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Ministry of Higher Education and Scientific Research

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Handout Titled

Information Systems

Intended for second-year undergraduate students in Computer Science

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Foreword

This handout serves as a course material for second-year students pursuing a degree in Computer Science with a specialization in “Information Systems (IS)”.

The course is divided into 4 chapters:

Chapter 1: defines the characteristics of a company, the systemic approach to organizations, and the information system (functional aspects and structural aspects: concept of station, workstation, flow, documents), Flowchart;

Chapter 2: focuses on information representation techniques;

Chapter 3: addresses information input and control;

Chapter 4: covers the practical part, detailing the steps and processes involved in developing an information system (IS) using the MERISE method.

Objectives:

The objective of this course is twofold. On one hand, it aims to provide computer science students with a grasp of the fundamental concepts related to information systems. On the other hand, it enables students to learn a methodology for designing computer systems. By the end of this course, the student will be capable to:

- Analyze an information system from informational, organizational, and technical perspectives.
- Understand the lifecycle and implementation phases of an information system.
- Employ a professional methodology for designing an information system.
- Comprehend the objectives of the MERISE method and its various procedural levels.
- Acquire specific terminology related to the method.
- Differentiate the complementarity of systemic and analytical approaches.
- Skillfully formalize conceptual models using MERISE.
- Identify the roles and responsibilities of different stakeholders involved in the design process.

Chapter 1

Generalities and Definitions

Contents

- Definitions and characterizations of the company
- The functional and structural aspects of the company
- Systemic approach of organizations
- The information system (Functional aspects and Structural aspects)
- Exercises

1. Definitions and characterizations of the company

The needs of human beings for food, clothing, etc. are satisfied thanks to economic entities that combine various factors of production. These entities are called companys.

1.1. Definition

The company is an organization forming an economic unit intended for the production, exchange, or circulation of goods and services. It has human and material resources that it mobilizes to manufacture products, carry out works, or provide services.

1.2 Creation of the organization

The overall subordination to an Objective O,
The use of well-defined means M (human and material) at a given time,
An environment E that is more or less changing and specific to the organization in question.

(O + M + E) + N ⟶ Organization / N: order

2. Functional and structural aspects of the company

2.1 Company structure

2.1.1 Definition

The structure of an organization is the set of mechanisms through which a company distributes, coordinates, and controls its activities. This structure can be represented by an organizational chart.

2.1.2 The structure of the organization chart

The organizational chart is a diagram that schematically represents the structure of the company or a service. It should specify in particular:

- Distribution of tasks between services
- The hierarchical levels of the different responsibilities (directors, service heads, executives, etc.)
- Hierarchical or functional links between the different services.

Example

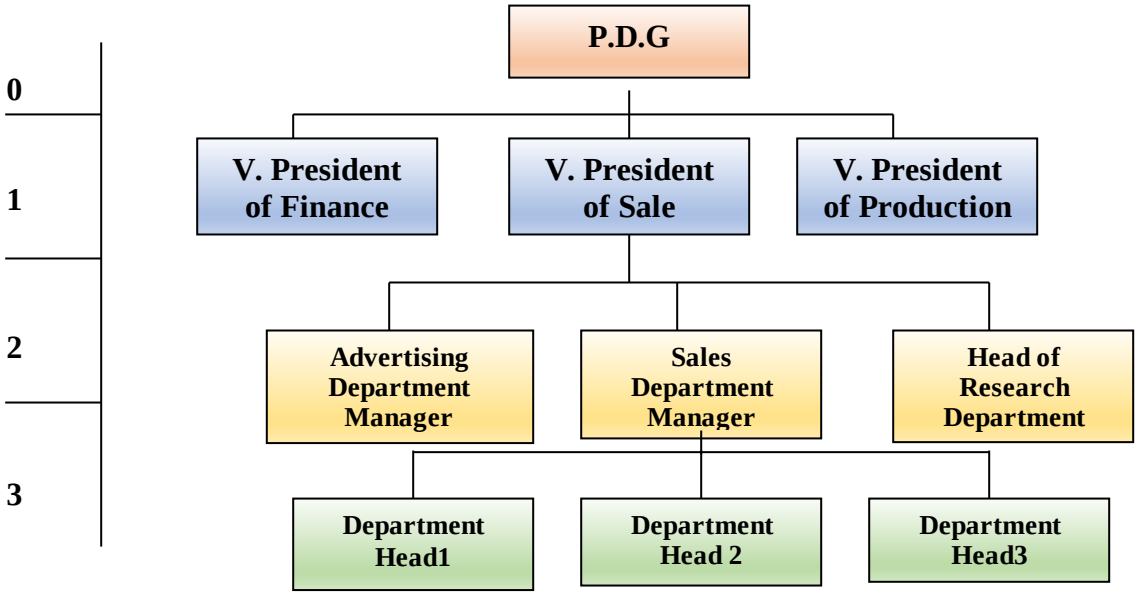


Figure 1.1 Illustration of an organization chart

This organizational chart has a pyramidal shape. Each vice president may be responsible for 3 department heads. Each department head can oversee 3 section heads, and so on.

2.1.3 The different structures

According to the activities and objectives of the company, several types of organizational charts can be used to represent the company's structure, among which we have :

- The hierarchical structure
- The functional structure
- The Staff and line structure

2.1.3.1 Hierarchical structure

It is based on the principle of the unity of command, where each employee is accountable to only one superior in the hierarchy.

Advantage: Simplicity of command and clarity.

Disadvantages: poor flow of information, cumbersomeness, bureaucracy.

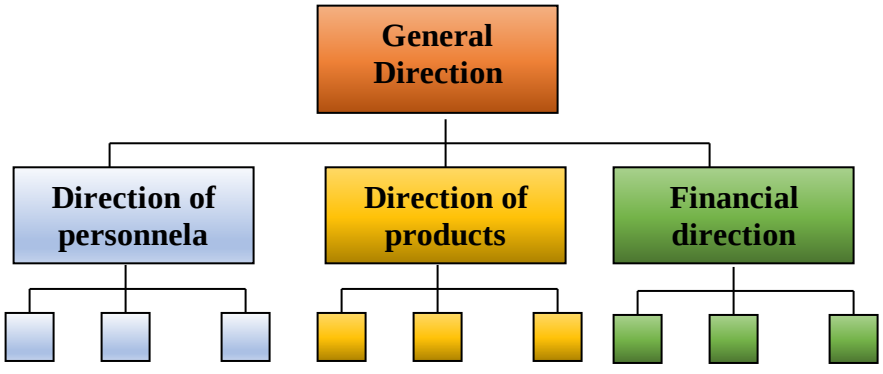


Figure 1.2 Example of a hierarchical structure.

Level 1: General Direction
Level 2: Directions specialized (production, personnel, marketing, finance, etc.)
Level 3: Under directions
Level 4: Department heads

2.1.3.2 Functional structure

It is based on the principle of functional division of authority and plurality of command, where each employee is accountable to multiple supervisors, each having authority only in their area of competence.

Advantages: Very effective specialization of personnel, grouping of skills

Disadvantage: Possibility of conflicts generated by the multiplicity of command.

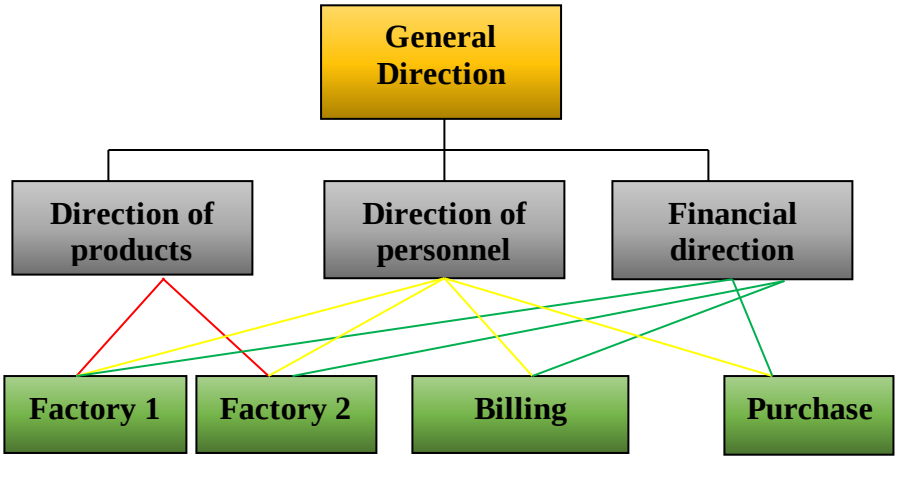


Figure 1.3 Example of a functional structure

2.1.3.3 Hierarchical-functional structure

It is based on the principle of unity of command and the need to resort to advisory bodies composed of specialists. Specialized advisors in specific areas are attached to hierarchical heads:

the hierarchy makes decisions, and functional managers assist in decision-making. This results in two lines of authority:

- the line of command (operational directors)
- the advice line (functional directors who do not give orders)

This structure is also called "staff and line" (staff: advice, line: decision-making power)

Disadvantage: risk of difficult relationships between operational and functional staff.

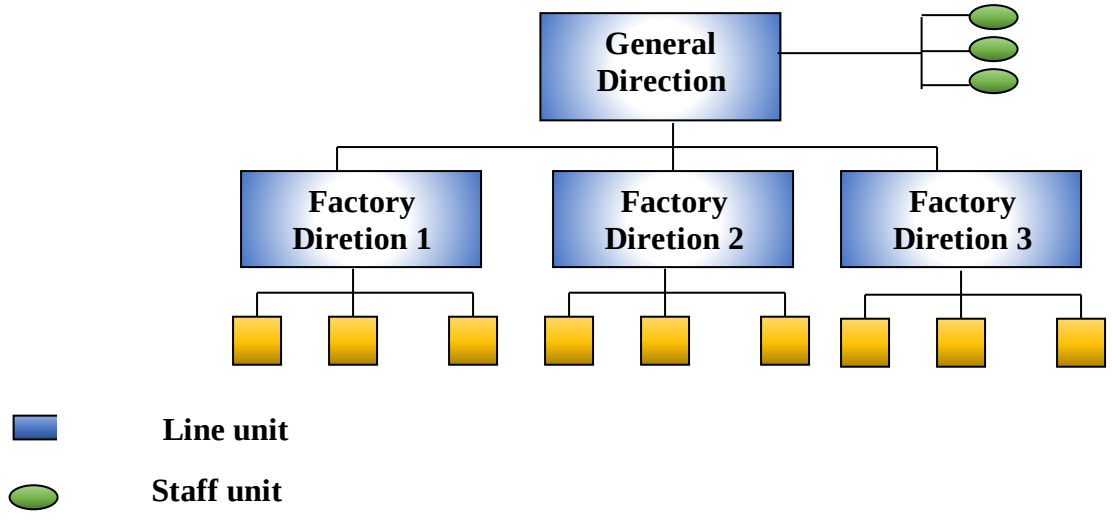


Figure 1.4 Example of a hierarchical-functional structure

2.2 Main functions of the company

To produce, the company must perform various functions that are interconnected or combined. These functions vary depending on the nature and activity of the company: industrial, agricultural, small business, large business, etc.

Example

In an industrial company we have the following functions:

Purchase → production → sale → accounting

The main functions of a company are as follows:

- **The production function:** Involves preparing the work for the transformation of raw materials, overseeing its execution, and monitoring it (work methods, programming, launching, scheduling, and quality control).

- **The procurement function:** Enables making available the necessary products for production at an optimal cost (searching for suppliers, scheduling orders, inventory management).

- **The commercial function:**
  - Marketing: predicting and generating sales (market research, advertising, sales promotion, etc.)
  - Sales and after-sales

- **The financial function:** It provides the company with the capital it needs at any given moment, with the least cost and maximum security. It involves interactions with banks, insurance companies, clients, the government, and investors.

- **The functions of the staff**

- Personnel administration: recruitment, secondments, transfers, layoffs, training, sanctions, dismissals
- Staff payroll: attendance checks, pay slips, bonuses and salary deductions, social declarations, taxes
- Social management (the social act)

3. Systemic approach to organizations

3.1 Definition

"A system is a set of dynamically interacting elements, organized according to a goal "
J. de Rosney

Example

A boiler converts coal into heat

3.2 Overall presentation of the three systems

The organization studied as a system can be broken down into:
- The Decision System (DS)
- The Information System (IS)
- The Operating System (OS)

3.2.1 Operating system

The operating system is the ensemble that carries out all the execution tasks and transforms a physical flow of inputs into a physical flow of outputs to practically achieve the objectives of the company (such as purchasing raw materials, banking transactions, receiving finished products, etc.)

Example

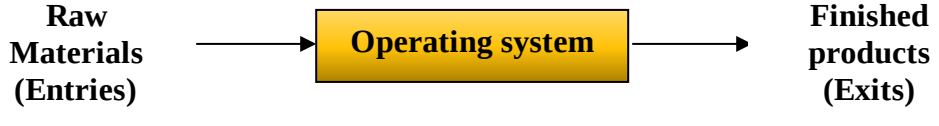


Figure 1.5 Example of the operating system

3.2.2 Steering system (Decision system)

The control system regulates and monitors the operating system by deciding on its behavior based on set objectives, such as the assignment of individuals to functions, pricing policy, etc.

Examples

1. The operator who makes adjustments and controls the coal flow at the input forms the control system of the boiler
2. A control system consisting of the sales department, financial department, production department, etc.

3.2.3 Information system

As an interface between the operating system and the control system, an information system is used to process and convey information between the two systems

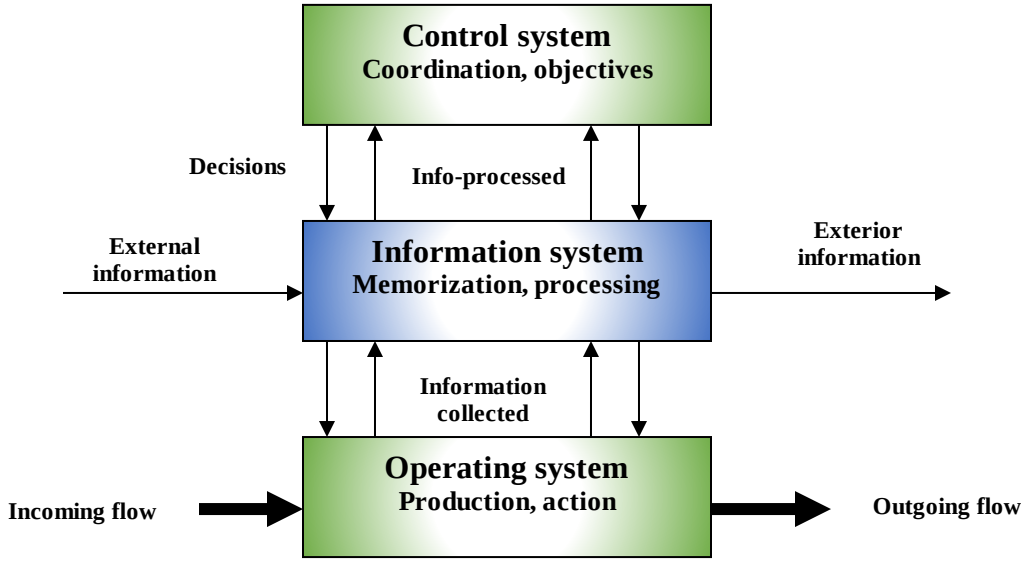


Figure 1.6 Systemic diagram of the company (after J.L. Lemoigne)

- The information system serves as the information memory of the company.
- The internal environment of the information system is composed of the control subsystem and the operating subsystem
- The external environment of the information system is the external world of the company (customer, supplier, bank, etc.)

