

Business Intelligence for The Internet of Things

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Logistic information

- Lectures
 - On Mondays, following usual schedule
- Office hours:
 - At the end of lessons, on appointment (e-mail)
- Lectures organization
 - Frontal lectures & lab

Prerequisites

- Basic knowledge of
 - Algorithms & Data structure
 - Databases

Objectives

The aim of the course is to illustrate the structure and function of enterprise information systems through the study of algorithms, methods and tools and their implementation in real systems.

Starting from the decision-making process, you will learn how tools for data warehouse, data mining methods and learning algorithms can be used in the context of the Internet of the Things.

Finally, we will illustrate specific cases of application.

How can I participate?

- Taking part in lectures and discussions,
- Enriching the course material:
 - FAQ,
 - bibliography,
 - URL,
 - solutions to the exercises,
 - ...
- Theses, dissertations and projects,
- ...

Syllabus

- Introduction: corporate information systems and the components of the decision-making process
- Business intelligence
- Data warehousing & Data Mining
- Preparation of data (laboratory)
- Exploration of data (laboratory)
- Regression
- Series (laboratory)
- Classification (laboratory)
- Clustering (laboratory)
- Examples: Marketing models, logistics and production models, data envelopment analysis (laboratory)

Why?

- The "bag of tools."
- Mastering your instruments, allows you to get better results.
- Even microwave ovens make decisions from the analysis of the data!
- "You're a Bachelor in Informatics, right?"

BI & IoT

- For business intelligence (BI) we intend the set of methods and models that explore the data in order to obtain information and then knowledge.
- Internet of Things: a global network of interconnected objects.
 - In Y2008, for the first time more object than people were connected to Internet!
- Merging the concepts from those two fields will provide new ideas and methods to solve problems.

