MODULE 5

AGE-FRIENDLY PRODUCT DESIGN

UNIT 1

HOW TO DESIGN AND DEVELOP AN AGE-FRIENDLY PRODUCT DESIGN FROM SCRATCH

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DESIRE

DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.

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AGE-FRIENDLY PRODUCT DESIGN

The goal of this module is to give an overview of product design with a focus on older adults and their household environment. Design matters and is one part of the solution to a more inclusive world in which all people will have equal opportunities for independence, autonomy, and participation.

Within this module, the participant will learn how to incorporate age-friendly product design into their projects given the importance of the group to an ageing or special needs population. The module is designed to involve other types of publics apart from the product designers themselves who may be interested in these issues such as older adults, their relatives or caretakers so that they themselves can create or adapt their homes.

UNIT 1 – HOW TO DESIGN AND DEVELOP AN AGE-FRIENDLY PRODUCT DESIGN FROM SCRATCH

An effective design makes the goal of the product explicit and serves as the foundation upon which is built. Developing a design demands a clear understanding of the type of problems to be solved, the ideal aesthetic style, the target audience, and their needs. This introductory unit will provide to participants an overview of what it is understand by age friendly design, but also the culture and methods around the term. Moreover, creativity plays a big role when creating new ideas to design new perspectives on existing ones and there are ways to develop and improve it.

1.1 WHAT IS MEANT BY AGE-FRIENDLY PRODUCT DESIGN?

1.1.1 Design

Today we live surrounded by objects, machines and constructions that ease and support almost all our daily activities. These elements can be of quite diverse types and functionalities, such as household appliances, clothes, cars, houses or furniture. Part of our lives, they are unreplaceable.

One of the features differentiating us from other animals is the manufacture of objects. It is part of our existence as species. Over time, humans have designed and manufactured objects and tools by progressively improving manufacturing techniques.

1.1.2 Definition

Design is a discipline whose products have a strong impact on people's daily lives, but, in turn, are conditioned by the particularities of the society or group to which they are addressed.

In a broad sense, design is defined as the process of materialising an idea that seeks to provide a solution to a previously defined need or problem. These range from the creation of items or furniture for our homes to the construction of housing and urban planning. In any area of our lives, we can find something to design.

In addition, design refers to different fields, such as graphic, industrial, architectural, or urban design, making it an ambiguous term.

Until the Industrial Revolution, objects were produced handicraft and their design and manufacture were craftsmen' responsibility, who carried out all the production processes. Before the Industrial Revolution, the systematic introduction of machines into the production process led to the mechanisation of work and the elimination of manual labour. Consequently, these new objects were dehumanised. A lack in many designing aspects led to a need of rethinking the product. Industrial designer as a profession was born in response to this problem.

1.1.3 Definition

Industrial design is the human activity aimed at creating, developing and humanising industrial products. As an applied art, it seeks to resolve the relationship between form and function of items that can be produced industrially. Its purpose is the industrial production of objects that responds to society's demands by considering the functional and structural relationships that make an object a coherent whole, balancing technical and aesthetic aspects.

Industrial designer as a profession was born in response to this problem. Industrial design is the human activity aimed at creating, developing and humanising industrial products. As an applied art, it seeks to resolve the relationship between form and function of items that can be produced industrially. Its purpose is the industrial production of objects that responds to society's demands by considering the functional and structural relationships that make an object a coherent whole, balancing technical and aesthetic aspects.

1.1.4 Inclusive design

Inclusive design is based on the recognition of human diversity, which is the right of all people to enjoy the environment and objects on equal terms, seeking total accessibility to any good or service. In this way, greater integration and equal opportunities are provided for all citizens.

The purpose of inclusive design is to simplify everyday tasks by making products, services and environments easier to use for everyone, with as little effort as possible. In addition, it seeks people's comfort in using objects or spaces they inhabit.

Inclusive design aims to benefit all people, regardless of their age and ability. It seeks suitability for all, either through the same design or by offering options for different needs. In addition, inclusive design has the capacity to create shared value, both for the user and for the production company. On the one hand, it improves the societies in which it is distributed and, on the other hand, by being useful for a greater number of people, it increases the company's competitive capacity. From this perspective, human diversity, social inclusion and equality are to be valued through the generation of ideas and the creation of products, systems and services.

To learn more about inclusive design you should read Module 3 Unit 1.3.

IN A NUTSHELL

To sum up, inclusive design can be defined as the design of products, services or spaces that enable access to a large majority of people, in the most reasonable way regardless of their location, in a wide variety of situations and to the greatest extent without the need for any special adaptation or specialised design.

Its main features include the following:

- Flexibility: ability to adapt objects or spaces to various circumstances, situations or needs.
- Equal use: standardise the existing opportunities so that there is fair equality among disabled and non-disabled people.
- Appropriate spaces: spaces must have the right size and comfort so that most people can make use of them.

