IN4151 - Information Engineering

Fundamentals of Information Management and Business Analytics

Part I

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Disclaimer

- This presentation has some slides extracted from lectures of a previous course (IN3501 - Information and Communication Technologies for Management), made by Víctor Hernández, Ángel Jiménez, and Juan Velásquez.
- New slides made by Prof. Ángel Jiménez and Prof. Sebastián Ríos (used with permission) have been added.

Agenda

1. Organizations
   - Introduction
   - Management
   - Organization's structure
   - Strategy
   - Value chain and business processes

2. Business Analytics
   - Decision making
   - Types of business analytics
   - Examples

Organizations

Since the time of the caves, human beings have **organized** themselves to ensure their survival. According to Yuval Noa Harari:

- After the *cognitive revolution* of the species.
- After the *agricultural revolution* 10,000 years ago.
- With greater complexity after the *industrial revolution* 250 years ago.
- Humanity is currently facing a *technological revolution* driven by information and communication technologies (ICT) and biology.

Organizations

- Organizations are systems designed to achieve a mission through human and other resources.
- They exist in the public and private world.
- They are made up of *interrelated subsystems* that perform specialized functions (see Adam Smith).

Management Science

Management Science (MS)

- It is the interdisciplinary and comprehensive study of **problem-solving** and **decision-making** in human organizations.
- It uses the scientific method and tools of economics, mathematics, ICT, data science, marketing, finance, operations management, statistics, among other disciplines.

Industrial Engineering

Industrial Engineering

It is the branch of Engineering that cultivates the use of MS to manage the design, implementation, operation, and redesign of organizations to fulfill their mission.

Organizations are our laboratory.

What's Management?

Management (wordreference.com)

Set of procedures that are carried out to resolve a matter.

Management (definicion.de)

Perform formalities leading to the achievement of a business.

Management (H. Fayol)

Planning, organizing, leading, evaluating, and controlling, also known as functions of the administration.

Management (M. Waissbluth)

It is the strategic and operational management of an organization, project, or program.

Understanding the organization

"Divide to conquer"

- In the context of an organization, it is understood as dividing the organization into fundamental and manageable parts according to its functions.
- In this paradigm, the organizational structure is functional and hierarchical.

The classic **organization charts** are derived from the previous idea.

- These explain the structure of a company.
- However, they do not explain **how its parts are interrelated.** (also known as *functions*). We will return to this point.

