



UNIVERSITY OF CAGLIARI

DIEE - Department of Electrical and Electronic Engineering

Project design

Prof. Mauro Fadda



Outline

- **Project and System Development Life Cycle (SDLC)**
- **The different phases of SDLC**
- **An use case example**

Terminology

➤ **Project**

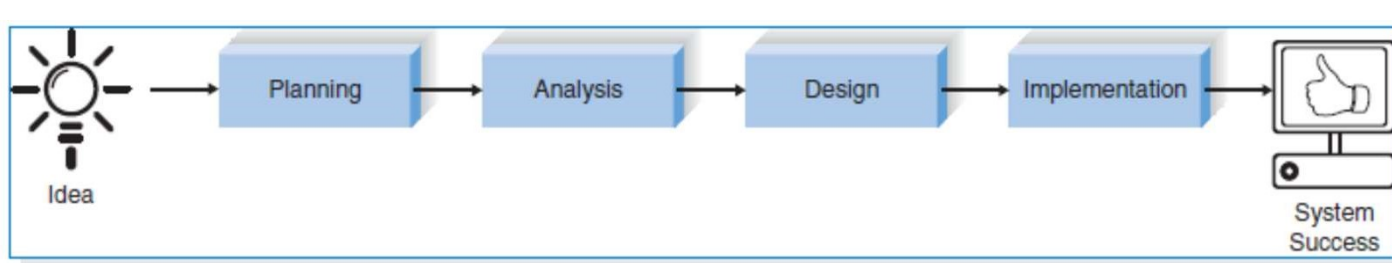
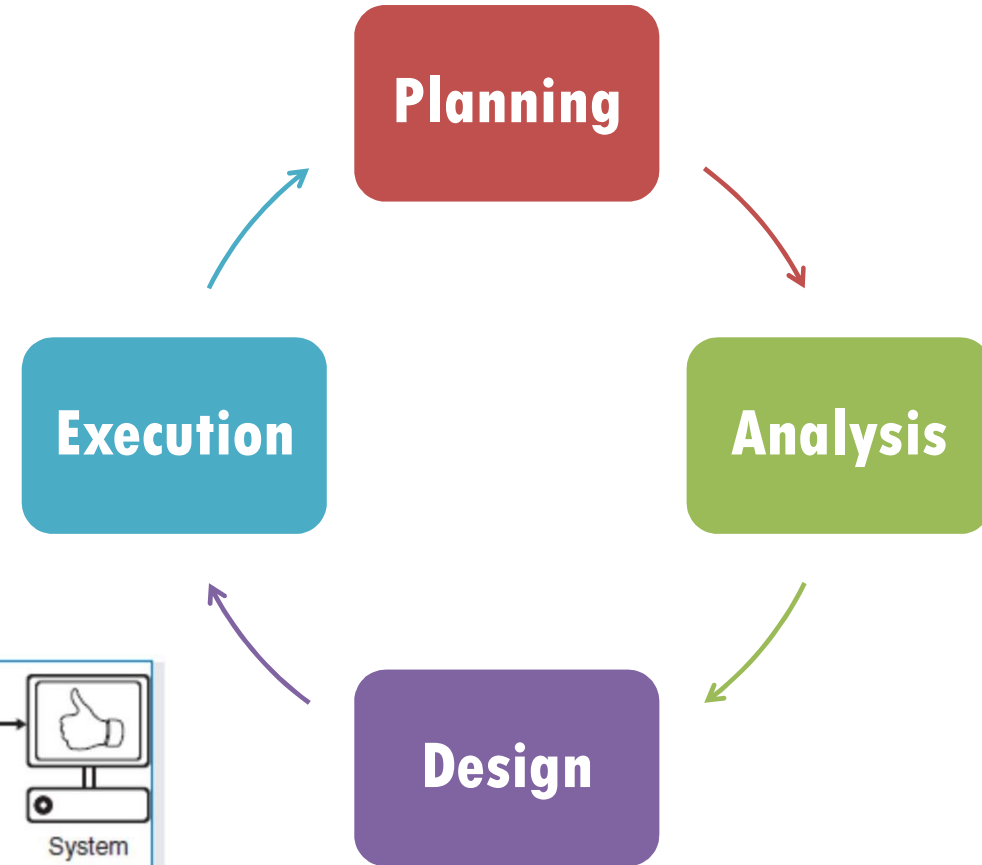
- ✓ **An organized programme of pre determined group of activities that must be completed using the available resources within the given time limit**

