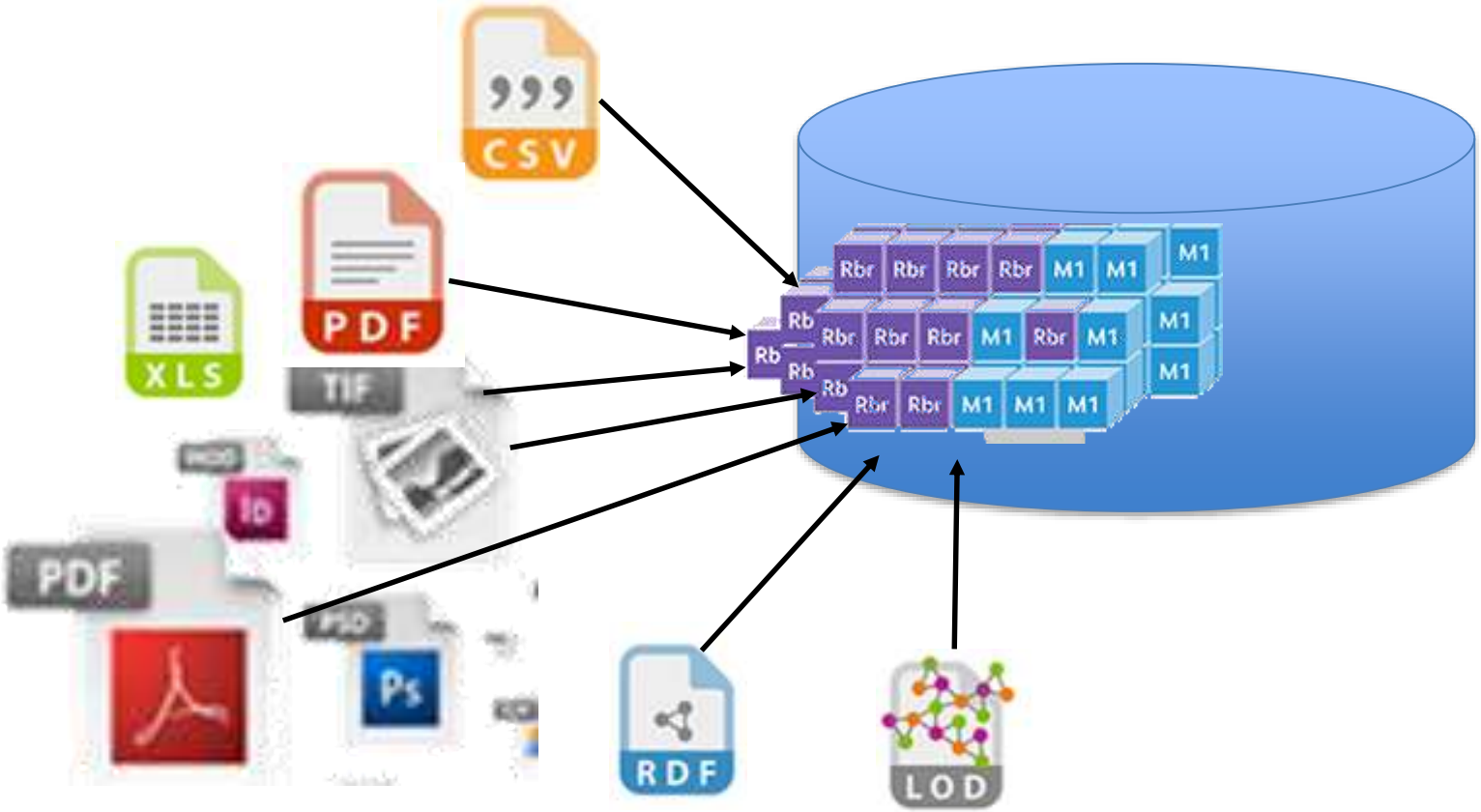


- **Volume**

Internet Of Things.

Variety

No standard format of data in storages. Meta-Data of structures and organizations, semantic Data, images, videos, texts, XML, text formats, etc.

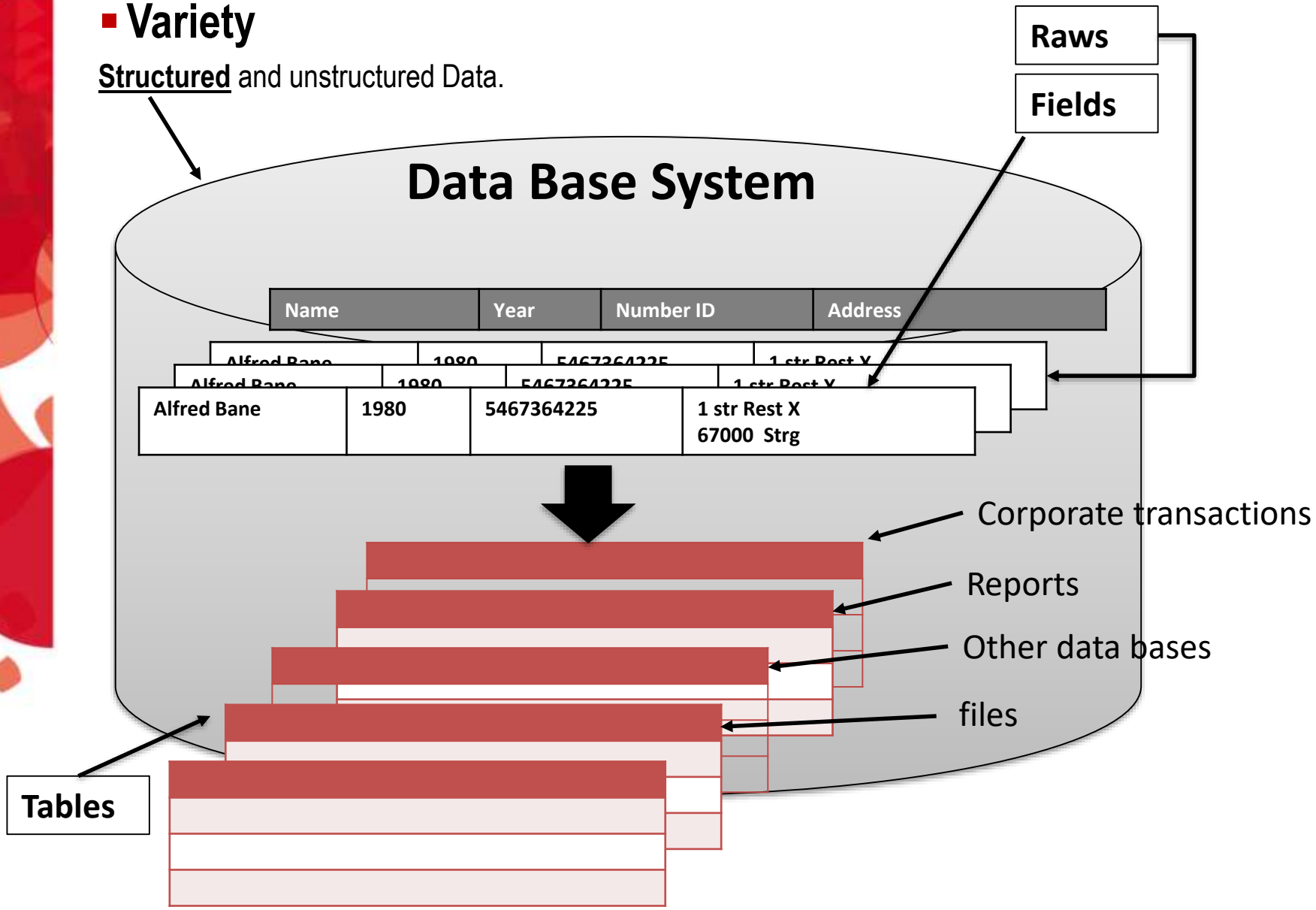


Variety

Different sources.

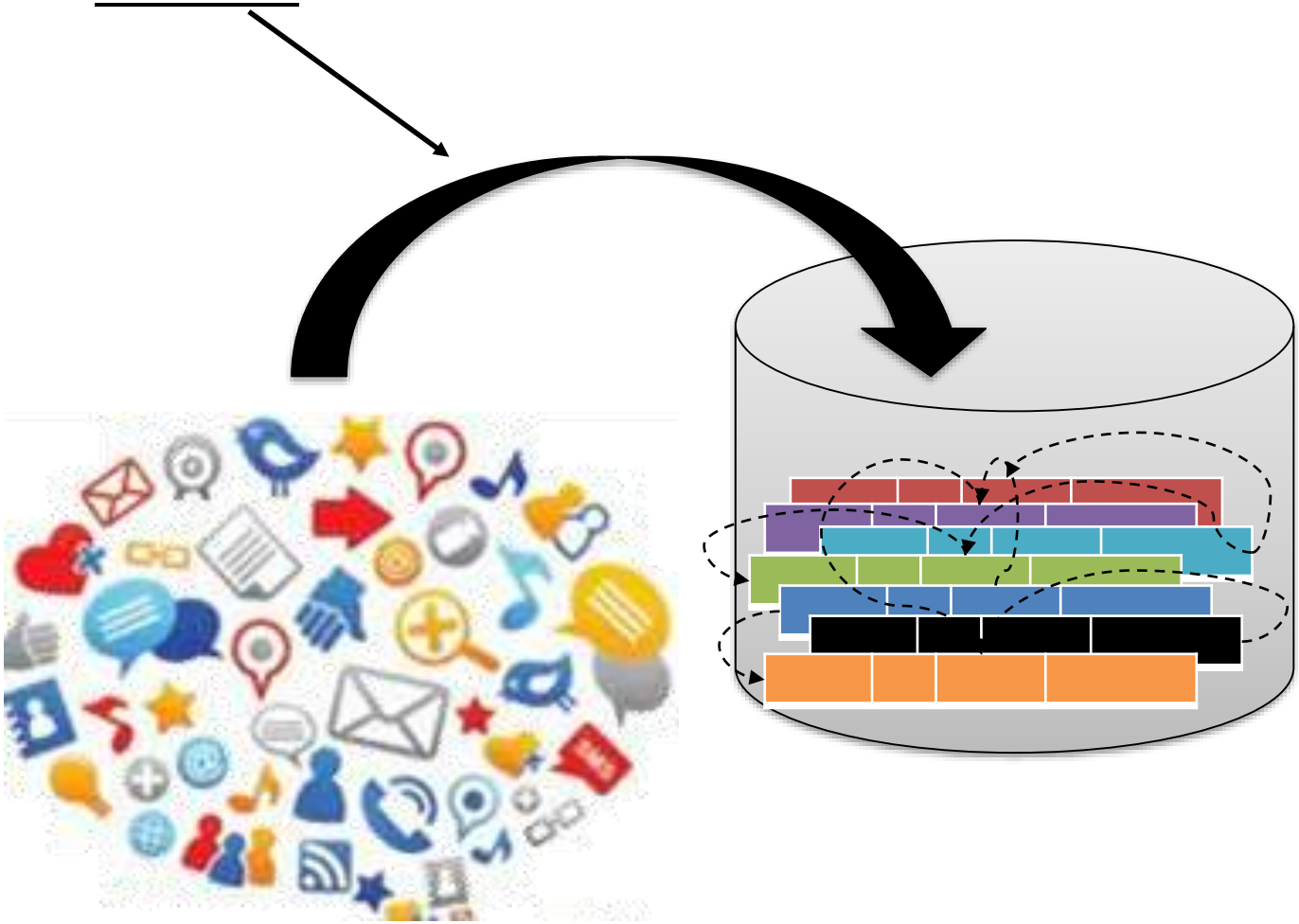
Variety

Structured and unstructured Data.



- **Variety**

Structured and **unstructured** Data.



Applicative Exercise 1

Group work. Duration 30min. Sore: 0.5

Try to list more than 10 data sources in at least 3 areas. For example RFID in Manucturing and Logistics

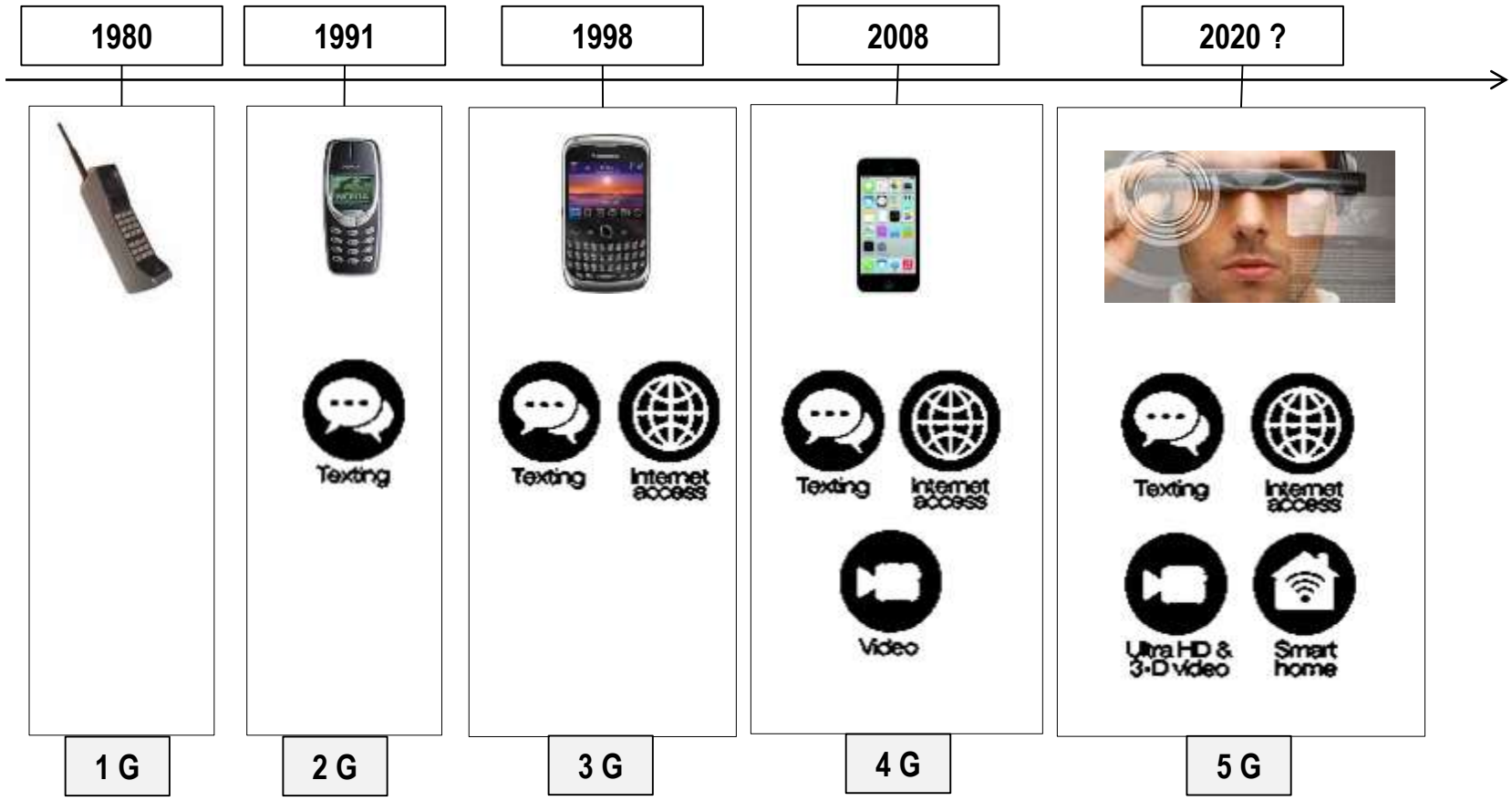
Data source	Type	Area	Image/Pattern
RFID	Chip with Digital code	Manufacuring / Logistics	

- **Velocity**

Speed of data flows is going increasingly because of IT high process.

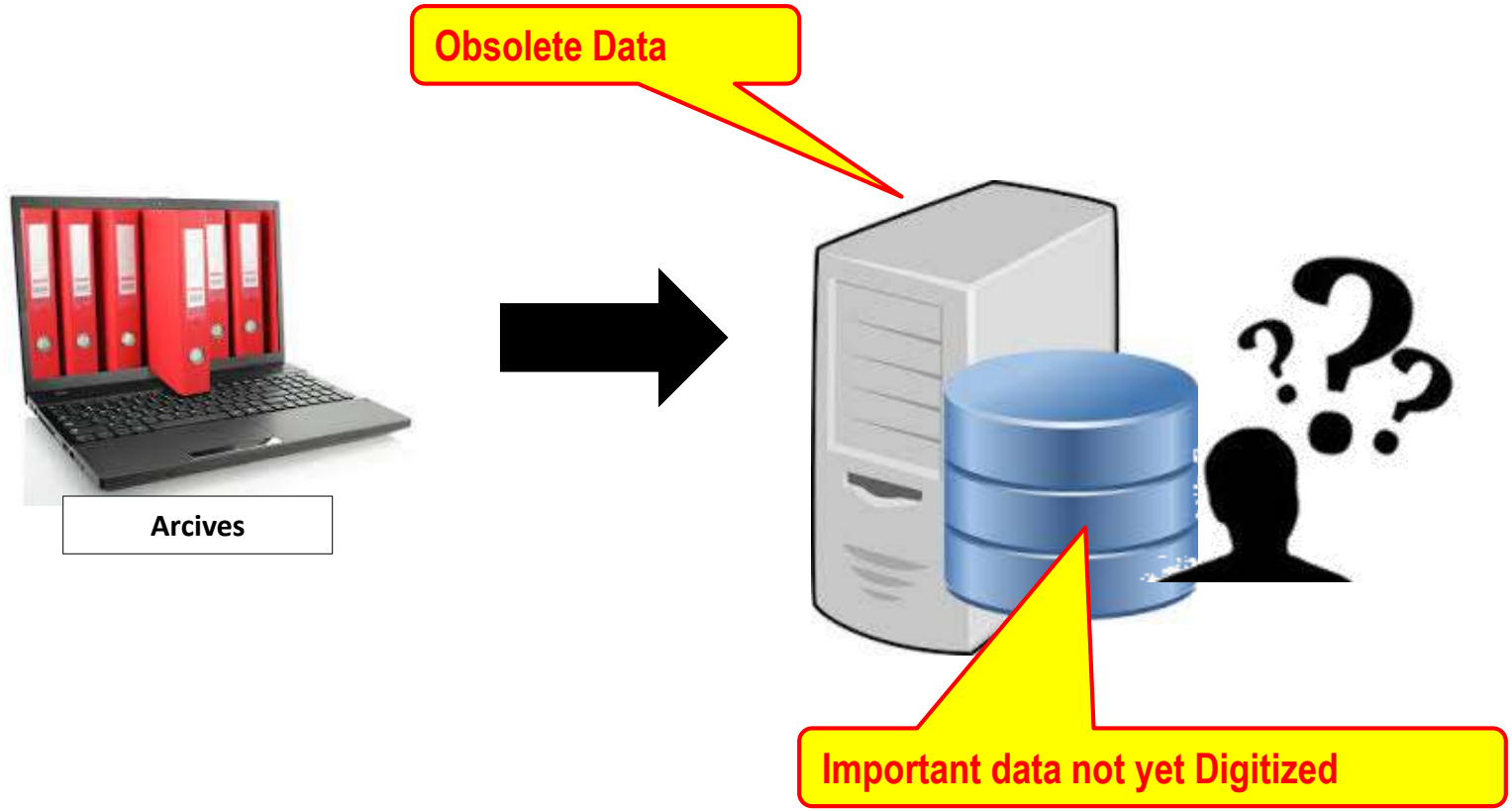
- **Velocity**

Speed of data flows is going increasingly because of IT high progress.