An Italian dream



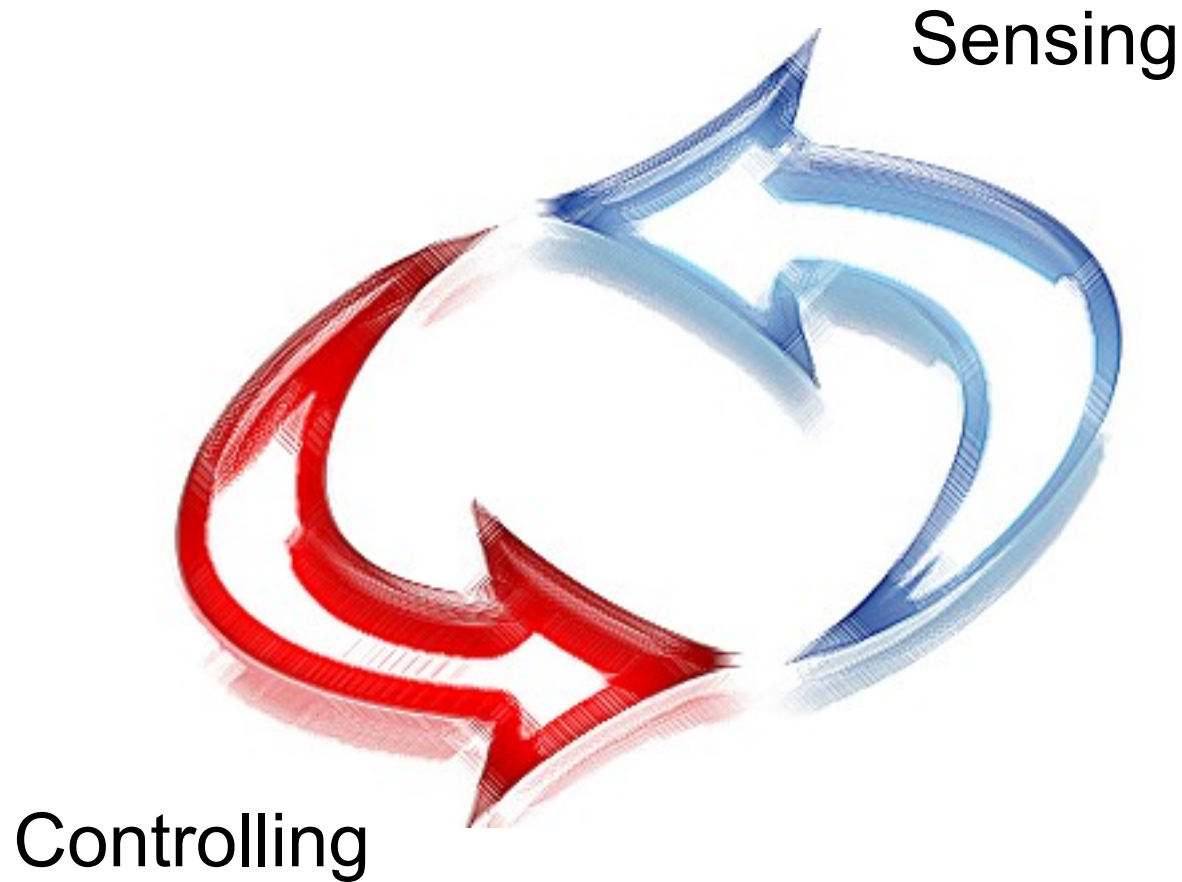
Ferrari control center



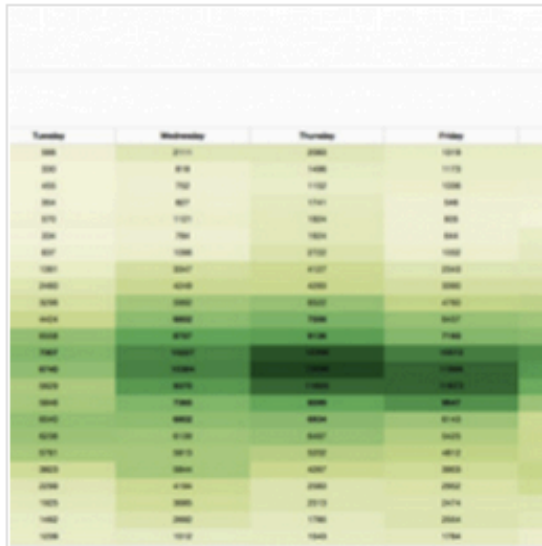
Ferrari computing center



Real time controlling system



Pedestrian & vehicular patterns



Storefront Analytics: Motionloft

Motionloft

Online companies have been using web analytics for years to analyze how long a visitor stays on their site and what they clicked on. The concept is now being extended to the real world via a wide range of sensor systems, machine learning and image recognition technologies that enable building owners, real estate

agents and store managers to better understand pedestrian and vehicular activity patterns throughout the day and year.

How to build business





London

New York

Dublin

Toronto

All 9 Cities

Check out the Driver App →

HAILO. The Black Cab App.

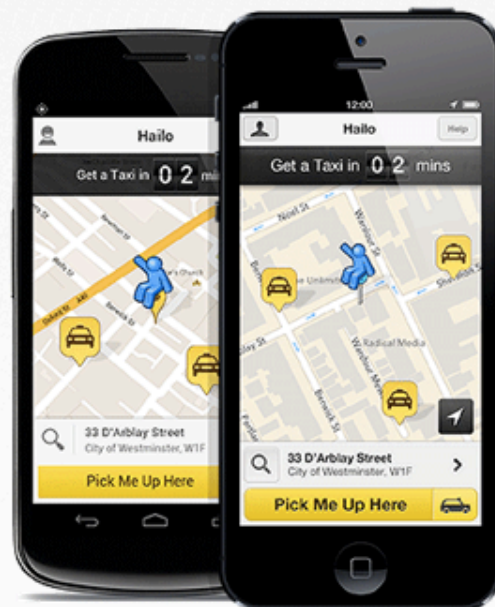
Use Hailo to get a black cab wherever you are, whenever you want. All it takes is two taps on your iPhone or Android Phone. Pay cash or card, with no charges above the meter.



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Get Picked Up



Use Hailo to hail a London taxi with just two taps. No more arm flailing, trying your luck with cab roulette.

Pay by Card



Automatically pay with your credit or debit card. We charge only the meter - no hidden fees. And we accept cash, too.

