

# The design process in twelve steps

## Introduction

- A design can be for a physical object (such as a chair, car, or appliance), or for something non-physical such as software (e.g. a computer game) or a service;
- The best designs optimize desired qualities\* within the given constraints.  
(\*such as safety, reliability, efficiency, aesthetics, user-friendliness, environmental issues, costs etc.)  
Sometimes, a design can be very successful, mainly because it fits in a trend;
- The design process typically occurs in teams, whose members contribute different kinds of ideas and expertise;
- All designs build on the creative ideas of others, and any design can be improved!

## The Design process

- The design process involves a series of (logic) steps and decisions, that lead to the development or redesign of a (new) product, system or service;
- Unlike problem solving in other fields of study (in which *absolute*, or “*right answers*” can be found), in a design process there are always multiple solutions to a problem;
- The design process is influenced by requirements called *criteria* and *constraints*.

## Steps of the design process

1. Define the Problem
2. Research and Gather Information
3. Identify Criteria and Specify Constraints
4. Generate Ideas, Brainstorm
5. Explore Possibilities
6. Select an Approach
7. Develop a Design Proposal
8. Make a Model or Prototype
9. Test and Evaluate
10. Refine the Design
11. Create or make Solution
12. Communicate Processes and Results

### 1 Define the Problem

- Identify the problem to solve, including its scope, nature and background;
- Write a short statement giving the general outline of the problem or need.

### 2 Research and Gather Information

- Develop an understanding of users’ expectations through task analyses and other research;
- Involve users, conduct interviews with those affected by the problem:
  - make sure to ask the right questions (to the right people);
  - consider and discuss all (user-interface) issues you can think of;
  - use all available resources to understand users’ requirements;
  - involving users has the most value when trying to improve the completeness and accuracy of (user) requirements. It is also useful in helping to avoid unused or little-used system features;
  - user involvement may improve user acceptance (It is not yet clear, that it does in all cases);
  - the research suggests, that users are not good at helping make design decisions: users are most valuable in helping designers know what a system should do, but not in helping designers determine how best to have the system do it.
- Look at the right places to find the right information;
- Research solutions that may already exist (identify if they are appropriate to a given situation).

### 3 Identify Criteria and Specify Constraints

- *Criteria* identify the desired elements and features of a product or system and usually relate to their *purpose* or *function*;
- *Constraints*, such as size and cost, establish the *limits* on a design;
- Establish preliminary goals: devise a list of criteria to identify what the solution should do, *and* the degree to which the solution will be pursued;
- Identify constraints;
- Draft a preliminary Design Brief (including *working criteria* to compare possible solutions).

#### 4 **Brainstorm**

- Establish a diverse team: best size is somewhere between six and twelve people;
- Add one or two outsiders from other areas, or even from outside the business;
- Determine who in the group will facilitate the brainstorming;
- Discussion facilitator should try to get everyone to contribute;
- Clearly define the problem you want solved, and lay out criteria to be met;
- Start session with quiet time; group members start by writing down first ideas that come to mind;
- Develop as many creative ideas as possible;
- Take turns reading ideas and submitting to group;
- If ideas written on yellow stickies, then facilitator can post and sort during feedback session;
- Caution: no criticisms during session, encourage creativity;
- Keep the mind alert through rapidly paced sessions;
- Reflect and build on each other's ideas during session;
- End session when creativity appears to be tapped out;
- Do not evaluate (save analysis for later);
- If time permitted, hold a second session to give people time to consider additional options;
- Next day compile ideas and analyze;
- After analysis, complete the design brief and report findings to the team.

#### 5 **Explore Possibilities**

- Consider further development of brainstorming ideas with constraints and tradeoffs;
- Explore alternative ideas based on further knowledge and technologies;
- Use *parallel design*: have several designers/developers independently propose designs and use the best elements from each design;
- Eliminate duplicate ideas;
- Clarify ideas;
- Select ideas to analyze in more detail:
  - Qualitative analysis;
  - Quantitative analysis;
  - Democratic analysis.