Functional structure of an organization

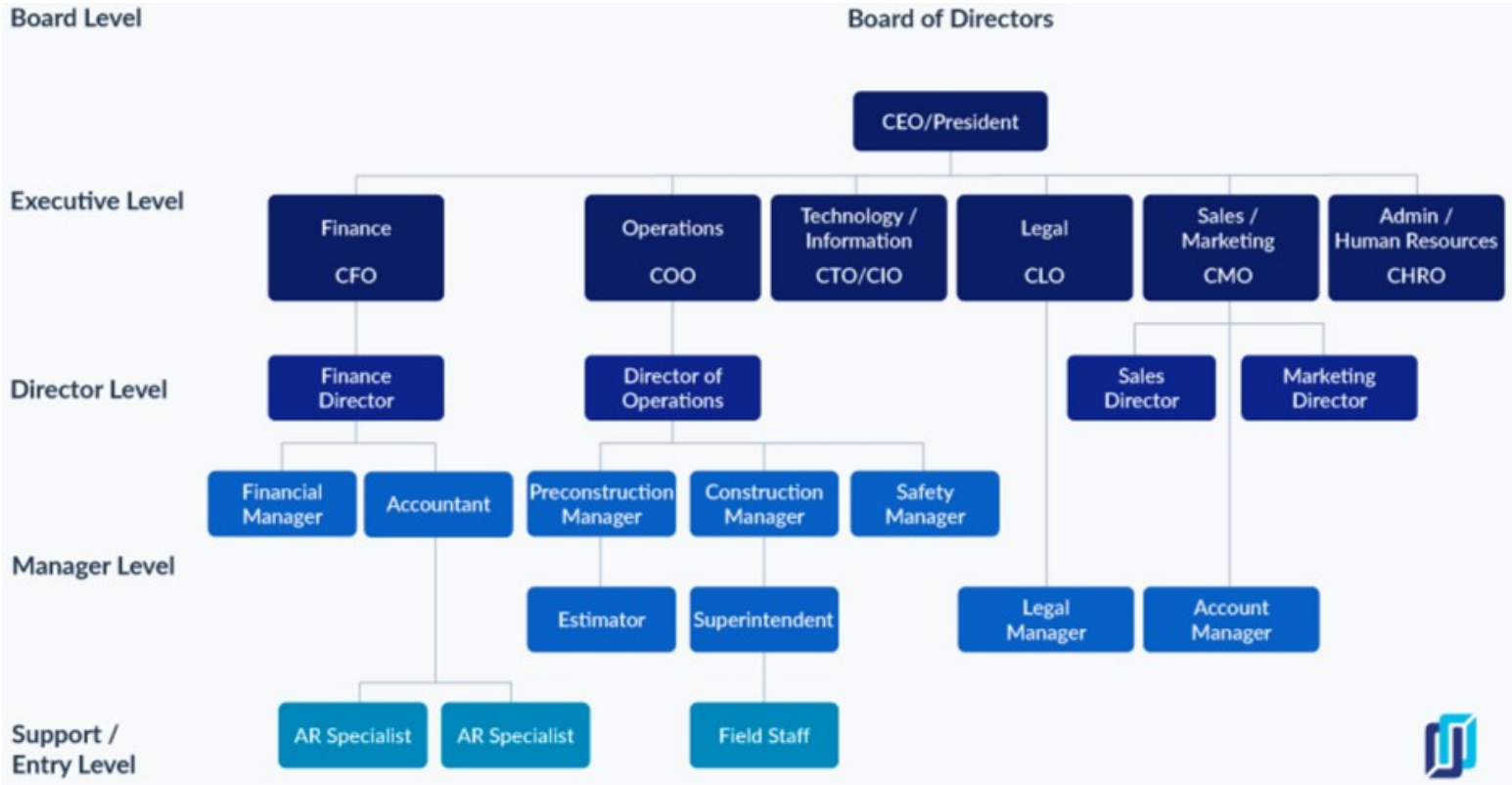

Figura 1: Organizational chart example.

Overall, a company has different functional areas, each with a well-defined objective.

Is it enough to divide to conquer?

Roles in a functional structure

Board of directors

In general, they are the owners or their representatives, in charge of defining the strategic long-term goals (they are the ones who provide the $$)

Chief executive officer

Responsible for defining and leading the implementation of short and medium-term strategic objectives for the organization.

Chief finance officer

Responsible for managing the organization's money (manage credits, decide and make investments, prepare income statements, etc.)

Roles in a functional structure

Accountability

Record all inflows and outflows of money from the company, calculate taxes, pay salaries, etc.

Chief marketing officer

It is responsible for generating customer value based on the organization's products and services. In addition, it prepares campaigns to publicize the company's activities, especially about the sale of its products and services. Take control of daily sales and, above all, the sales force.

Chief supply officer

Responsible for purchasing supplies for the company.

Roles in a functional structure

Chief human resource officer

Responsible for managing the company's most valuable resource: people. Ensure the welfare of staff, and manage employment contracts.

Chief technology/information/data officer

"A chief data officer (CDO) is a corporate officer responsible for enterprise-wide governance and utilization of information as an asset, via data processing, analysis, data mining, information trading and other means' '. https://en.wikipedia.org

There are many other roles.

Challenges imposed by functional structures

- The big question: If I have several chiefs in the company (or several functions), how do I make sure that they all add value to the business and have a common goal?
- Depending on the size of the company, functional areas are usually *fiefdoms* apart. In other words, they need to **coordinate their actions** in an increasingly complex environment.

Then, divide to conquer?

OK, but creating instances to unify them under a common **strategy**.

Strategy

Corporate strategy

In short, set of actions that allow achieving a competitive advantage.

- Set a direction.
- Define priorities.
- Focus activities.
- Generate alignment.

How an organization achieves its mission?