Example

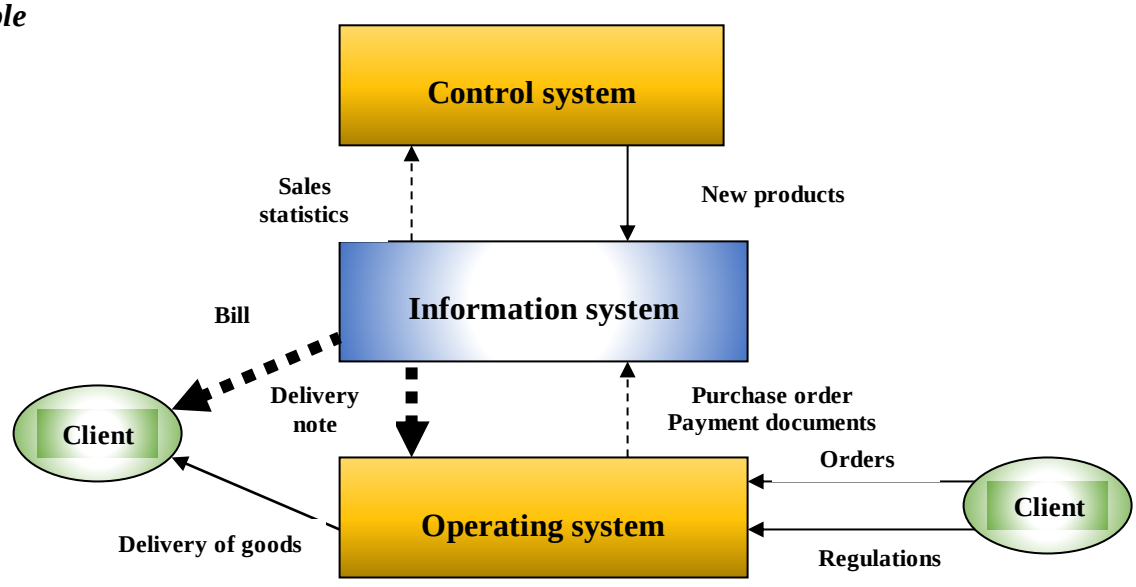


Figure 1.7 Example of a Systemic Diagram

The IS has two aspects:

- a static aspect: facts and data
- a dynamic aspect: operations on information (updated). This aspect is called "information processor"

3.3 Decision System

3.2.1 Definition

The decision system is the set of processes by which information is converted into action.

3.2.2 Classification of decisions

Decision-making is an intellectual process that leads a person to make a choice based on the information available. Decisions can be classified by levels or by method.

3.2.2.1 Classification by Level

Harry Igor Ansoff prioritized decisions into three levels:

- **Strategic decisions**
    - Define the company's strategy.
    - They are taken by the top of the hierarchy and commit the organization in the long term;
    - They reflect the overall policy of the organization; for example, a company specializing in mattress production decides to diversify by also manufacturing beds and bed bases.

- **Tactical decisions**

  - They are taken by the department directors
  - These are medium-term decisions that concern the management of the organization; for example, the Human Resources director decides to hire a new employee;

- **Operational decisions;**

  - They ensure the daily functioning of the organization;
  - These are short-term decisions;
  - They pertain to day-to-day operations. For example, it involves managing schedules and placing orders for supplies.

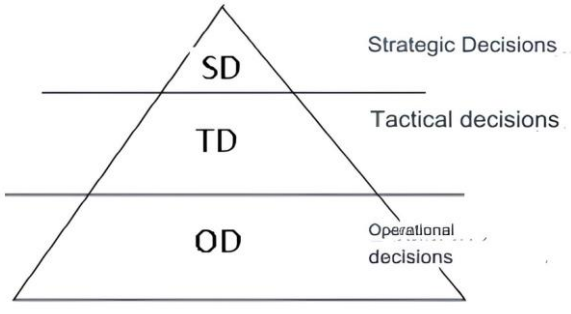


Figure 1.8 Classification of decisions according to their level

3.2.2.2 Classification by method

Decision-making is so crucial that decision-makers seek to rely on methods and tools for decision support, although it is not always possible. To study how business leaders make decisions, Simon (1960) proposes another classification that involves determining whether a decision is programmable or not.

- **Programmable decisions**

These are repetitive and routine decisions, and a procedure has been defined to carry them out, avoiding the need to reconsider them each time they arise. The organization thus defines how tasks related to this decision should be accomplished, as well as the methods for resolving any potential obstacles. This notion refers to scheduling and task planning.

Example

Inventory management: every Tuesday, the company receives 50 packages,
Customer account management

- **Non-programmable decisions**

In this type of decision, it has not been possible to define a specific procedure to carry them out; either because they are new, unstructured, unusual, etc. A decision is also non-programmable when it depends on essentially environmental factors that cannot be controlled by the organization. For example, the decision to launch a new product fall into this category.

3.2.3 Decision table

A decision table is a logical tool that easily models a set of choices of a certain complexity. This type of table exhaustively expresses the relationships between the internal logic of a function or process, the input data, and the output data.

- The data provided as input becomes the conditions of the decision table.
- The data returned as output comes from the actions triggered by the decision table
- The pairs (conditions, actions) become the rules of the decision table or, in other words, the internal logic of the function.

Example

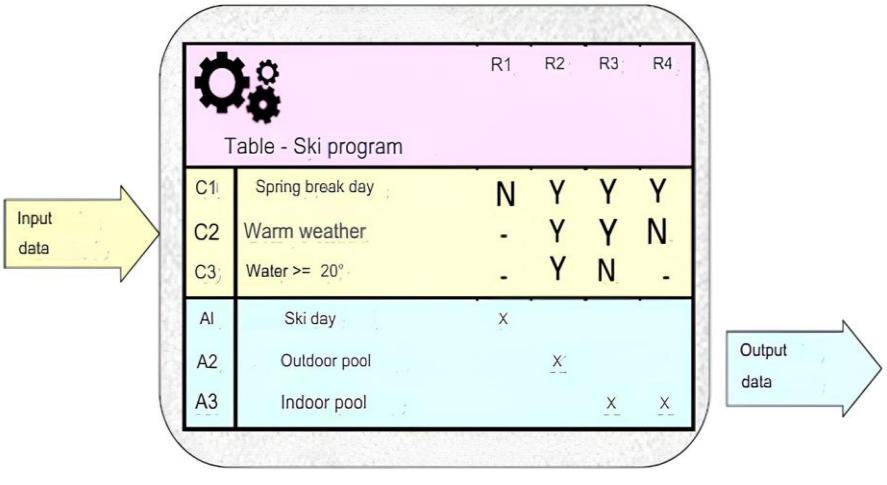


Figure 1.9 Internal logic of a function

The rows of a decision table are separated into conditions and actions; conditions come first, followed by actions. The columns represent, in the form of rules, the relationships between condition values and actions.

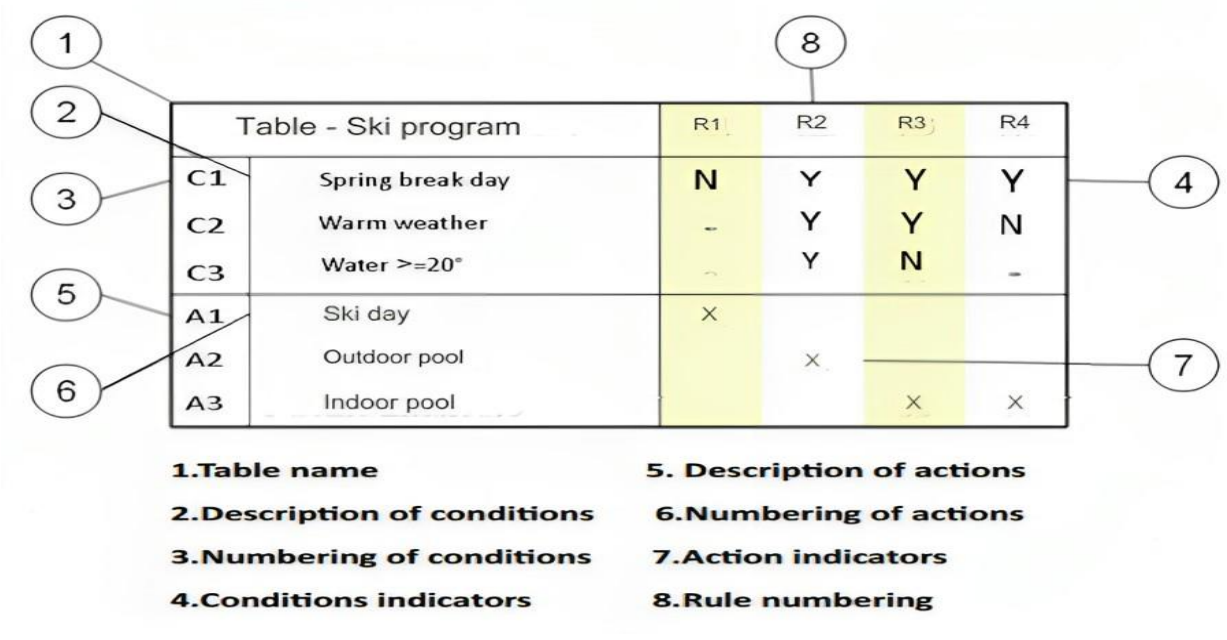


Figure 1.10 Structure of a decision table

4. The information system

4.1 Definitions

Definition1: An Information System (abbreviated as IS) represents all the elements involved in the management, processing, transportation, and dissemination of information within the organization.

Definition2: "An information system is the set of methods and means used to collect, control, and store information in the exercise of activity at any point within the organization".

As per Lemoine

4.2 Role of the Information System

An Information System (denoted as IS) represents all the elements involved in managing, processing, transporting, and disseminating information within the organization.

The information system enables:

a) Ensuring the transmission of information between:

- the Planning System and the Operating System
- the organization and the external environment

b) Making available to the control system information regarding:

- the operating system's state to make necessary decisions for better adaptation.
- the overall functioning of the organization.

c) Providing the operating system with the necessary information for its functioning.

4.3 Functional aspects of Information System

An information system allows the:

- Collection and entry of information
- Memorization (raw information or processing results)
- Processing of stored data
- Transmission of data from and to: the system and the external environment

- **Information Collection**

The information system collects information from:

- both the steering and operating systems
- the external environment

Example:

The information system of an industrial company collects:

1) From the steering system: the quantity of products to be produced and the production rules to be applied.
2) From the operating system: the production status and the list of present workers.
3) From the external environment: the list of suppliers and market research.

- **Information Storage**

The information system must store all information collected and managed by the organization.

Example:

Information to be stored:

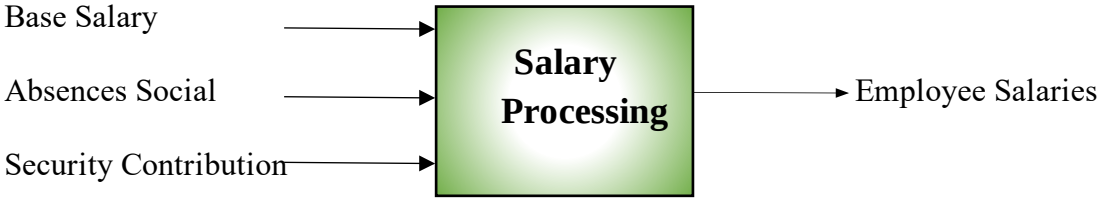
- Employees: Employee number, name, address
- Products: product reference, description, unit price, etc.
- Procedures, methods, and standards to be followed during product manufacturing.
- Internal personnel regulations.

- **Information Processing**

The information system applies processes to stored information to produce other information in the form of results.

Example:

Processing: Calculation of employee salaries



- **Information Transmission**

The information system ensures the transmission of information between different systems within the organization and also facilitates the circulation of information to and from the external environment. This ensures good coordination among different parts of the organization, consequently enabling its proper functioning.

Example:

In an industrial company, an IS allows:

- Sending a report of absent employees to management.
- Transmitting the list of available products to customers.

4.4 Structural aspects of Information System

The systemic approach to the enterprise has emphasized the importance of the concept of flow and the existence of three subsystems (decision system, information system, and operating system)

Among all the flows traversing the enterprise, information flows play a major role. They ensure the economic and social cohesion of the company by conveying an essential resource: information.

Information transits through the information system with specific purposes and functions..

The information system of a company can then be considered as being composed of a set of information flows that transit between various stations.

Incoming flow **Station** **Outgoing flow**

Stations are the places where information is processed. Sometimes, a station can be subdivided into sub-stations.
The flow can be translated through written documents or through oral information exchanged between two stations.

Goal: Create the most comprehensive inventory possible of information exchanges between different participants in the study domain and the treatments carried out.

4.5 Data Flow Diagram (DFD)

A data flow diagram is a graphical representation of the exchanges between actors. It allows us to have:

- An overview of the information flow among the actors involved in a defined activity.
- To analyze information exchanges within the information system of an organization (company, administration, or association) and with other information systems.

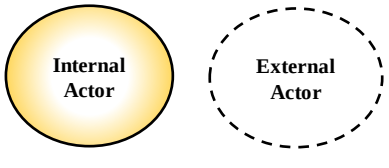
a. Actor

An actor is a sender or receiver of an information flow related to an activity within the information system of an organization. An actor receives an information flow, enabling them to act by transforming the information and sending one or more other information flows to other actors.