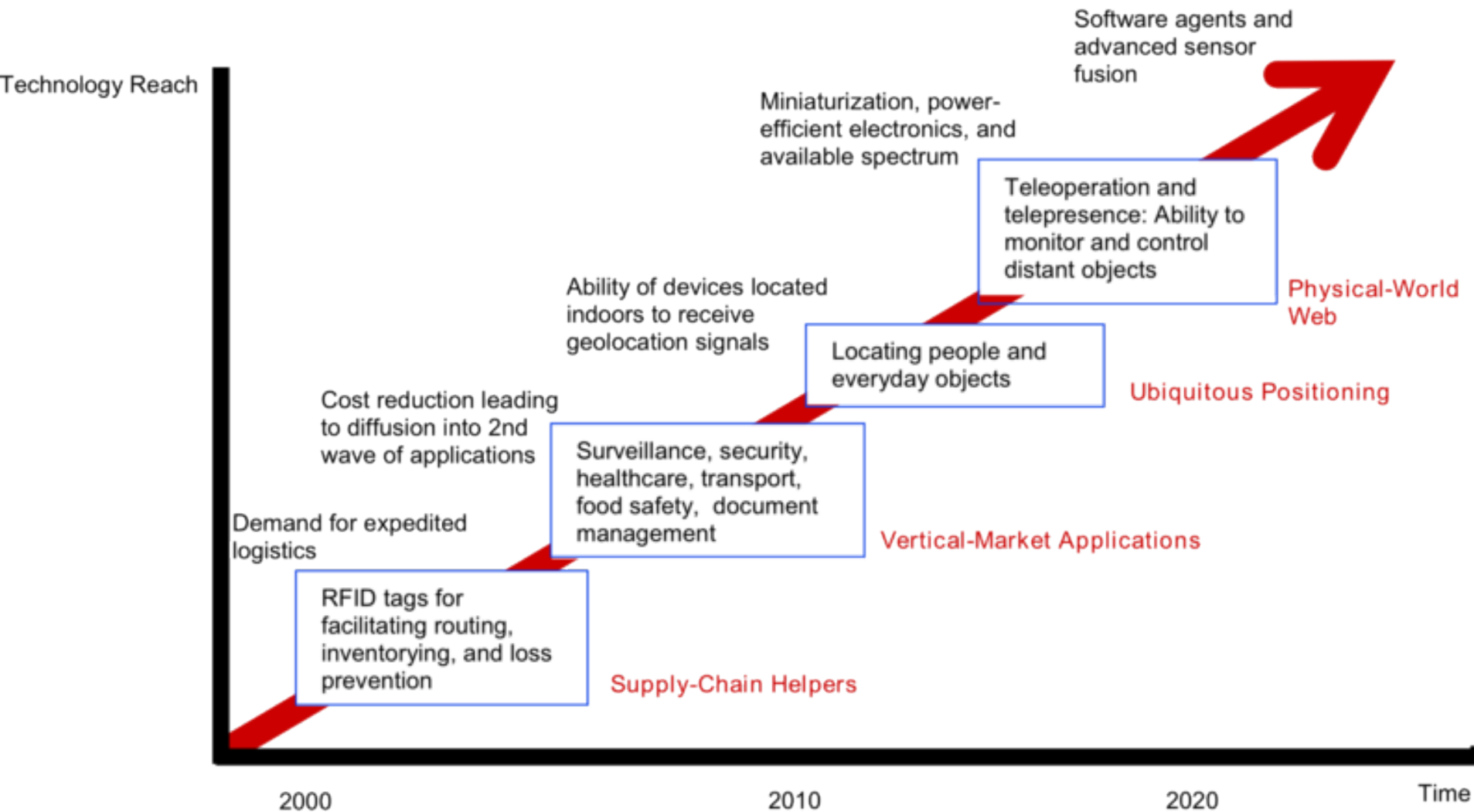
Fully Secure

Be Safe



Be Safe. Hailo works with London's 23,000 trusted black cab drivers.

Technology roadmap of IoT



BI & IoT enabling factors

- Tagging, sensing, shrinking, connecting have made easier to access and share large amounts of data.
- Data available from many sources, but heterogeneous in origin, content and representation.
 - Commercial transactions, financial, administrative,...
 - Transport & energy,
 - Clinical data, ...
- Their presence opens scenarios and opportunities that were unthinkable before.

Drawbacks

- Privacy
 - More we are connected, more we loose privacy.
- Fragmentation of identity
 - Skype, Messenger, Facebook, Tweeter...
- Efficiency
 - More data, more time for analysis.
- Delegation
 - We still need to think.

Effective and timely decisions

- The availability of information and knowledge derived from quantitative analysis allows to make effective decisions.
- The ability to dynamically react to the actions of competitors and the market needs is a critical success factor.
- It is therefore necessary to have software tools and methods that allow you to identify effective and timely decisions.