- **Veracity**

Uncertainty of the data - Uncertain multichannel sources : Archive

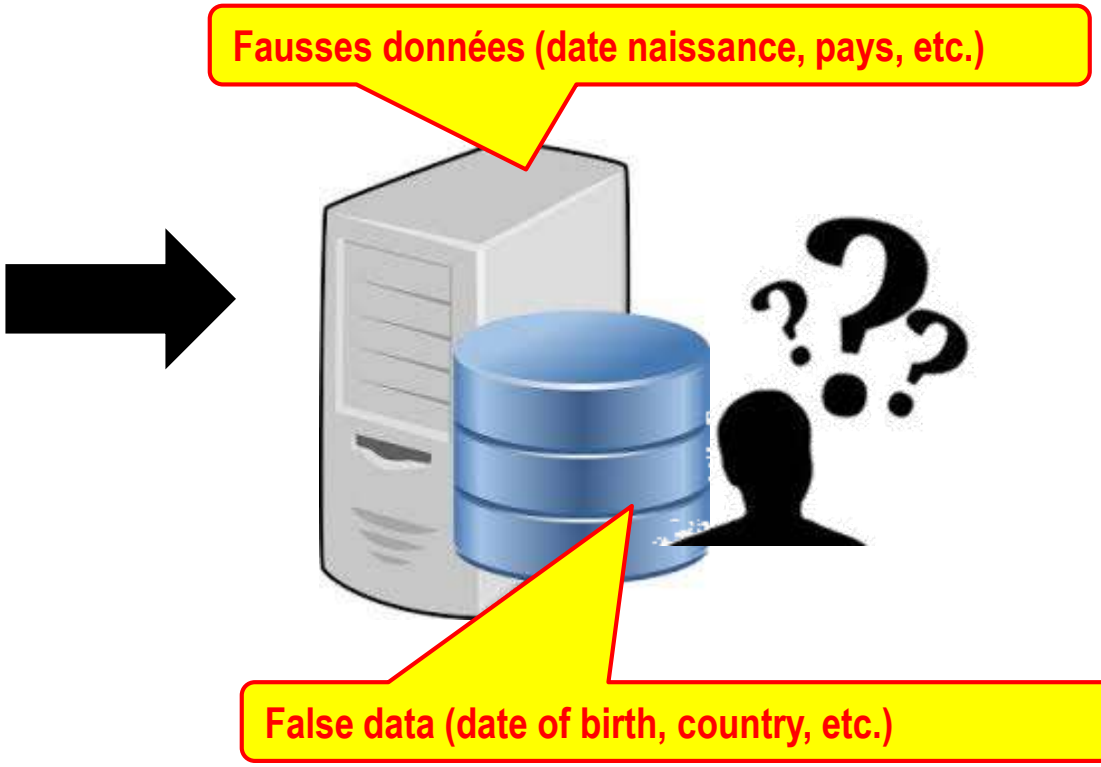


Veracity

Uncertainty of the data - Uncertain multichannel sources : Multiple profiles

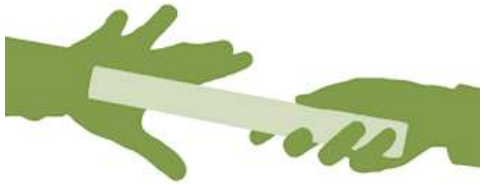
fake profiles on social networks

Multiple profiles



- **Veracity**

Uncertainty of the data - Uncertain multichannel sources : Delegation

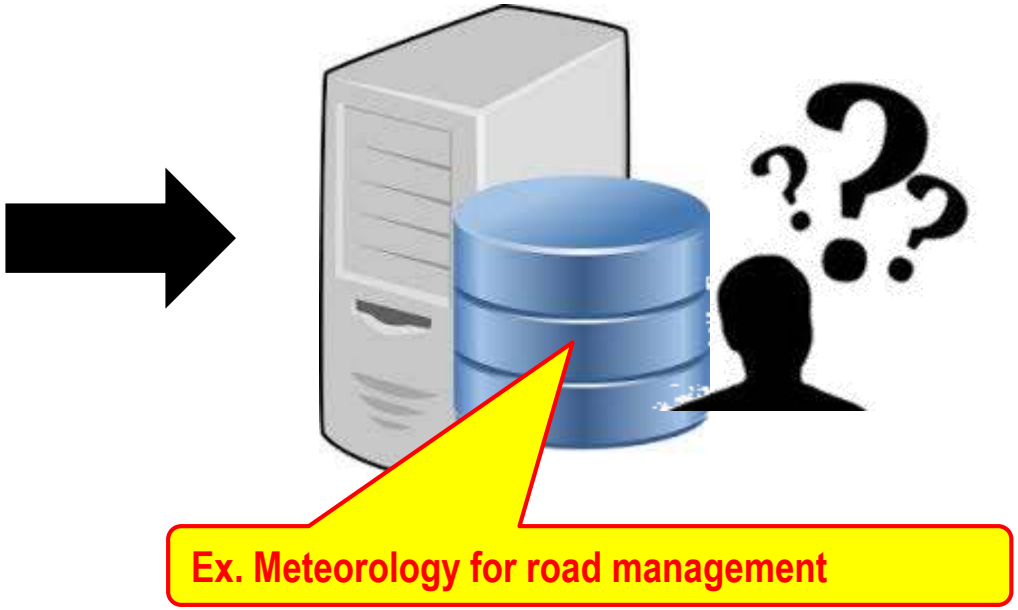


Delegation in transactions

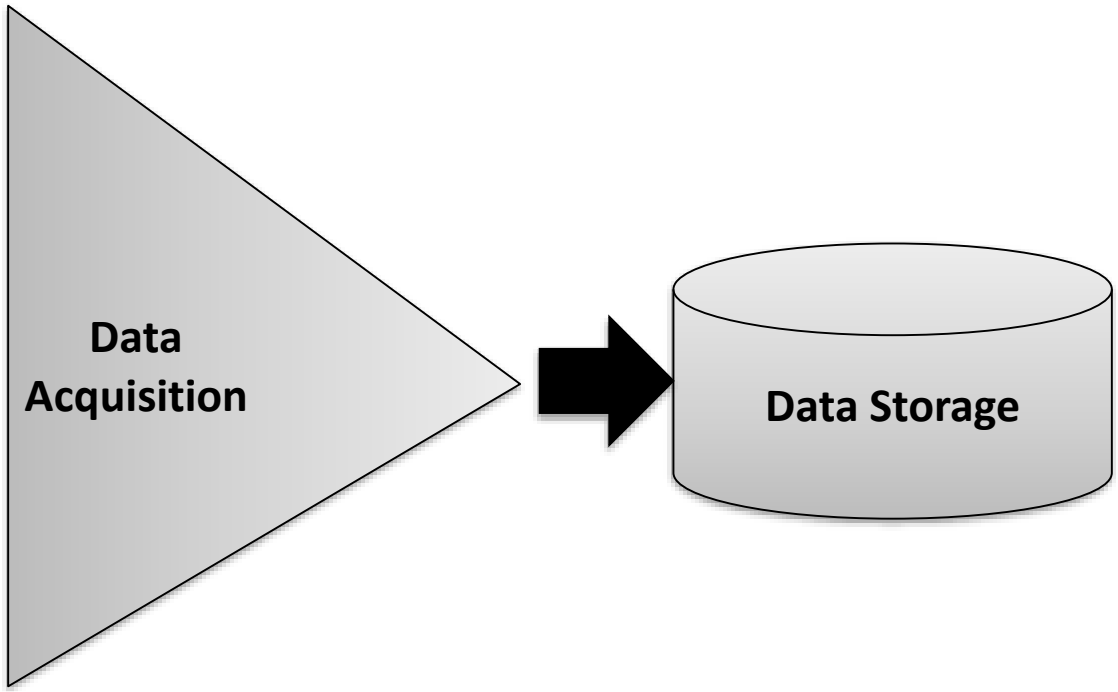
Veracity

Uncertainty of the data - Uncertain multichannel sources : forecasted by nature

Uncertain by nature



- **Big Data Life Cycle**



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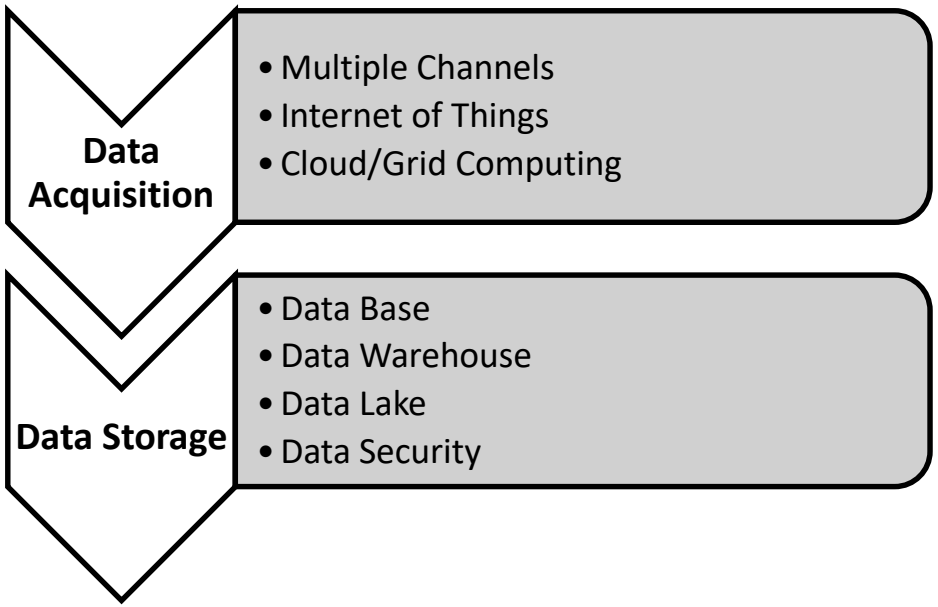
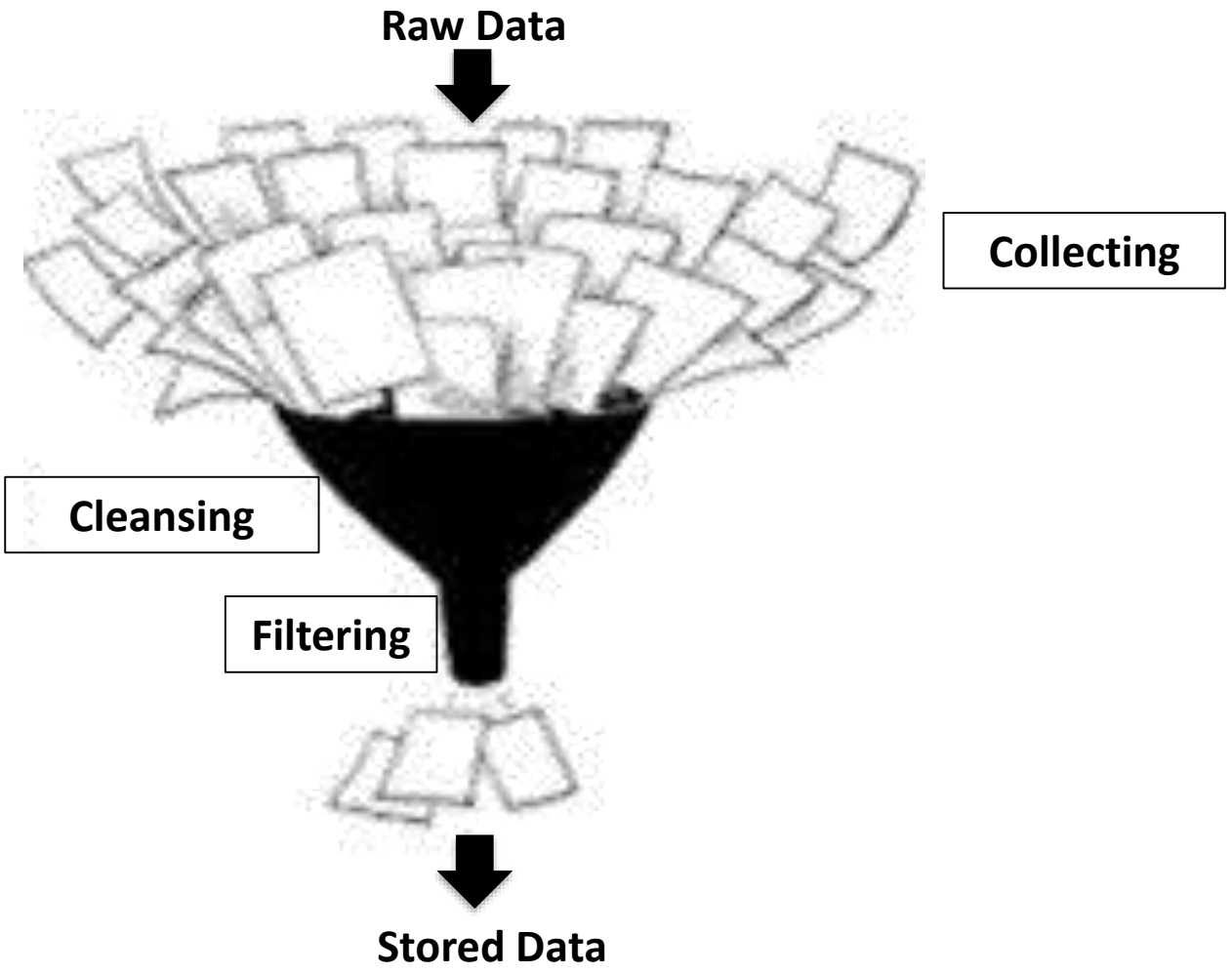


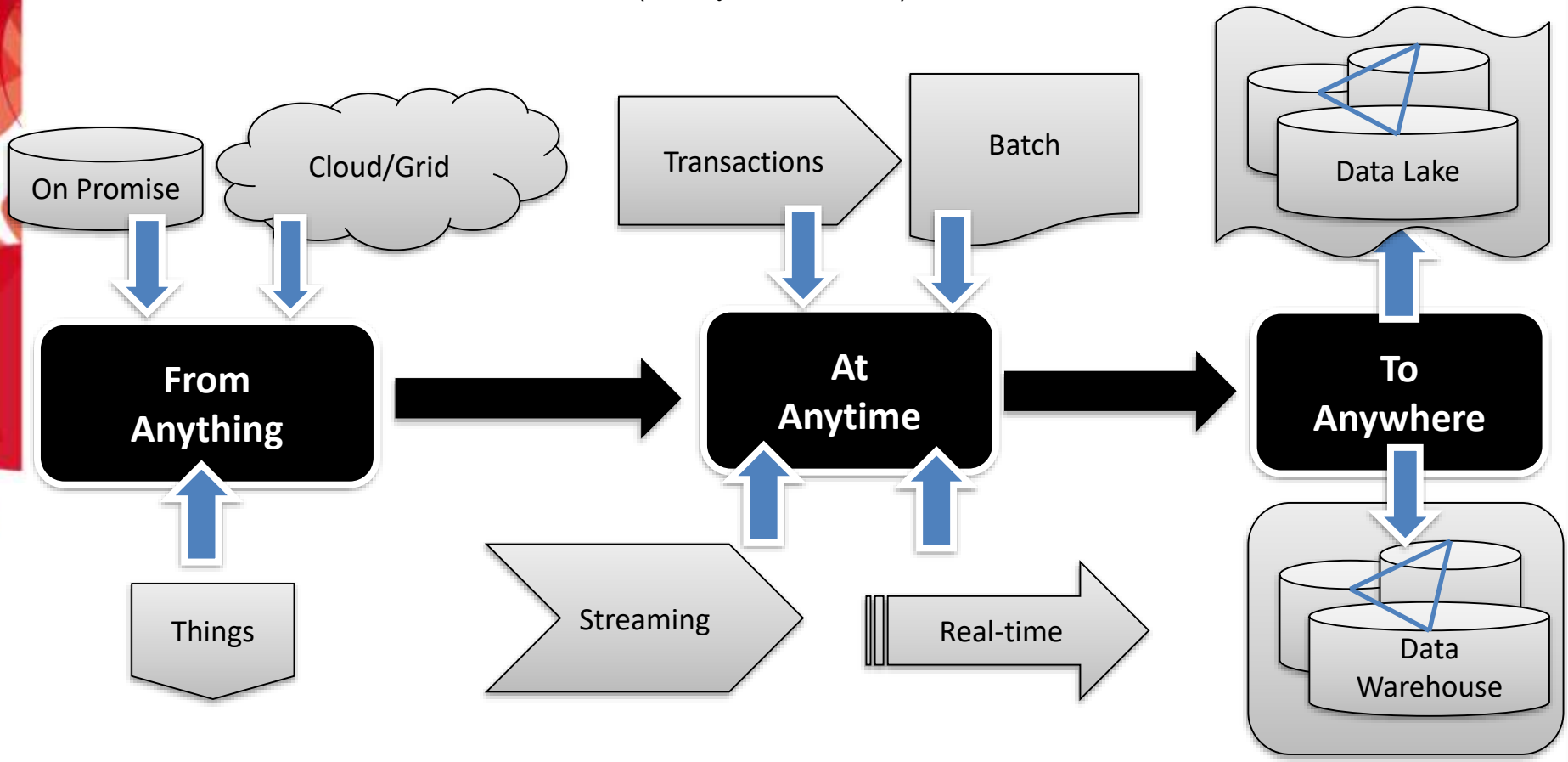
Data Acquisition

Is the process of collecting, cleaning, and filtering data before the data is put in a the storage.



Multiple-Channels

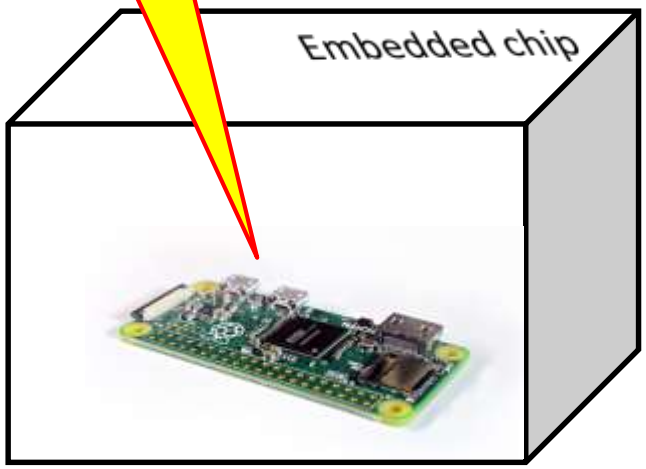
- **Data streaming** → structured and unstructured Data (mainly from Internet of Things)
- **Batch and Events sourcing** → Data from insfrastructures (mainly from cloud and on Pro)
- **Real-time Data flows** → Real-time/near real-time flows (mainly from Internet of Things and cloud)
- **Data transactions** → structured Data (mainly from On Pro)



Internet of Things (IoT)

A set of devices that are able to connect and exchange data through Internet.

----- Smaller
&
+++++ Faster



Embedded Computing > 233 billions USD/ 2021

Gartner®

- **Internet of Things (IoT)**

Smart washing machine

Smart fridge

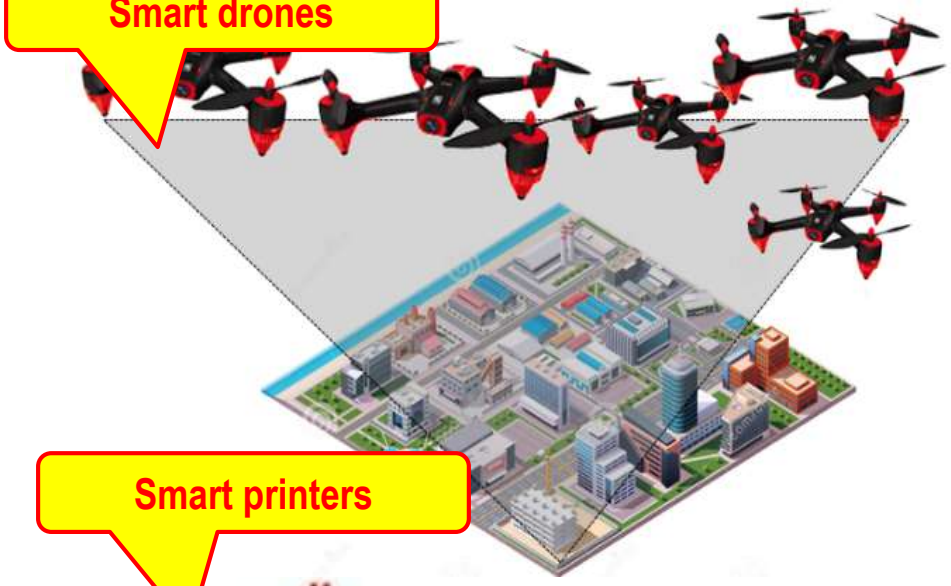
Smart watch

Smart phone (smart assistant)

- **Internet of Things (IoT)**

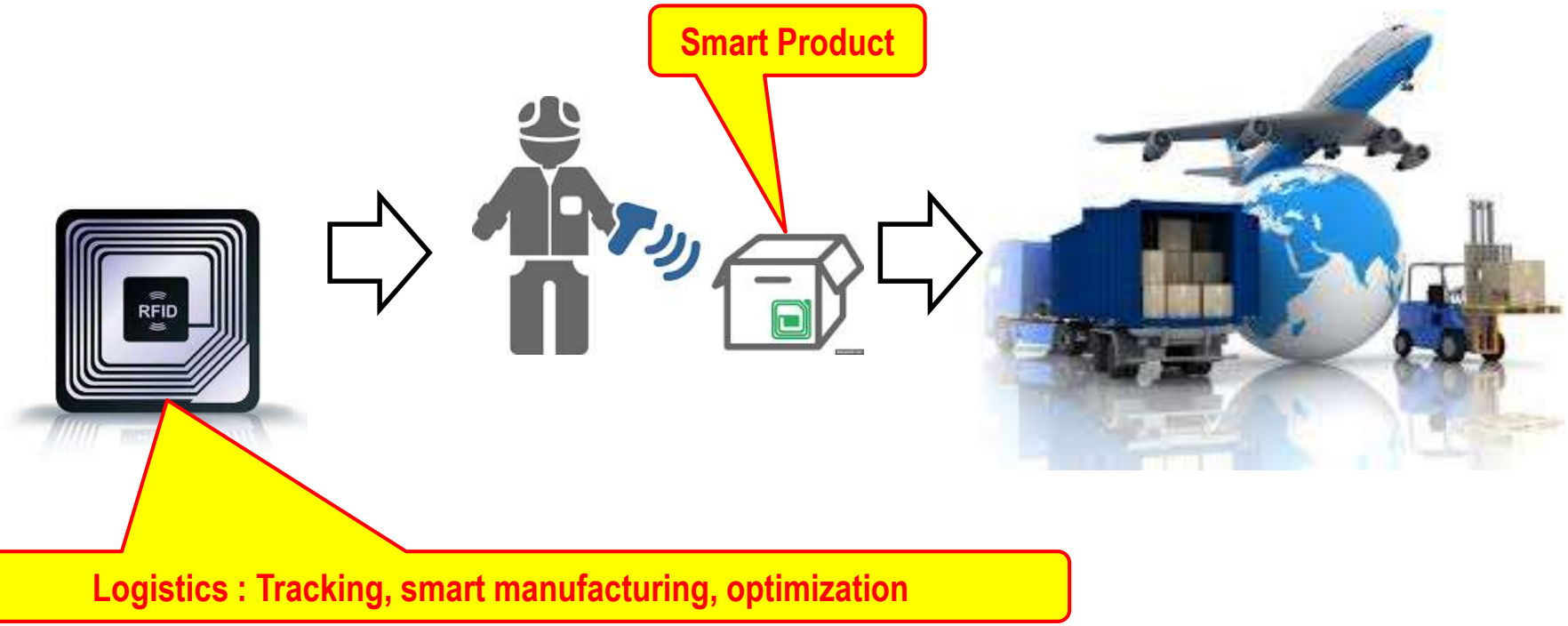
Smart cars

Smart drones



Smart printers

- **Internet of Things (IoT)**



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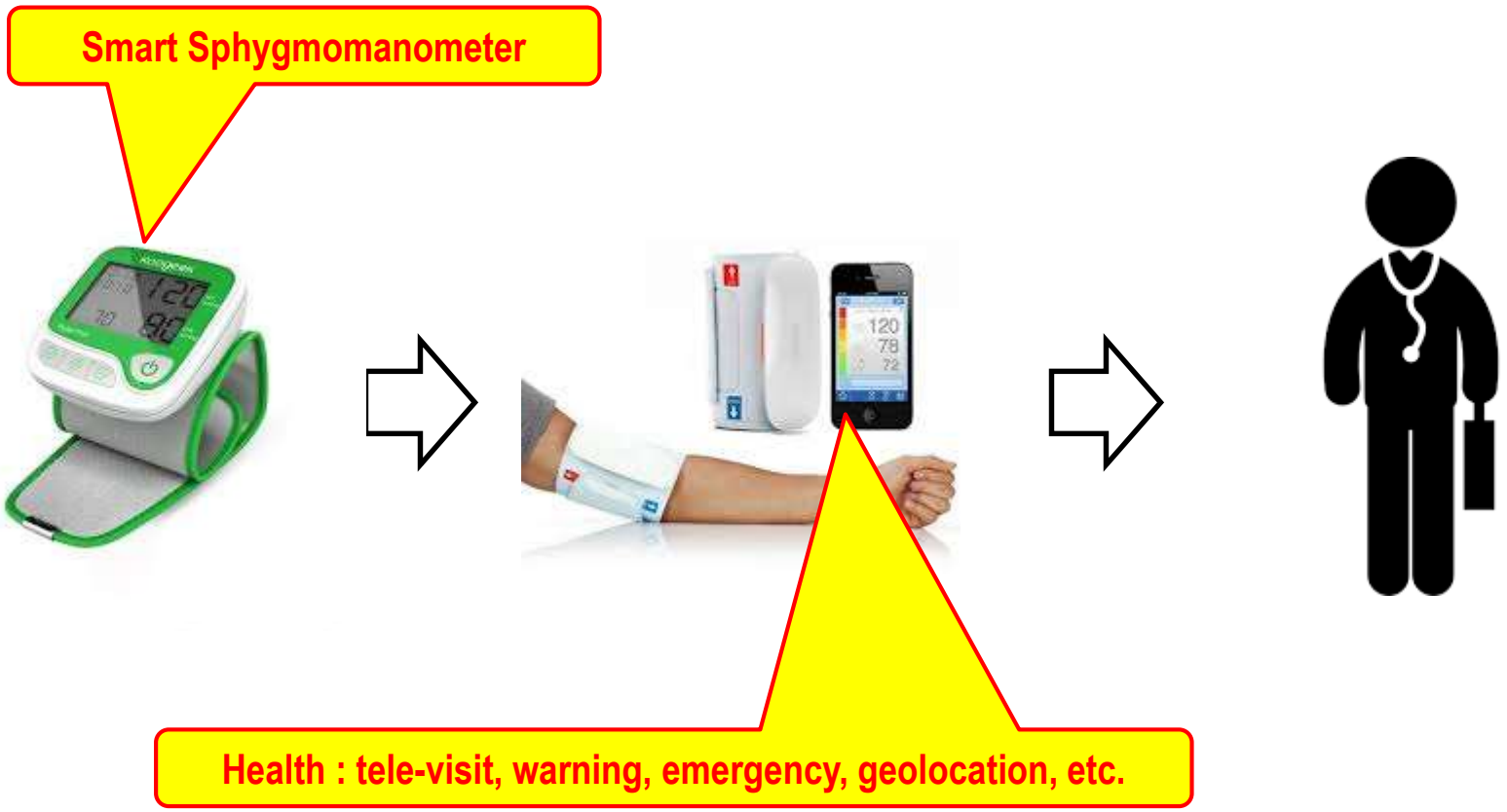


- **Internet of Things (IoT)**

Smart car

Road safety: study of roads, traffic, tracking, verbalization, etc.