We distinguish between:

- Internal actors who are part of the study domain.
- External actors who are not part of the domain but have exchanges with internal actors within the scope of the studied activity

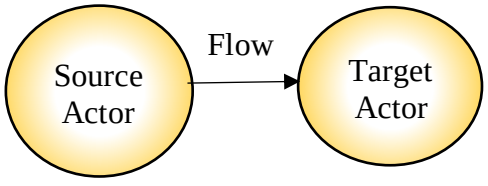
In the notation we will use, an external actor is represented by a dashed circle, while an internal actor is represented by a solid circle. The name of the actor is placed inside the circle.



b. Flow

A flow refers to the transfer of information between two actors in the information system. A flow originates from a source actor and ends at a target actor, represented by an arrow. Different

categories of flows can be identified (physical flows, financial flows, for example), and these flows should be explained in the form of information flows.



Flows can occur in a specific order, and this order can be noted to facilitate reading. Flows between external actors may not be of interest.

How to build a flow diagram:

1- Define precisely the scope of the study, namely: which activity or process within which organization.

2- Identify external actors and internal actors.

3- Identify the flows between actors.

4- Draw the corresponding flow diagram.

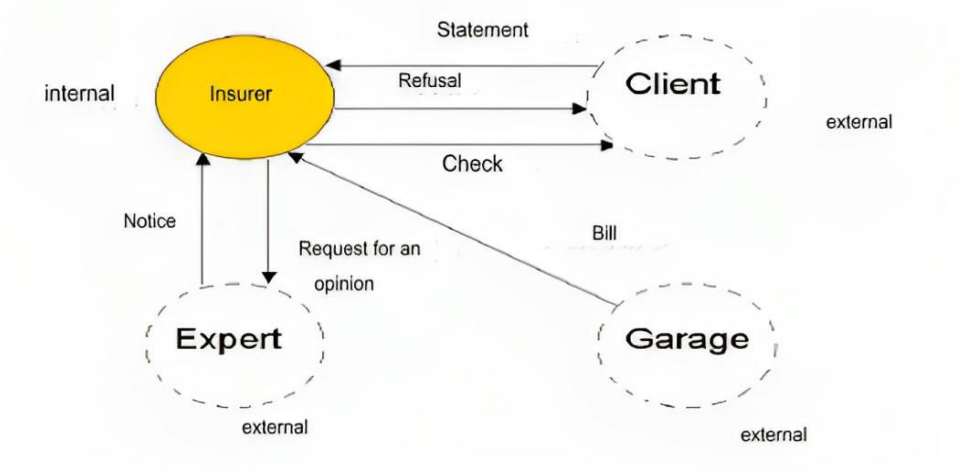
Example

Managing claims in an insurance company

Upon receiving a claim, it is examined. If the claim is valid, the opinion of an expert is sought; otherwise, a refusal is communicated to the policyholder. Upon receiving the expert opinion and the garage invoice, the reimbursement amount is calculated, and a check is sent to the client.

List of actors: Insurer (internal), Client/Insured (external), Expert (external), Garage (external)

List of flows: Statement, Request Opinion, Bill, Refusal, Notice, Check



5. Exercises

Exercise 1

In an industrial company, the personnel are as follows: 1 Director, 3 Assistant Directors (a Director of the Sales Department, a Director of the Production Department, and a Director of Accounting). Additionally, the company employs an accountant, an accounting secretary, a sales manager, 5 salespersons, a production manager, and 6 workers.

Questions:

1. Draw the organizational chart of this company as clearly as possible.
2. Determine the three subsystems that can be highlighted in this company.
3. Determine the external environment of this company; Knowing that this company must: be insured, have bank accounts, and pay its tax obligations.
4. Diagram the information flows circulating between this company and its external environment.

Exercise 2

A (specialized) company manufactures and markets plastic objects. It is divided into a Technical Department that handles production and a sales Department that manages raw material purchases, sales, invoicing, and accounting.

The considered case relates to the system corresponding to the Sales Division. Purchases are made through orders from suppliers, based on a production schedule and specific requests from the production division. The sales department relies on representatives who visit retailers, and important clients directly depend on this department and can sign sales contracts. Order tracking ensures the processing of orders and their modifications. A "store" manages the storage of manufactured products, prepares and sends deliveries. The manufacturing department handles invoicing, and the accounting department is responsible for collecting payments and authorizing expenses.

Every year, a catalog is published, presenting the manufactured products divided into 2 classes: Finished products that are resold without modification by customers, and component products that are used in the production or assembly of products by customers. Component products are generally sold to production companies and are the subject of contracts, but they can also be sold to retailers as spare parts.

Questions

1. Describe the main function of the commercial division.
2. Schematize the organization chart of this division (Complete the organization chart with the sub-departments and/or agents) necessary to accomplish the different operations in each department.
3. Give examples of information from each level of decision system (management), information system, operating system of the company. We will represent the flow of information between systems using a pyramid diagram.

Exercise 3

Algerian telecom operator, Ooredoo, introduces its brand new football-exclusive offer. This offer encompasses the purchase of a SIM card providing a welcoming credit of 500 Algerian Dinar, in addition to the following benefits:

- For each goal scored by the national team (the Greens), receive 10 free SMS.
- Upon every victory by the national team, get 100 Algerian Dinar in free credit.
- Enjoy a 50% bonus on all recharges up to 500 Algerian Dinar.

Question

Develop a decision table containing the appropriate conditions, actions, and corresponding decision rules.

Exercise 4

A health center is equipped with an information system for patient management. This system is described as follows:

Upon arrival at the center's reception, the patient goes to the secretary to fill out an information form containing their name, surname, address, etc. The secretary keeps a copy of the form and gives another copy to the patient, who then proceeds to the consultation room.

After reviewing the form, the doctor examines the patient, issues a prescription, and updates the "patient" file. If the patient requires analyses, the doctor fills out an analysis form specifying the type of analyses to be done and directs the patient to the center's laboratory.

In the laboratory, the patient is taken care of by a specialist who reviews the form and conducts the requested analyses. A results form is given to the patient, who brings it back to their doctor to receive a prescription based on the established results.

Question*:* Create the flowchart corresponding to the described system.

Exercise 5

A company works with over 150 account clients. At the beginning of the month, the "Accounting-Finance" department requests a list of negligent clients (clients with more than 5 days of delay in paying an invoice) from the "Customer Accounting" department.

For each of these clients, a request for information is transmitted to the sales department through the internal messaging system.

Based on the gathered information, the department contacts the clients to inform them of the delay and obtain an explanation. If the client's financial situation does not appear too critical, they establish new payment conditions. Otherwise, they forward the case to the litigation department, which initiates legal proceedings for debt recovery.

Question: Create the corresponding data flow diagram for the described system.

Exercise 6

The central personnel management of an administration wishes to develop a computerized personnel management system. This administration oversees a workforce of agents distributed across different assignment units.

The regional administration (RA) initially decides to automate the personnel recruitment process, which can be described as follows:

Description of the recruitment process:

After a competitive process, a list of admitted candidates is established by the recruitment service (SR) and transmitted to the regional administration (AR) with the complete files of the concerned agents. The AR proceeds to record the admitted candidates and generate a recruitment decision for each agent.

Each decision, identified by a number, pertains to an agent who will occupy a position. Each generated decision follows the following circuit:

Sent to the central personnel management (DCP). The DCP verifies the actual existence of the position and then forwards the decision to the financial control service (SCF).

This service checks all financial elements of the decision and issues a visa, which can be: accepted (general case), rejected (irregularity observed), or deferred (pending supporting documents).

The decision is returned to the AR. A first copy of the decision is sent to the agent. A second copy of the decision is sent to the agent's assignment unit (UA). A third copy is stored in the agent's file.

The AR also provides the UA with the list of new agents and a reduced individual file for each new agent. When a new agent takes up duties in their assignment unit, the head of that unit sends a notice of assuming duties to the AR. For agents who have not assumed their duties, a weekly list is prepared and sent by the AR to the DCP.

Questions:

1. Specify the scope of the case study.
2. Determine the interfaces of the case study with other projects.
3. Examine the information flows of the case study.

Chapter 2

The Techniques of Information Representation

Contents

- Concept of Information
- Forms of Information
- Manipulation of Information
- Study of Information
- Schema and Information encoding
- Exercises

Introduction

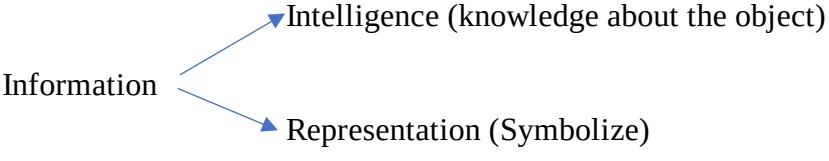
Technical representation constitutes a graphical form enabling the communication and transfer of information. It materializes through drawings, symbols, or graphs, providing a clear and precise presentation of the idea to be conveyed. Data processed by a computer can take various forms (text, numbers, images, sound, videos, etc.), but they are systematically manipulated and represented in digital form by the machine. The process of encoding information establishes a correspondence between its external representation (text, image, etc.) and its internal representation in the machine, which always appears as a sequence of bits

1. Concept of Information

Information is any element of knowledge that can be perceived by one of the five senses of humans (sight, hearing, touch, taste, smell).

Examples

An image, a landscape, etc.	Perceived by sight
Taste, bitter, sweet, etc.	Perceived by taste
Sound, music, etc.	Perceived by hearing



Examples

The student in the university (object)
The order from a customer (event)
Traceability (concept)

2. Forms of Information

Information can be written, pictorial, oral... In cases where information results from processing, we refer to structured information (or formalized or documented).

Structured information is essential to the company because it is more concise, quickly communicable, often more reliable, and can be processed algorithmically to obtain new information.

3. Manipulation of Information

The basic actions concerning information are: Creation, Copying, Translation, Memorization, Transport, Processing, Destruction, understanding (the process by which one accesses the

meaning of information), Summarizing (Condensing a set of information while retaining its meaning).

4. Study of information

4.1 Class and class implementation

A type or class is a set of elements with the same characteristics. An instance of a type or class is a particular element of that set.

Example

The class of customers (each customer is considered an instance of the class of customers).

4.2 Class description

A description of a class or type encompasses all the fields allowing the description of a class of information (Entity, Association, Event).

To represent a class description, a descriptor is used, composed of: Class Name, followed by braces ({}) containing the list of relevant fields (separated by commas).

Example

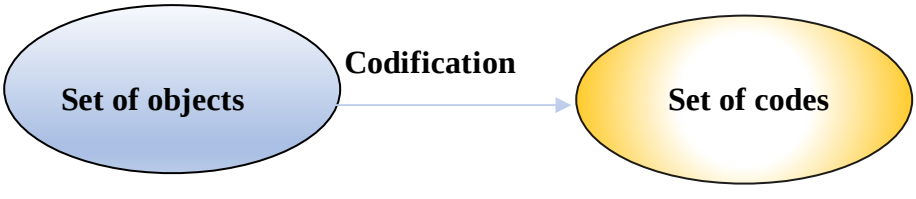
CUSTOMER {CustomerCode, CustomerName, ADDRESS {Street, PostalCode}}

5. Schema and Information Encoding

5.1 Definitions

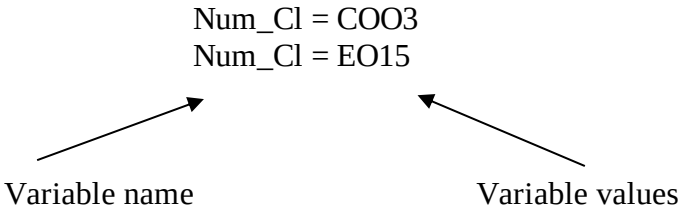
Code: A shortened name or representation of information that designates an object or concept clearly and uniquely.

Encoding: Encoding is an optimization technique that involves assigning codes to objects. It allows:
1. Unambiguous identification of an object within a set.
2. Saving memory space and search time.



Encoding applies to the name of the information (or concept) to be encoded or to its value. In computer programming, this would involve variable names and their respective values

Example



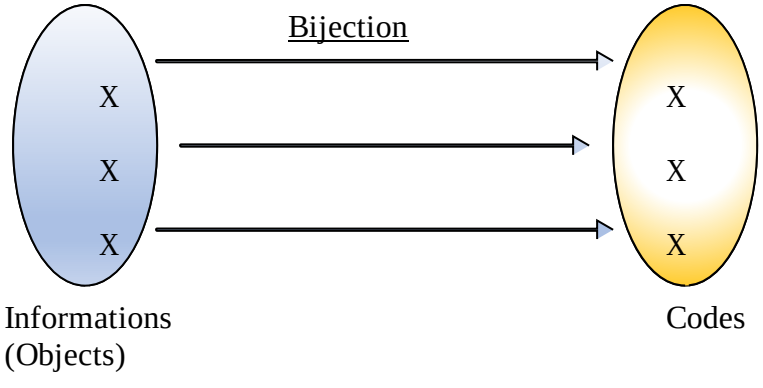
Customer Number: code→ Num-Cl
Values for this number: COO3, EO15, COO1, EOO1.

5.2 Key characteristics of a coding system.

5.2.1 Unambiguity

Encoding must not be ambiguous, meaning it should assign one and only one code to each information to be encoded, and each code must be assigned to one and only one piece of information. In other words:

- Each code must designate one and only one object.
- And each piece of information must be associated with one and only one code."



Example

Num_C ⟶ Order number
Num_C ⟶ Customer Number

Num_C simultaneously designates both pieces of information: order number and customer number.

The solution would be to choose another code for the customer number (e.g., Num_Cl).

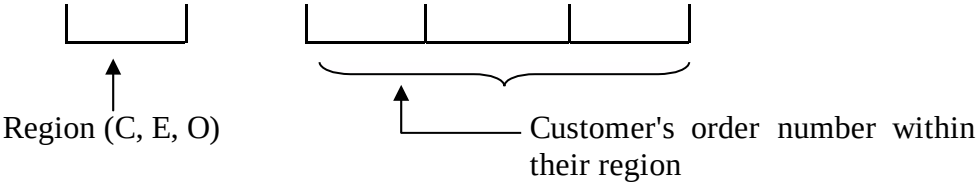
5.2.2 Ease of use

The encoding and decoding functions should be easy and simple for the user to perform. In other words, a user should be able to add new codes and interpret pre-established codes independently.

Example

Consider the code associated with the customer number.

Cust_Num



This encoding is:

- Easy to interpret
- It is easy to encode a new client

If the company has acquired a new client in the West region, the encoding is straightforward:

Region: West

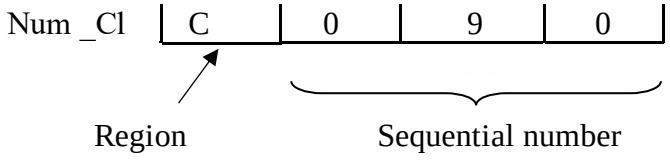
Number of the last client in the West region: 301
The new client will be the 302nd in the West region. So, the number for the new client will be: O302.