Benefits of BI

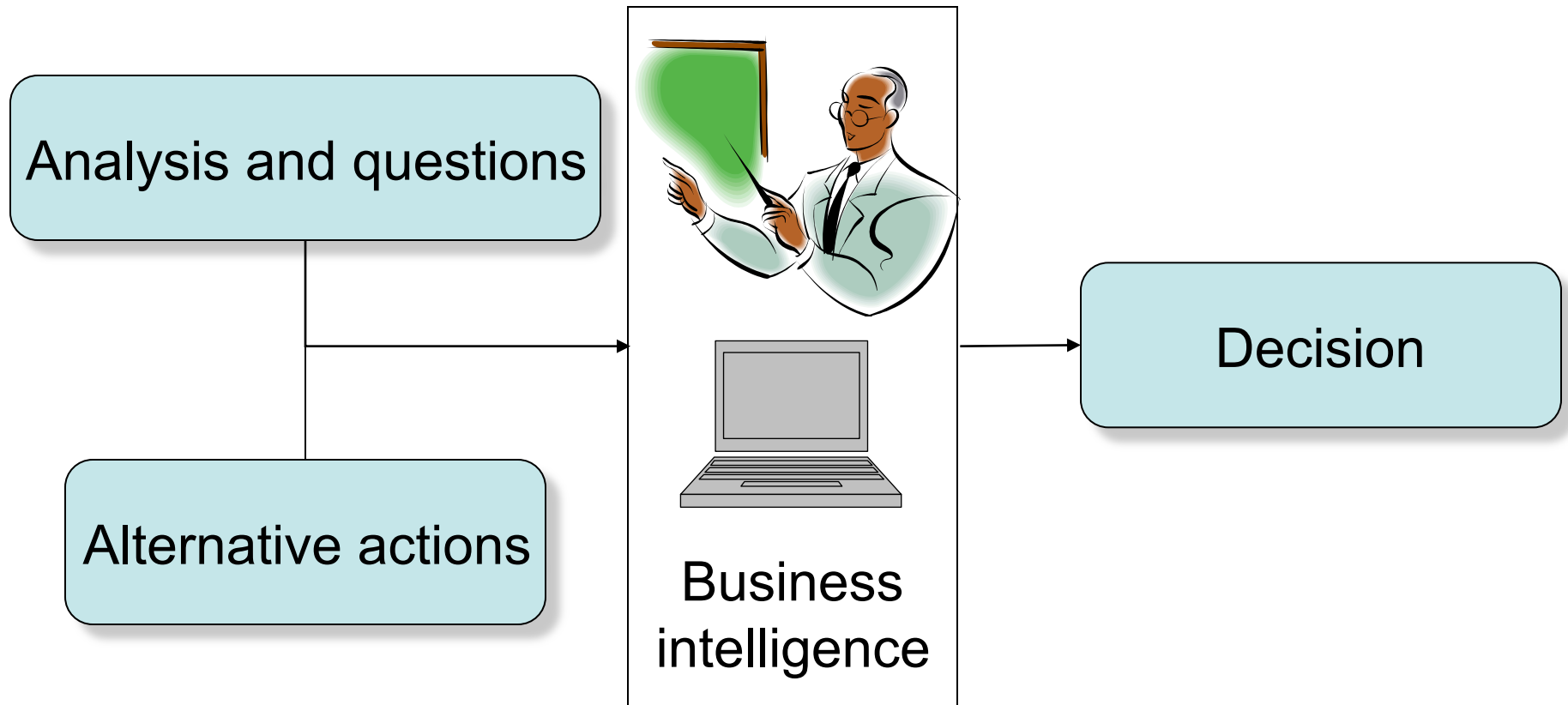
Analysis and questions

Alternative actions



Decision

Benefits of BI



- More alternatives analyzed
- More precise conclusions
- **Effective and timely decisions**

Data, information and knowledge

- Data from administrative, logistical and commercial enterprises and public administration are, by nature, heterogeneous.
- Although collected in a systematic and structured way, these data cannot be used directly in decision-making processes.
- Need to organize and process data using appropriate tools to transform them into information and knowledge applicable by decision makers.