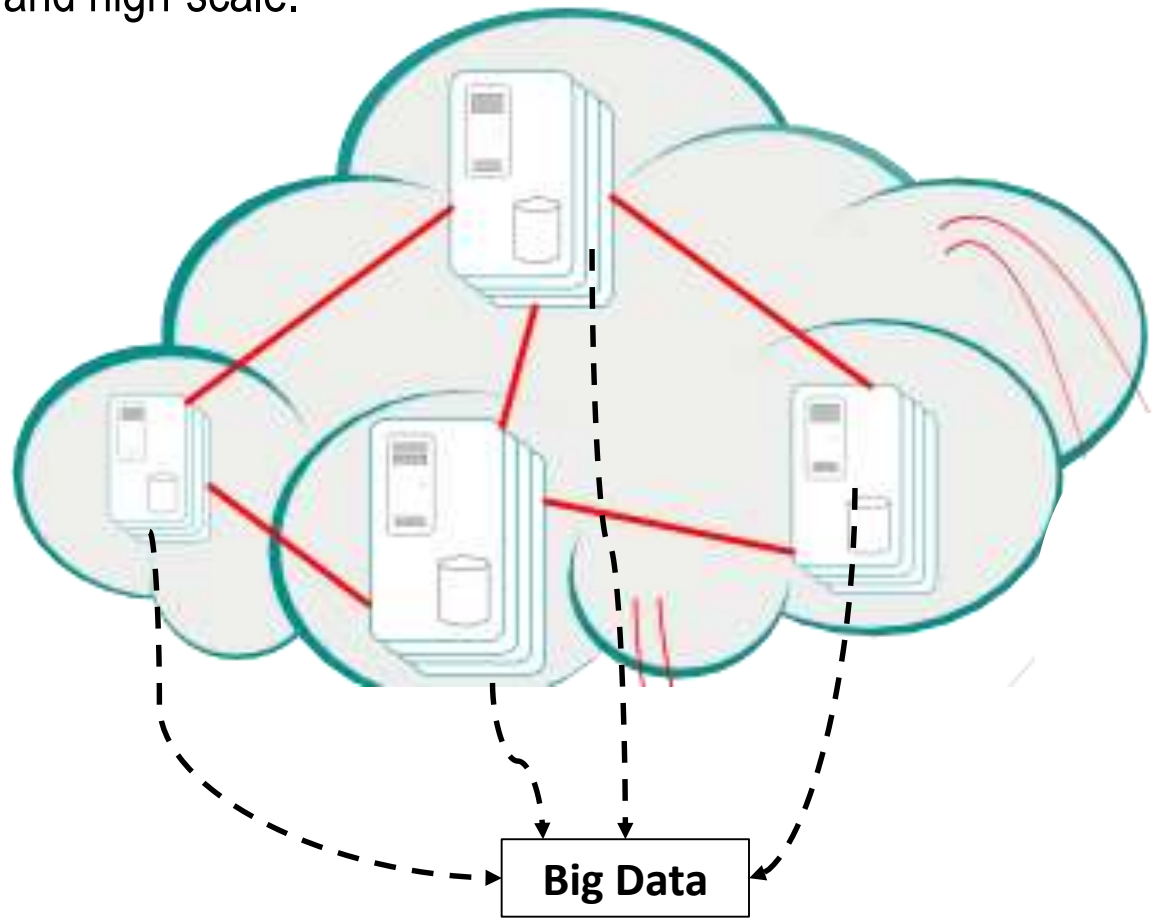
- **Internet of Things (IoT)**

Smart thermometer

Meteorology: localized forecasting, weather risk prevention, weather warnings, etc.

Cloud/Grid Computing

Computer resources that are located anywhere with access over Internet and processing Data and information in a distributed mode. They provide sharing, archiving, and high-scale.



Data Storage

Storage infrastructure dedicated to save, protect, manage, recover, archives, alter, delete, and retrieve records of Data.

Storage Disks

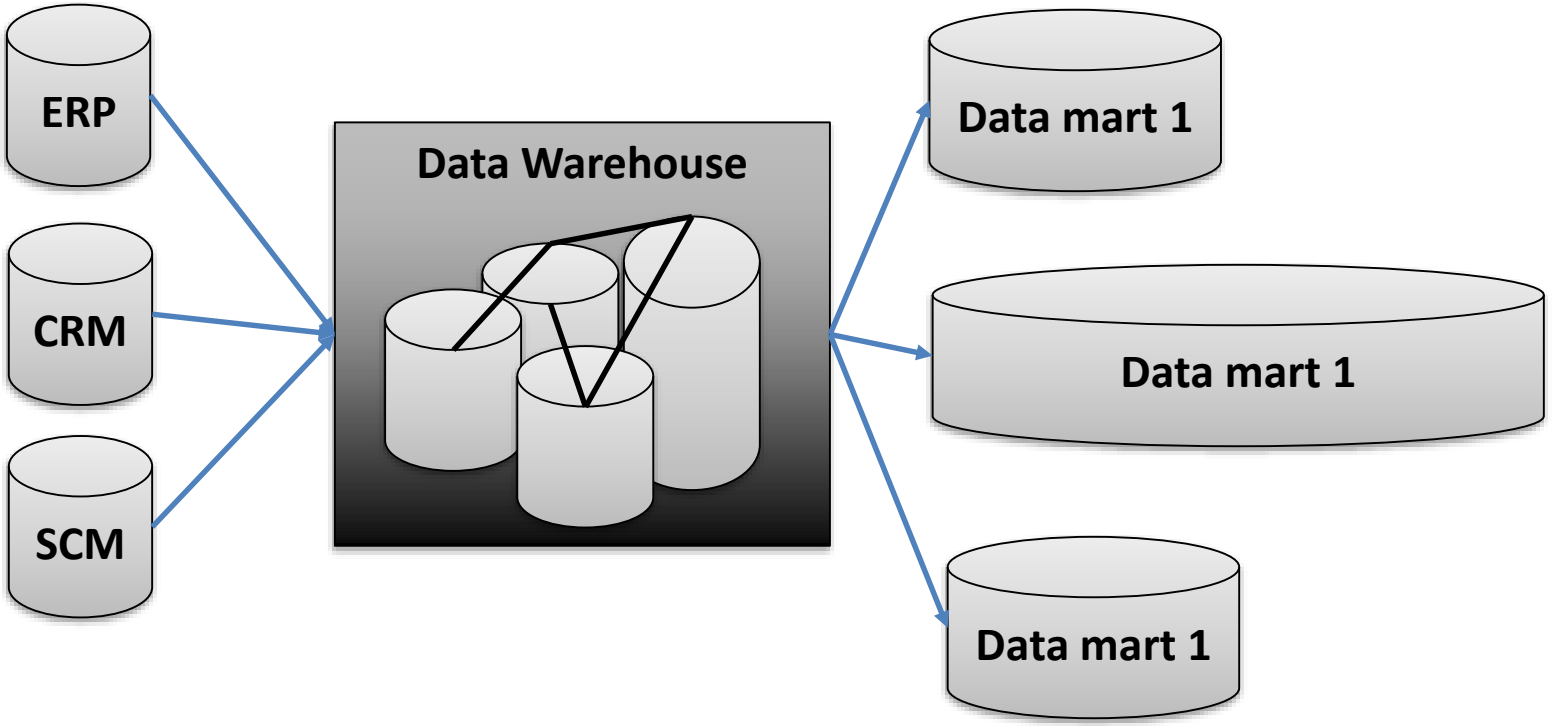
Data Base

SQL and especially NoSQL Data Bases like **MongoDB, Cassandra ou Redis**.

Data Warehouse

Repository of Data (set of connected storages) regarding an organization in order to feed Data Marts usually used for Business Intelligence applications for reporting, dashboards, and decision making.

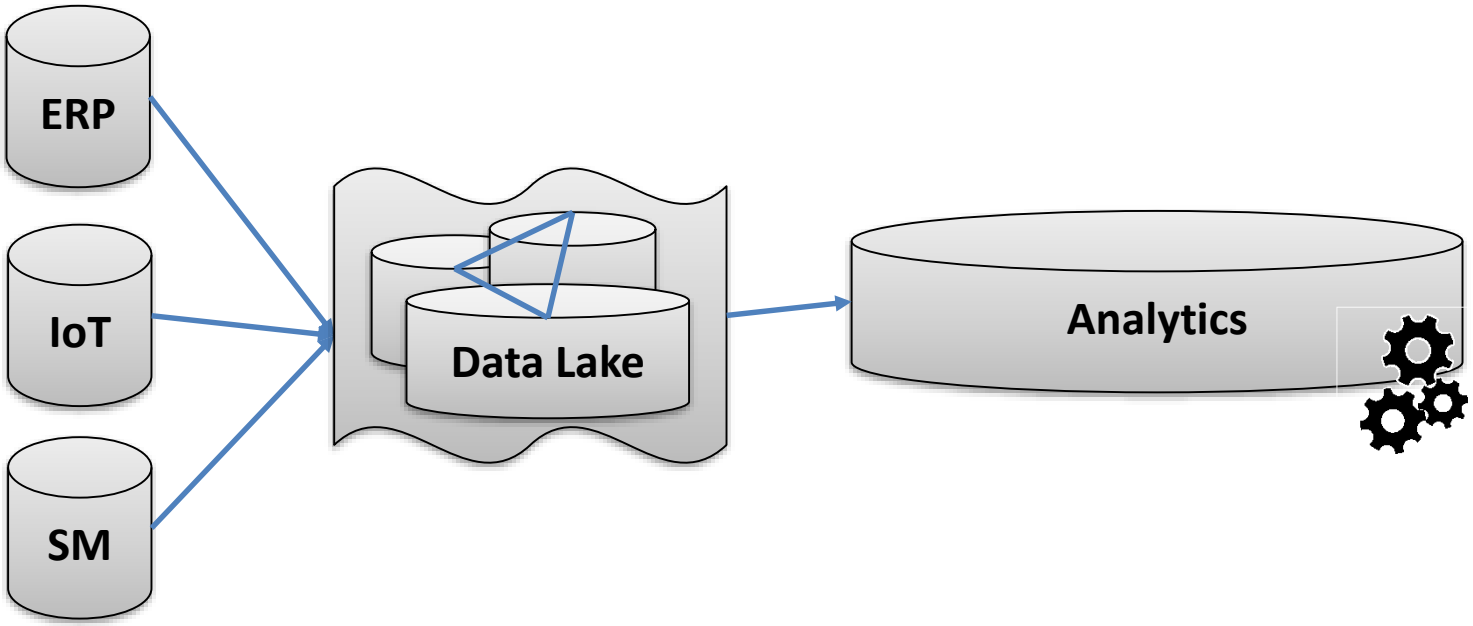
- Data sources are usually transactional like ERP, CRM, SCM, etc.
- Data are structured.
- Data are stored in formated models (records and rows).



Data Lake

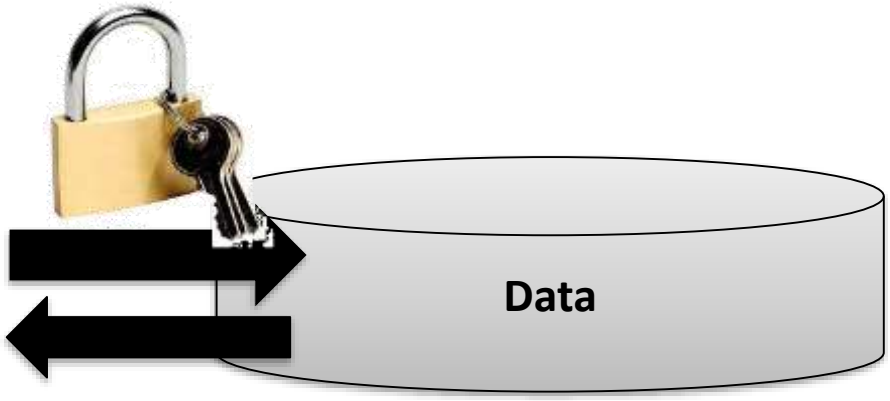
A centralized architecture of one or more repositories of Data that are not related to one organization in order to feed Data Analytics (for processing).

- Data sources are mutliple
- Data are structured and unstructured
- Data are stored in unformated models.



Data Security

It is the set of methods and tools that aim to protect electronic privacy of people and enterprises against illegal access to Data from malicious uses.



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Concept

Analytics denotes the set of methods, techniques, heuristics, and processes of analyzing data in order to find valuable information by:

- Revealing **hidden pattern,**
- Finding **connections** between concepts,

With this, businesses may take better/more accurate decisions.

Types

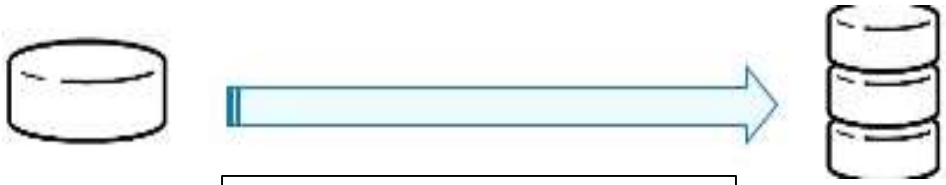
In Business, there are 2 generations of Analytics :

- **Traditional Analytics:** The set of common tools of analytics that use the data in a surface as to try understanding what is going on, what is the best result, what was the set best strategy, and so forth. This kind of Analytics does not need complex methods but common practices.

  Examples: Excel, Oracle, ERP, etc.

- **Advanced Analytics:** Some traditional tools cannot process the huge volumes of Data, so more complex methods are available in statistics, mathematics, artificial intellience, etc.

  Example of volumes where Excel can't exceed thousands of rows

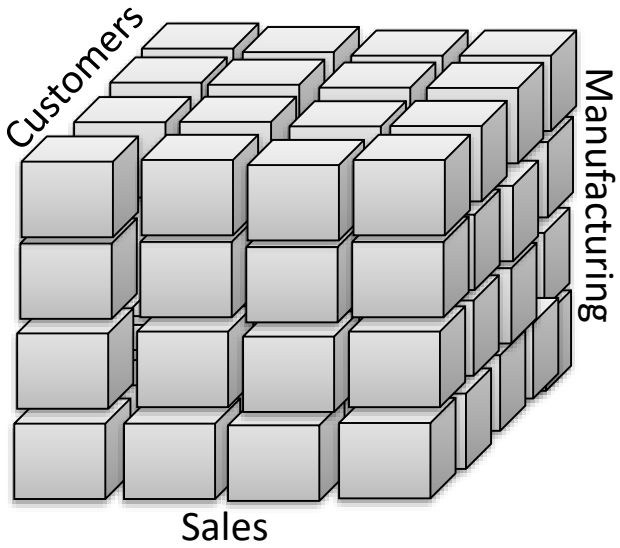


Traditional Analytics

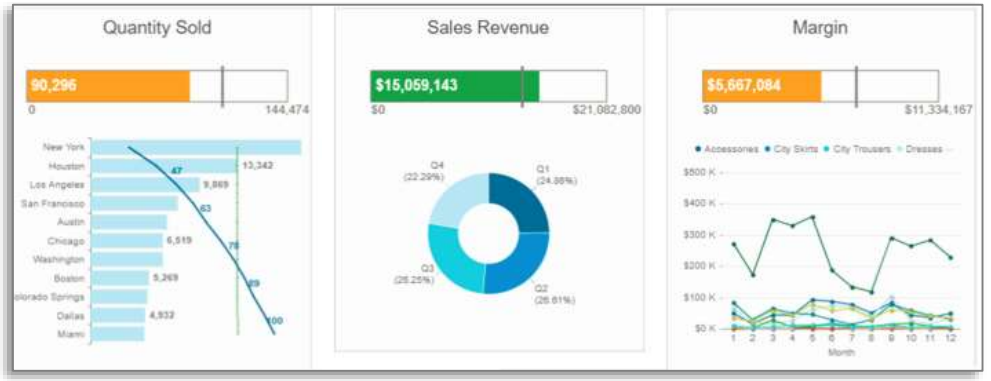
Traditional Analytics

- **Business Intelligence (BI) :** tools that allow business to accumulate data from internal and external sources in order to provide dashboards, and reporting for management

- **OnLine Analytical Processing (OLAP):** tool that allows users to selectively query data from different views dynamlically.



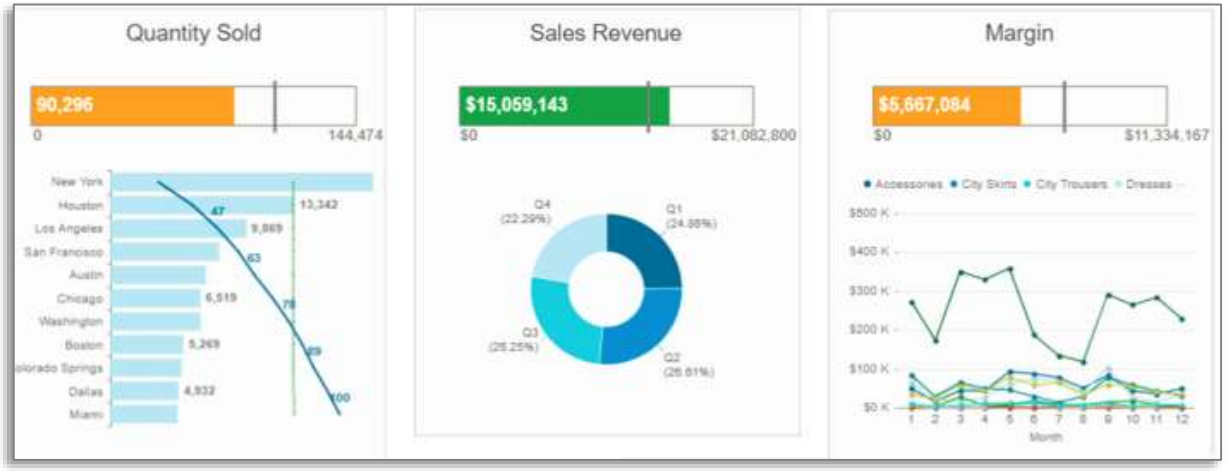
OnLine Analytical Processing (OLAP)



Business Intelligence (BI)

Business Intelligence (BI)

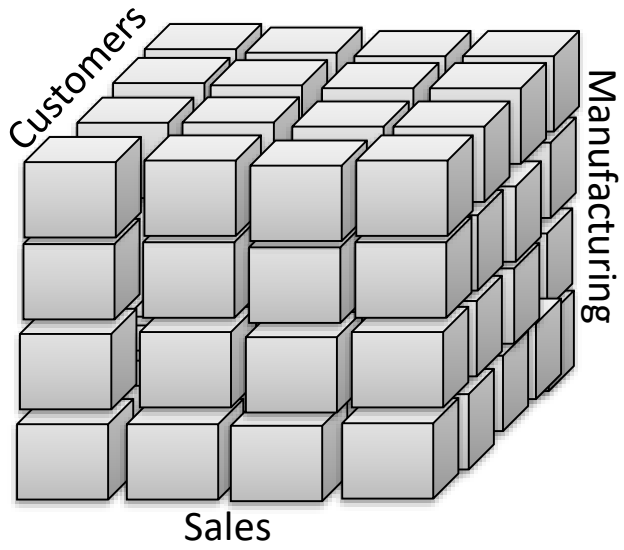
Tools that allow business to accumulate data from internal and external sources in order to provide dashboards, and reporting for management



Business Intelligence (BI)

OnLine Analytical Pricessing (OLAP)

Tool that allows users to selectively query data from different views dynamlically.



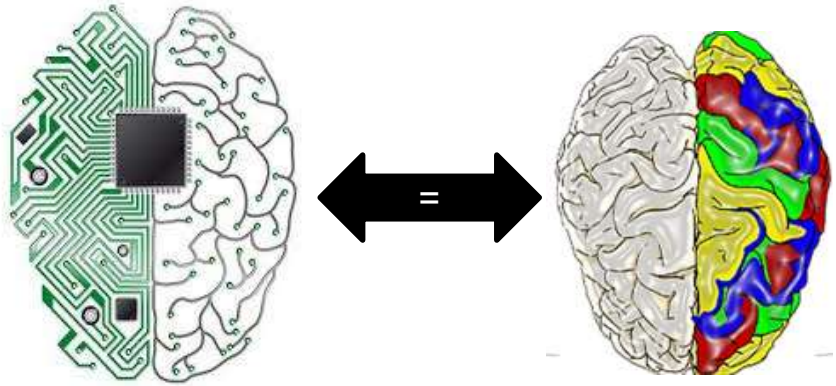
OnLine Analytical Processing (OLAP)

Advanced Analytics

- **Artificial Intelligence :** Any machine that observes the environment and decides automatically (through algorithms) to productively accomplishing goals.

- **Data Mining:** The set of approaches that allow identifying patterns in a set of Data. Meaningful information are extracted.

Data Mining



Artificial Intelligence

Applicative Exercise 2

Duration : 60min. Group Work. Score: 1.0

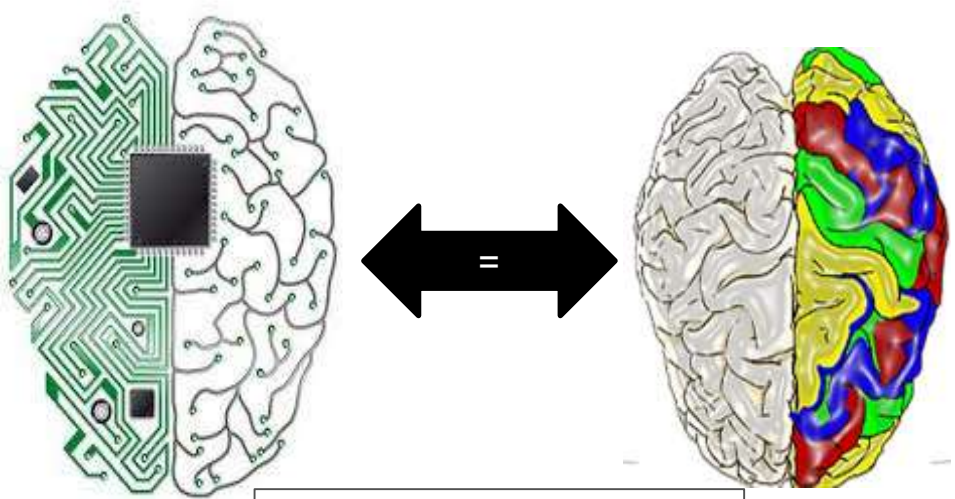
Context

Try to list more than 10 Companies that are specialized in Big Data Solutions for enterprises, with a brief description of each one, the names of the proposed products (software) and/or services (IT providing), and creation data of the activity.

Try to illustrate the evolution (history) of creation by dates and the number of companies by year in one chart. What do you have as result ?

Artificial Intelligence

- **Reasonning:** By rules, logic, deductions, generalization, etc.
- **Knowledge representation**: by gathering commonsense objects.
- **Multi Agent Intelligence:** by planning in a shared and parallel way for the same goals
- **Machine Learning:** algorithms that try to learn from experience to improve the present and future.
- **Natural Lanuguage Processing:** methods that allow the machine understanding the human language
- **Social Intelligence:** methods that allow the machine (usually set of machines) to bypass the numeric intelligence and introduce the emotional and behaivioral intelligence.
- And many other types and sub-types.



Artificial Intelligence

Data Mining

- Is the set of tools that aim to find hidden patterns and relationships between Data and information to answer one or more issues for an enterprise. These issues can be prediction of actions or decision making.

Data Mining

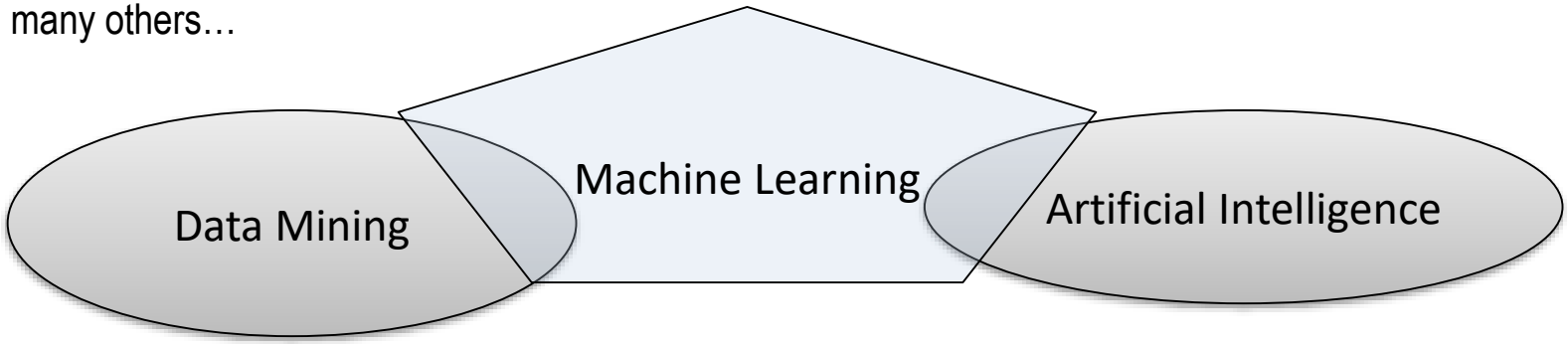
Machine Learning

The set of computational methods that automate the acquisition of knowledge from experience.