Similarly, interpreting this code is easy.

5.2.3 Possibilities of Expansion and Insertion

- Extension expresses the ability for the set of encoded information to expand. Insertion expresses the ability for a new code to be inserted between two existing codes."

Example



We can have 999 registered clients in the central region.

- Insertion expresses the ability to insert a new code between two existing codes.

Example 1

The encoding of a company's clients is as follows:

- Numbers 1 to 100 for clients from the East.
- Numbers 101 to 200 for clients from the West.

- Numbers 201 to 300 for clients from the Central region.

001
---
100 ⌐ Eastern Clients100

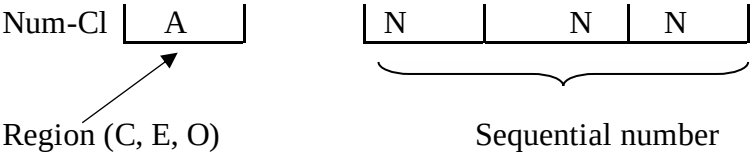
Unable to insert the 101st Eastern client because the number 101 is already taken.

101
---
200 ⌐ Western Clients

This code does not allow for more than 100 clients per region.

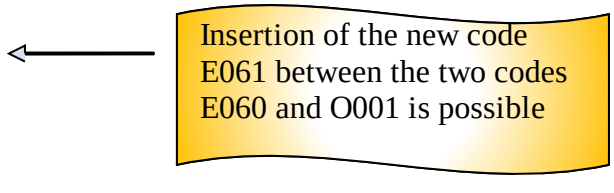
Example 2

However, a code having the following form is a code that allows insertion."



C001
C002
--
C085
E001
E002
--
--
E060
O001

O002
--
O101



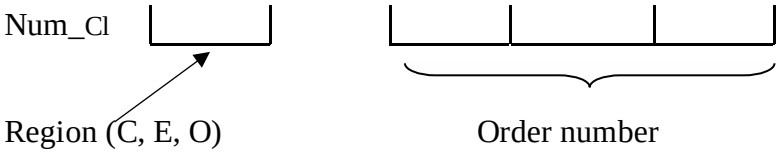
If a new client arrives in the East region, the code will be E061. This new code will be inserted between the two codes E060 and O001.

5.2.4 Conciseness

Conciseness reflects the idea that a code should be clear and short, without neglecting the possibility of evolving the set of information to be encoded.

Example

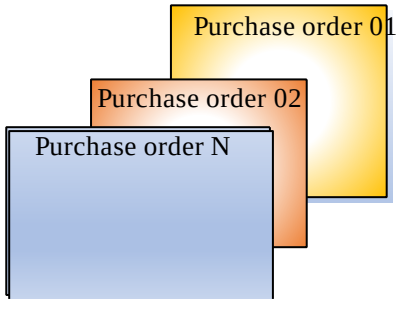
If the region number in the client's code is unnecessary, the client's number will be encoded in 3 positions instead of 4



5.3 Types of Encoding

5.3.1 Sequential Encoding: This involves assigning consecutive numbers (1, 2, 3, etc.) to the information to be encoded.

Example: Encoding Purchase Orders



Advantages

- Unambiguous
- Simple to implement (last N+1)
- Possible extension

Disadvantages

- Impossible insertion
- Not meaningful

5.3.2 Coding by Ranges

This involves assigning code ranges to categories of objects to be encoded. The codes are sequential within each range.

Example:

Coding books in a library

- Category 1: Computer Science Books -> from 001 to 100
- Category 2: Literature Books -> from 101 to 200
- Category 3: Sociology Books -> from 201 to 300

- Category 4: Medicine Books -> from 301 to 400
- Category 5: Architecture Books -> from 401 to 500

Advantages

- Unambiguous
- Simple
- Allows Insertions and Extensions

Disadvantages

- Not meaningful
- Number of codes in a range difficult to determine.
- Requires a correspondence table between Ranges and codes.

5.3.3 Articulated (Concatenated) Coding

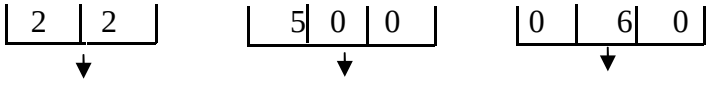
The codes are divided into multiple zones called 'descriptors,' each with a particular meaning.

Example

Coding students in a university Subjects taught:

- Computer Science (500)
- Accounting (400)
- Taxation (300)
- Marketing (200)

Student ID Number



Year of Baccalaureate | Specialty | Sequential Number

Advantages

- Widely used
- Unambiguous
- Insertion and extension possible
- Meaningful coding enabling data control

Disadvantages

- Code too long
- Possibility of descriptor saturation
- Unstable coding (e.g., changing specialty requires a new code)

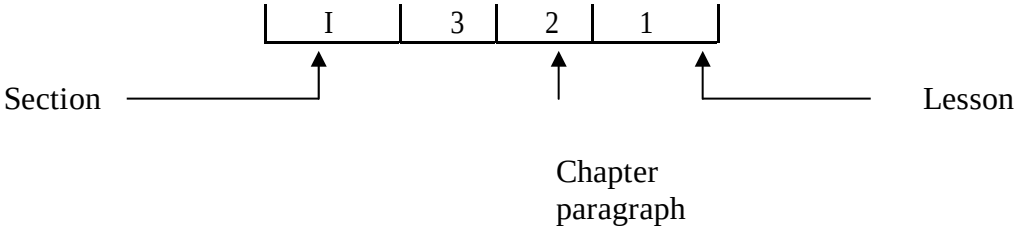
5.3.4 Hierarchical Encoding (by Levels)

This encoding is a specific case of articulated coding. It is used when there is an inclusion relationship between the sets to which the object to be encoded belongs (the descriptors are levels).

Examples

Postal code 16010

Coding of a paragraph in a book



Advantages

- Ease of search due to hierarchy (tree structure)

5.3.5 Mnemonic Coding

Involves associating a shortened name with the object to be encoded (using a reduced set of characters).

Example

Order Number: Num_Cd
Postal Code: CP
Postal Checking Account: CCP

Advantages

- Easy to implement
- Meaningful
- Practical coding for manual use

Disadvantages

- Generally used for coding variables, designations, or programs
- Focuses on the name and not the value

6. Exercises

Exercise 1

Consider the following codifications:

1. Employee code

Service Code Order Number

2. Library Work

Domain Code Sub-domain Code Order Number

Example

Book Code:

- Domain = Computer Science
- Sub-domain = Information Systems
- Book number = 100

3. Club Member

Activity Domain Seniority Sequential Number

Questions

1. What type of coding is used in each case?
2. Determine the disadvantage of each coding method and propose a new coding method if necessary.

Exercise 2

Consider an institution that offers training: Technicians and Senior Technicians. Each level has multiple specialties (Computer Science, Accounting, and Secretarial). Each specialty is organized into sections (maximum of 1, 2, or 3 sections). A section cannot contain more than 30 students.

Question

1. Describe the student codification for each type of coding.
2. Provide the disadvantages and advantages of each proposed coding method.

Chapter 3

Information Input and Control

Contents

- Definition of Control
- Main Types of Controls
- Exercises

Introduction

The accurate and precise circulation of information within an organization holds paramount importance in ensuring its optimal functioning and enhancing the decisions made by its leaders. The intrusion of errors into this information can have devastating consequences for the organization. Therefore, the implementation of preventive controls is crucial to avoid such errors.

1. The controls

The information within an organization's information system must align with the reality it represents to prevent errors from creeping in and to ensure the smooth functioning of the organization. To avoid these errors, implementing controls is necessary.

1.1 Definition

The control of information involves verifying its accuracy and ensuring its alignment with the reality of the organization.

Examples

The following information should not be accepted in an IS (Information System):

- An unmarried employee with four children.
- A university student born in 2023.

Note

The computer only executes commands that are input by humans. Therefore, controls must be planned and requested by the user for the machine to execute them and minimize errors in the IS."

2. Main types of control

2.1 Direct controls

These are controls performed directly on the information itself, without considering other existing information within the system.

Example: The unit price of a product is greater than 0.

2.1.1 Presence control

It involves verifying the presence or absence of specific information on a medium, which could be a document or a file.

Examples

1. **Presence Control**: lending a book to someone requires verifying the affiliation of the subscriber (the subscriber must exist in the subscriber file).

2. **Non-Presence Control**: when registering a new subscriber, they should not already exist in the subscriber file.

2.1.2 Format control

It involves checking the type and length of values for different properties. This type of control is typically done automatically according to the declaration of the properties.

Example:

The property 'Numprod' is numeric and has a length of 4.
'Numprod = A300' is erroneous because the character 'A' is not a digit."

2.2 Indirect controls

It involves verifying the type and length of values for different properties. This type of control is typically performed automatically based on the declaration of the properties.

Example:

The property "Numprod" is numeric and has a length of 4. "Numprod = A300" is erroneous because the character 'A' is not a digit.

2.2.1 Internal consistency check

It involves verifying the accuracy of one part of the information concerning other parts of the same information.

Example

The date 30/02/2023 (DD/MM/YYYY)

Internal consistency check detects an error because:

MM=02 $\longrightarrow$ DD $\leq$ 29

2.2.2 External consistency check

It involves verifying the conformity of information concerning other pieces of information.

Example

Given the following information:
- Year of recruitment: 2000
- Seniority: 17 years

The external consistency check detects an error because:
Seniority = Current year - Year of recruitment

Seniority = 2023 – 2000 = 23 years

2.2.3 Plausibility Check

In this type of check, it's crucial to ensure that the information is possible and conceivable given its context.

Examples

1. Date of birth = 15/15/2023

Month=15 (MM = 15) ⟶ The month is implausible because 1 ≤ month ≤ 12.

Postal code = 49010 ⟶ The postal code is Implausible because 1 ≤ Wilaya ≤ 48.

3. Exercises

Exercise 1

The management of a university library requires the use of the following files:

Book (Book code, book title, Year of edition).
Author (Author code, Author's last name, Author's first name).
Subscriber (Subscriber number, Subscriber's last name, Subscriber's first name).
Book specialty (Specialty code, Specialty designation).
Loan (Subscriber number, Book code, Loan date).

Questions

1. Each book in the library can have a maximum of 20 copies and can exist in up to 3 volumes. Propose a suitable coding for the book code.
2. In this library, there are 9 specialties (Example: General Culture, Architecture, Arabic Literature, etc.). Propose a new coding for the books in case they are grouped by specialty.
3. What are the controls to be performed when registering a new book?

Note

The library has a capacity of:

- Maximum 1000 books per specialty.
- Maximum 500 subscribers.

Exercise 2

Consider the teaching staff file of an educational institution, represented by the following information: **number, last name, first name, date of birth, address, postal code, phone number, year of recruitment, grade, and category (temporary or permanent).**

Questions

1. Propose a coding system for the teacher number? (Should consider the year of recruitment and allow the distribution of teachers according to the category).
2. Use a table to list all the checks that the fields of the teacher file might undergo when registering a new teacher?

Exercise 3

Hospital admission management is based on the following files:
• Patient (code, last name, first name, date of birth), department (code, name)
• Hospitalization (hospitalization code, patient code, admission date, admission reason, discharge date, discharge reason).

Questions

1. Could the NSS (National Health Service) be used to code all patients?
2. The patient code should be able to indicate if the patient is a male or female and their year of birth. Propose this patient code? Control the addition of a new patient?

Exercise 4

A student file containing the following information: ID number, name, date of birth, place of birth, postal code, city, telephone, year of enrollment, study program, prepared degree, year of study.

Questions

1. Propose a coding system for the student ID number. The suggested code should consider the enrollment year and classify students based on their study program (Bachelor, Master, Doctorate).
2. Outline the necessary checks for each piece of information in this file.

Chapter 4

Methodology for developing an IS (Information System)

Contents

- Development process of an IS
- Methodology MERISE
- Concepts for Static Modeling
- Concepts for Dynamic Modeling
- Exercises

Introduction

With the increasing complexity of information systems and the growing involvement of multiple stakeholders in their design, developing methods to properly conceive these systems and establish models as a foundation has become essential.

Modeling involves creating a virtual representation of reality, highlighting elements of interest. This approach falls under analysis. Among the various existing analysis methods, the most widespread is the MERISE method (Method for Study and Information System Realization in Enterprises).

1. Development process of an IS

The information system development process is a structured set of activities to achieve the objectives of an IS project. These activities vary depending on the organization, the project, and the type of system to be developed.

This process may vary based on development methodologies (such as Agile, waterfall, etc.) and project specifics.

1.1 Information System Lifecycle

The information system lifecycle reflects the chronological path of the system from its creation and development to its end. The purpose of this breakdown is to define key stages for validating development, ensuring the software's compliance with expressed needs, and verifying the development process.

This segmentation arises from the reality that errors become more costly when discovered late. The lifecycle helps identify these errors early, ensuring better control over software quality, development timelines, and incurred costs.

The IS lifecycle generally includes the following activities:

- Requirement Specification involves identifying the system requirements and objectives.
- Analysis studies the problem and functions to be automated.
- Design provides a functional and technical description of the system.
- Implementation puts into effect the chosen technical solutions (programming).
- Testing verifies the proper functioning of the system and corrects any errors.
- Maintenance involves extending the system's life and adapting it to new business needs.

1.2 Methods for IS Analysis and Design

The goal of IS design and development methods is to represent an approach and a set of models to implement a new system. The use of a method should enable:

1. Control over system development
2. Communication through a common language among stakeholders
3. Facilitation of maintenance
4. Improvement of system performance.

A development method consists of:

- **A model**: A set of concepts and rules intended to explain and represent organizational phenomena or the elements comprising the IS and their relationships.
- **A language** for developing specifications and facilitating their communication.
- **An approach**: An operational process encompassing modeling, description, evaluation, and IS realization.
- **Tools** supporting the approach.

A method is a specific manual for a model.

1.3 Typology of IS Development Methods

Three generations of design methods:

Generation	Period	Approach
1st generation	The 70s	*Analytical or Cartesian methods*
2nd generation	The 80s	*Systemic methods*
3rd generation	The 90s	*Object-oriented methods*

Table 4.1: Generation of design methods

1.3.1 Analytical or Cartesian Methods

Cartesian methods favor a treatment-oriented approach. The approach involves: breaking down the study domain into functions, hierarchically decomposing each of these functions into sub-functions, and finally stopping the decomposition at a sufficiently detailed level for easy coding of the sub-functions.