#### 6 **Select an Approach**

- Review brainstormed information and answer any lingering questions.  
Narrow ideas down through a voting process, or by use of a decision matrix;
- Do not have individuals make design decisions by themselves or rely on the ideas of a single designer. Most designers will adopt strategies that focus on initial, satisfactory, but less than optimal solutions;
- The best approach is parallel design, where designers independently evaluate design issues and propose solutions. The more varied and independent the proposed ideas, the better the final product will be. Attempt to 'saturate the design space' before selecting the ideal solution;
- Decide on an idea (usually through group consensus) that best meets the criteria, fits within the constraints, and has the least amount of negative characteristics:
  - List the strengths and weaknesses of each alternative;
  - Make improvements to the design idea (e.g. for better performance, aesthetics or increased safety);
  - Trade-off: giving up one desirable trait for another (i.e., giving up on using a certain material so that the object is more affordable).

#### 7 **Develop a Design Proposal**

- Explore the idea in greater detail with annotated sketches;
- Make critical decisions such as material types and manufacturing methods;
- In most cases, it is better to make a few "questionable" decisions that keep the design process moving forward, rather than delay decisions to make the design "perfect".  
Remember: "*better is the enemy of good enough*", hence, avoid the temptation to make the design better if it is already good enough;
- How to adapt to trends?;
- Generate (through computer models) detailed sketches to further refine the idea;

- Check 'usability issues':
  - Users define 'usability', as their perception of how consistent, efficient, productive, organized, easy to use, intuitive, and straightforward it is, to accomplish tasks within a system;
  - Users can have expectations based on their prior knowledge and past experience. Sometimes users will act on their own expectations, even when there are indications (on the screen) to counter those expectations;
- Produce working drawings so the idea can be built.

## 8 Make a Model or Prototype

- Develop models/prototypes for the selected solution(s), to help communicate the idea, and to study or test aspects such as performance, ergonomics, shape, form, fit, or texture. (types of models: descriptive, functional, mathematical, computer, and scale);
- Prototypes are most useful/successful, when people (the design team, the user, and others) can experience and interact with them (learn from those interactions!);
- Note: in industry a model is usually built first and the final product is developed from it, but in most classrooms, the model is the final product.

## 9 Test and Evaluate the Design Using Specifications

- Design experiments to test the models in controlled and working environments;
- Test each model against working criteria and goals (functionality & performance):
  - Did we frame the problem correctly?;
  - Does it function the way it should: are we sure it meets user expectations?;
  - Is it safe for people and the environment?;
  - Is (using) it comfortable?;
  - Is it affordable?;
  - Does it look good, does it fit in trends?;
  - Will it last as long as it needs to?;
  - Does it *really* meet all criteria and constraints?;
- Evaluate: gather performance data, analyze and check results against established criteria;
- Conduct a formal critique to flesh out areas of concerns, identify shortcomings, and establish any need for redesign work;
- If none of the solutions are ideal, return to stage 4 or 5, else go to stage 10.

## 10 Refine the Design

- Specify *what* will be modified, also specify *why* the design modification is required;
- Characterize the difference in relevant terms: reliability, cost saved, user-friendliness, mass reduction, reduced power draw, etc.;
- Make design changes, modify or rebuild the prototype: make all necessary refinements, until accuracy and repeatability of the prototype's performance results are consistent;
- Receive user's critique to provide outside perspective to help determine if established criteria have been met;
- Update documentation to reflect changes.

## 11 Create or make Solution

- Determine custom/mass production;
- Consider packaging.

## 12 Communicate Processes and Results

- Document the design's specifications and measurements and communicate to all groups involved (communication between groups is especially important in this stage);
- Prove to all groups the design is worthy of manufacturing (provide information that is relevant, appropriate, consistent and engaging);
- All groups should agree on the proposed project, including: management, technical, business, and legal support representatives;
- Production;
- Market the Product;
- Distribute.