In Enterprises application, Machine Learning uses Statistics, Mathematics, Computer Science, and Graphs Theory in engineering tasks related to business. This provides unseen patterns and diminish irregularities in human errors

Applications in management can be:

- Stock prediction,
- Accounting accuracy,
- Insurance Fraud detection,
- Bankruptcy prediction,
- Risk Prediction,
- Business Process Improvement,
- And many others…



Agenda

Big Data

- **Data Concept**
  - Data
  - Information
  - Knowledge
- **Big Data Concept**
  - Volume
  - Variety
  - Velocity
  - Veracity
- **Big Data Life Cycle**
  - Data Acquisition
    - Multi-Channels
    - Internet of Things
    - Cloud/Grid Computing
  - Data Storage
    - Data Base
    - Data Warehouse
    - Data Lake
    - Data Security

Analytics

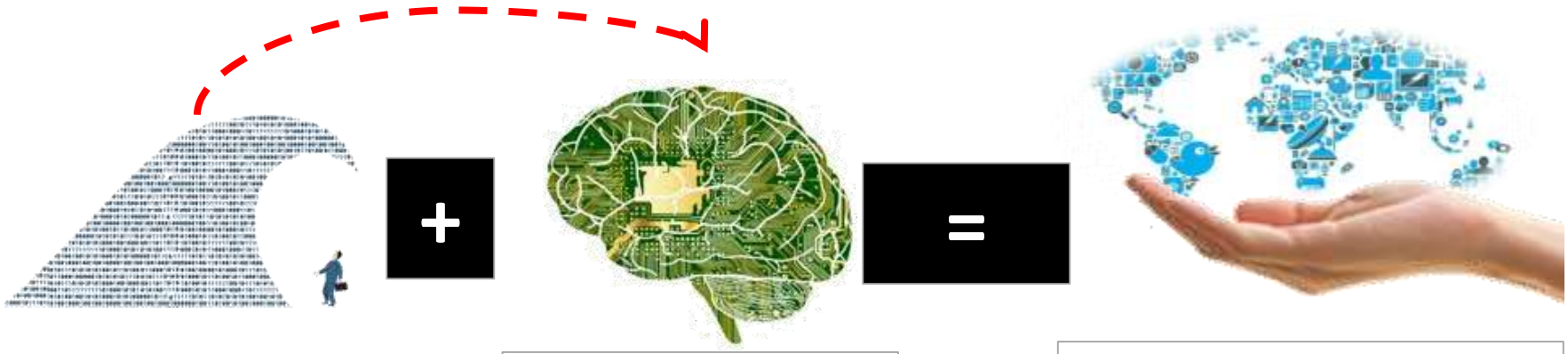
- **Concept**
- **Types**
  - Traditional Analytics
    - Business Intelligence (BI)
    - OnLine Analytical Processing (OLAP)
  - Advanced Analytics
    - Artificial Intelligence
    - Data Mining
    - Machine Learning

Big Data Analytics

- **Concept**
- **Role**
- **As a field**
- **Technically**
- **Big Data Analytics Life Cycle**
  - Data Processing
    - Hadoop
    - MapReduce
  - Data Quality
- **Big Data Analytics Project**
- **Technological and Social Mutations**
- **In Management**
  - Applications
    - Predictive Management
    - Prediction in Unstructured BPM
    - Marketing/Sales Compliance
    - Supply Chain Advanced Risk Management
    - Supply Chain Predictive Risk Management

Big Data Analytics → Concept

- **Concept**



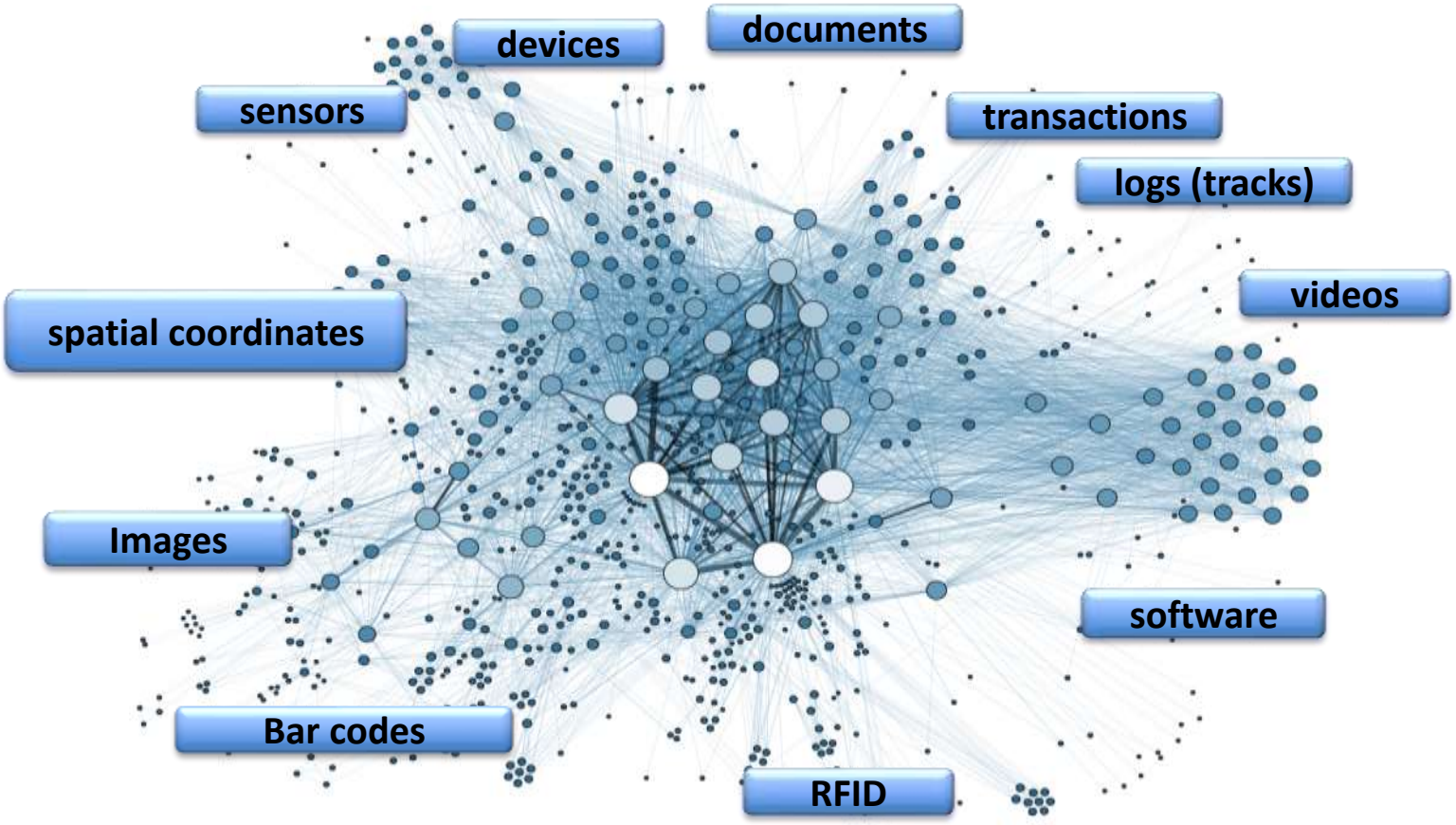
Big Data
Data Acquisition
Data Storage

Analytics
Data Analysis
Data Quality
Data Visualization
Business Intelligence (BI)
OLAP (Online Analytical Processing)
Machine Learning (ML)
AI (Artificial Intelligence)

Big Data Analytics

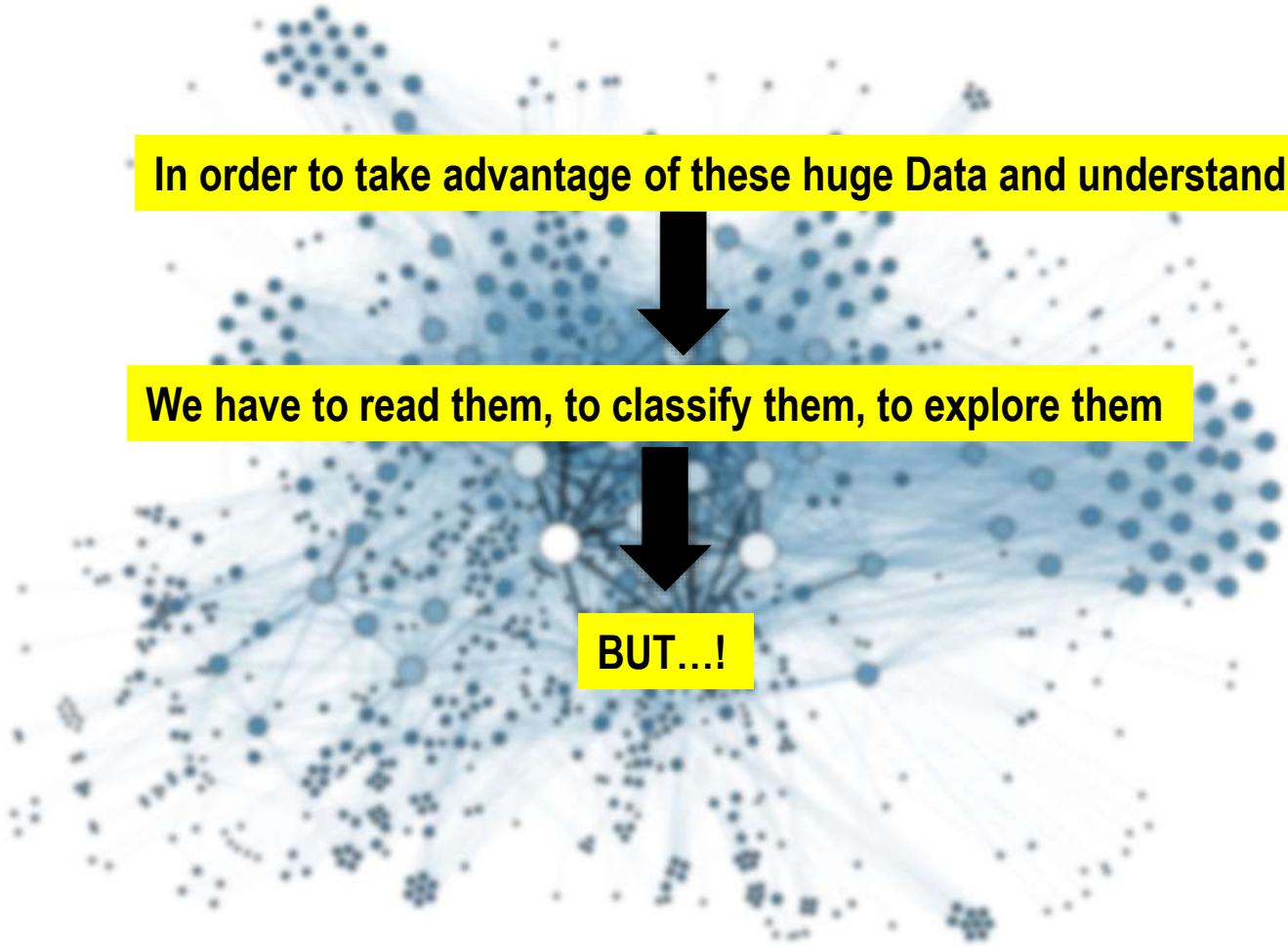
- **Concept**

A wide cloud of data in dynamic flows.



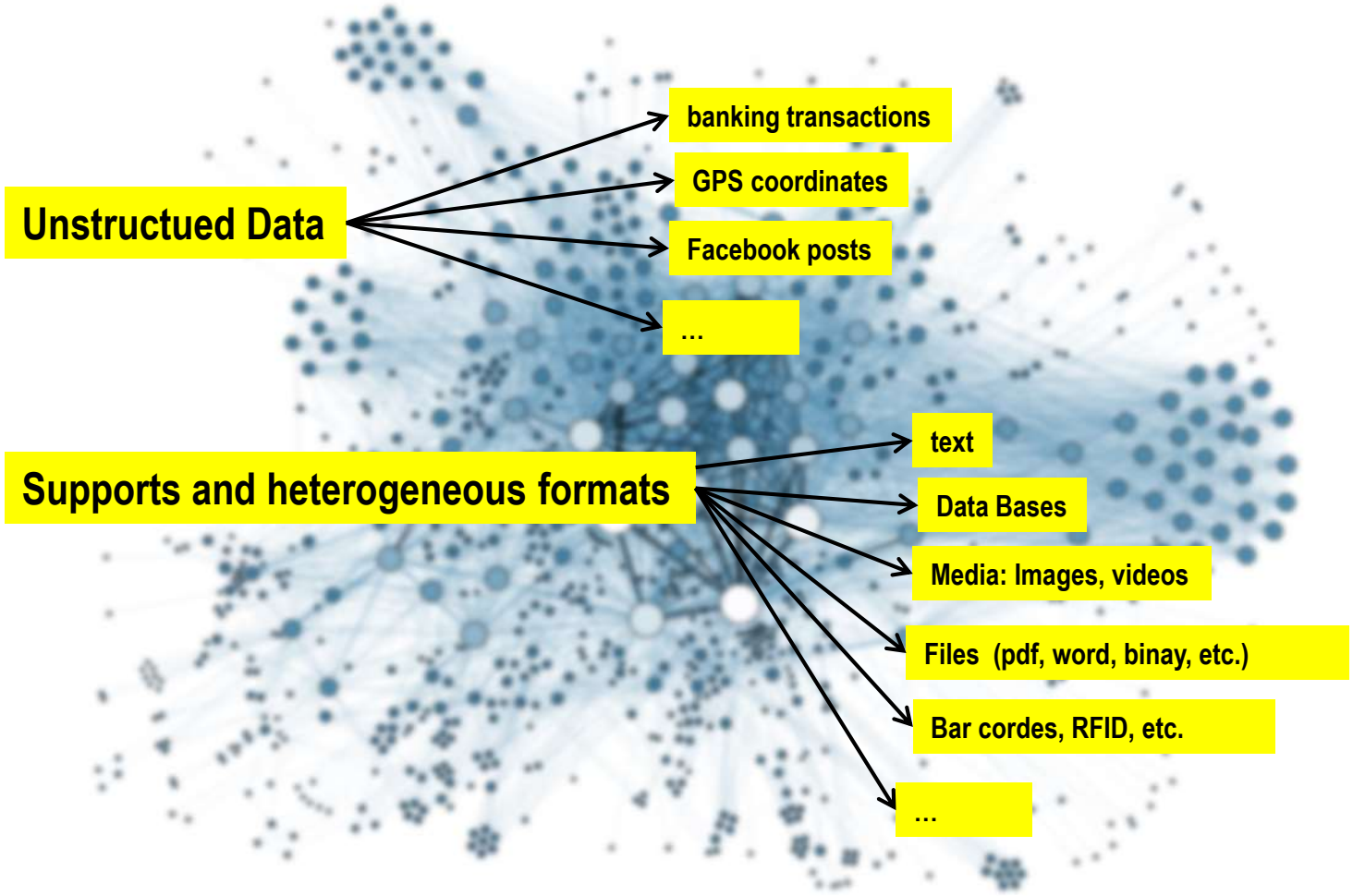
- **Concept**

A wide cloud of data in dynamic flows.



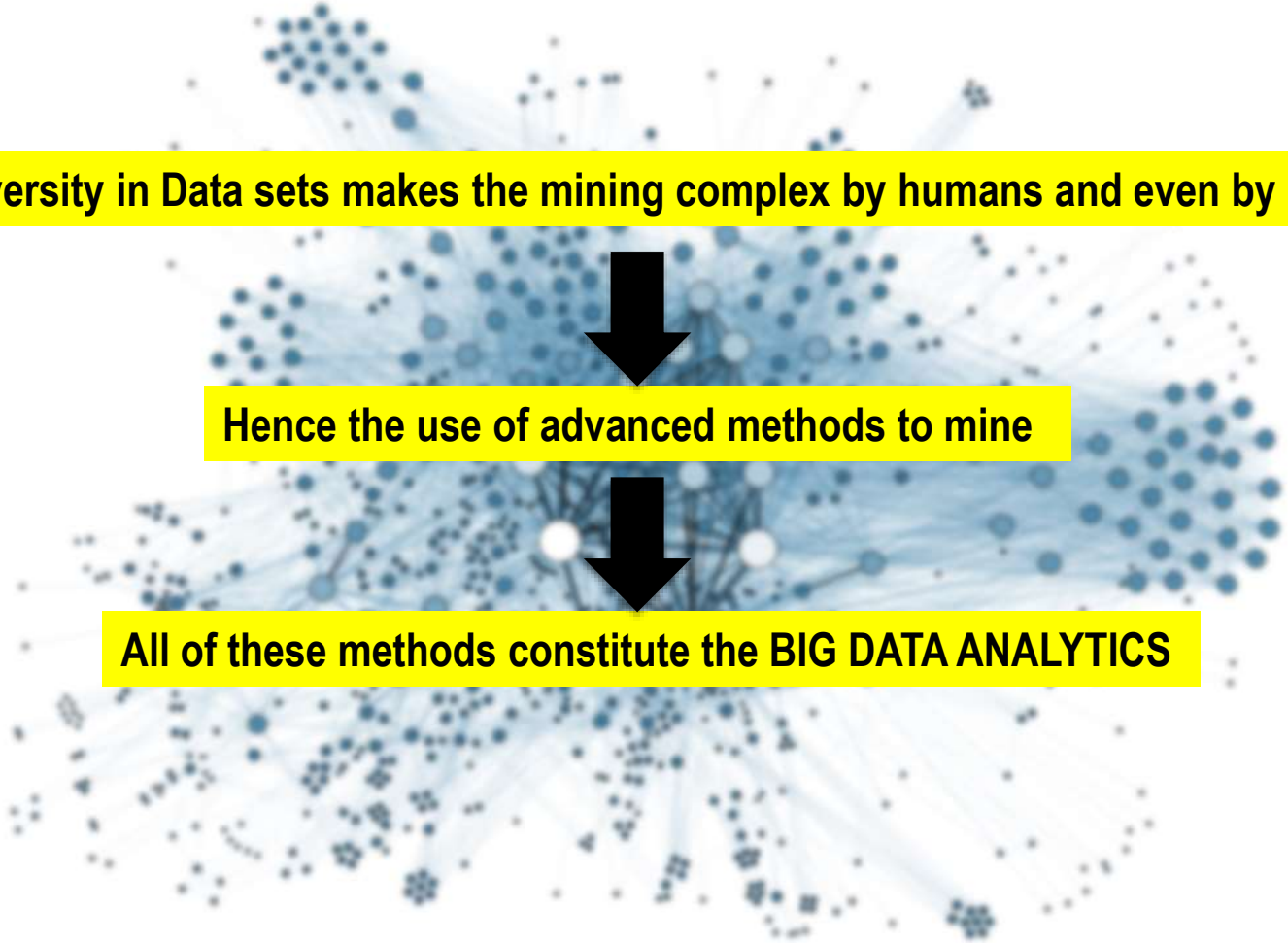
Concept

A wide cloud of data in dynamic flows.



Concept

A wide cloud of data in dynamic flows.



Diversity in Data sets makes the mining complex by humans and even by machines !

Hence the use of advanced methods to mine

All of these methods constitute the BIG DATA ANALYTICS

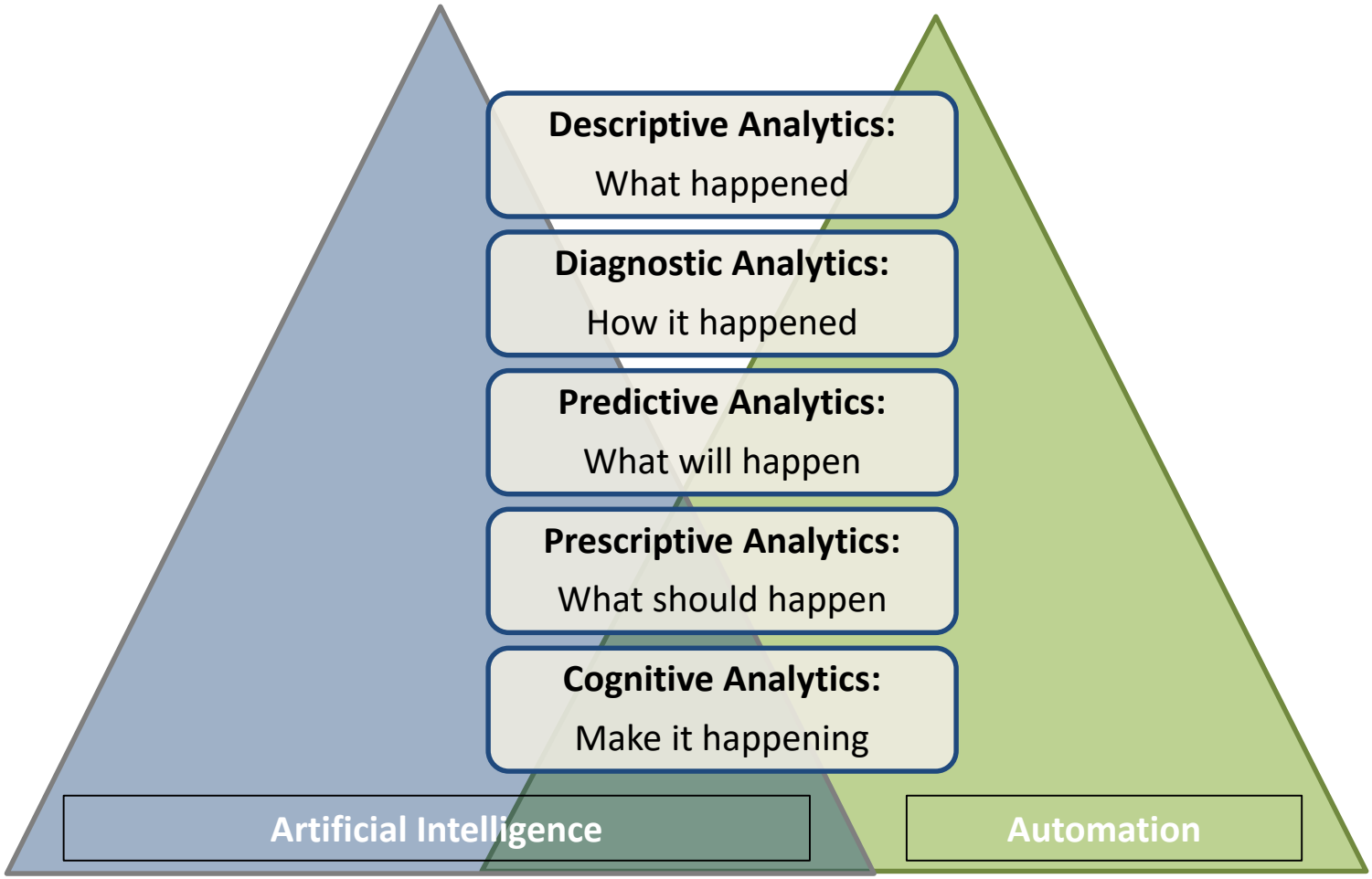
Concept

Big Data Analytics are the set of tools that aim to process the stored Big Data in order to :

- **Reveal hidden** patterns,
- **Discover unknown** correlations,
- **Forecasting** market trends,
- **Finding** customer preferences,
- **Accurating** forecastings,
- **Unconvering** unexpected information and knowledge.
- …