Examples: SADT (Structured Analysis and Design Techniques), Yourdon Method (Modern Structured Analysis), Corig, RSA, etc.

Disadvantages:

- Analysis focuses on treatments at the expense of data coherence.
- Lack of decomposition rules leading to varied hierarchies of decompositions depending on analysts.

1.3.2 Systemic Methods

These approaches view the enterprise as a complete system. They stand out for their ability to describe links between information, model the specific business domain, manage information flow according to the decision hierarchy, and adopt an abstraction process, moving from the global level to the specific level. These methods ensure better data coherence.

Examples: MERISE, Axial, Information Engineering (IE), REMORA, AXIAL, MEGA, OSSAD, etc.

Disadvantages:

- Lack of rules to ensure coherence between data models and treatment models.
- Weakness in treatment modeling: mixing knowledge (business rules) and control (integrity constraints).

1.3.2 Object-Oriented Methods

The object-oriented approach primarily focuses on identifying application domain objects and their interactions. It represents the IS dynamics as a set of operations linked to the system's constituent objects.

These methods mainly offer increased modularity and reusability of information system components.

Examples: OOD, OMT, HOOD, etc.

Disadvantages:

- Difficulty in abstraction efforts.

2. Methodology MERISE

2.1 Introduction

The use of a method is crucial for any IT development to ensure consistency between the initial specifications defined by managers and the application delivered to the end user.

MERISE (Method for Information Systems Study and Development in Enterprises) represents a versatile modeling methodology in the field of information system development, software engineering, and project management. Invented by Peter Chen and Hubert Tardieu in 1978-79, it has been widely used in France. This method has evolved and improved to be widely adopted by most large government, commercial, and industrial organizations in France.

2.2 Characteristics

MERISE follows a three-level modeling approach. Each level corresponds to a concern and a set of models for representing data and processes. The concerns of each level are presented in Table 4.2.

Levels	Concerns	Data	Processes
1	What? What is to be done?	Conceptual	Conceptual
2	Who? When? Where?	Logical	Organizational
3	How? With what means?	Physical	Operational

Table 4.2 The concerns of the levels in the abstraction cycle**.**

MERISE is a step-by-step and multi-level approach characterized by:

- **Systemic Approach**

MERISE defines a vision of the company in terms of systems. An enterprise can be considered to consist of 3 systems:

- The steering system that directs the company and sets objectives.
- The operational system that ensures production.
- The information system that links the others. We will mainly focus on this one.

- **Separation of Data and Processes.**

In MERISE, the information to be processed (data) and the processing of this data are subject to separate study approaches that can even be conducted in parallel by distinct teams.

- **Design by Levels**

MERISE distinguishes 3 levels of describing the information system:

- ***The conceptual level:*** It describes the set of stable or variant data of the information system and all the management rules to be applied without considering any specific computer hardware to support this information.

- ***The organizational or logical level***: Its role is to define the organization that should be put in place to achieve desired objectives. It specifies workstations, the sequence of operations, and the use of databases.

- ***The physical or operational level***: It defines the physical organizations of data and the description of processes performed by each processing unit.

At each level, the separation of data and processes must be respected as follows:

Levels	**Data**	**Processes**
Conceptual	Conceptual Data Model or **CDM**	Conceptual Process Model or **CPM**
Organizational or Logical	Logical Data Model or **LDM**	Organizational Process Model or **OPM**
Operational or Physical	Physical Data Model or **PDM**	Operational Process Model or **OPM**

Table 4.3 MERISE Models

3. Concepts for Static Modeling (CDM of MERISE)

3.1 Conceptual Data Model (CDM)

The Conceptual Data Model (CDM) is a graphical representation of the information system. Its purpose is to formally describe the data that will be used by the information system. The formalism used to describe a CDM is that of the entity-relationship model.

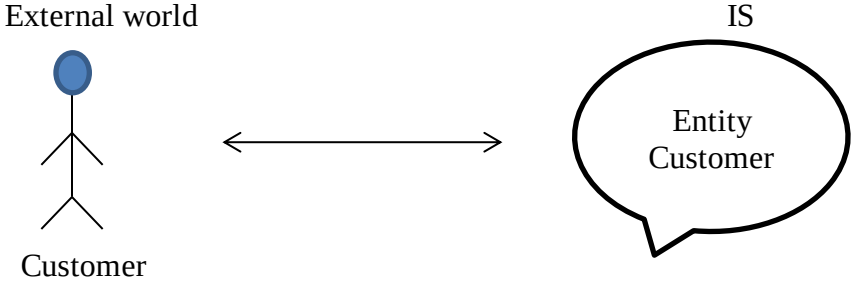
The entity-relationship model is a formalism for data representation proposed by Chen in 1976. This formalism's representation relies on three basic concepts: entity, relationship, and attribute.

3.1.1 Entity Concept

An entity or individual is the representation in the information system of a tangible or intangible object from the external world.

Example

The tangible object 'customer' from the external world is represented in the SI's memory by the entity 'customer'.



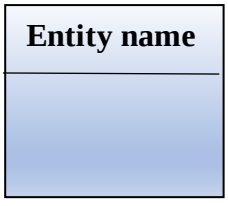
A type is a set of elements sharing the same characteristics.

An Entity type is a class of specific entities sharing analogous properties.

Example:

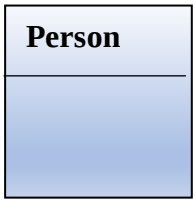
Any individual is of the 'client' type if they have at least one valid order in the company. They are characterized by attributes such as Client Name, Client Address, etc.

Formalism:



Example:

Entity type: Person



3.1.2 Notion of Property

A property is a fundamental data that characterizes the entity to which it relates.

Examples: Client Name, Client First Name, Client Address characterize the client entity.

A value is a symbol used to represent a basic fact; it often takes the form of a character string, but it can also be an image or text.

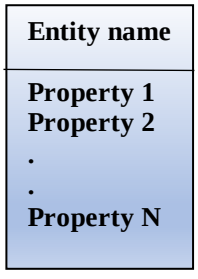
Examples: 'Ahmed', '5, Rue de la Paix' Value Type is the class or domain of all possible values for the property.

Value type is the class or domain of all possible values of the property.

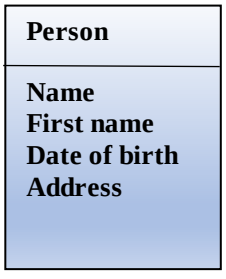
Examples:

- Client Name: is of type 'Name', representing all character strings of a certain length. This type can include names of individuals, company names, etc.
- Sale Price: is of type 'Real', representing all real values.
- Person's Age: is of type 'Interval', representing integer values ranging from 1 to 150.

Formalism:



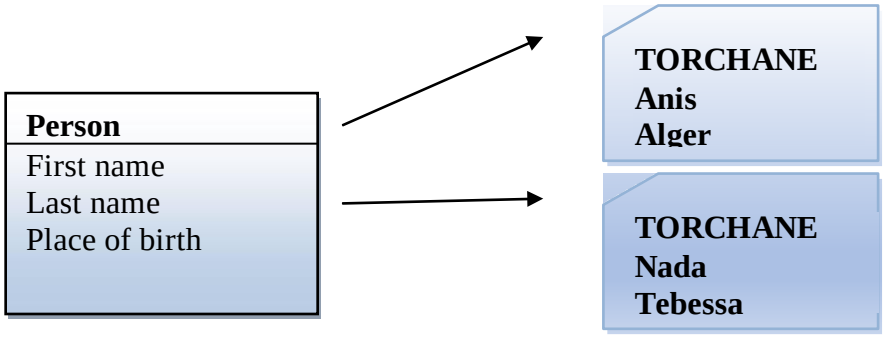
Example:



3.1.3 Notion of Occurrence

The occurrence of an 'entity type' is the set of values of the properties of a given entity.

Example:

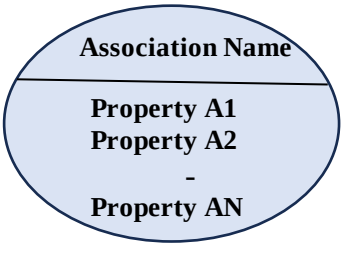


Identifier: a property or group of properties whose value uniquely identifies an entity. In an entity, an identifier is represented by an underlined property.

3.1.4 Notion of Association

An association represents a link between two or more entities. The association lacks its own independent existence: its existence is tied to the existence of the entities it interacts with.
The association can have one or several properties.

Formalism:



Example: The placing of order A10 by client Mohamed represents an association between Entity Order A10 and Entity Client Mohamed

- **Association type** is a relation between several entity types.

An association type is a relationship between multiple entity types.

Example: Association types like "placing orders," "studying," "teaching," etc.

An association type is used to link two or more entity types.

Denoted as R (E1, E2) / R: association type, E1: entity type 1, E2: entity type 2.

Example: Contains (order, product).

- **Dimension of an association type**

The dimension of an association type is the number of entity types participating in the association.
R (E1, E2, ..., En): Association type of dimension n.

Examples:

1. The association type "is married to," linking the person entity type with another person entity type, is of dimension 2. It's termed reflexive.
2. The association type "writes," linking the two entity types (author and book), is of dimension 2. It's termed binary.
3. The association type "place," linking the three entity types (Student, Exam, and Module), is of dimension 3. It's termed ternary.

Note: An entity type that links N entity types is called N-ary.

3.1.5 Notion of Cardinality

The cardinality of an entity concerning an association is expressed by two numbers:

- *Minimum Cardinality:* the minimum number of times an occurrence of an entity participates in occurrences of the association.
- *Maximum Cardinality:* the maximum number of times an occurrence of an entity participates in occurrences of the association.

3.1.6. The complete Formalism

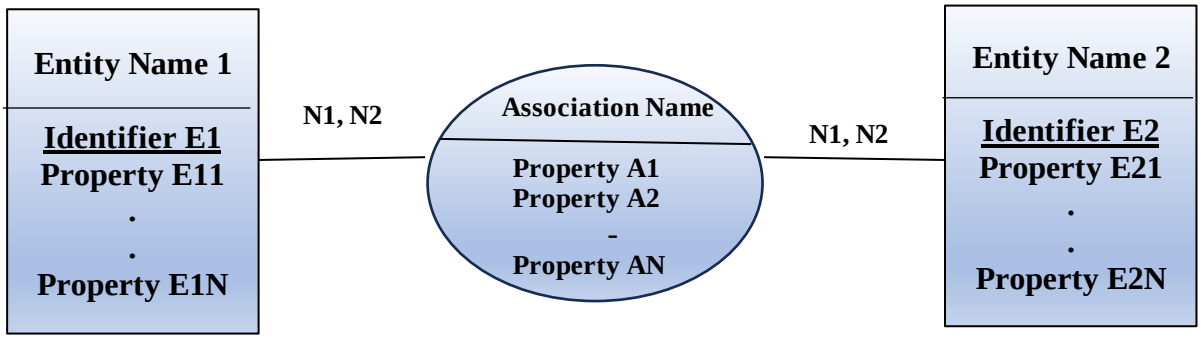


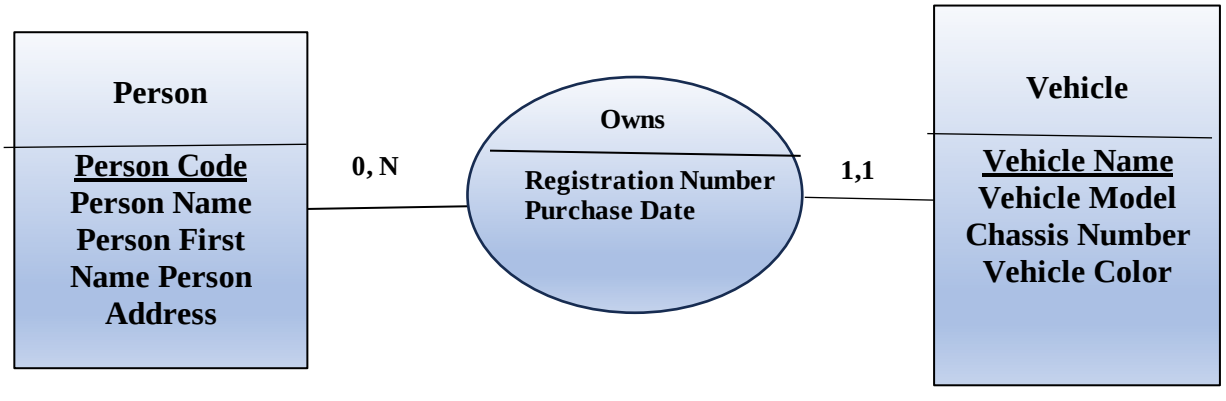
Figure 4.1 The complete Formalism of CDM

N1, N1: Minimum cardinality = 0 or 1

N2, N2: Maximum cardinality = 1 or N

The commonly used cardinalities are: (0,1), (1,1), (0, N), (1, N).

Example



3.2 Rules for Verification and Normalization of a CDM

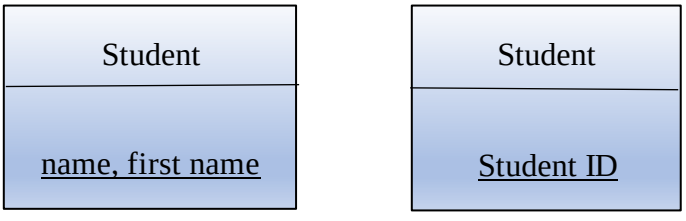
3.2.1 Model Verification

In this operation, the designer must ensure that the formalism rules have been properly followed. At this stage, it's about controlling and correcting errors by verifying the following rules:

Rule 1 Existence of an identifier for each entity

Example

The entity 'student' may have 'name, first name' as its identifier. 'Student ID' could also serve as a suitable identifier.