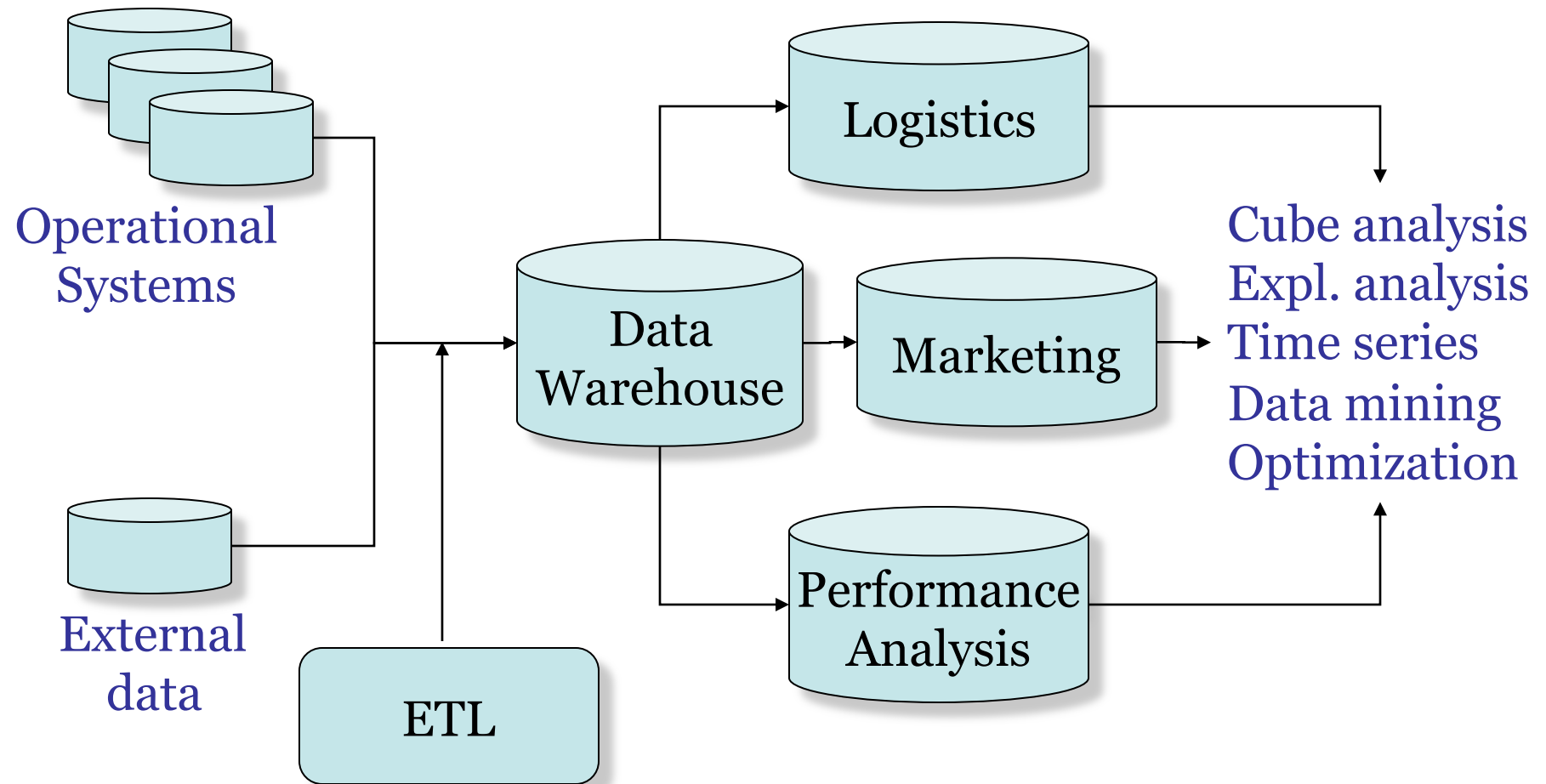
Data, information and knowledge

- **Data:** Layered coding of individual primary entities and transactions involving two or more primary entities.
 - **Example:** Sensed data from customers in a supermarket.
- **Information:** Result of extraction and processing carried out from the data.
 - **Example:** Customers who have reduced by more than 50% of the monthly amount of purchase in the past three months.
- **Knowledge:** Information contextualized and enriched by the experience and expertise of the decision makers.
 - **Example:** Analysis of sales and the local context.