➤ **System Development Life Cycle (SDLC)**

- ✓ **It is a conceptual model used in project management to describe the overall process of developing information system through a multiphase process**

SDLC

- **Each phase is itself composed of a series of steps, which rely on techniques that produces deliverables**



SDLC

- **The SDLC helps in establishing a system project plan, because it gives the overall list of processes and sub-processes required for developing a system**
- **Each phase includes a set of steps that lead to specific outputs, called deliverables**
- **The system evolves through gradual refinement**

SDLC

Phase	Focus	Primary output
Planning	<i>Why build this system?</i>	<i>System Request with feasibility study</i>
	<i>How to structure the project?</i>	<i>Project plan</i>
Analysis	<i>Who, what, where and when for this system?</i>	<i>System proposal</i>
Design	<i>How will this system work?</i>	<i>System specification</i>
Implementation	<i>Delivery and support of completed system</i>	<i>Installed system</i>

Planning phase

- It is the fundamental process of understanding *why* an information system should be built.
- It has two steps:
 1. ***Project initiation.*** A project is identified when someone in the organization identifies a “business” need to build a system. Most ideas for new systems come from outside the IS area in the form of a system request. A *system request* presents a brief summary of a business need, and it explains how a system that supports the need will create business value. The IS department works together with the person or department generating the request (called the *project sponsor*) to conduct a feasibility analysis. The *feasibility analysis* examines key aspects of the proposed project:
 - The technical feasibility (Can we build it?)
 - The economic feasibility (Will it provide business value?)
 - The organizational feasibility (If we build it, will it be used?)
 2. ***Project management.*** The *project manager* creates a *work plan*, staffs the project, and puts techniques in place to help the project team control and direct the project through the entire SDLC. The deliverable for project management is a *project plan* that describes how the project team will go about developing the system.

Planning phase

- ***Why build this system?***
- **System request:**
 - ✓ **To build an IoT demo for the event Notte dei Ricercatori 2016**
 - ✓ ***Optional:* to collect data on its usage**
- **Feasibility analysis**
 - ✓ **Can we build it? *Of course***
 - ✓ **Will it provide business value? *N.A.***
 - ✓ **If we build it, will it be used? *Based on previous effort, yes!***
- **First time estimation: *2 weeks***

Analysis phase

- **The *analysis phase* answers the questions:**
 - ✓ ***who* will use the system**
 - ✓ ***what* the system will do**
 - ✓ ***Where* the system will be used**
 - ✓ ***when* the system will be used**
- **During this phase, the project team investigates any current system(s), identifies improvement opportunities, and develops a concept for the new system.**

Analysis phase

- **The analysis phase consists of three steps:**
 1. **The *analysis strategy*, which is developed to guide the project team's efforts. It usually includes**
 - **A study of the current system (called the *as-is system*) and its problems (if available)**
 - **The envisioned ways to design a new system (called the *to-be system*).**
 2. **The *requirements gathering*, which are obtained through interviews, group workshops, or questionnaires. It usually includes**
 - **The requirements' definition**
 - **The use case analysis**
 - **The process and data modelling**

Analysis phase

- 3. The *system proposal*, which is presented to the project sponsor and other key decision makers (e.g., members of the approval committee) who will decide whether the project should continue to move forward**
 - **It is the initial deliverable that describes what business requirements the new system should meet**
 - **It is both an analysis and a high-level initial design for the new system**

Analysis phase - SmartBin

1. Analysis strategy

- Previous effort:

https://www.youtube.com/watch?v=xsjMMW0_hVI <- as-is system

- Problem: It's not an IoT system!!
- To-be system: to use not only one sound but also lights and different kinds of sounds, that can be controlled via the Internet

2. Requirements:

- How many bins?
- How to control them?
- How to avoid people to destroy them?
- ... and so on



Analysis phase - SmartBin

- **Use case analysis:** people participating to the Notte dei Ricercatori could play with the bin
- 3. **System proposal:**
 - **a smart bin for non-technical IoT users, which plays sounds and lights every time something is thrown into it, and that can be controlled via mobile application**
- ***We are able to answer the following questions:***
 - ✓ ***who* will use the system**
 - ✓ ***what* the system will do**
 - ✓ ***where* the system will be used**
 - ✓ ***when* the system will be used**