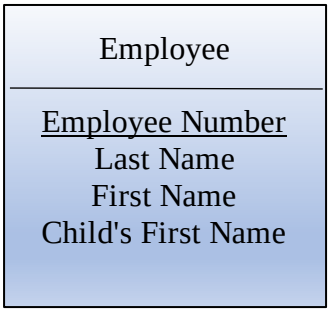


Rule 2

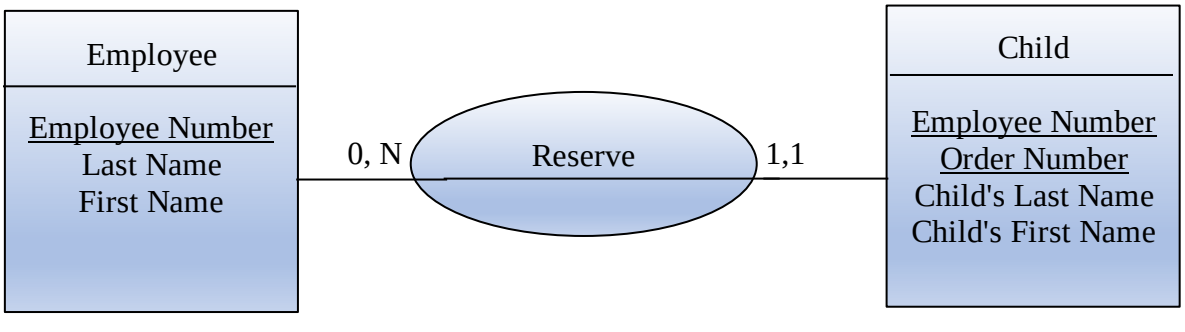
Lack of repetitive property

Example:

The property 'Child's First Name' can take multiple values depending on the number of children.



Therefore, we need to have the updated CDM:

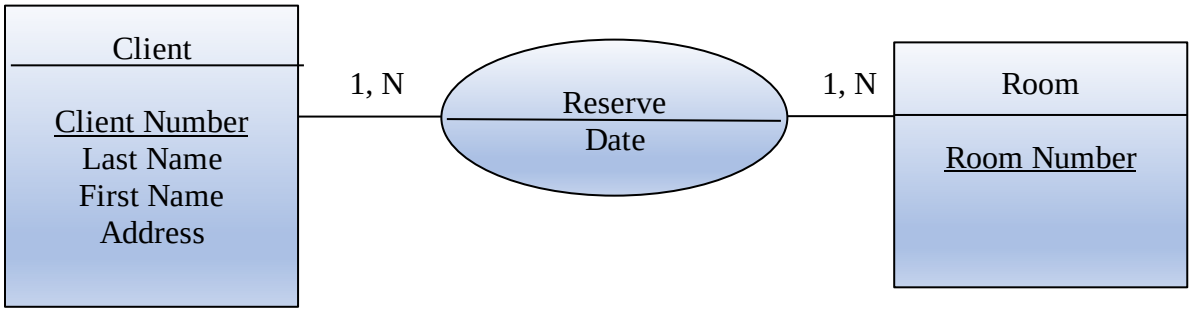


Rule 3

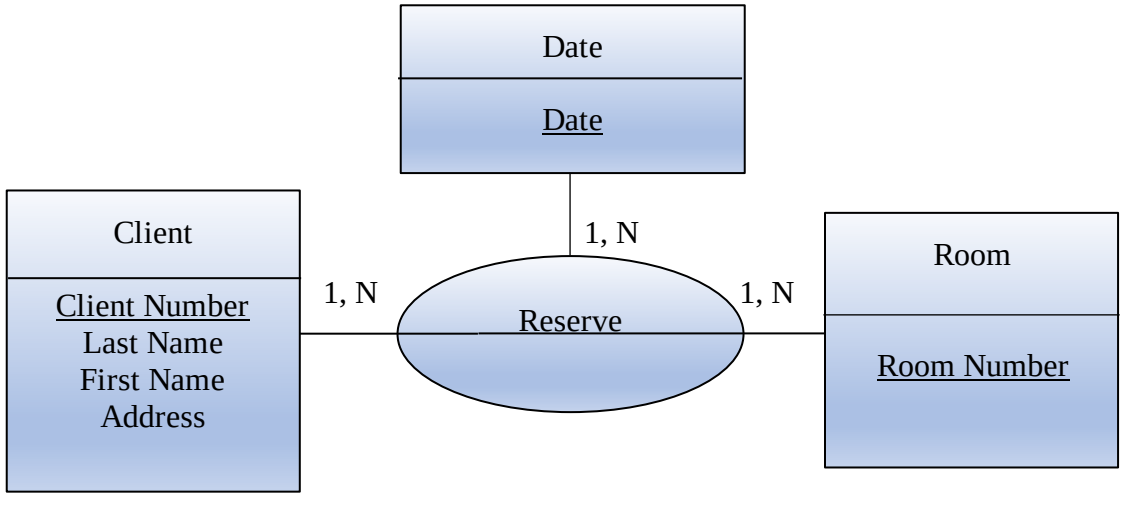
Two occurrences of an object cannot participate in the same occurrence of the relationship

Example

The same customer cannot reserve the same room a second time



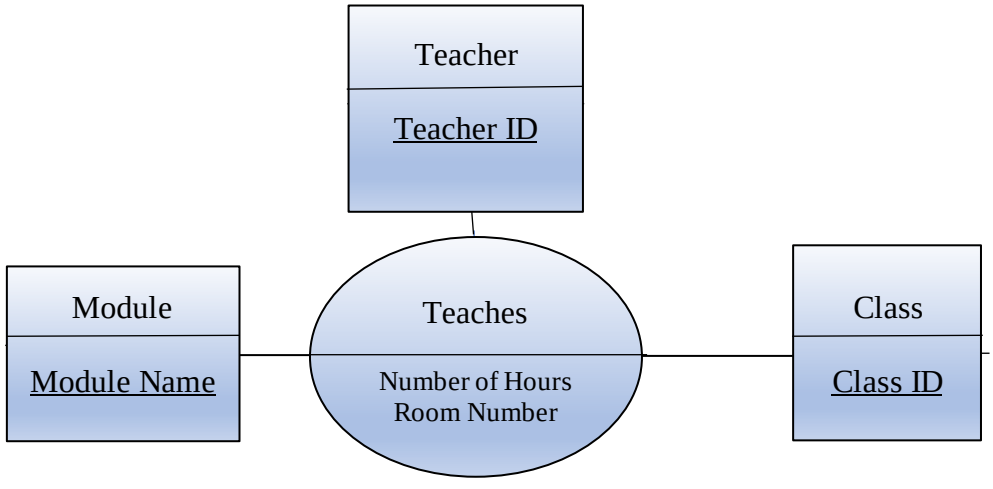
Thus, the resulting CDM is as follows:



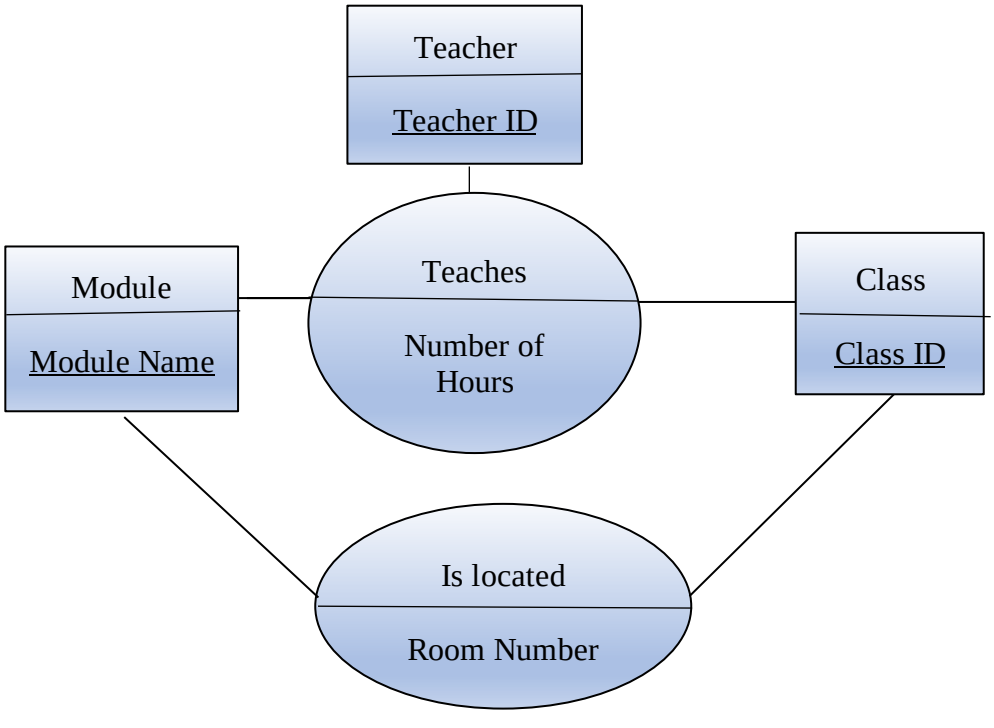
Rule 4

For a relationship occurrence, there are no optional participations of an object.

Example



If a module is taught to a class in the same room regardless of the teacher, we'll have the following CDM:



Rule 5

All existing business rules must have been translated into the model. In particular, the cardinalities must adhere to the business rules.

3.2.2 Model Normalization

In this task, the designer should consider a modeling approach that minimizes information redundancy while adhering to the business rules.

Rule 1 (1st Normal Form - 1NF)

All properties should be elementary (non-decomposable) based on the management choices.

Example:

The property 'Address' could be:

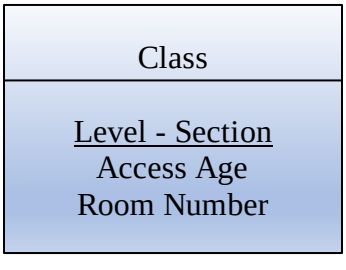
1. Elementary: in a system that globally manages addresses.
2. Decomposable into (Street Number, Street Name, City): in a system that details addresses.

Rule 2 (2nd Normal Form - 2NF)

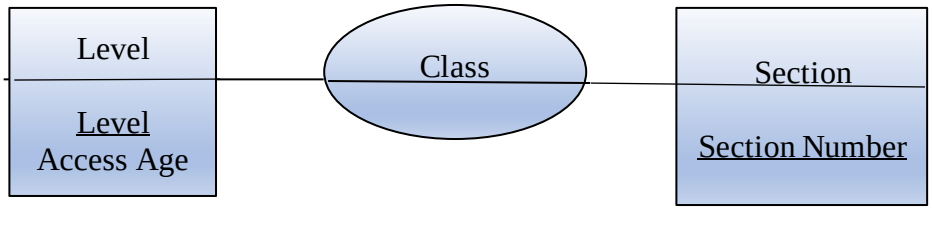
Properties should depend on the entire identifier.

Example:

The property 'Access Age' does not fully depend on the identifier but rather on a part of it. The access age depends on the level and section name.



So, here's the new CDM:

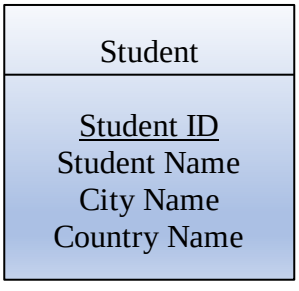


Rule 3 (3rd Normal Form - 3NF)

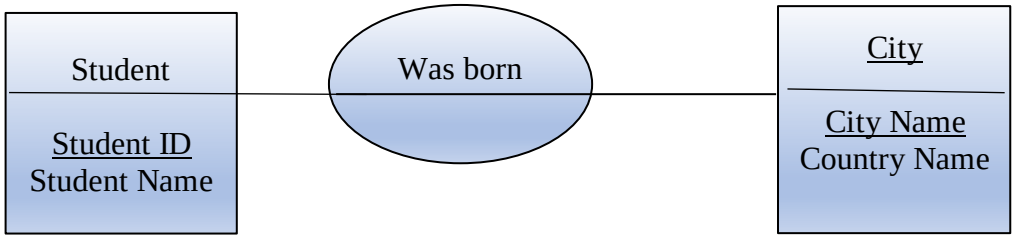
Each property should depend directly on the identifier.

Example

In the 'Student' object, the property 'Country Name' depends on the identifier 'Student ID' and also depends on the property 'City Name,' leading to repetition for each student.



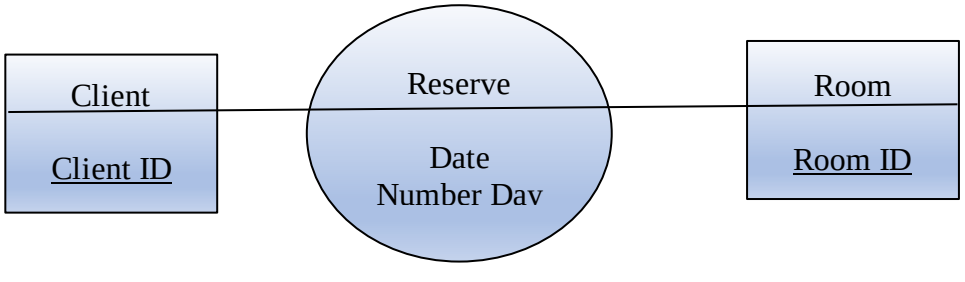
So, here's the new CDM:



Rule 4

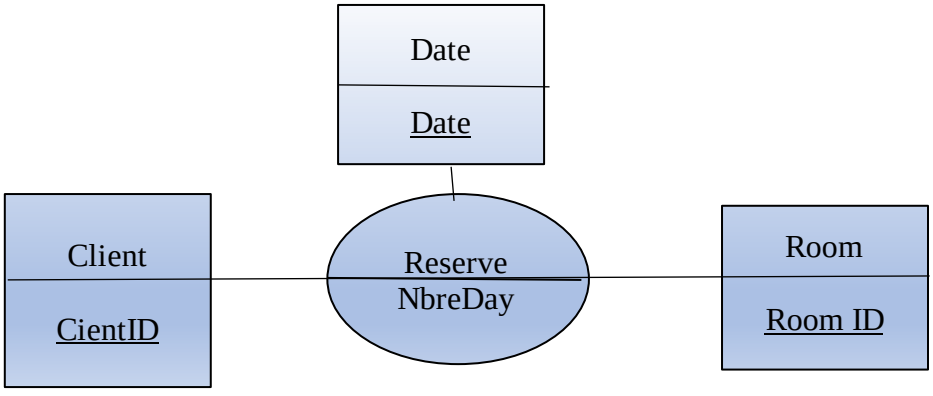
Every occurrence of a relationship can has only one value for each property of the relationship.

Example



The values of the properties 'Date, Number Day' must be unique for the same client and the same room (a client cannot reserve the same room on different dates).