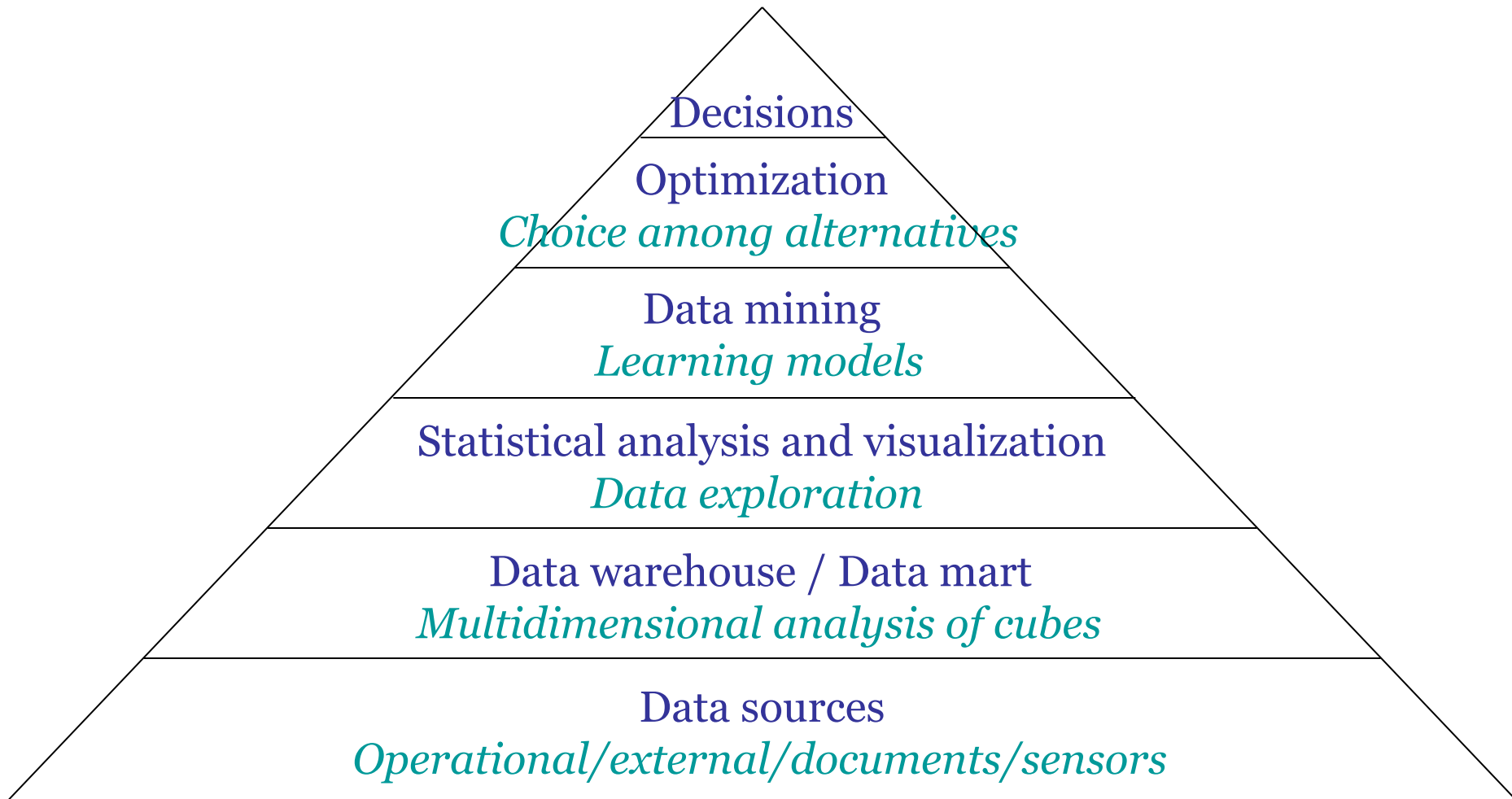
Mathematical modeling

- A BI environment provides information and knowledge to the decision maker from data, using appropriate mathematical models.
- This type of analysis tends to promote a scientific and rational management of companies:
 - Identify the objectives of the analysis and performance indicators,
 - Develop mathematical models that relate the control variables with the parameters and metrics,
 - Analyze the performance effects of changes in control variables.