According to Porter:

- Achieving sustainability of the business model over time in a competitive environment.
- It depends on how it adapts to uncertainty, and creates new **competitive advantages**.
- For doing this, the organization needs to achieve its goals with high **efficiency** (e.g., productivity), and **operational effectiveness** (benefits), based on the chosen **strategic positioning**.
- For the above the interrelationship between the different functions is critical.

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Strategic positioning

Hax's Delta

1. **Best product**: Offer products with unique differentiating attributes that meet customer preferences (Apple)
2. **Integral solutions**: Offer customized solutions with an excellent understanding of customer needs (companies outsourcing its logistic to FedEx). They are usually integrated into the customer's value chain and become indispensable.
3. **Systemic Lock-in**: Create conditions that create exit barriers for customers (it is costly to leave) so that they can't function without my products and services (Microsoft: windows and office)

Figura 2: Strategic positioning.

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How to create competitive advantages?

Value chain

The value chain is a reference framework that guides the creation of new competitive advantages. The value chain seeks to unravel the company's competitive advantages to enhance or rethink them. It shows the main activities of an organization to generate value for its customers.

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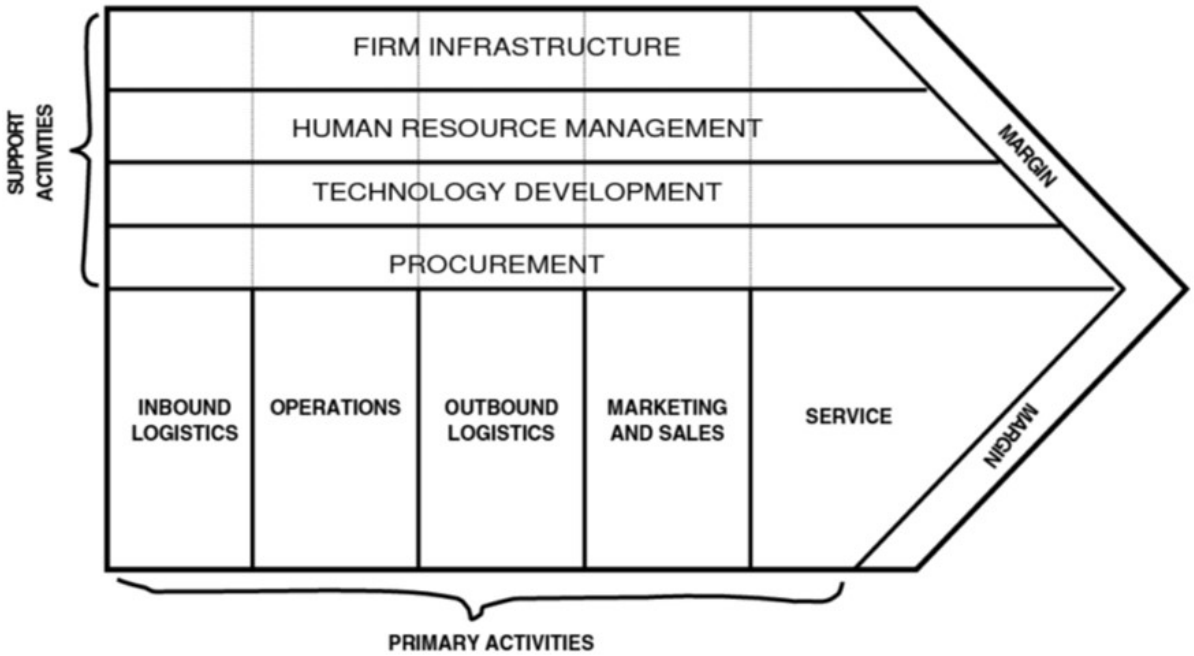

Value chain's primary activities

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- **Inbound and outbound logistics**
  - Fleet management (vehicles, how many, when, routes, flows)
  - Warehouses (localization, size)
- **Operations**
  - Production planning and programming.
  - Service allocation (taxis, technicians, virtual machines)
  - Work team design.
  - Equipment maintenance.
- **Marketing and Sales**
  - Sales Forecasts.
  - Customer segmentation.
  - Churn prediction.
  - Design of products/services and campaigns.
  - Product/service choice modeling.