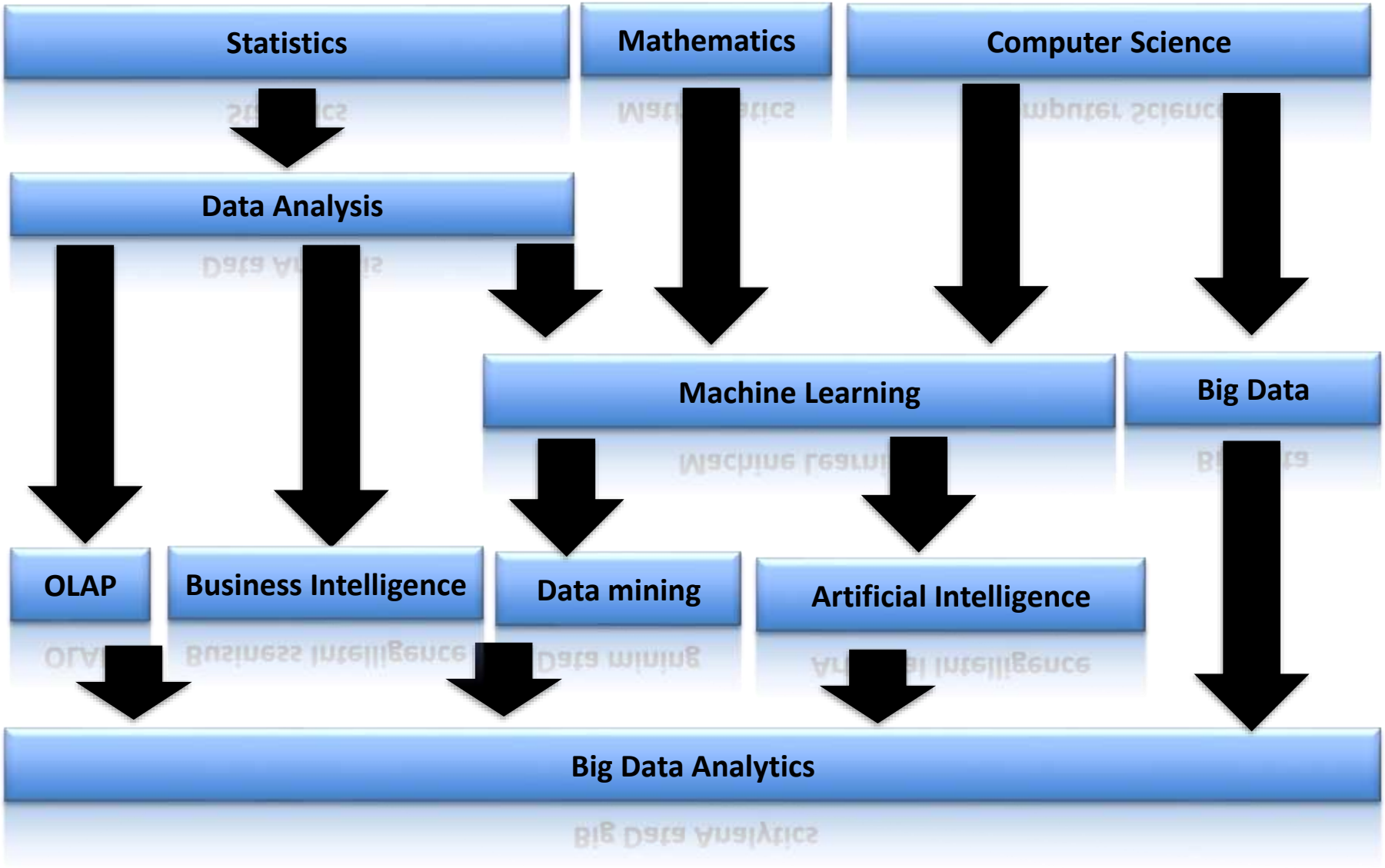
Big Data Analytics → Role

- **Role**



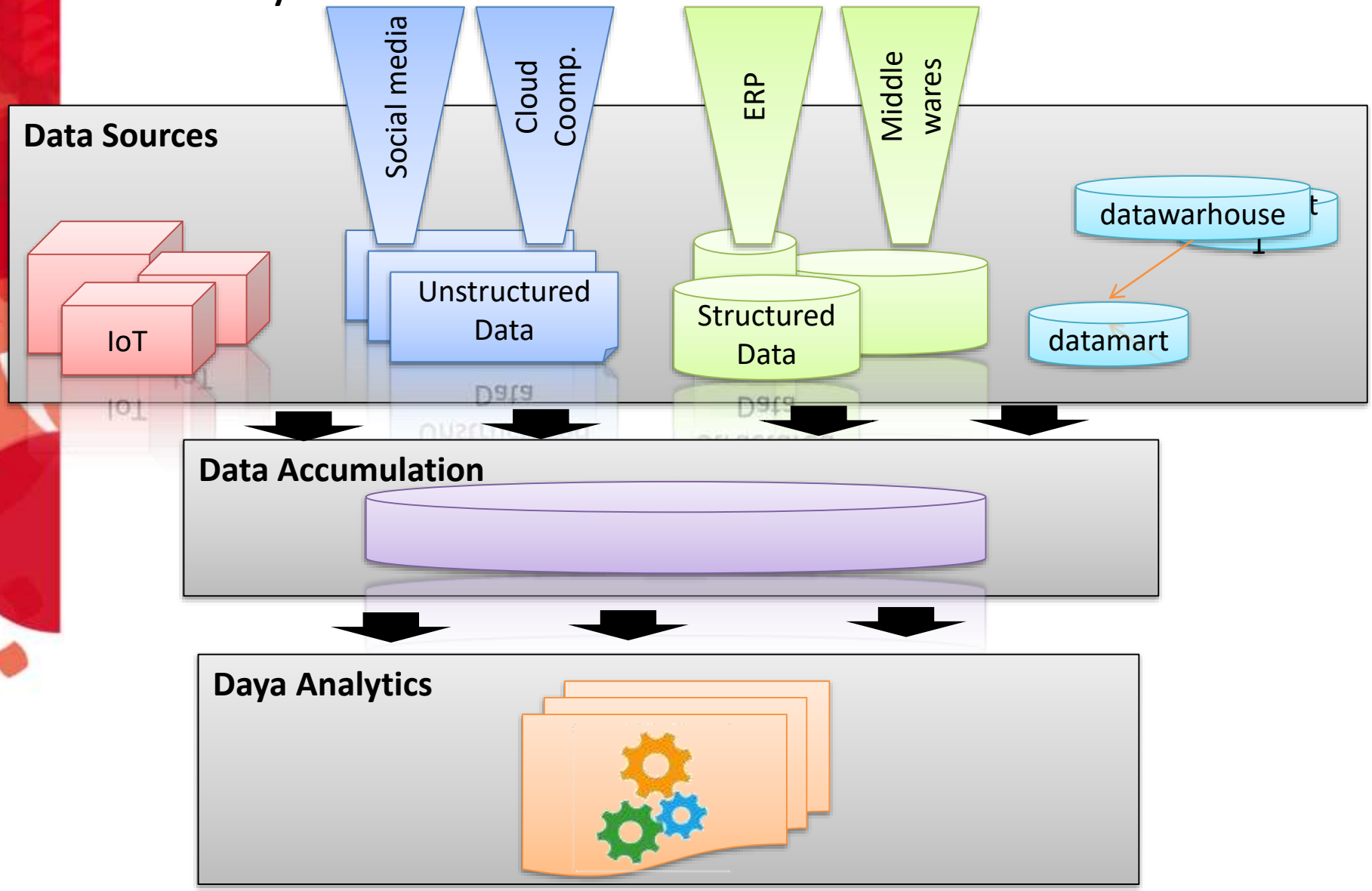
Big Data Analytics → As a field

- As a field



Big Data Analytics → Technically

- Technically



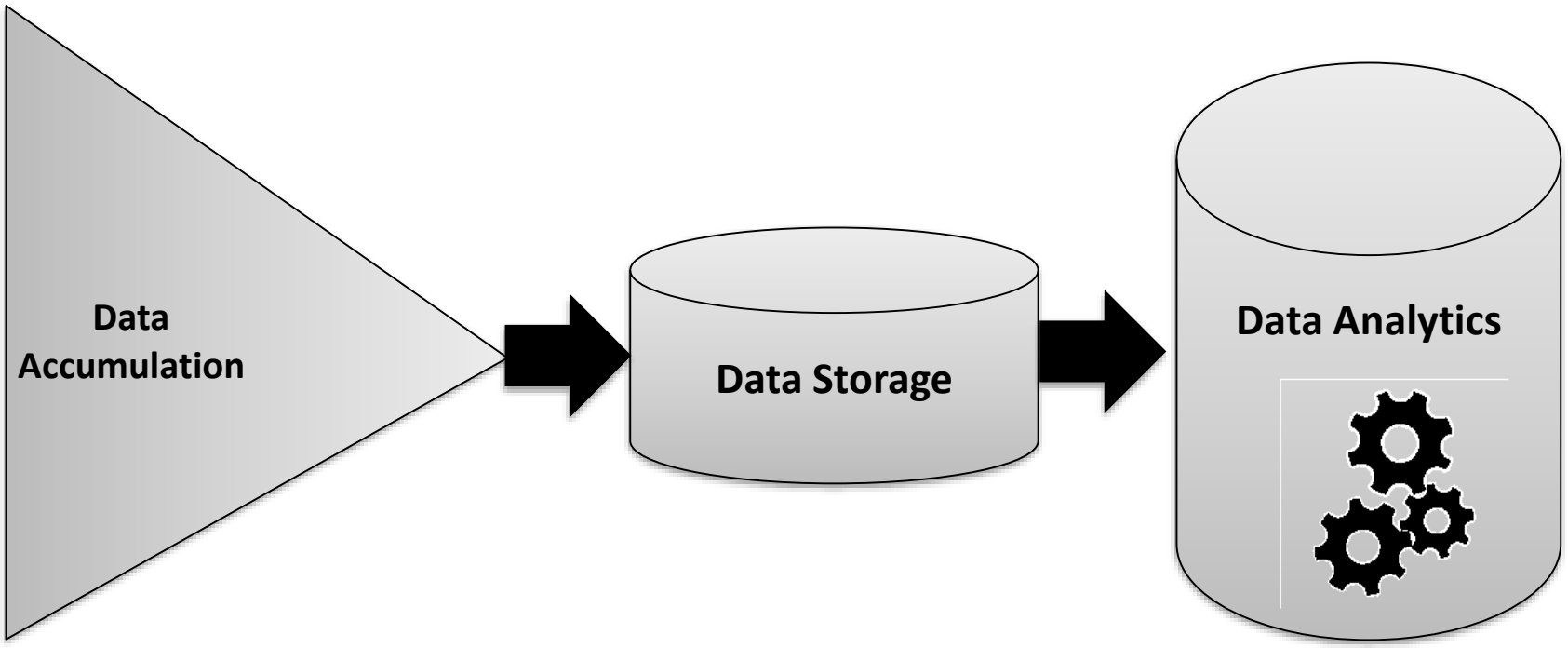
Applicative Exercise 3

Group work. Duration 1 week. Score 1.0

Try to list more than 10 applications of Bid Data Analytics in Management/Business with information about area, concerns, and possible Data sources. For example Segmentation of Customers (finding hidden segments of new customers) in Customer Relationship Management (CRM) as following.

Application	Area	Concern	Data sources
Customers Segmentation	Customer Relationship Management	Helping in opening new markets and/or new market/products opportunities	Data sources: Demographic Data from territories, social media (new population), weater/tourism (seasonable products), etc.

- **Big Data Analytics Life Cycle**

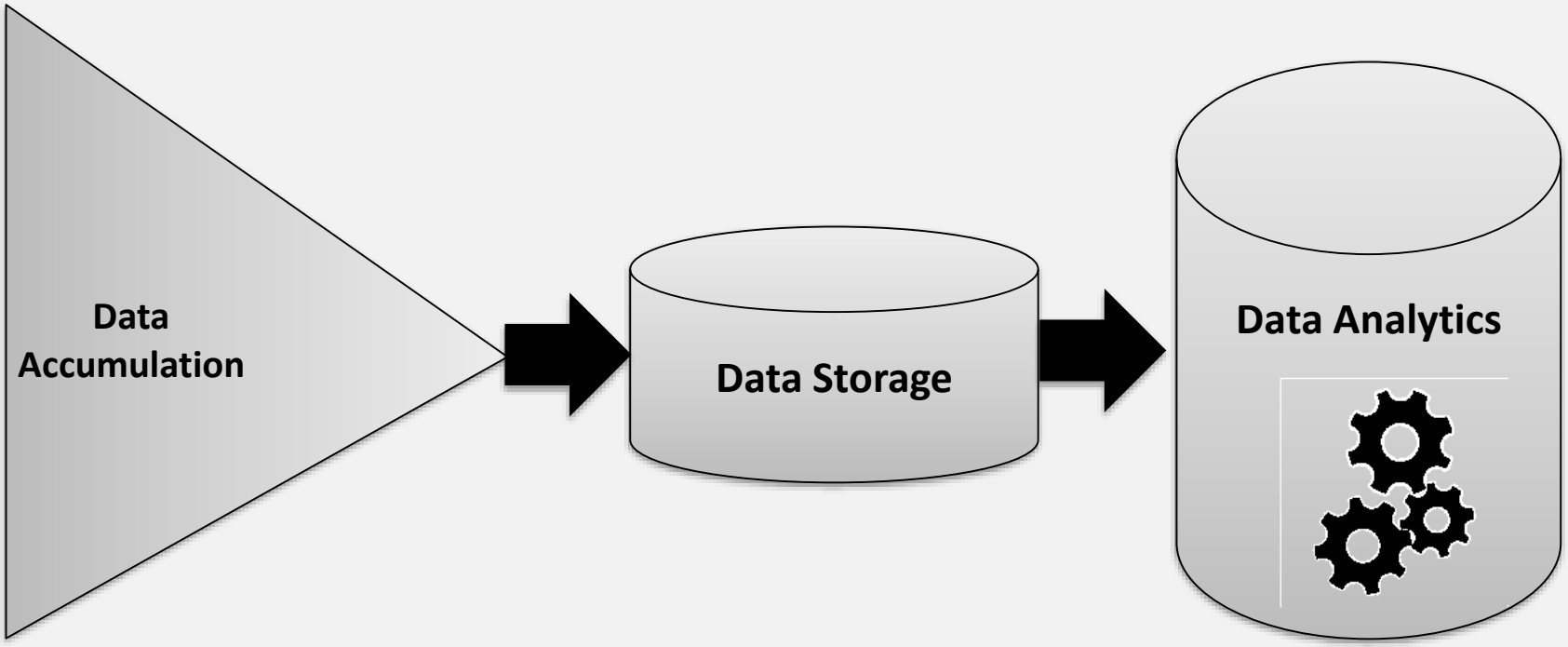


- **Big Data Analytics Life Cycle**

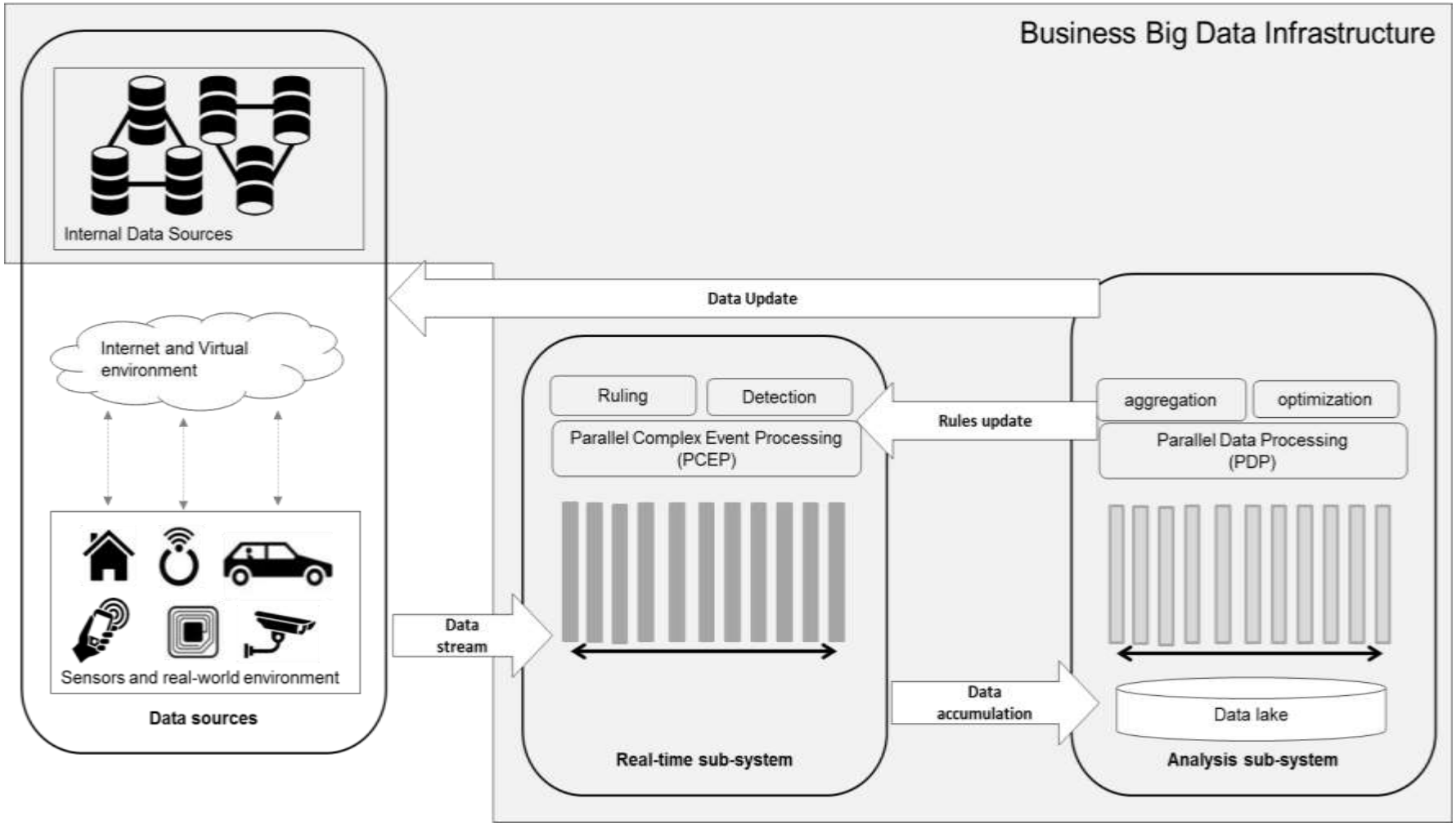
Applicative Exercise 4

Individual work. Duration 20min. Score 0.5

Try to find and distinguish between the paradigms **'Data', 'Information',** and **'knowledge'** in the figure below (Figure Big Data Analytics Life Cycle).



- **Data Processing**



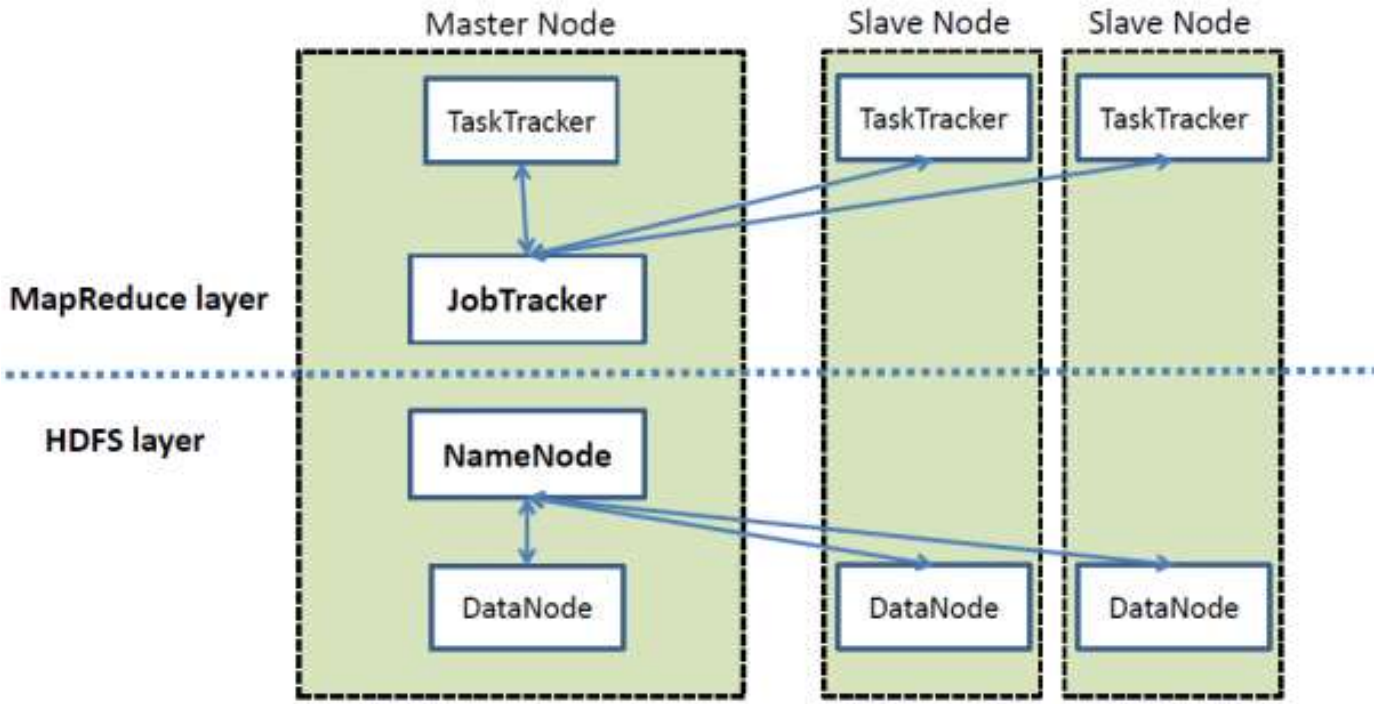
Data Processing

A number of frameworks exist for data parallel processing:

- **Spark:** Open-source more adapted for wide assortment of workloads and more powerful in streaming mode.

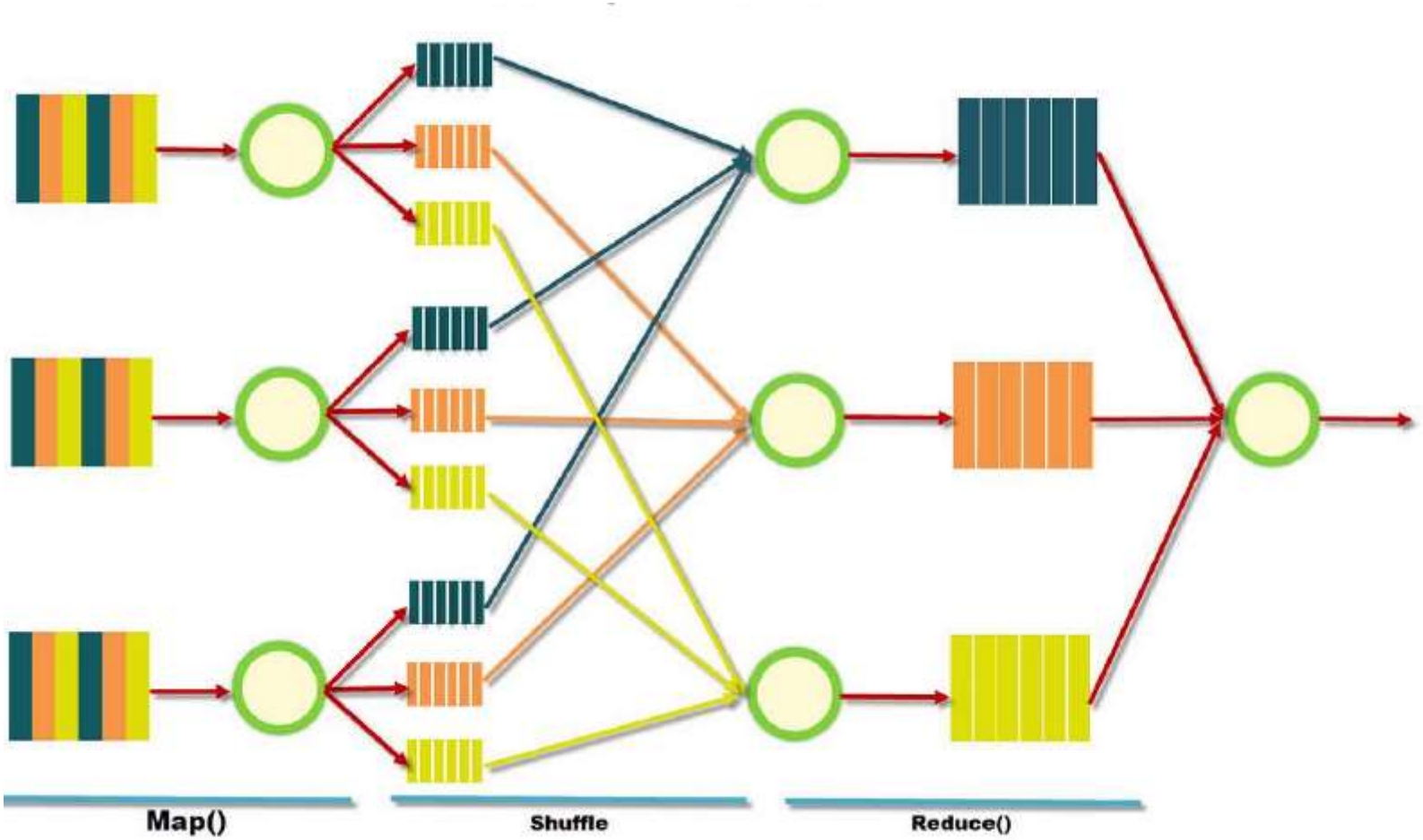
- **Hadoop MapReduce:** Open-source framework processes Data stored in HDFS format (Hadoop Distributed File System), with an algorithm MapReduce and a combined with the Data Base Hbase. It is more adapted for wide volumes of data and more powerful in batch mode..