BI architecture



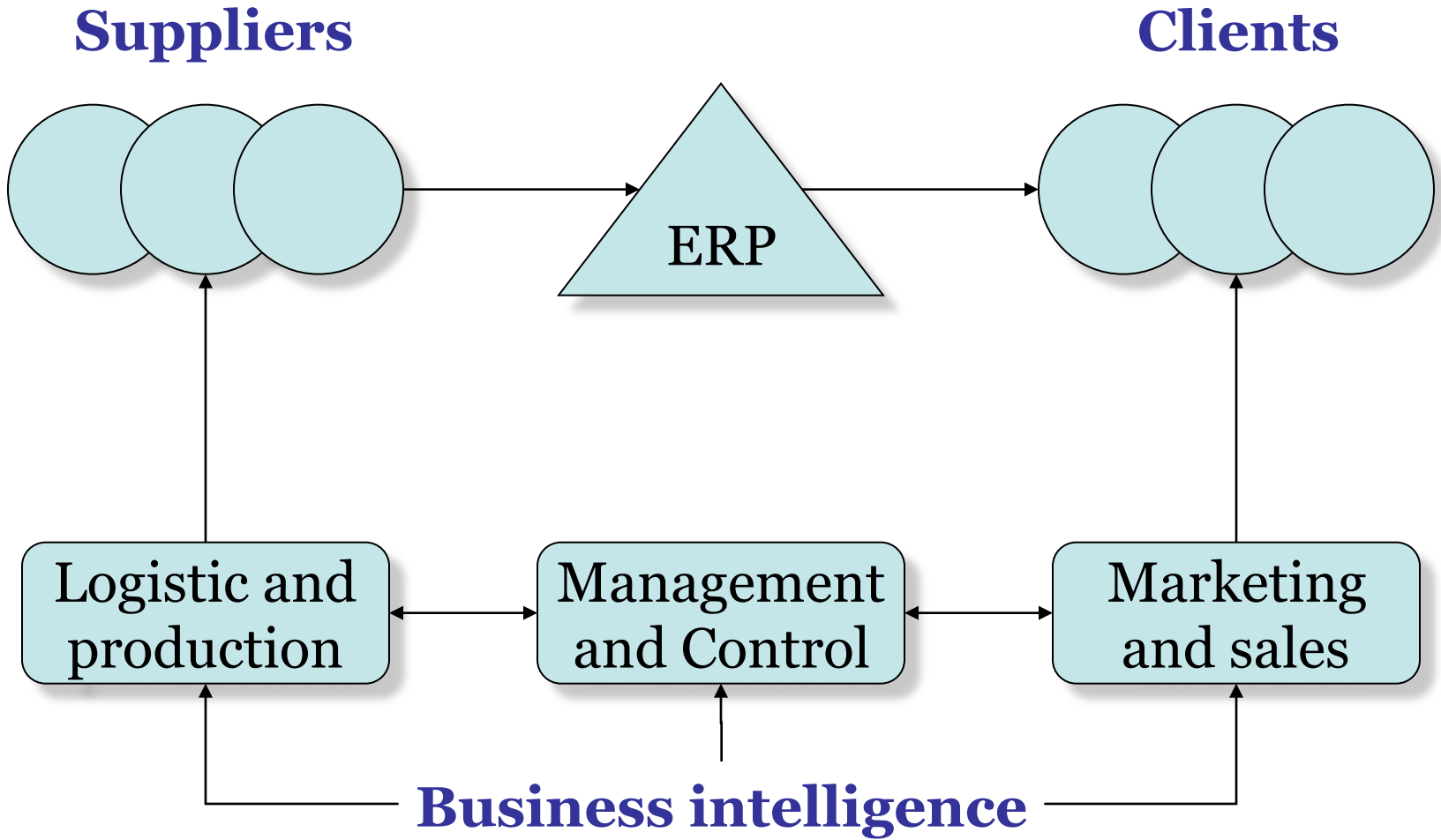
BI components



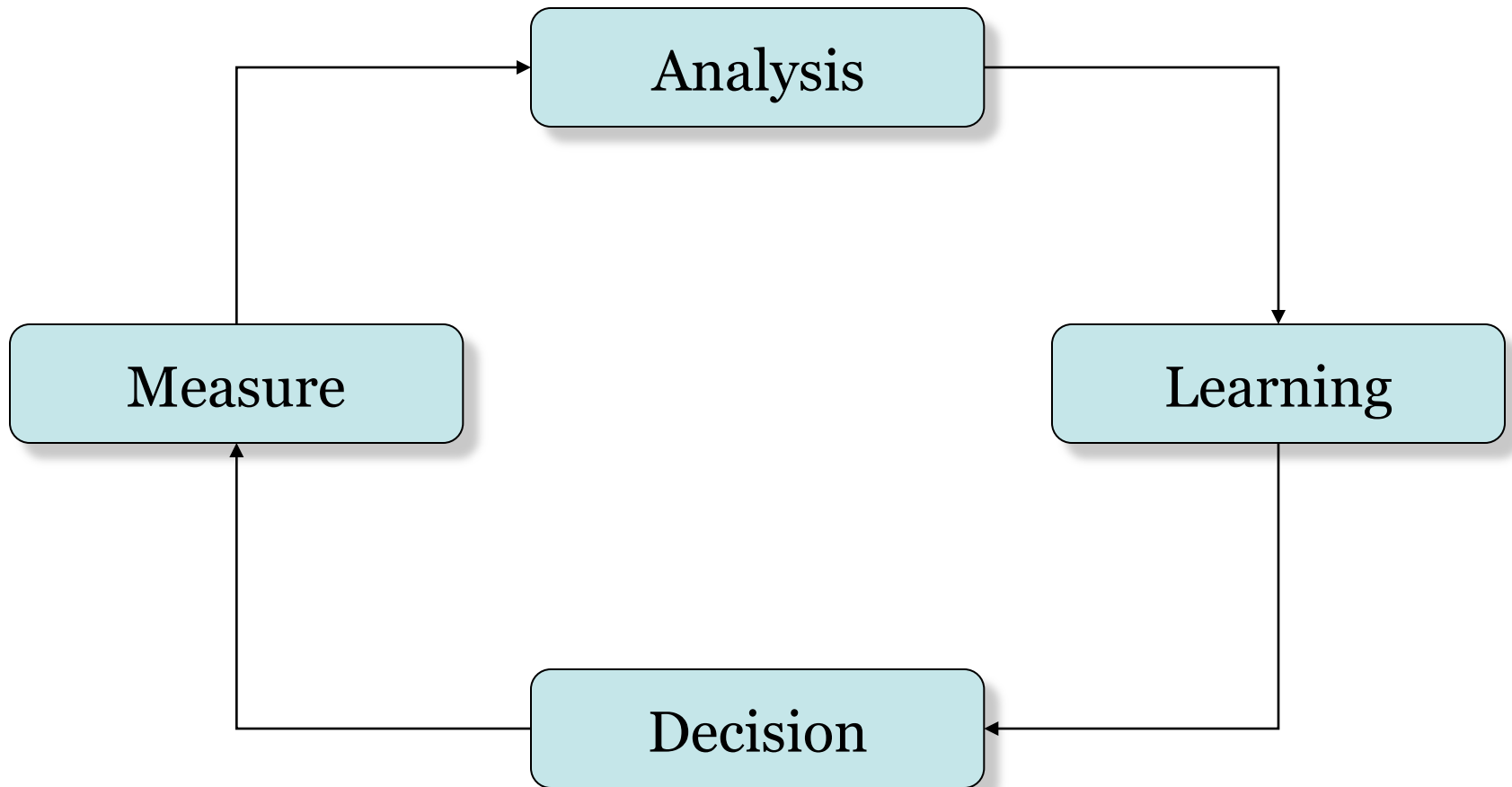
BI analysis

- The analysis of BI are devoted to different types of organizations with complex structures.
- If we restrict our attention to enterprises, we can place the BI methodologies into three departments:
 - Sales and marketing,
 - Logistics and production,
 - Management control and performance measurement.