1.1.5 Gerontodesinging or age-friendly design

IN A NUTSHELL

GERONTOLOGY

"The science that studies the process of ageing in man, i.e. it investigates the morphological, physiological, psychological and social changes that follow the action of time on the human organism, independently of any pathological phenomenon".
(Fontanine, 2000, p. 26).

AGE-FRIENDLY DESIGN. DEFINITION

Age-friendly design is the combination of gerontology and design intended to transform the existing productive systems, projecting and developing them in order to include older adults and improve their quality of life. Age-friendly design not only seeks to develop goods or services for older adults, but also to break taboos and social stigmas about ageing.

Ageing is part of the very nature of human beings. However, it has not been a priority prior to the current perception that it is a looming problem in the coming years.

This problem stems from the imminent ageing of population. By 2050, around a quarter of the world's population is expected to be over 60 years old. As a result, more and more designers are looking at improving the quality of life of this increasingly important population group, and solutions are being considered from a universal and inclusive perspective, not exclusively for older adults.

In order to narrow down a definition of age-friendly design, the science on which it is based should be specified.

Having this in mind, the target of age-friendly design is older people who require products, services and spaces that respond to their needs, regardless of their dependence (or not) on other people. The approach adopted by age-friendly design is based on a single user and not on groups, where design is a discipline for the resolution of human problems and seeks the integration of any user in the use of a product or space. These products or spaces are not for people with different abilities (for example, it is not a medical equipment or a geriatric product), so age-friendly design is not focused on people with ailments or disabilities.

Figure 5.1.1 Older adults

1.2 AGE-FRIENDLY PRODUCT DESIGN CULTURE

We live surrounded by objects, products of industrial design, which frame our daily lives and aim to make them more comfortable and pleasurable. The following is a summary of the main movements that in one way or another have influenced and have been linked to Industrial Design. The origin of the profession of industrial designer is taken as a starting point, which is determined at the beginning of the first Industrial Revolution (early 19th century).

The term **industrial** is a direct reference to the system of manufacturing goods that was born during the first Industrial Revolution and replaced the craft production system. This historical process began in England in the late 18th and early 19th centuries.

The term **design** refers to the process of materialising an idea that seeks a solution to a need or problem previously defined. In industrial production, the previous conception is key, since it is impossible to industrially manufacture an object without defining its tangible attributes and production features.

1.2.1 End-of-millennium design

NEOCLASSICISM

The overcoming of the Baroque period was mainly due to the series of archaeological discoveries that took place during the 18th century, when different archaeological sites in Italy began to be exhumed. History itself became fashionable and there was an eclecticism so broad that it embraced any previous style.

Regarding design and object manufacturing, the production system was based on artisanal handicraft, and earlier styles were revived but adapting them to new needs. Thus, Egyptian, Neo-Indian, Neo-Greek and Neo-Gothic art came back into fashion. However, the lack of a new language for the applied arts became apparent.

Figure 5.1.2 Neoclassical sofa

Figure 5.1.3 Chippendale Neo-gothic chairs

ONE OF THE FIRST PRECEDENTS: THONET CHAIRS

In the first half of the 19th century, Neo-classicism and eclecticism (with all its neo-) were the predominant styles in the Western World. Industrial design has its origins in the questioning of the aesthetics of these early objects of industrial production, and Thonet furniture is an early precedent. This furniture is made using bent wood, whose mass production dates to the 1940s.

Figure 5.1.4 The No. 14 chair by Thonet (1859)

In contrast to solid furniture, Thonet proposes finesse, lightness and comfort. The Industrial Revolution was at its height and Thonet moved from handcrafted to mass production. Its products transformed the concept of furniture at that period gaining universal fame, with 50 million chairs produced until the outbreak of the First World War, when production had to be halted.

Figure 5.1.5 Rocking chair, model 1 (1860)

1.2.2 Iron architecture and the Great exhibition 1851

IRON ARCHITECTURE

The Industrial Revolution saw the arrival of new materials such as iron, reinforced concrete, glass and, in the second half of the 19th century, steel.

The development of iron architecture was linked to new needs, such as railways, bridges, stations, factories, libraries, markets, hospitals. These were buildings that had to be built quickly and in a cheap way. Iron was first used to build infrastructure, such as bridges and railway stations.

In the second half of the 19th century, glass, iron and reinforced concrete were used. The latter is cheaper than iron, can be made in moulds and does not have the problems of dilatation that iron has. So, it was used in public buildings such as markets, museums and libraries. A great example of a central market is Les Halle, in Paris, designed by Víctor Baltard in 1853.

Figure 5.1.6 First metal bridge over River Seven

Figure 5.1.7 St Lazarus station, hall England (1777–1779) Paris (Source: Wikipedia)

Figure 5.1.8 Les Halle, Paris

THE GREAT EXHIBITION 1851

The Great Exhibition of the Works of Industry of All Nations was an international exhibition and the first of a series related to industry. Crystal Palace was built to hold the exhibition. It was an ephemeral, modular and demountable iron and glass building designed by Joseph Paxton. The nature of this building completely broke with old Classicism patterns, which were typical in that period.