Value chain as a coordination of business processes

Value chain's activities can be abstracted as a set of coordinated *business macro-processes*:

1. **Customer relationship management**
2. **Suppliers relationship management**
3. **Production/service delivery and distribution management**
4. **Production/service delivery and distribution**
5. **Business processes state**

Highlights

- This perspective focuses on processes, not functions.
- Either an internal or an external customer, always try to meet or exceed customer expectations.

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Definition

Business Process

- How work create value for customers
- A chain of connected activities
- Transform inputs (raw materials, capital, persons, equipment, energy, etc.) into outputs (goods and services)
- They are cross-functional
- They cross different decision levels

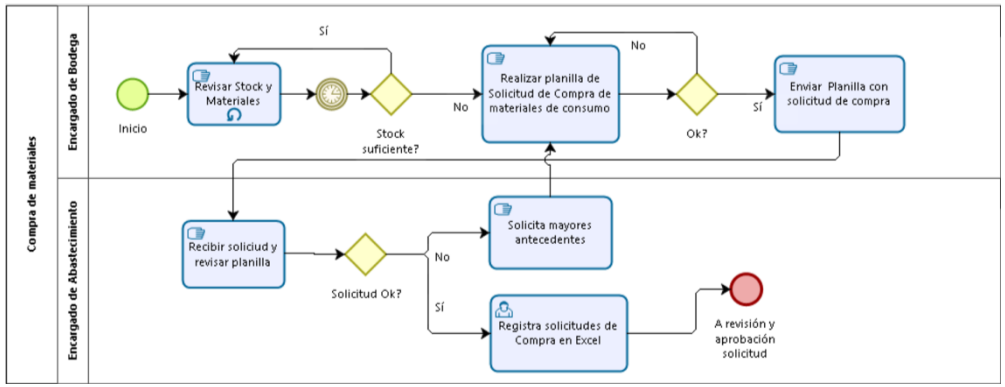

Figura 4: A process.

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Macro-processes of the Value Chain