- **Hadoop**



Hadoop

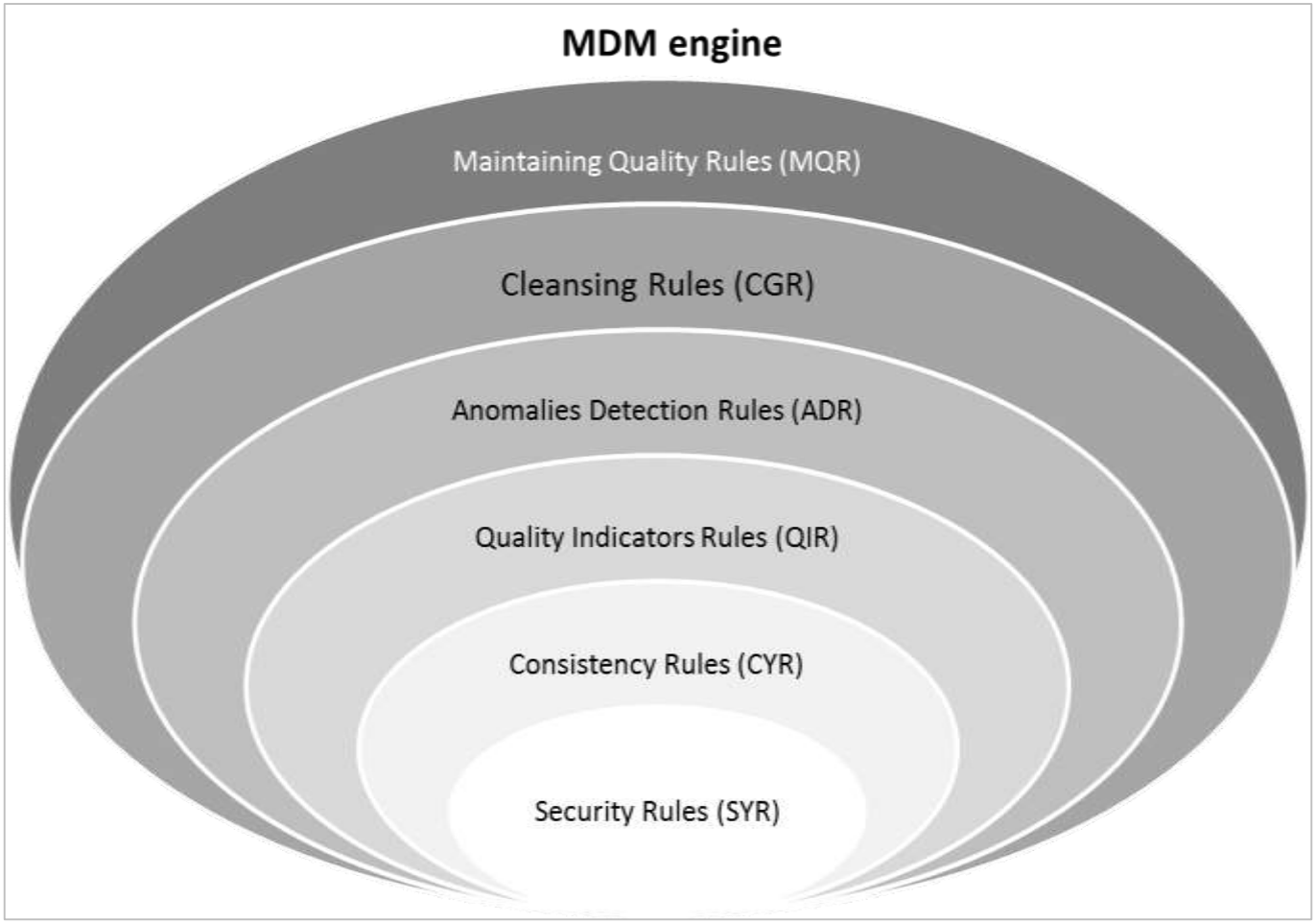
- **MapReduce**



MapReduce

- # Data Quality

Is the set of operations for cleansing of Data by improving truthfulness, consistency, compliance, and significance. The management of these operations in the field of Big Data Analytics is called **'Master Data Management'**



Big Data Analytics Project

Step 1

Identify the context and the objective(ex. Target Marketing)

Etape 2

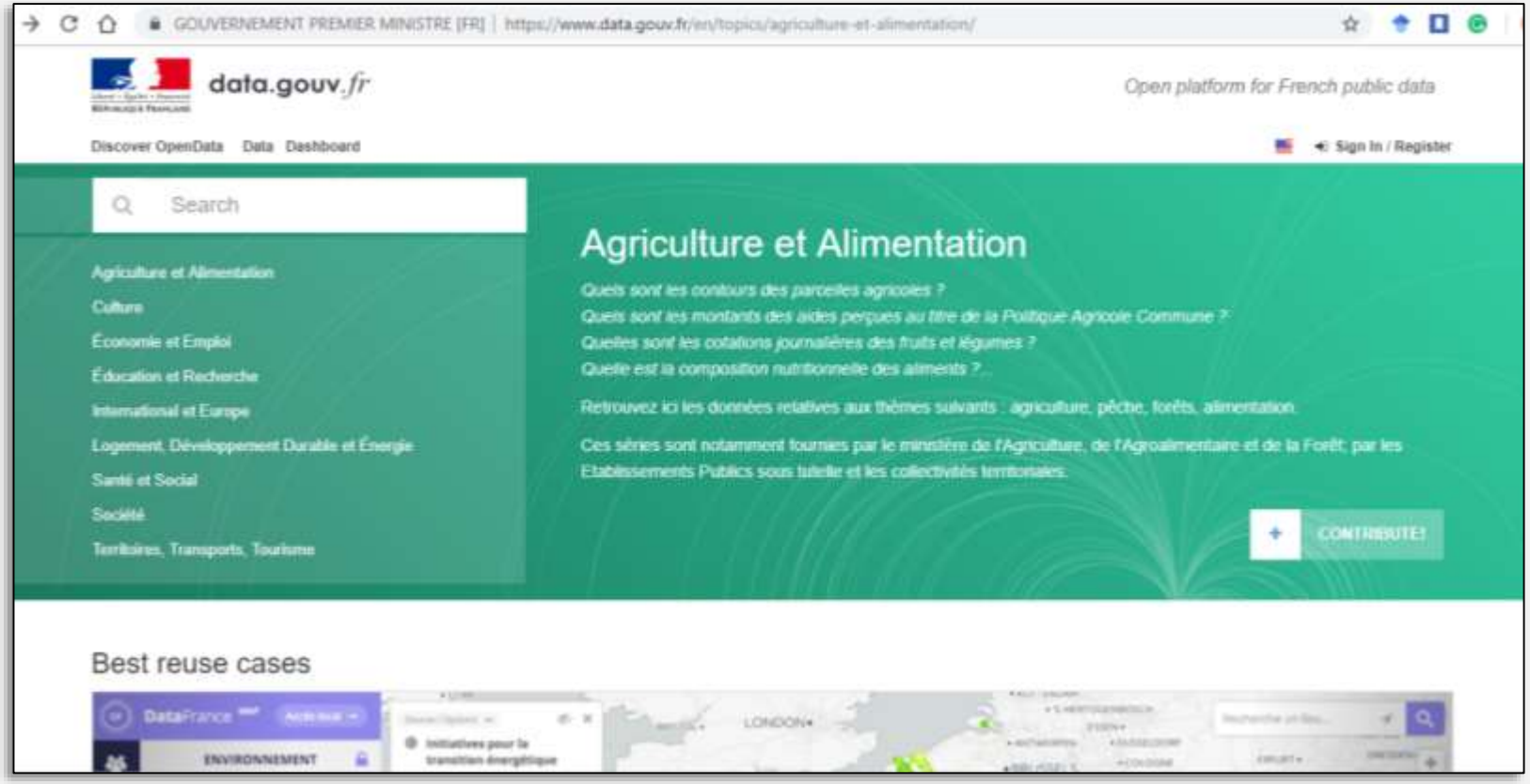
Aggregate the Data (ex. Buy and open Data flows from FB, and/or Open-Data)

Etape 3

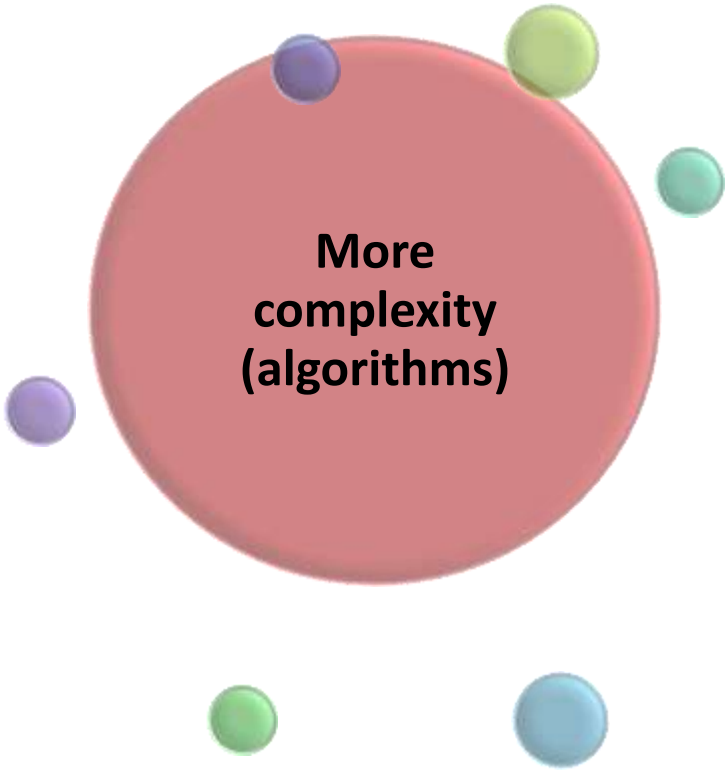
Exploration of the accumulated Data (ex. Hadoop, MapReduce , Cassandra, ..)

Applicative Exercise 5

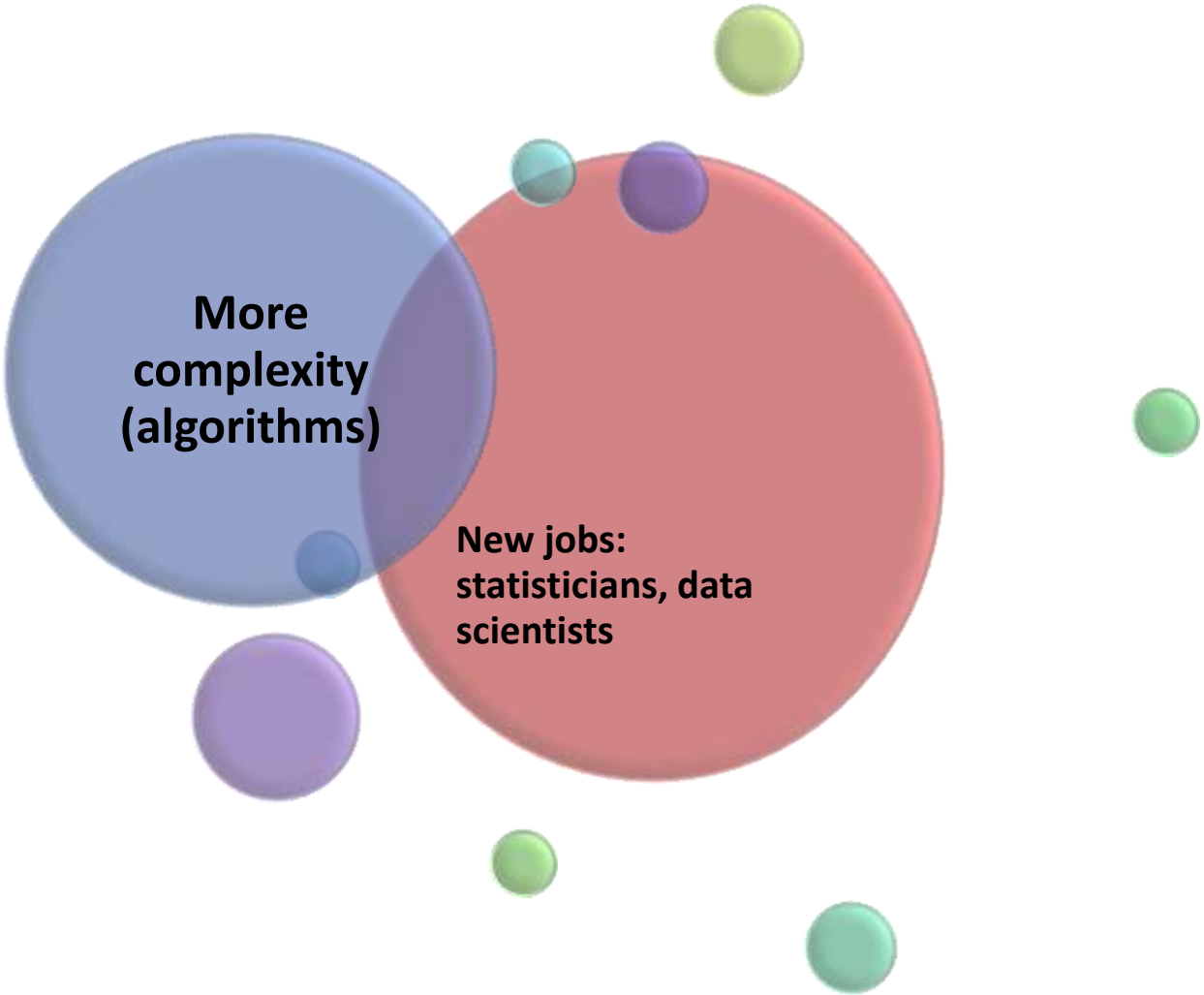
Try to export an Excel file of Data from the Open Data of French government (ex. agriculture data of Strasbourg) (https://www.data.gouv.fr/)



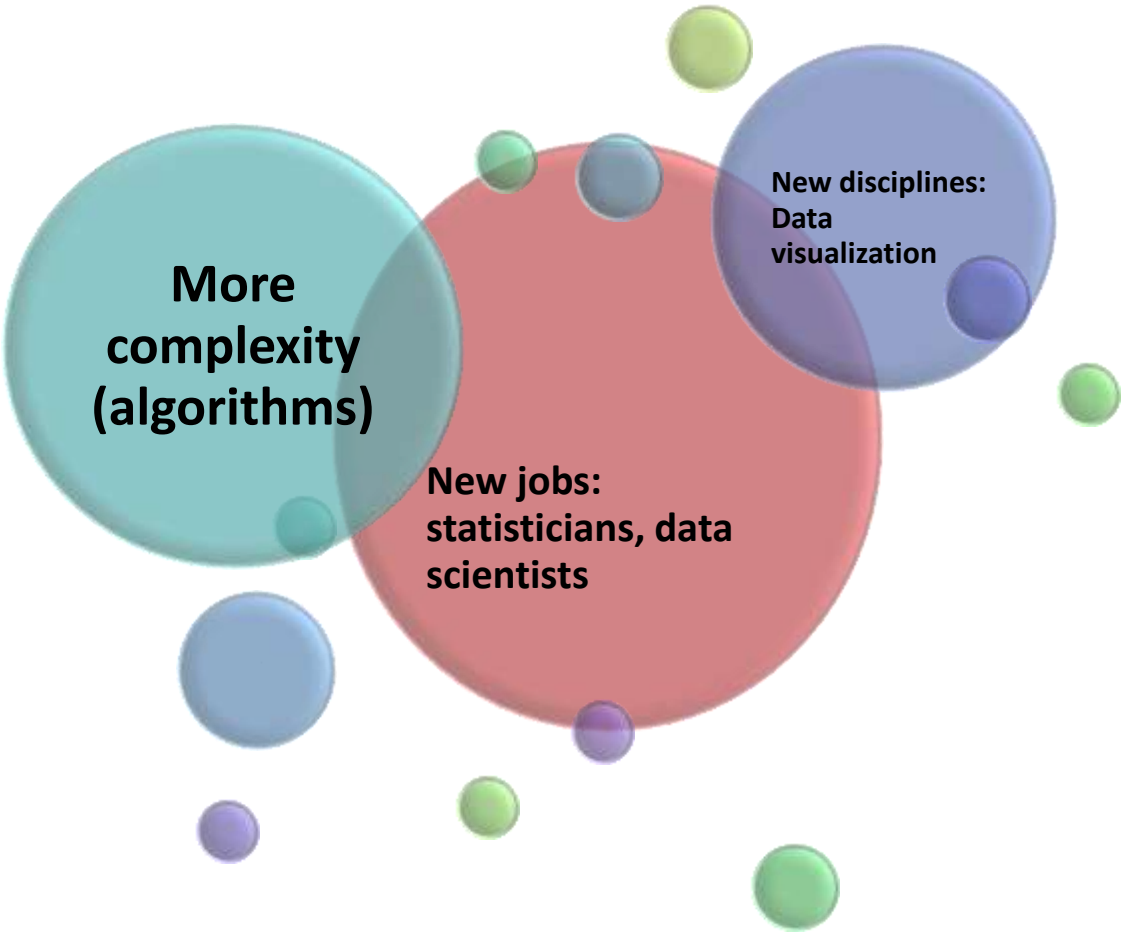
Big Data Analytics → Technological and Social Mutations



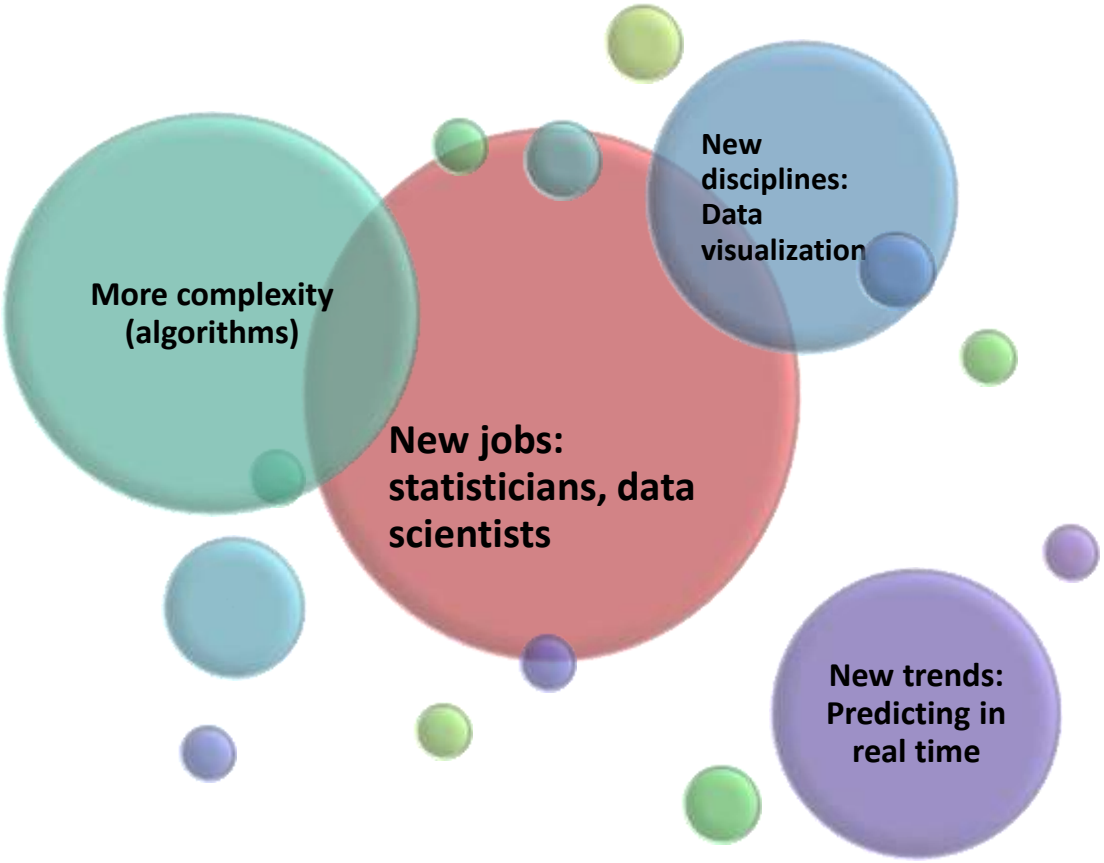
Big Data Analytics → Technological and Social Mutations