Design phase

- **The design phase decides *how* the system will operate in terms of**
 - ✓ **The hardware, software e network infrastructure that will be in place**
 - ✓ **The user interface, forms and reports that will be used**
 - ✓ **The specific programs, databases and files that will be needed**
- **The primary output of this phase is the *system specification***
 - ✓ **It is the collection of the results of all the steps that are included in this phase**

Design phase

- **The design phase includes four steps**
 1. **The *design strategy*: it clarifies whether the system will be**
 - **Developed by the company's own programmers**
 - **Its development will be outsourced to another firm (usually a consultant firm)**
 - **An existing software package will be bought**
 2. **The *architecture and interface design*: it describes the hardware, software and network infrastructure that will be used. In most cases, the system will add or change the infrastructure that already exist**

Design phase

- 3. The *database and file specifications*: it defines exactly what data will be stored and where they will be stored**
 - 4. The *program design*: it defines the programs that need to be written and exactly what each program will do**
- **At the end of the design phase, the feasibility analysis and project plan are reexamined and revised, and another decision is made by the project sponsor and approval committee about whether to terminate the project or continue.**

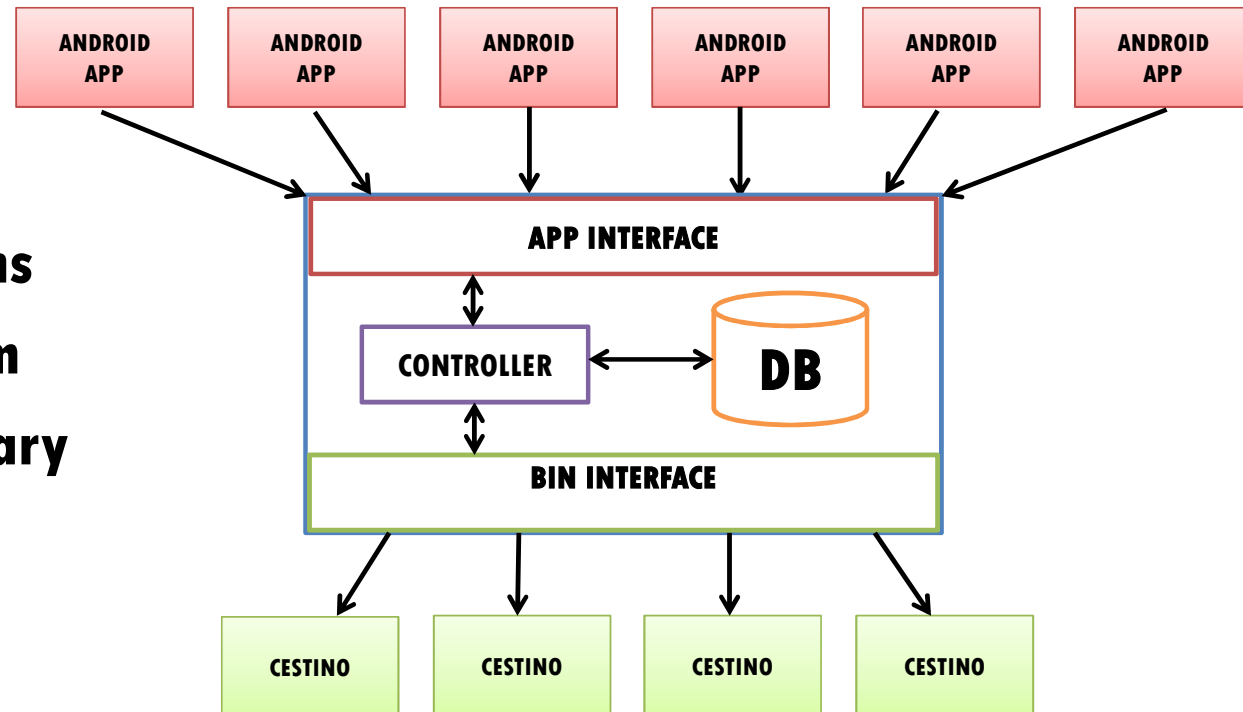
Design phase - SmartBin

1. **Design strategy: Developed by the company's own programmers (a.k.a. Salvatore Martis)**