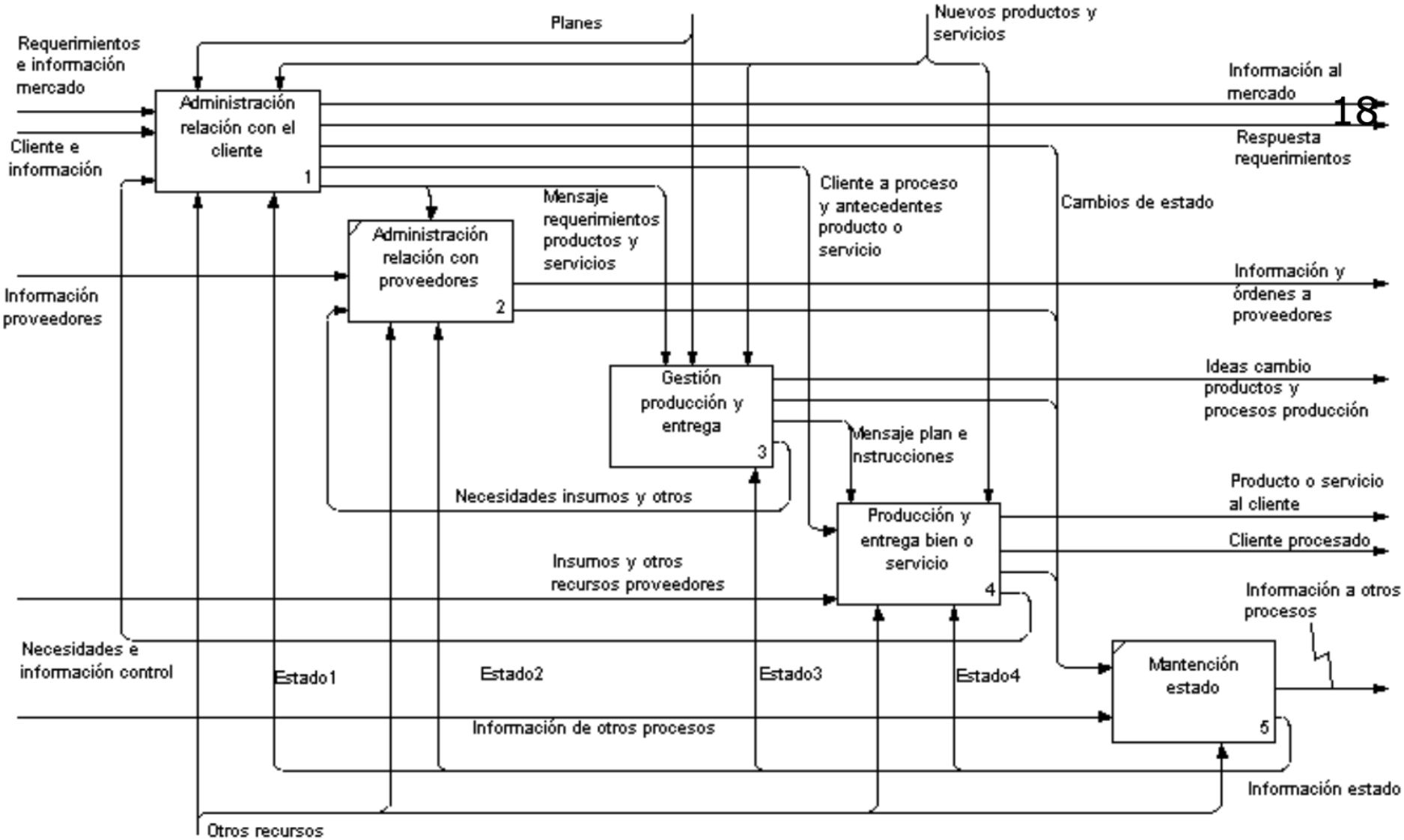

Figura 5: A view of the value chain's macro-processes.

Support Processes

- Firm infrastructure process
- Human resource management process
- Technology development process

Check: Wolf, C. Value chain and business processes. BPTrends. URL: https://www.bptrends.com/publicationfiles/11-03 %20TB %20Value %20Chains %20and %2
%20Wolf.pdf

Contenidos

Decision levels in an organization.

Slide by Prof. Sebastián Ríos, extracted with permission from a lecture of the IN5502 course.

Given a strategic positioning, at each macro-process organizations need to perform different types of **decisions** to achieve **efficiency** and **operational effectiveness**.