Big Data Analytics → Technological and Social Mutations

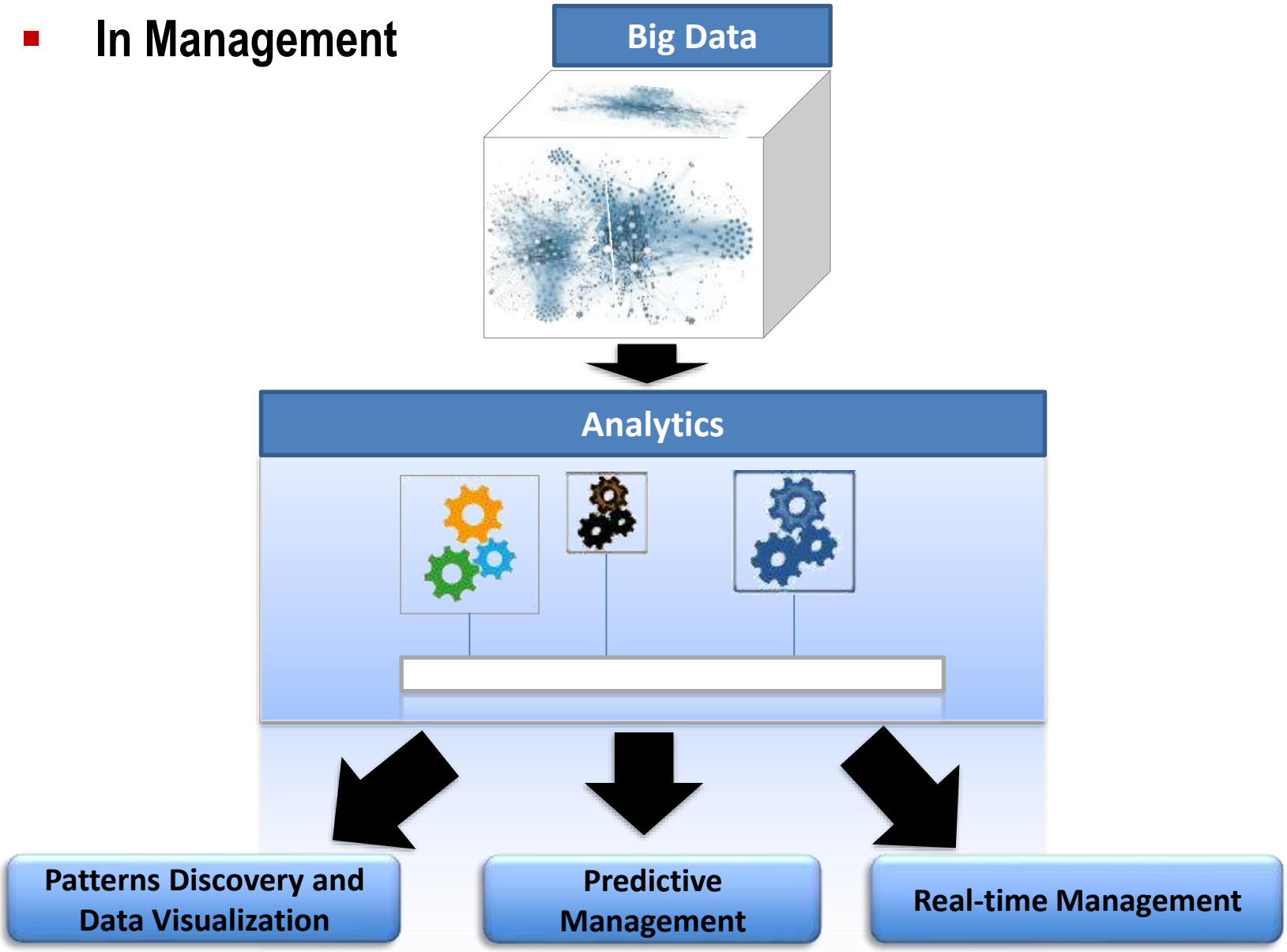


Big Data Analytics → Technological and Social Mutations

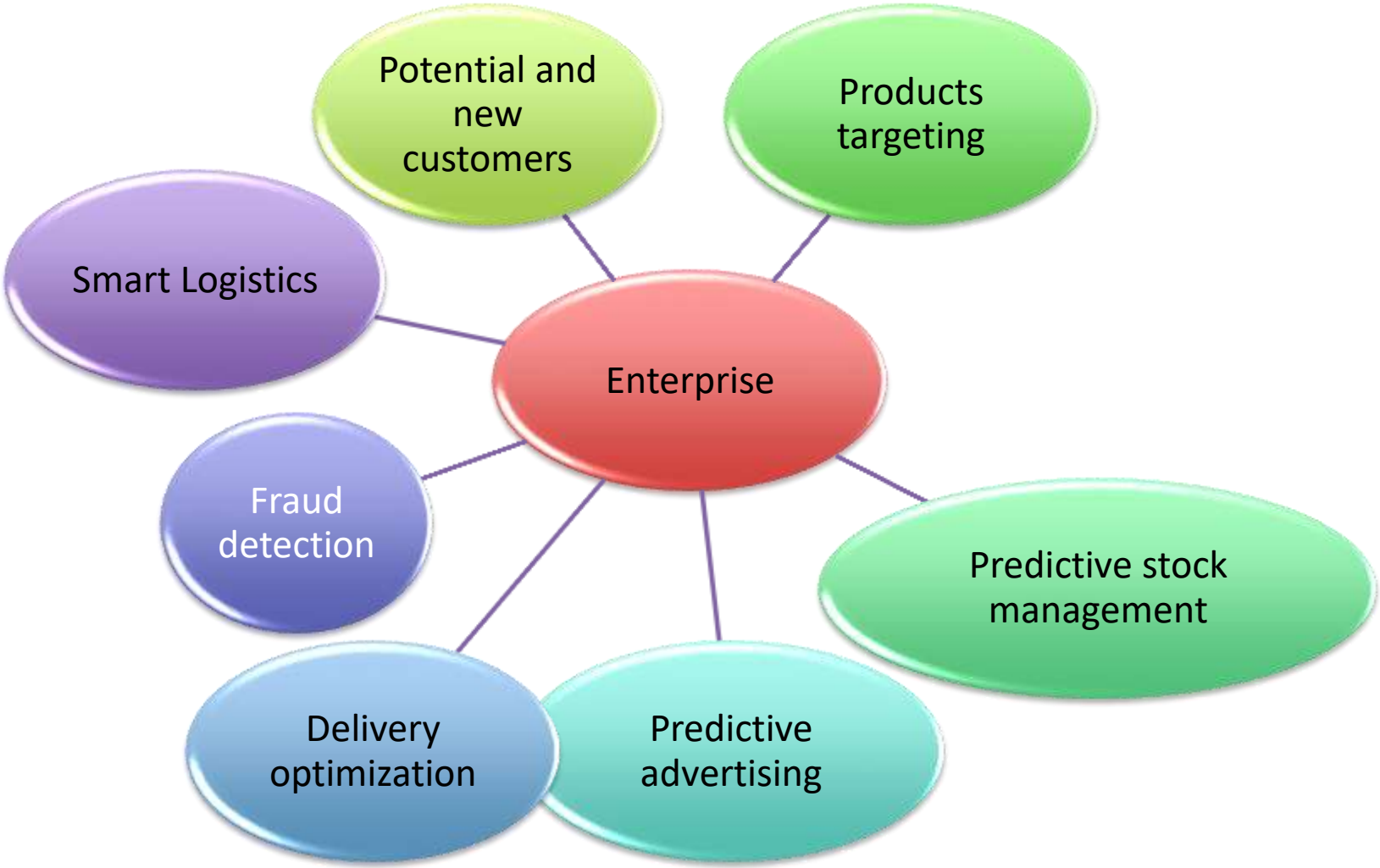


Big Data Analytics → In Management

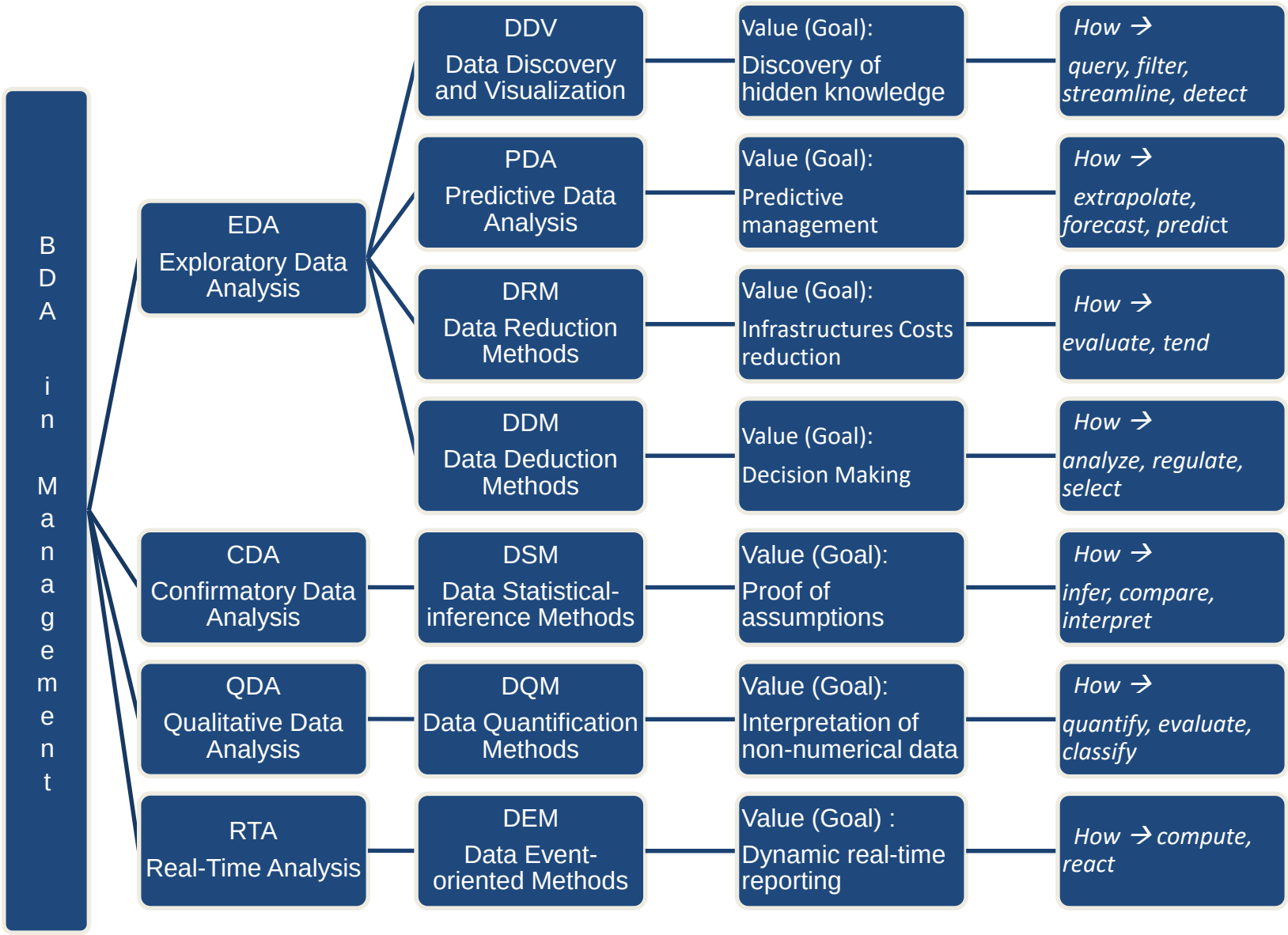
- **In Management**



Big Data Analytics → In Management → Applications



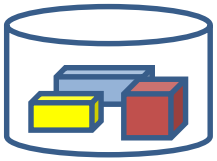
Big Data Analytics → In Management → Applications



Before Big Data Analytics

Data from internal services and other organizations, ...

Data integration



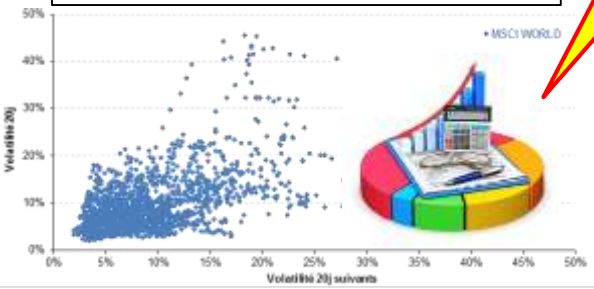
IS (ERP, etc.)

Managers

Tools

Data from IoT, ERP, social networks, smartphones, ..

Proactive/Predictive Tools

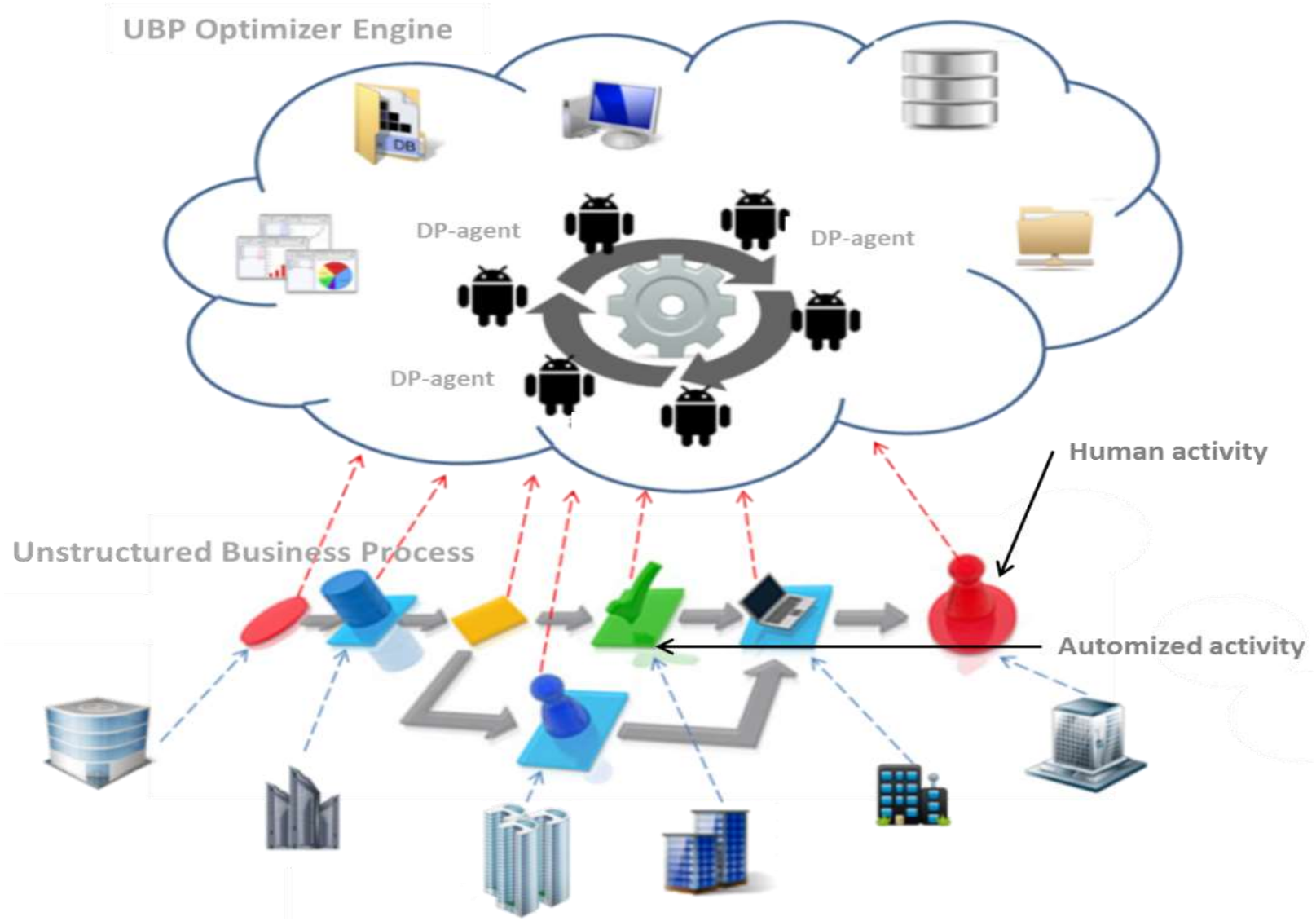


Analytics

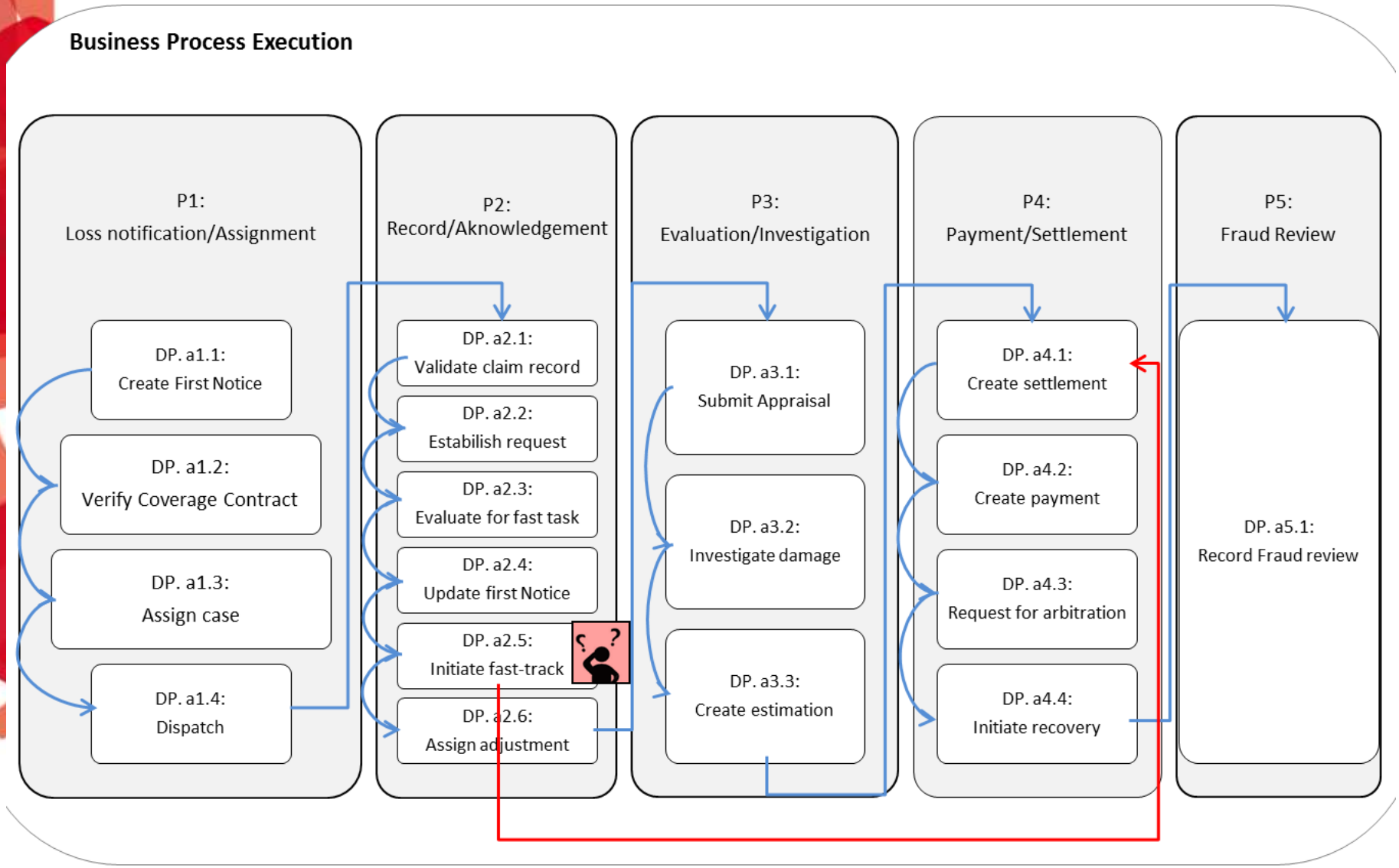
Managers

With Big Data Analytics

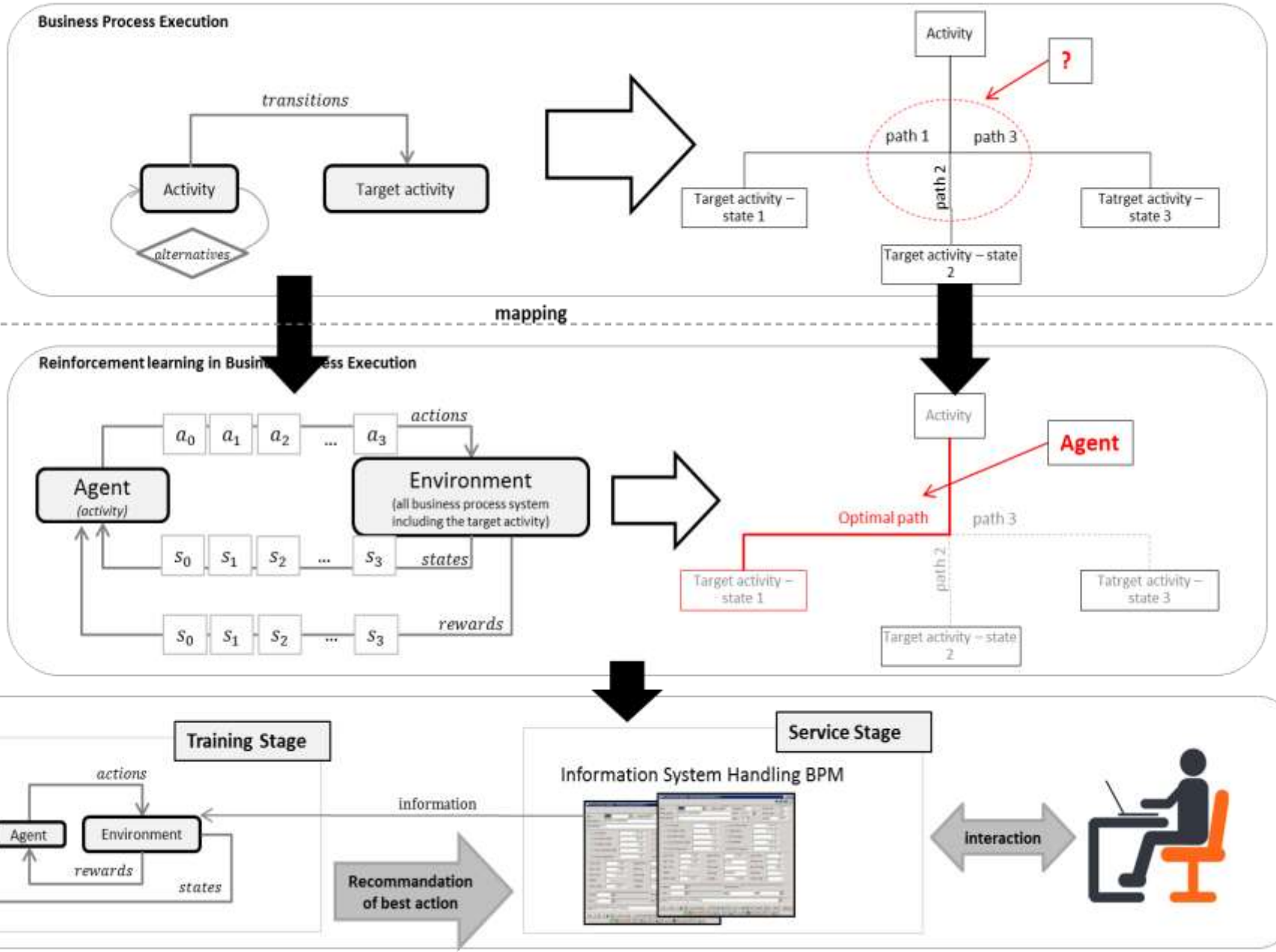
Big Data Analytics → In Management → Applications → Prediction in Unstructured BPM



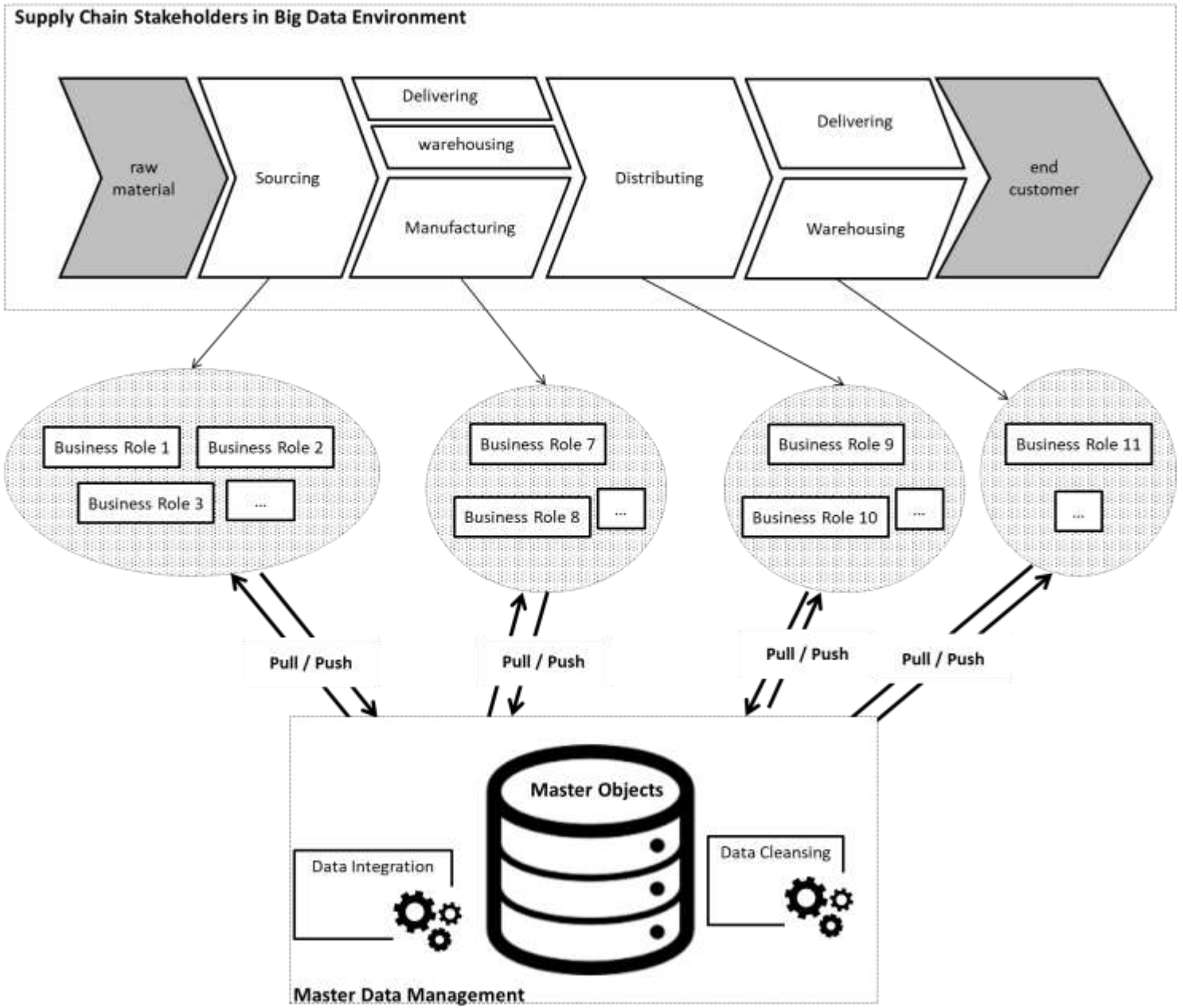
Big Data Analytics → In Management → Applications → Prediction in Unstructured BPM