2. **Architecture design:**

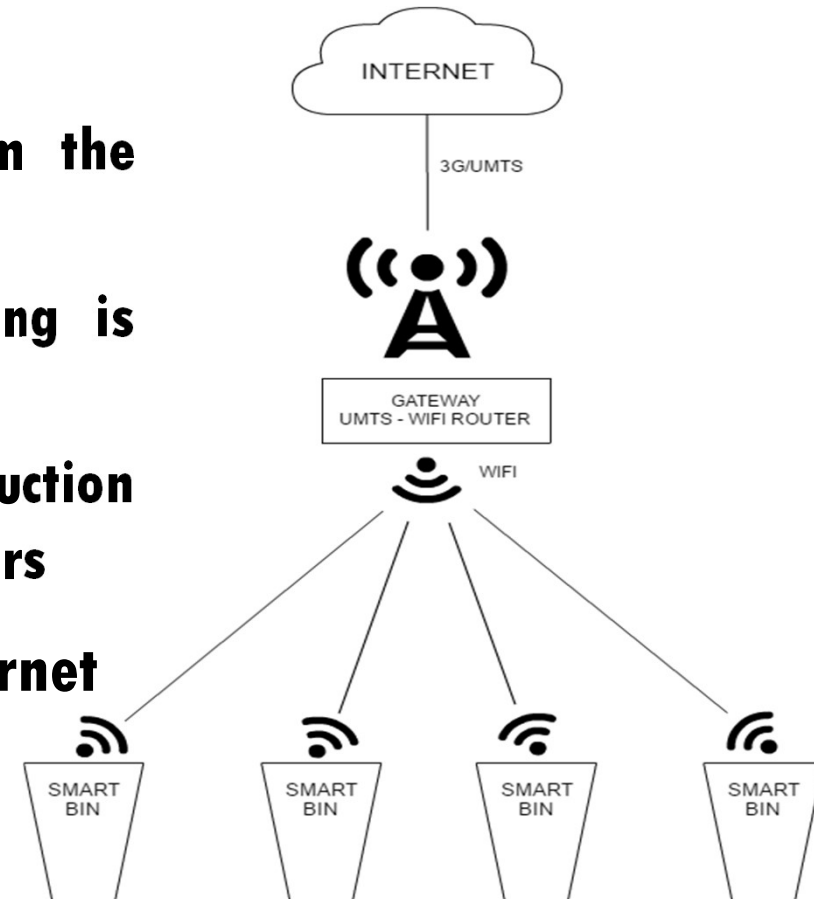
– **What do we need?**

- **To make smart the bins**
- **An app to control them**
- **A server as intermediary**



Design phase - SmartBin

- ✓ **Needed hardware for the bin:**
 - **Raspberry. To receive commands from the app and act on the actuators**
 - **1 sensor to detect whenever something is thrown into the bin**
 - **2 actuators: speaker for sound reproduction and a mini led spotlight for various colors**
- ✓ **Raspberry can not connect directly to Internet**
 - **We need a gateway!**



Design phase - SmartBin

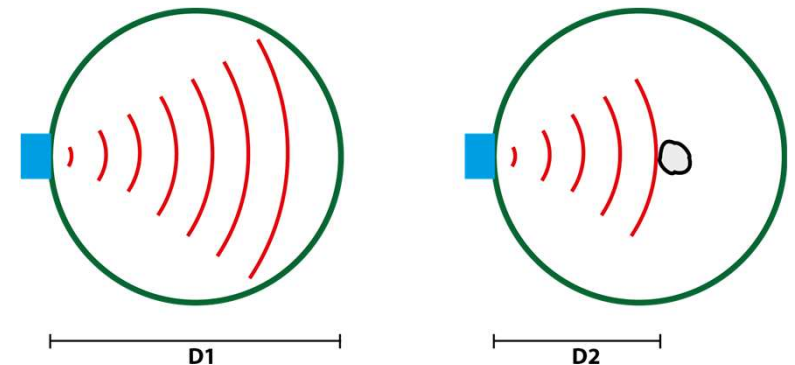
✓ Which sensor to use to detect the trash?