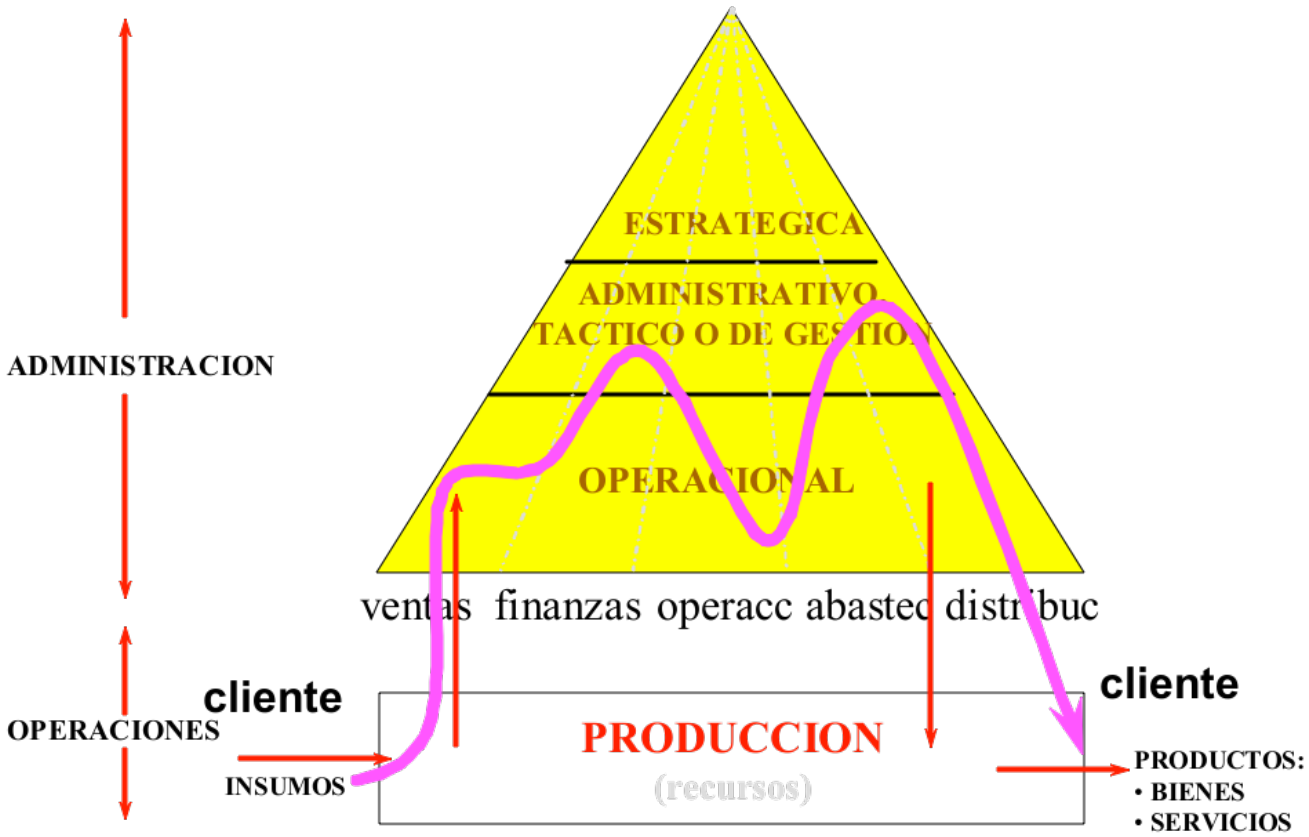

Figura 6: Processes of the value chain cross different functions, and perform decisions at three levels.

Business Analytics

- The use of business analytics relates to providing *intelligent business logic* to support **decision making**.
- Intelligent, automated business logic formalizes routines, procedures and rules to make decisions needed to deliver products and services to customers.
  - Demand forecasting models.
  - Customer behavior's predictive models. Churn prediction. No-show prediction.
  - Finding customer's purchasing patterns. Cross-sell products from retail transactions.
  - Finding, assessing, and predicting customer segments.
  - Prescribing optimal assignations. Minimal cost of job scheduling.
  - Predictive maintenance models. Online equipment monitoring employing remote sensors. Anomaly detection.
  - Patient disease's prediction.
  - Web user click-intent prediction.
  - Etc.

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Exercise

- Perform an association of each of the previous business analytics examples (slide 25) to macro-processes of the value chain.
- Think about the data you would need for each example.

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Types of Intelligent Business Analytics

- **Analytics 3.0:**

Predictive Analytics (data-driven analytics)

Use data-driven approaches for decision making, such as static, dynamic and sequence data mining, process mining, econometric, and machine/deep learning models in service/product delivery and management processes. Use the Knowledge Discovery in Databases methodology (KDD) or equivalent. We will return to this later.

Prescriptive Analytics

Use operation research and management science techniques, such as optimization models, both linear/non-linear, discrete and combinatorial; heuristics, probabilistic and simulation models, among others.

Check: Barros, O. *Business Engineering and Service Design*. Business Experts Press, second edition, Volume 1, 2017.

Other Types of Business Analytics

Analytics 2.0:

Statistical analysis, such as (logistic) regression and factorial analysis; forecasting, such as time-series models, and some basic clustering models are traditional, not advanced intelligent analytics.

Analytics 1.0:

Access and reporting from data using information dashboards are basic BI tools that need to be distinguished from intelligent analytics.

Exercise

- What type of business analytics is each example of the slide 25?

Examples of Analytics 3.0

- Walmart implements a hybrid scheme mixing both predictive and prescriptive models.
  - First, a predictive model forecasts the demand at each sales point.
  - This forecast is used by optimization models to determine actions over the supply chain process to assure product availability at minimum distribution cost.
- Walmart is also using social media data to predict shoppers' purchases and act on that basis to plan logistics.

Figura 7: A supermarket.

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Examples of Analytics 3.0

- Crisis risk prediction of diabetes/EPOC patients.
  - A predictive model determines patient decompensation's probability based on historical patients' data, such as vital signs time-series, social, and demographics information. [1]
- A sequence pattern mining model predicts COVID-19 patients' symptom trajectories, based on symptoms time-series, social, and demographics information.

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Thank you