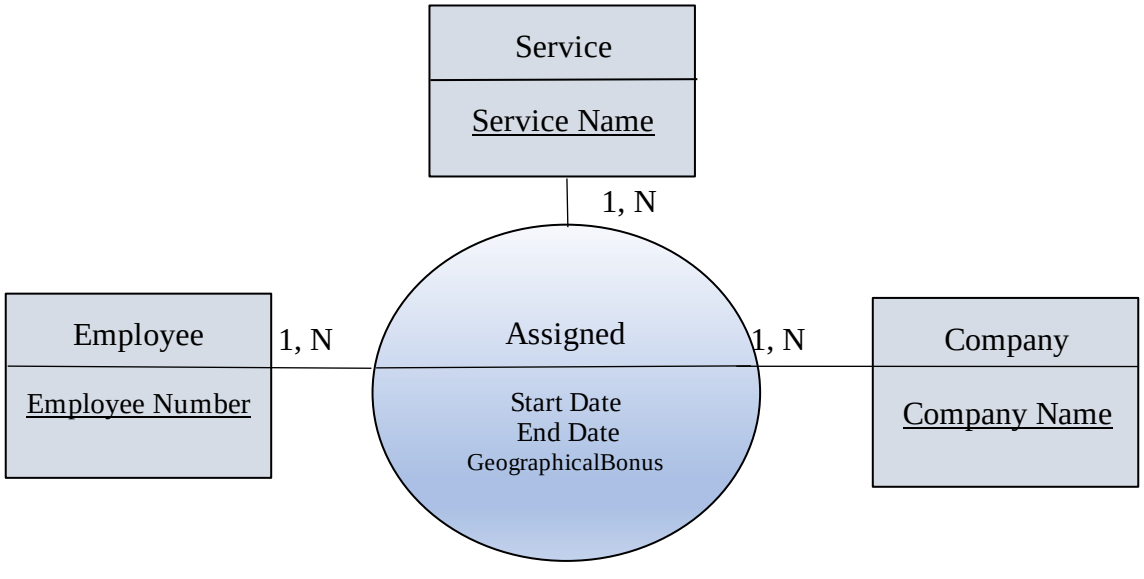
Therefore, the new CDM is as follows:



Rule 5

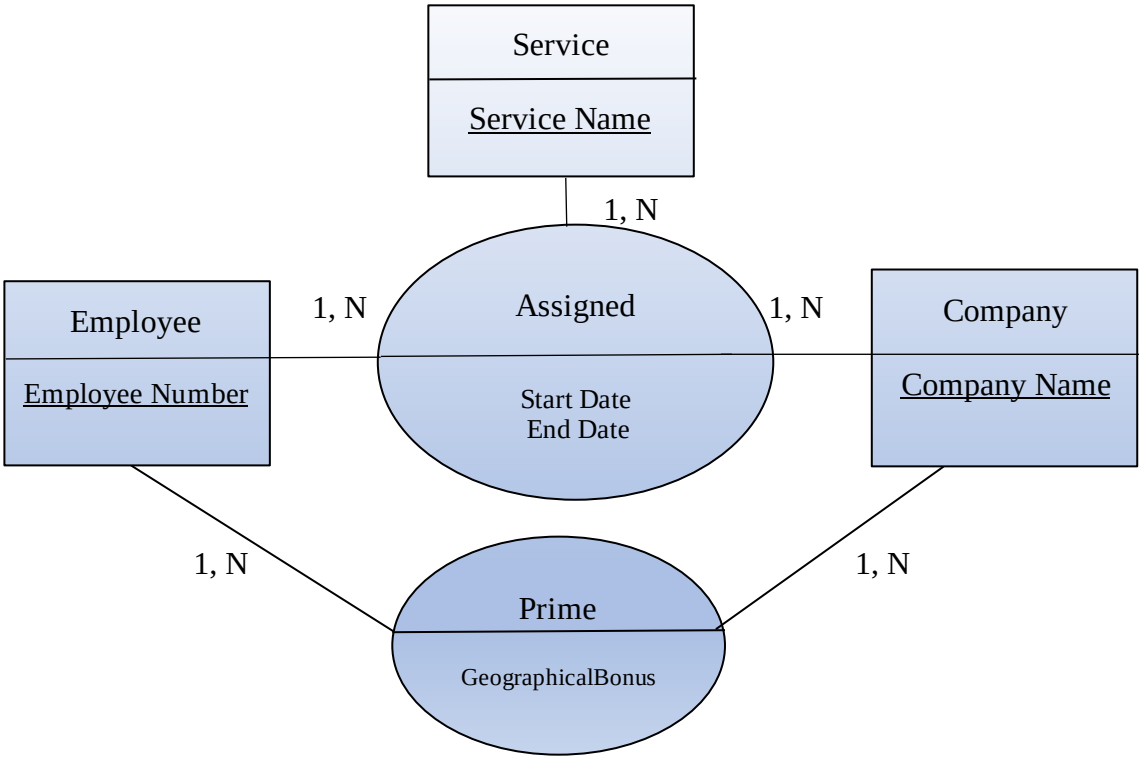
All properties of a relationship must fully depend on the identifier of the relationship.

Example



The properties 'Start Date, End Date' depend on all three identifiers. The property 'GeographicalBonus' depends only on the service and company.

Hence, the following CDM



4. Concepts for Dynamic Modeling (CPM of MERISE)

Processes constitute the dynamic part of the system. They describe the actions to be executed on the data to obtain the results expected by the business.

4.1 Conceptual Model of Processes (CPM)

The Conceptual Processes Model (CPM) offers a dynamic representation of the company's information system. Based on the specification of business rules, this model provides a conceptual representation of the processes carried out within the company.

4.2 Concepts

4.2.1 Event

An event is a real fact whose occurrence triggers the execution of one or more actions.

Examples: School enrollment, Stock depletion, etc.

Formalism

Examples

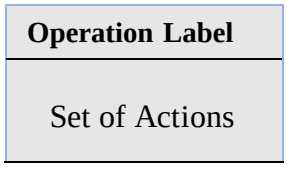
4.2.2 Operation

An operation is a set of actions whose sequence, once initiated, is not interruptible and is not dependent on the occurrence of any event other than the initial trigger.

Examples: Order processing, Invoice payment.

An action is an elementary function. Between the actions of an operation, there is no waiting state, and their execution is sequential.

Formalism



Examples

1. The actions: "Ensuring checks, Correcting copies, Grading tests" constitute an operation.

2. The operation 'preparation of an order' is made up of the following uninterrupted actions:

   - Determining products and quantities to order
   - Choosing the supplier
   - Drafting a purchase order
   - Preparation of an order

Order Preparation
- Determining products and quantities to order - Choosing the supplier - Drafting a purchase order - Preparation of an order

4.2.3 Synchronization

The synchronization of an operation is a boolean condition, reflecting business rules, that events must meet to trigger actions.

Examples

(Out of Stock) and (Demand Fulfilled)
(Grades Assigned) and (End of the Quarter)

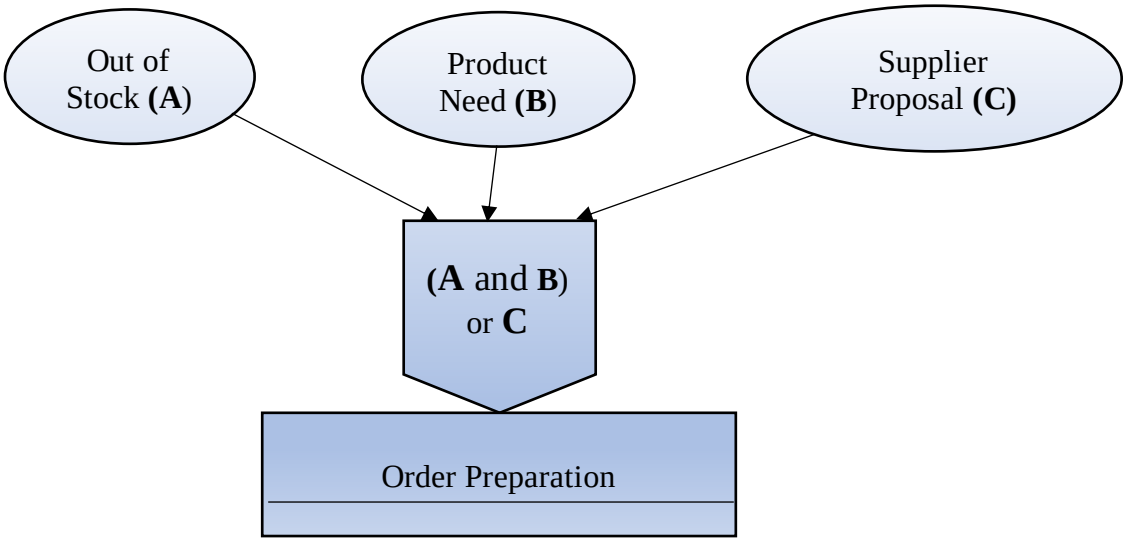
Formalism

The synchronization of triggering events is described within a synchronizer linked to the operation.

Events are represented by symbolic letters.

Logical propositions are presented by '^' for 'and' and 'v' for 'or'.

Example



4.2.4 The Result

The result is a real fact of the same nature as the event. The result produced from the execution of an operation can trigger another operation.

Examples

Order transmitted, Established schedules, etc.

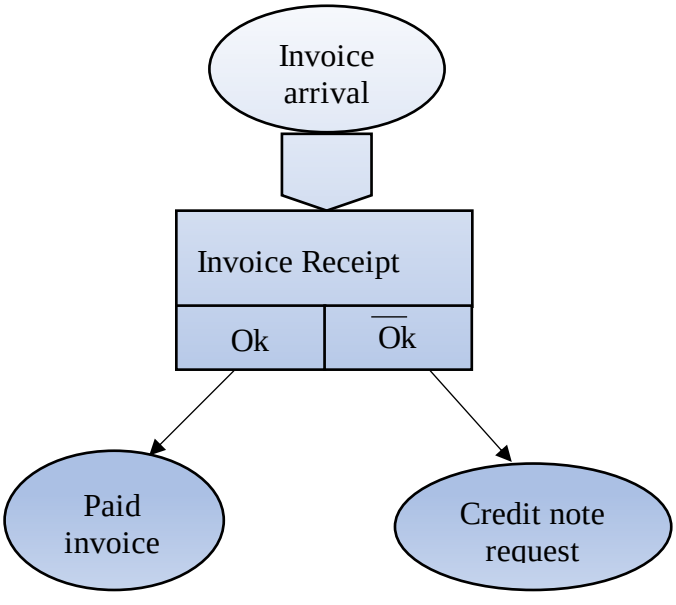
4.2.5 The Emission Rule

The emission rule is a conditional statement that translates the rules of management, which dictates the emission of results from an operation.

Formalism

The condition for emitting the result can be specified within the rectangle of the operation, and essential messages may appear: OK, if, else, etc.

Example



Complete formalism

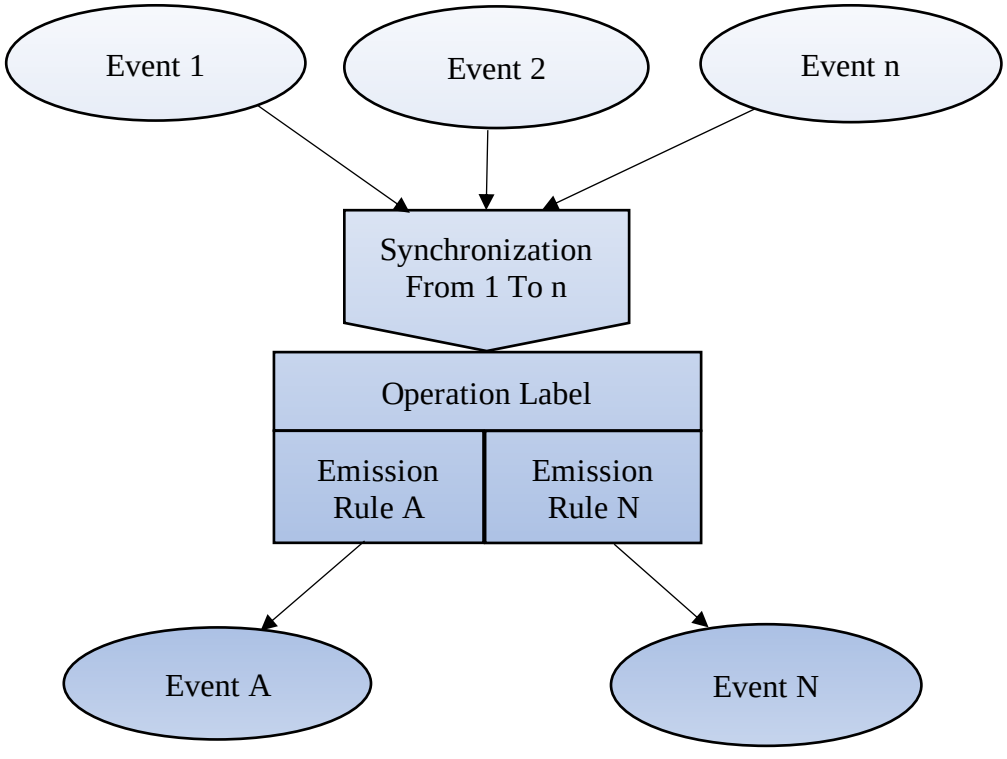


Figure 4.2 The complete Formalism of CPM

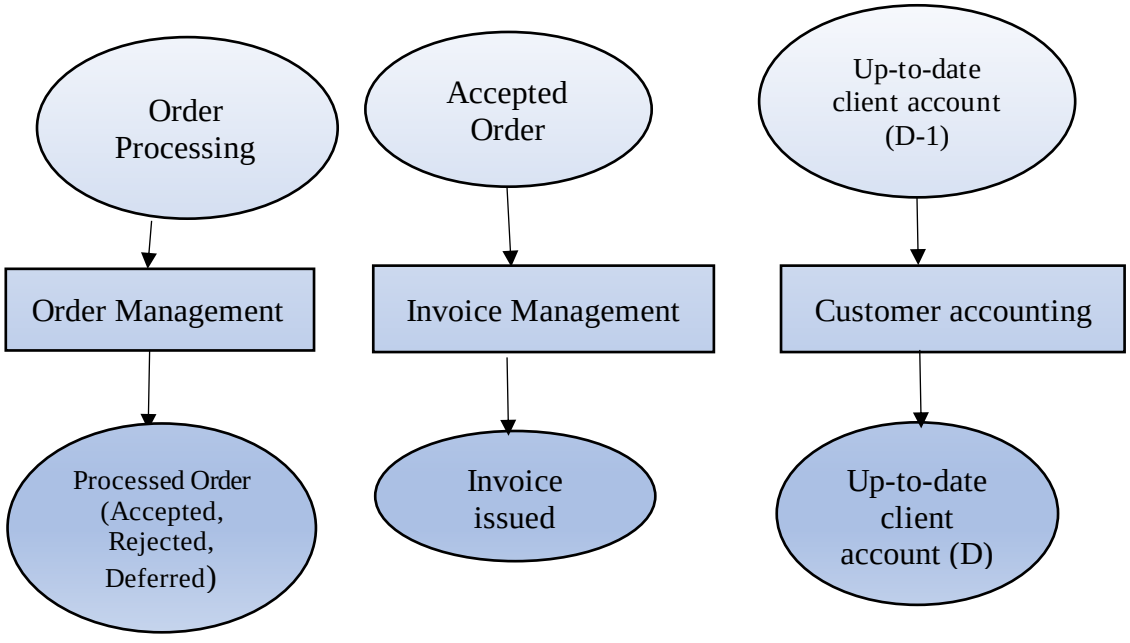
4.2.6. Process

A process is a sequence of operations included within the same field of activity.