▪ Choose typology

- Occupancy
- Motion
- Position
- Displacement
- Level
- Distance

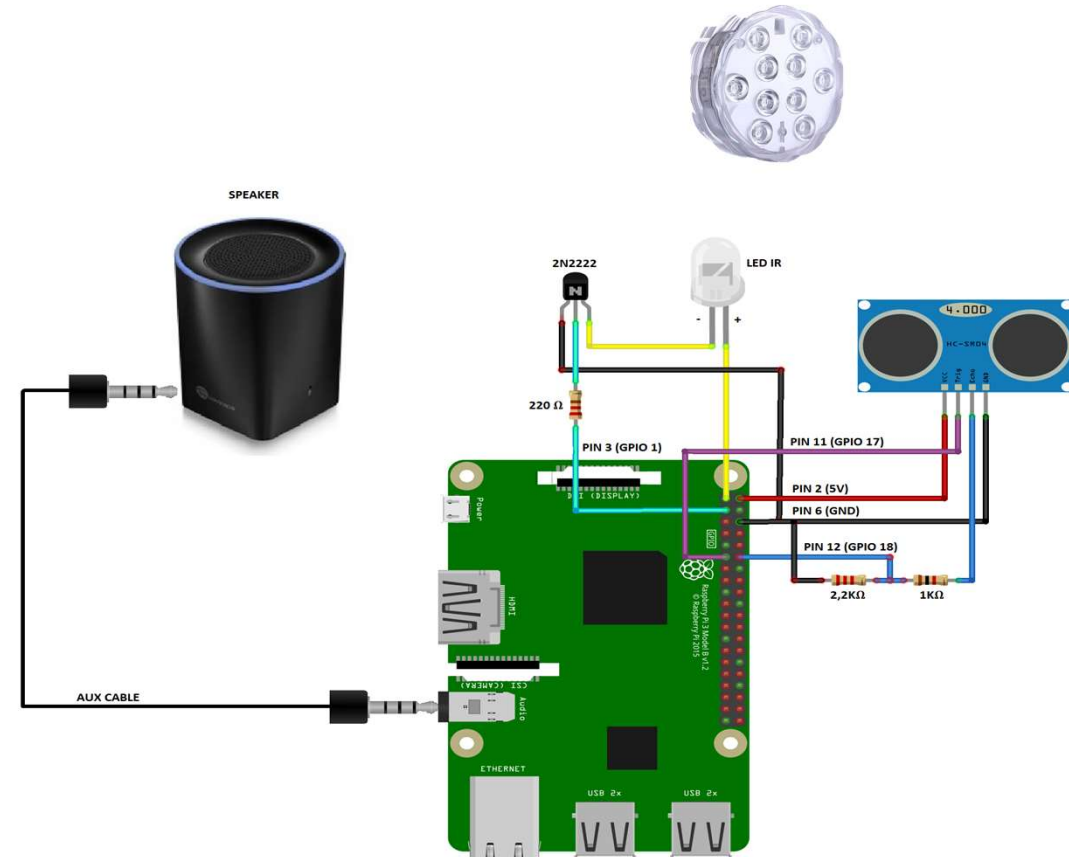
▪ Choose sub-typology

Ultrasonic sensor used as a distance sensor



Design phase - SmartBin

- **Complete hardware architecture**
- **We need to send commands to the light in an automatic way without the remote controller**
 - ✓ **Raspberry used as the remote controller**
 - **TO DO LIST: Reverse engineering of the remote controller**