Enterprise functions & BI



Phases of analysis BI



Justification

Needs
Identification

Planning

Infrastructure
evaluation

Project
planning

Design

Definition
of specifications

Definition
of mathematical models
for analysis

Data identification
data warehouse
and data mart design

Prototype
realization

Realization and testing

Implementation of
data warehouse
and data mart

Metadata
development

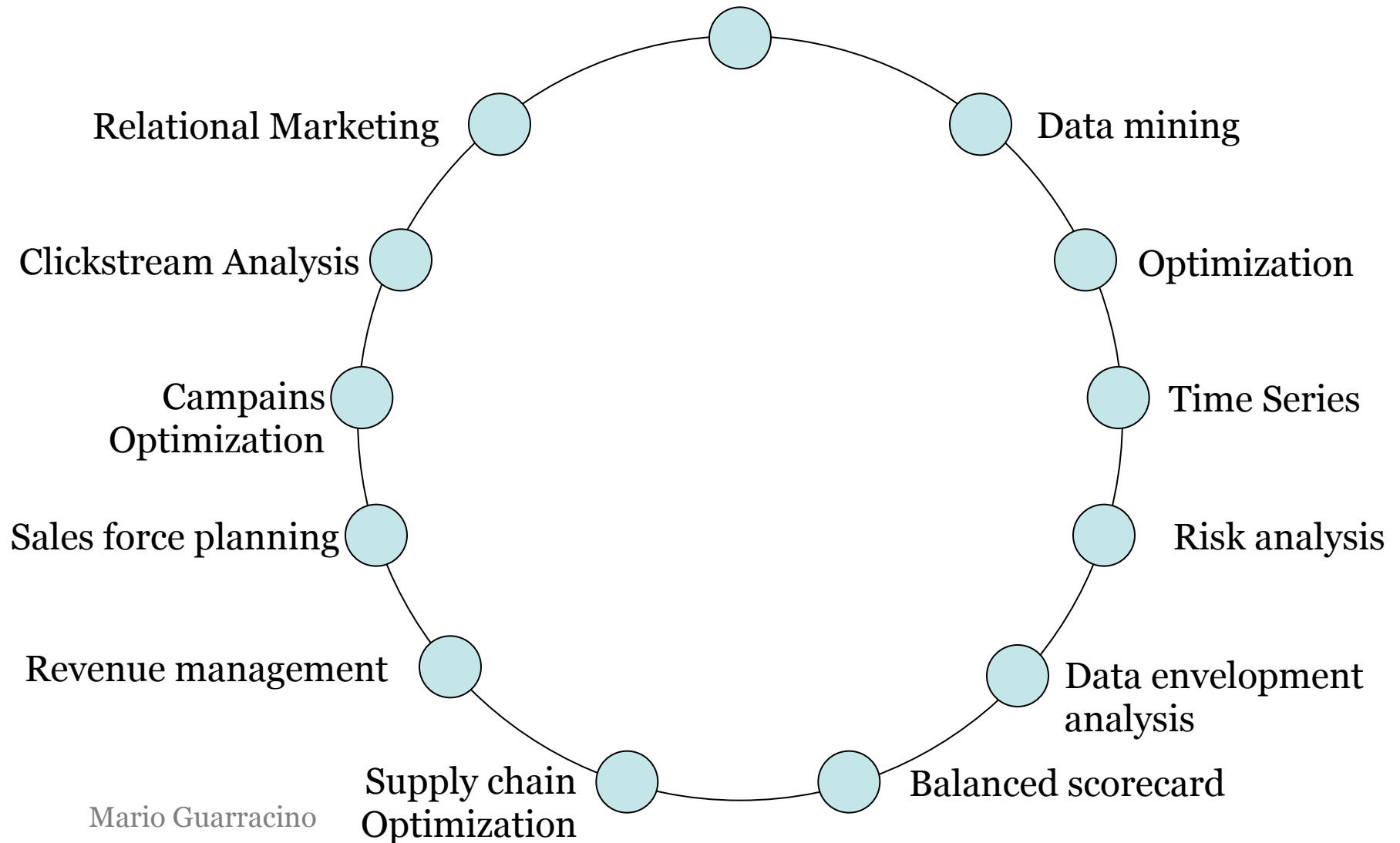
Development of
ETL procedures

Application
implementation

Application
release and testing

BI Analysis methodologies

Multidimensional cubes



Summary

- We have seen:
 - Why is it interesting to study the BI for IoT;
 - What problems can be solved;
 - The difference between data, information and knowledge;
 - What are the mathematical models in this context;
 - How BI architectures are logically organized.

Next lecture

- Data warehousing:
 - Data warehouse e data mart;
 - Architetture dei data warehouse;
 - Cubi ed analisi multidimensionali;

Homework

- Find a problem that can be described by data produced by sensors.
 - Health state of a person
 - Power consumption in a municipality
 - Traffic congestion in roads
- Imagine how these data coming from multiple entities might be integrated with external data.
- Provide examples of questions whose answers might bring to interesting (business) outcomes.
- Wrap up in a ppt/pdf (max 5 slides) and send by next Friday to mario.guarracino@cnr.it.