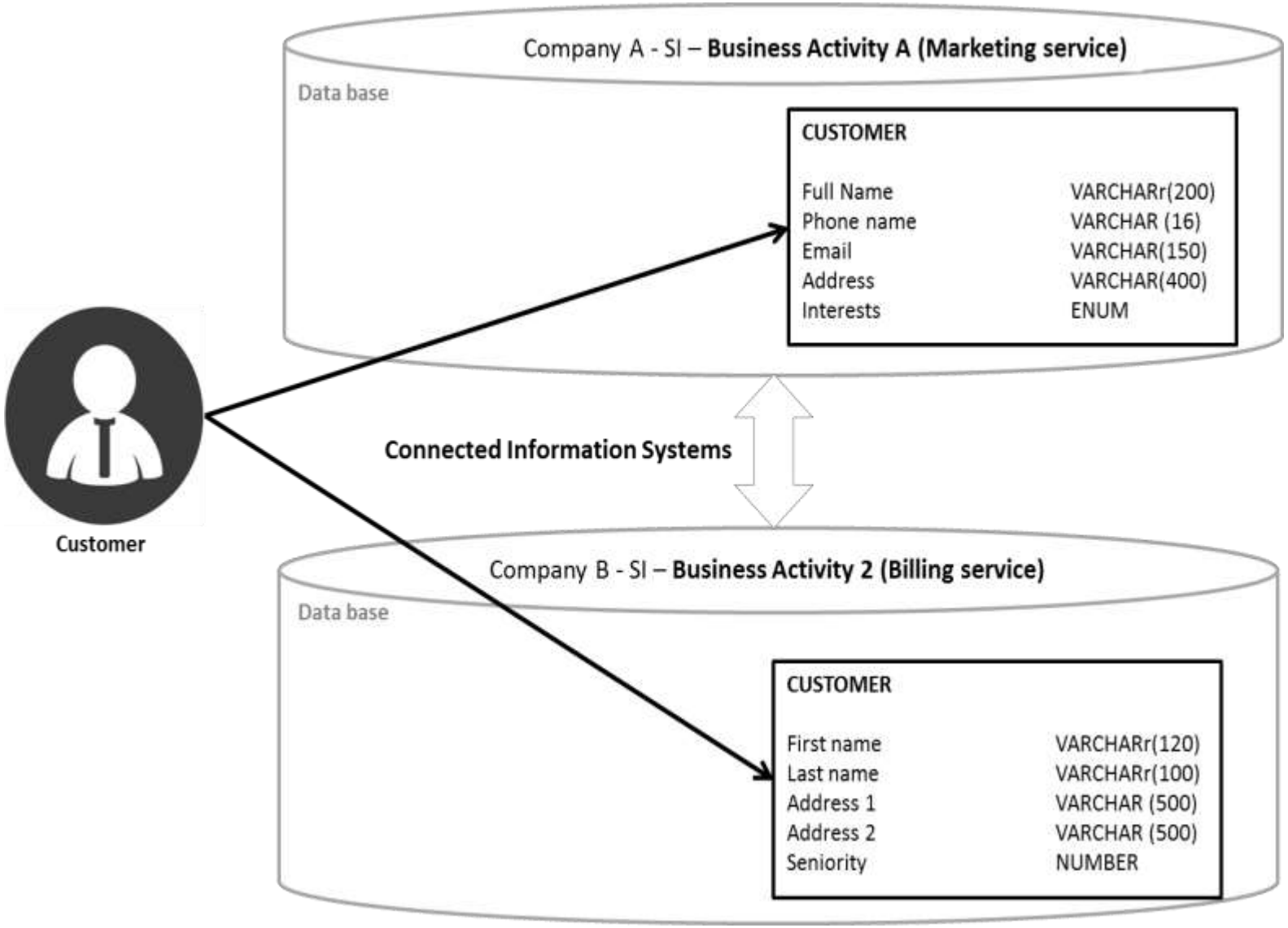
Big Data Analytics → In Management → Applications → Prediction in Unstructured BPM



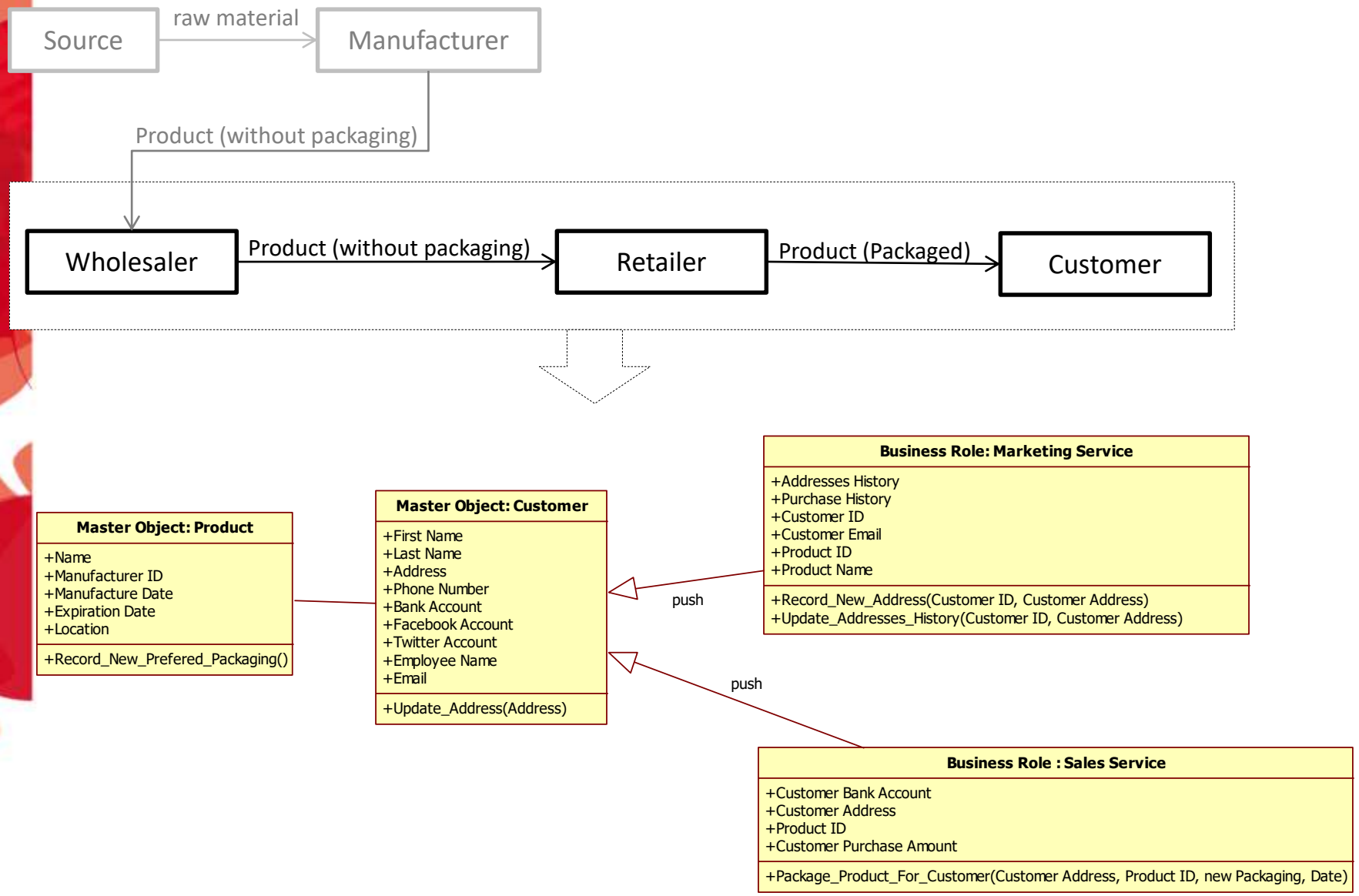
Big Data Analytics → In Management → Applications → Marketing/Sales Compliance



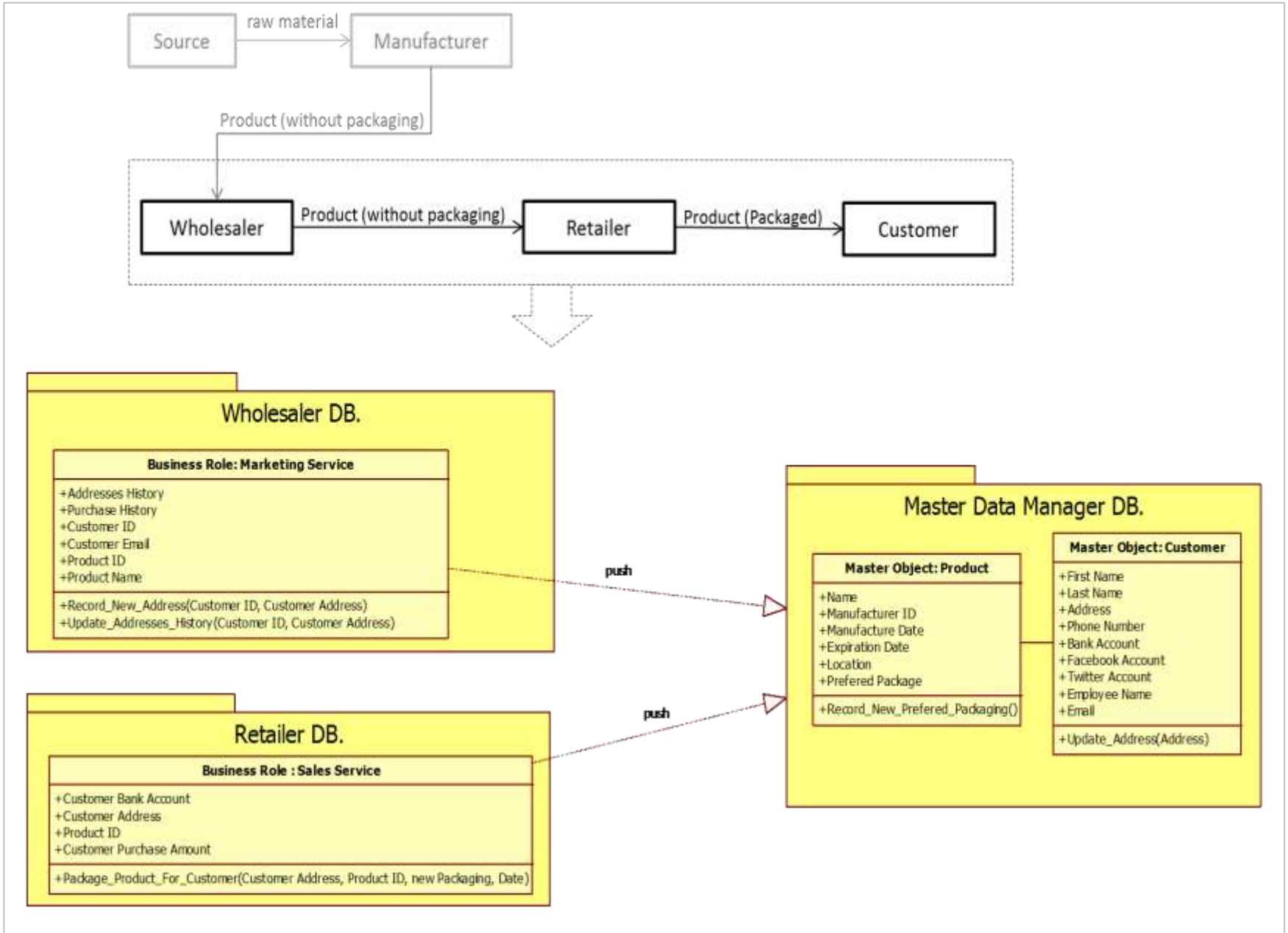
Big Data Analytics → In Management → Applications → Marketing/Sales Compliance

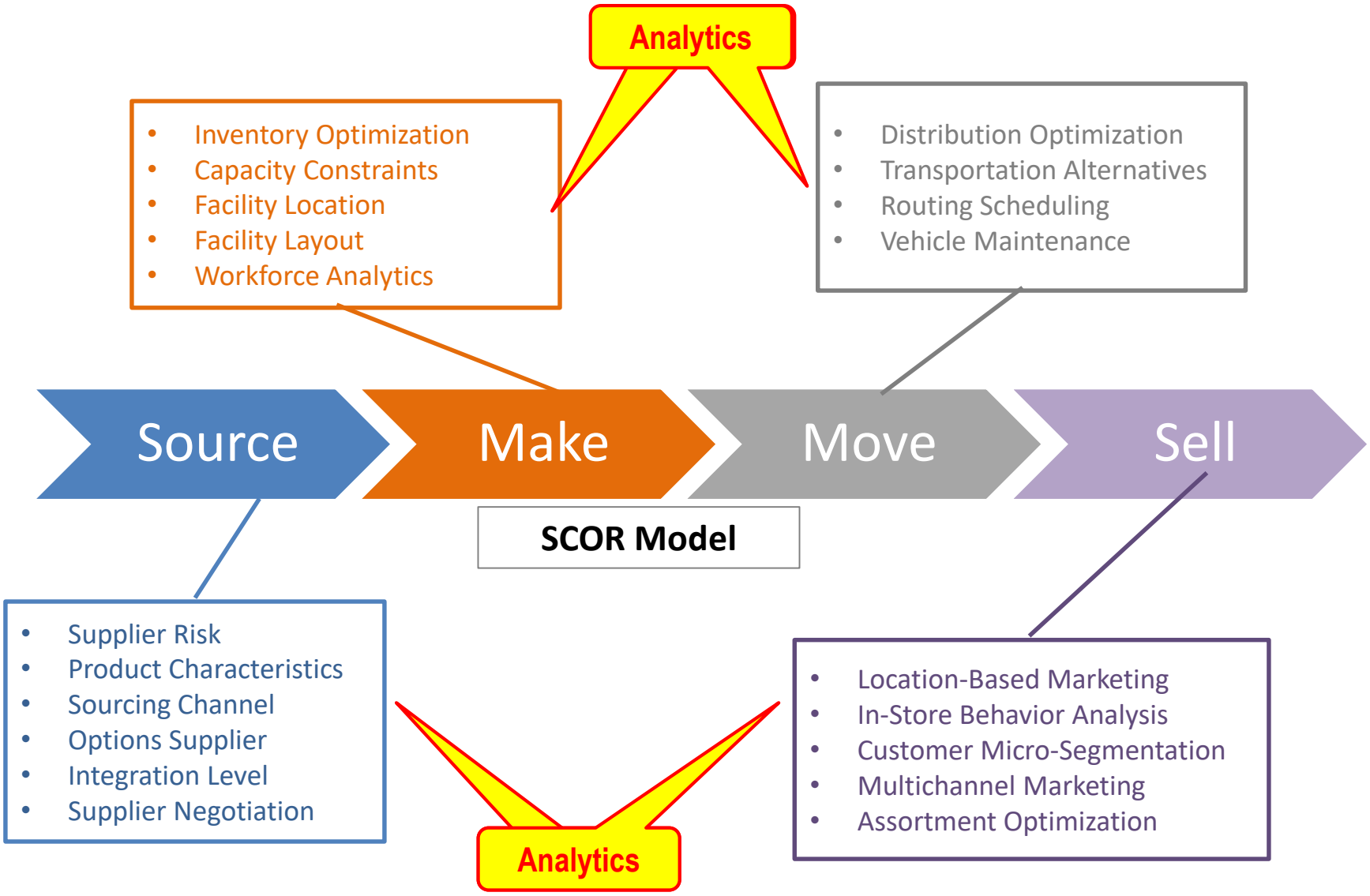


Big Data Analytics → In Management → Applications → Marketing/Sales Compliance



Big Data Analytics → In Management → Applications → Marketing/Sales Compliance




Analytics
Inventory Optimization
Capacity Constraints
Facility Location
Facility Layout
Workforce Analytics
Distribution Optimization
Transportation Alternatives
Routing Scheduling
Vehicle Maintenance
Source
Make
Move
Sell
SCOR Model
Supplier Risk
Product Characteristics
Sourcing Channel
Options Supplier
Integration Level
Supplier Negotiation
Analytics
Location-Based Marketing
In-Store Behavior Analysis
Customer Micro-Segmentation
Multichannel Marketing
Assortment Optimization

Applicative Exercise 6

Group Work. Duration 60min. Score 1.0

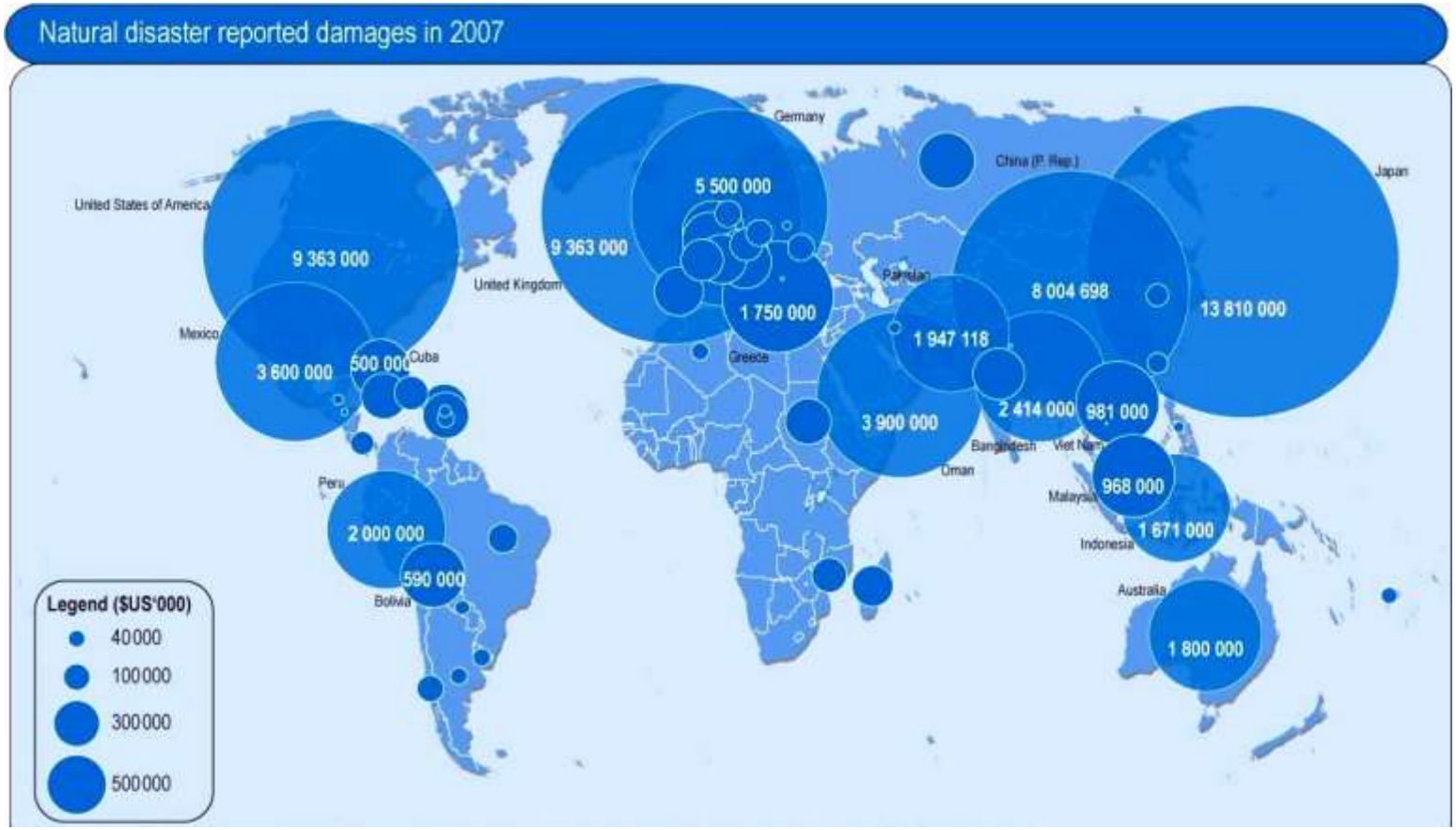
In the given SCOR model, select an operation then propose a solution based on Big Data Analytics following the following information:

- Operation in SCOR
- Objective
- Data Sources

For example:

- **Function in SCOR:** Distribution optimization
- **Objective :** Predictive Optimization
- **Data Sources:**
  - GPS,
  - History of vehicles/Distribution (indents, duration, delays, etc.)
  - Weather forecasting
  - RFID
  - …

Big Data Analytics → In Management → Applications → Supply Chain Predictive Risk Management



Big Data Analytics → In Management → Applications → Supply Chain Predictive Risk Management

Detroit - USA

Katrina hurricane 2005

Ford Factory devastation
Detroit - USA

Sales points of Ford in France (Rhone-Alpes-Auvergne)

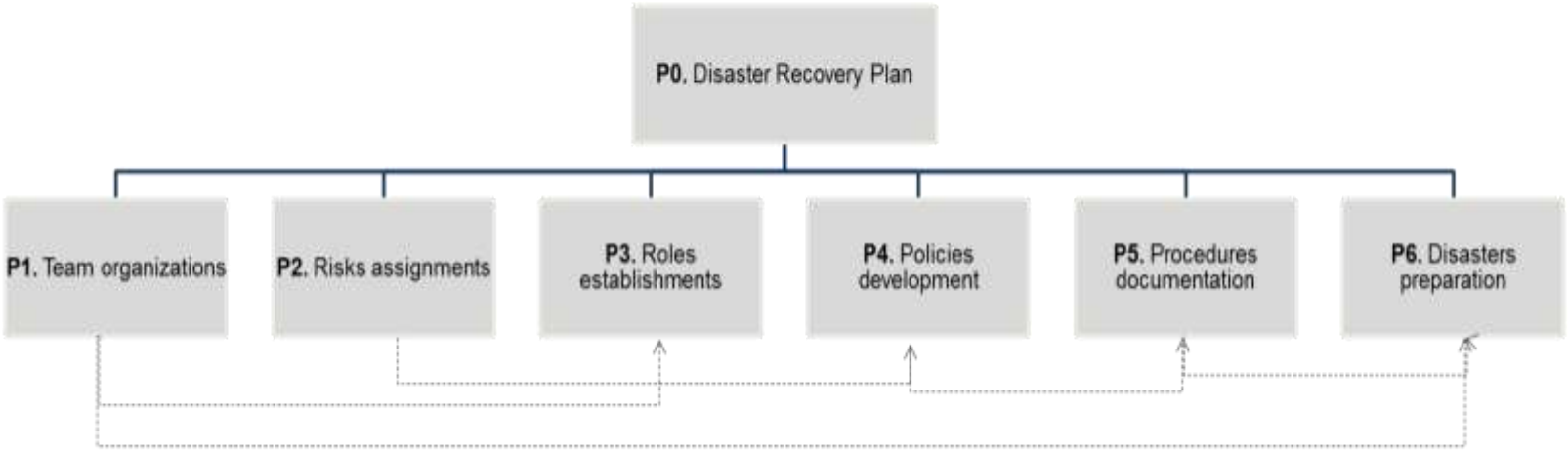
Big Data Analytics → In Management → Applications → Supply Chain Predictive Risk Management

?

Big Data Analytics

Supply Chain Risk Management

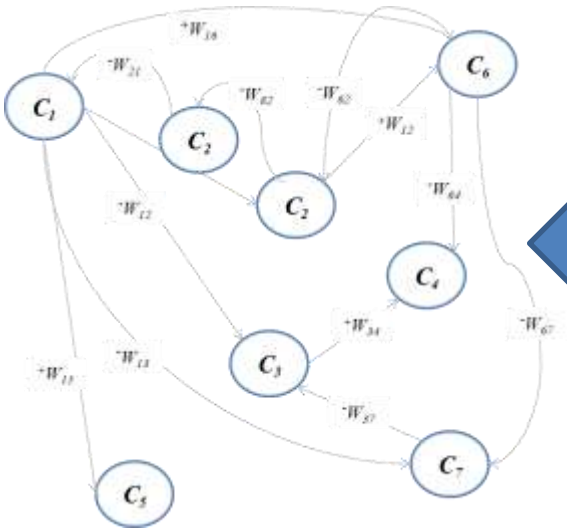
Big Data Analytics → In Management → Applications → Supply Chain Predictive Risk Management



DRP processes

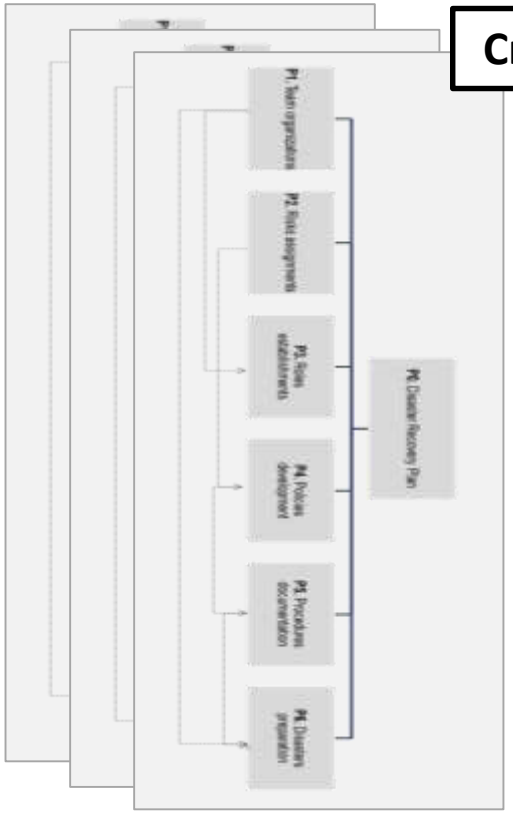
Big Data Analytics → In Management → Applications → Supply Chain Predictive Risk Management

Big Data Solution



Sub-Process
=
Node

Cross-DRP



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UNIVERSITY OF STRASBOURG

Thanks … any questions ?

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EFMD EPAS ACCREDITED

CONFÉRENCE DES GRANDES ÉCOLES
EXCELLENCE FOR A COMPLEX WORLD