Design phase - SmartBin

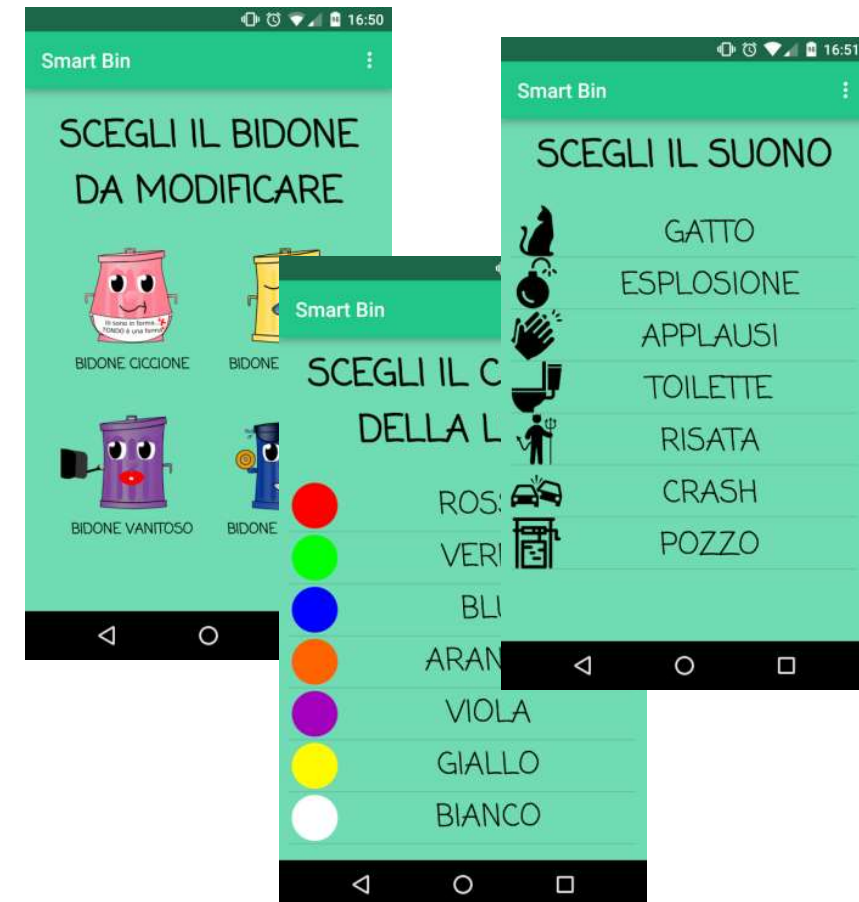
✓ Interface design

➤ The app will need to

- Set the color of the light between a set of available colors
- Set the sound between a set of available sounds
- Communicate the new settings to the server

➤ Needed interfaces

- Splash screen (to upload contents)
- Choose the bin
- Choose the light
- Choose the sound



3. database and file specifications

Add database fields

Design phase - SmartBin

4. Programs design

- ✓ **Define the programs to be written**
 - **Set up new configuration (interface server-app) – which protocol will we use?**
 - **Set up new configuration (interface sever-bin) – which protocol will we use?**

- ✓ **Management:**
 - **Insert a new bin**
 - **Eliminate a bin**
 - **Set a bin to the active state**
 - **Set a bin to the disactive state**
 - **Change the position of a bin**
 - **Change the light and sound configuration of a bin**
 - **Change the key of a bin**

Implementation phase

- **The *implementation phase* is the longest and most expensive part of the development process**
- **During this phase, the system is either developed or purchased**
- **The primary output of this phase is the installed system**
- **The implementation phase includes three steps**
 1. **The *system construction*: it is the process of building and testing the system to ensure that it performs as designed**
 - **Testing is one of the most crucial steps, as fixing bugs can be highly expensive**

Implementation phase

- 2. The *installation*: it is the process by which the old system is turned off and the new one is turned on**
 - **One of the most important aspects is the training plan, used to teach users how to use the new system and help manage the changes caused by the new system**
- 3. The *support plan*: it is the collection of formal or informal post-implementation reviews**
 - **It includes the system maintenance**

Implementation phase - SmartBin

1. During the implementation phase, unexpected problems will surely arise

➤ Example problems:

- ✓ **Speaker goes to standby mode if non used for a certain time**
- ✓ **Ultrasound sensor has a 50 msec intervale between one signal and the next**
- ✓ **Ultrasound sensor used as a distance sensor is oversensitive to change of position**
- ✓ **People can modify the same bin at the same time**



2. Installation:

- ✓ We had to eliminate the "normal" bins from via Università, so that users would choose our bins.
- ✓ Unfortunately, there was catering for the event and they added additional bins

3. Support plan:

- ✓ During the event, crashes were resolved in real time through sophisticated machine learning and artificial intelligence techniques (switch off and on again).

Common Errors

- **Always review documents**
 - ✓ **You lose points !!**

- **Planning:**
 - ✓ **Lack of Management WP**
 - ✓ **Breakdown of incorrect activity: PM and developer with the same number of hours**
 - ✓ **Indications need to be provided on the indicators leaving the project**
 - ✓ **Attention to GANTT and costs!**

➤ **Analysis:**

- ✓ **Lack of analysis of the state of the art**
- ✓ **Lack of identification of functional and non-functional requirements**
- ✓ **Lack of reference scenario**

Common Errors

➤ Design

- ✓ **It must not be delivered together with the implementation, the client must have the possibility to make changes**
- ✓ **Lack of a complete vision of architecture**
- ✓ **Remember to define data exchange format, database design and management algorithm (s)**