Example

For commercial management, it will be convenient to create 3 processes:

- Order Management
- Invoice Management
- Customer Accounting Management



Note
In cases where the overall conceptual schema appears unreadable, the initial domain will be divided into sub-domains with limited communication among them, each having only one process applied.

Example

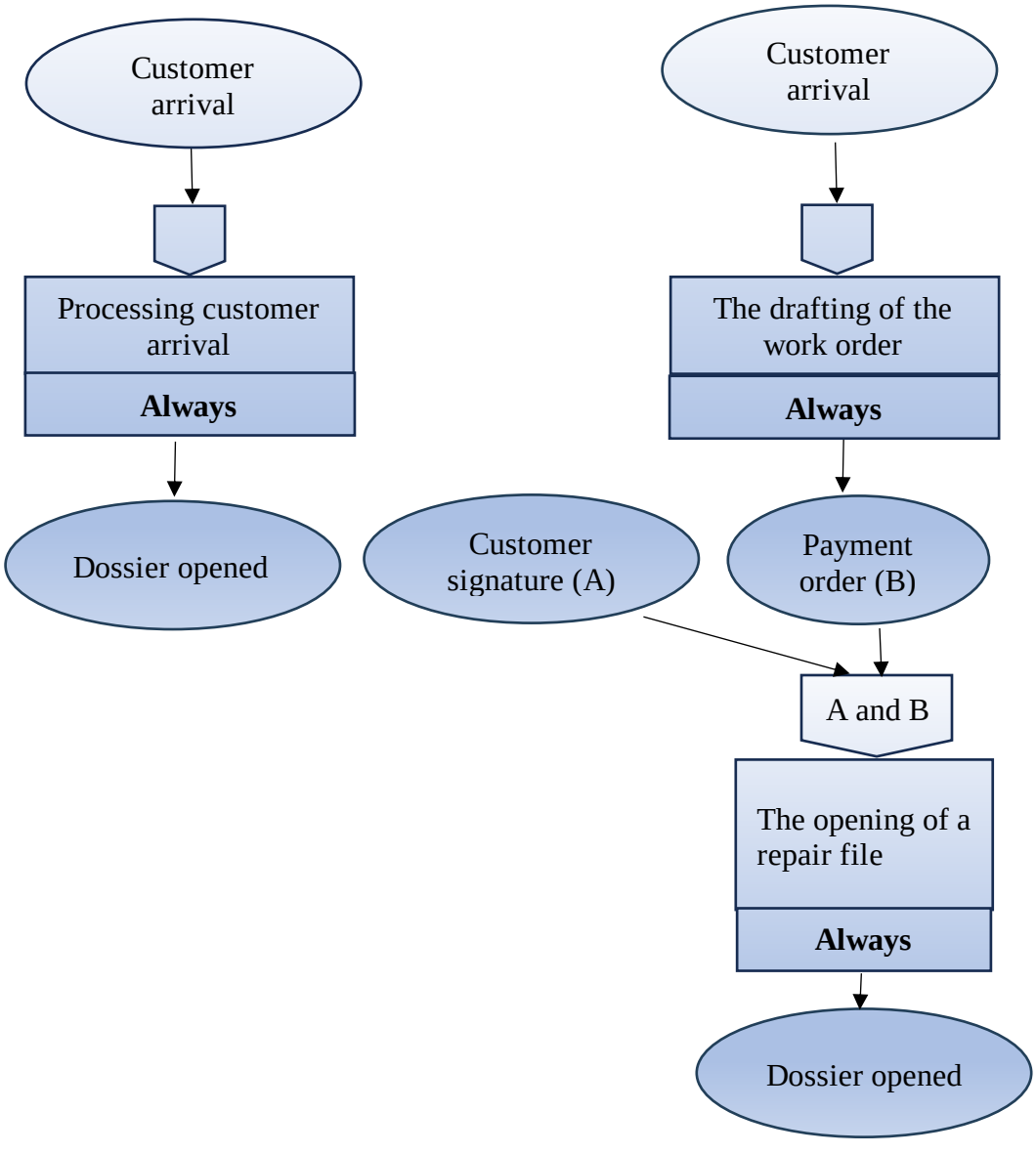
The 'Stock Management' domain can be divided into three processes:
- Stock Replenishment
- Destocking
- Inventory

4.3 Construction Rules of an MCT

Rule 1

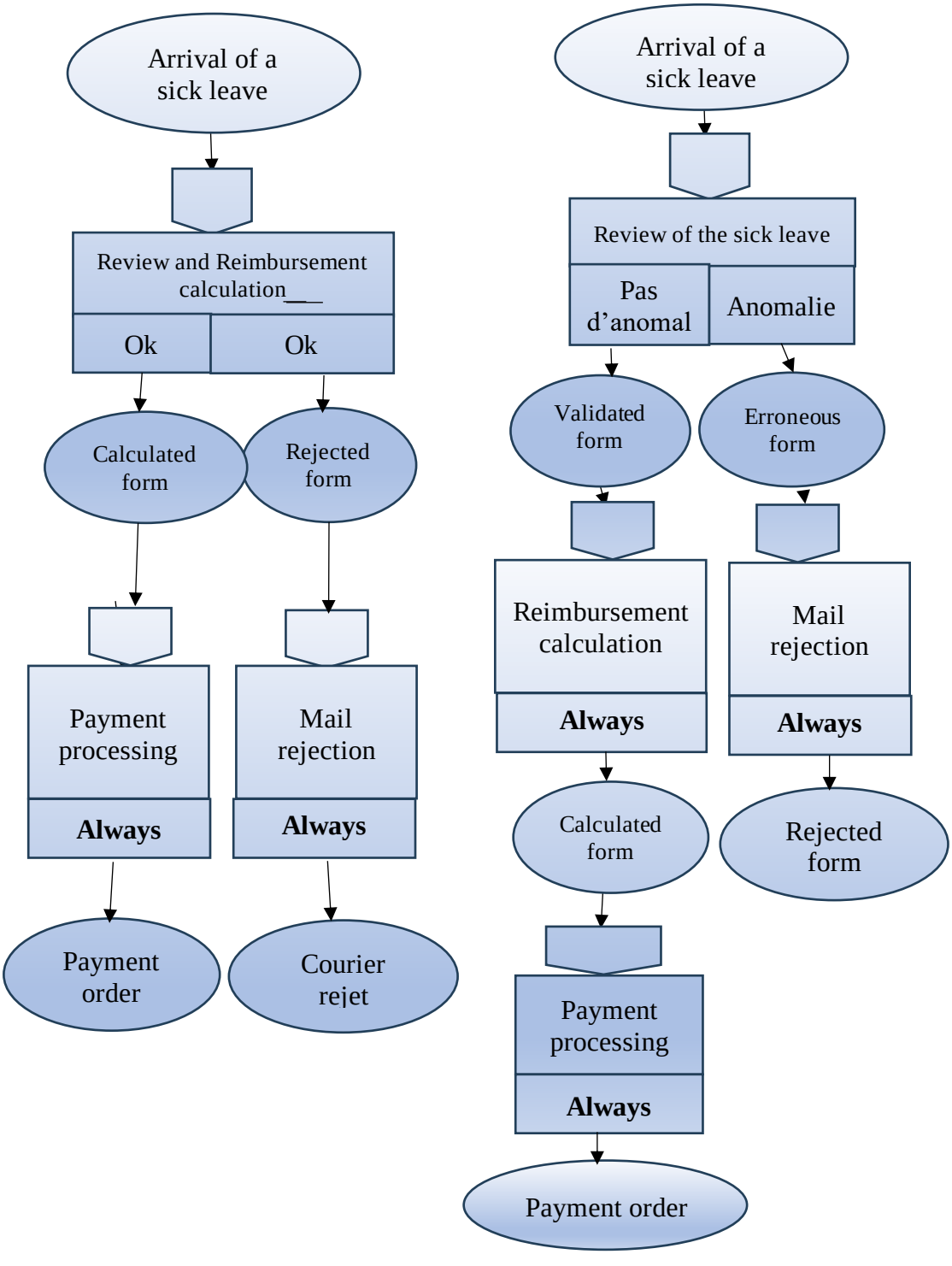
Any intervention by an external actor causing an interruption leads to the segmentation of the operation.

Example



Rule 2

Within an operation, there should be no results that could condition or affect the subsequent flow of operations within the process


Arrival of a sick leave
Review and Reimbursement calculation
Ok
Ok
Calculated form
Rejected form
Payment processing
Always
Mail rejection
Always
Payment order
Courier rejet
Arrival of a sick leave
Review of the sick leave
Pas d'anomal
Anomalie
Validated form
Erroneous form
Reimbursement calculation
Always
Mail rejection
Always
Calculated form
Rejected form
Payment processing
Always
Payment order

5. Exercises

Exercise 1

A company specializing in hotel management wants to automate its activities. This company manages hotels divided into 4 classes. For each hotel, there are a maximum of 9 room categories (shower, bath, etc.). The price of a room, fixed for a hotel class and a given category, will depend on the number of occupants (one or two persons).

The prices of various consumptions are specific to each hotel.

This system should, among other things, allow:

- Recording of client reservations, along with the number of days of reservation.
- Recording of client stays (actual arrival of clients).
- Recording of various consumptions during the stay.
- Printing the occupancy status of hotel rooms during a given period.
- Printing the list of expected arrivals for a given day.

Question

Establish the conceptual data model corresponding to the described activity.

Exercise 2

Currently, the library's management is entirely manual, using a system of handwritten cards. You have been contacted by the director of a municipal library who wants to computerize its management.

Through the computer system, a subscriber should be able to find a book in the aisles knowing its title. Books are identified by a catalog code assigned to them at purchase and by a classification that allows their location in the library. The subscriber should also be able to know the list of books by an author, by publisher, or by theme (comic, science fiction, detective, etc.). Each book is purchased in one or several copies (the acquisition date is stored). All copies of the same book have a different classification but the same catalog code. The different copies of the same book may come from different publishers. To closely monitor the stock, the library uses a code indicating the wear condition of each book. This wear code is possibly updated by a librarian upon each return of a loaned book. The director also wishes to implement a documentary search procedure by keywords. Therefore, you should foresee the possibility of searching for all corresponding works from a keyword. A work may have any number of keywords.

The library also uses a file of subscribers organized by a matriculation number containing, among other details, the subscriber's information (name, address, phone), date of membership, date of birth, and professional category (student or teacher).

The loan management requires at all times the list of books held by a subscriber, and conversely, the ability to find the names of subscribers holding a book not present in the aisles. Loans are granted for a duration of 15 days, potentially renewable if no demand for the book has occurred

in the meantime. Therefore, for each borrowed book, it's necessary to know the loan date and return date. Loan management also requires memorizing the books requested by a subscriber. This subscriber will have priority upon the return of the loaned book. Their priority is maintained for a week from the return date of the book.

Question

Establish the Conceptual Data Model of the future library.

Exercise 3

As part of a decentralization policy, the central management wishes to develop a computerized personnel management system for its administrations. For this purpose, it has chosen an initial pilot administration for the first implementation.

Employees from different units have tracking records. Each record includes:

Complete identification of the employee, the history of grades since the employee's entry into the organization.

Employee's assignments, qualifications, and diplomas with their acquisition dates.
The administration also wants to manage the leaves of each employee (each leave will be described by its leave code).

Additionally, it is requested to be able to track the different positions occupied by an employee during their career. Each position is characterized by a reference number and a grade that can be different from the agent's grade occupying it.

The management decides initially to automate the recruitment process described as follows:

After the competition, the list of successful candidates and the employee's file are sent to the relevant administration. It proceeds to record the successful candidates, as well as to issue a recruitment decision for each employee.

Each edited decision will be returned to the management, which will process it according to the assigned visa, which can be: accepted (general case), refused (irregularity detected), or deferred (waiting for justifying elements). Also, the management provides the list of new agents to the assignment unit, which in turn sends a notice of assumption of duties to the management as soon as the agent starts work in the unit. Regarding employees who have not taken up their duties, a weekly list will be established by the management.

Question

Establish the conceptual data model (CDM) corresponding to the described system

Exercise 4

A distribution company buys products to resell to its clients. Its stock management system is defined as follows:

R1 - A product can be stored in several stores
R2 - A product in stock can be moved several times
R3 - A product is sold by a single supplier
R4 - A replenishment order concerns a supplier
R5 - An order is placed with a supplier in one of the following two cases:
- An ordered product is out of stock:
- For a product in the store: Stock + Total Ordered < Minimum Stock

R6 - Any non-compliant delivery is rejected and returned to the supplier.
R7 - Theoretical stock is kept up-to-date according to stock movements.
R8 - At fixed intervals, an inventory is conducted to determine discrepancies by the information system.
R9 - Stock movements are:
a) Outside the inventory period:
- Supplier delivery: Stock = Stock + Quantity delivered.
- Customer delivery note: Stock = Stock - Quantity delivered.
- Customer merchandise return: Stock = Stock + Quantity returned.

b) During the inventory period:
- Adjustment following an inventory:

Stock = Stock ± difference between real and theoretical stock.

Question

Establish the Conceptual Model of Processes corresponding to the processes:
- Provisioning.
- Stock keeping.

Conclusion

Based on the concepts presented in this chapter, MERISE appears to be a methodology for constructing information systems. It stands out with an approach in terms of abstraction levels and construction stages. Its modeling process is based on a clear distinction between data modeling and processing modeling.

For data modeling, MERISE adopts the conceptual data model, based on the basic principles of the Entity-Relationship model. This approach represents entities, their attributes, and relationships. Then, these results are transformed into a relational model, facilitating the representation of data in interconnected tables.

Regarding process modeling, MERISE uses the conceptual model of processes to identify the different functionalities of a system, following a 'top/down' approach. This model decomposes the system into different functional parts. Then, this representation is transformed to take into account other important criteria on the organizational side of a system.

In summary, MERISE presents itself as a structured methodology, offering specific tools and approaches to design and build information systems by clearly separating data modeling from processing modeling, while considering various organizational aspects."

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