The exhibition offered the opportunity to get to know and take stock of the industrial production of many countries, revealing, from an aesthetic point of view, the evident lack of harmony in industrial products. In consequence, the relationship between art, aesthetics and industry needed to be solved.

Figure 5.1.9 Interior and exteriors views of Crystal Palace. Drawings by Pilar de Miguel Egea (Source: Wikipedia)

1.2.3 The arts and crafts movement

IN A NUTSHELL

The Arts and Crafts movement's main characteristics are summarised as follows:

- The search for unity in form, function and decoration.
- Inspiration in Gothic Historicism, using linear and organic motifs, mainly in its first period.
- Simple and elegant in form, structure was not hidden.

The trend was essentially British and later spread to the United States.

Questioning industrial products lead to a movement connected to decorative arts and crafts: the Arts and Crafts movement. This trend emerged in Britain as a response to the effects of frenetic industrial development. Its main theorists were John Ruskin and William Morris.

The movement encompasses artistic, social and moral aspects, questioning both the product and the process, reaching a point in which machine was considered a cause of moral and artistic perversion.

Figure 5.1.10 Armchair by Henry Mather

Figure 5.1.11 Piece of furniture by Gustave Stickley

1.2.4 Modernism

Modernism is an arts movement developed during the late 19th and early 20th centuries. It was named differently depending on the country and had its own aesthetic and formal features. In France it was called Art Noveau; in Great Britain, Modern Style; in Germany, Jugendstil; in Austria Sezesionstil and in Italy, Stile Liberty.

It is characterised by an opposition to any imitation of pre-existing styles and by the search for new artistic forms inspired by diverse sources, such as elements of nature or foreign arts (Japanese art). Besides, its style rejected a return to the past, and it was marked by a rich linear vocabulary composed of sleek, sinuous curves and undulating lines.

The movement is said to represent the nexus between the Arts and Crafts movement and the Industrial Design of the Avant-Garde, but, unlike the first one, Modernism had no philosophical basis of social commitment and was clearly aimed at the newly rising social class, the bourgeoisie, which sought to stamp its own image.

The movement arose in Belgium and its first representation is the Hôtel Tassel, a townhouse in Brussels designed by Victor Horta.

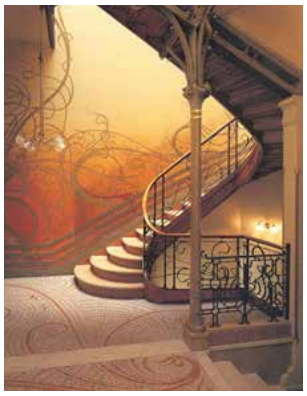

Figure 5.1.12 Exterior and interior views of Hôtel Tassel

Figure 5.1.15 Stoclet Palace by Joseph Hoffmann

Figure 5.1.13 Chair by Eugène Gaillard (Organic Modernism)

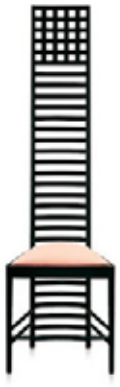

Figure 5.1.14 Chair by Rennie Mackintosh (Geometrical Modernism)

1.2.5 Avant-garde

THE DEUTSCHER WERKBUND

Shifting from handicraft to industrial production resulted in a shift from applied arts to industrial design. The new production system posed some aesthetic problems and Germany led the way in the search for a solution. To be competent in international markets, it took an organised approach to industrial development and set about improving the design and quality of its products.

The Deutscher Werkbund was an association born to satisfy these needs and grouped artists, artisans, designers, architects, art critics and industrialists to design quality products.

The Werbund promoted a simple aesthetic appropriate for this new machine era, emphasising materials and elements from industrial manufacture. The unity, functionality and quality principles taken from art, handicraft and industry were set up within the Werbund programme. The search for simplicity set out the need for reducing everything to its essential parts, basing aesthetics on pure, rational forms, which gave rise to the origin of machines' aesthetics. Thus, the Werkbund can be consider a direct predecessor of the Bauhaus.

Figure 5.1.16 AEG fan and electric kettle by Peter Behrens

DE STILJ

De Stilj was a movement that involved art, architecture and design. It was developed in the Netherlands and took its name from the journal by which the group expressed itself. Its main representatives were Theo Van Doesburg, Piet Mondrian, and Gerrit Rietveld.

De Stilj has a clear order, independent of nature, with images and geometrical elements. It is also regular and functional, as opposed to the undefined, random or expressive features of nature.

Inside De Stijl, Mondrian developed Neo-plasticism. It was based on a system of geometric-constructive forms, reduced to vertical and horizontal elements, and the use of the three primary colours (red, blue, and yellow), along with black, white, and grey. Neoplasticism represents the inspirational germ of rationalism. It aims to create pure reality, reducing natural forms to its constant elements.

Figure 5.1.17 Red and blue chair by Rietveld

Figure 5.1.18 The interior of the Shöeder House

1.2.6 The Bauhaus movement

IN A NUTSHELL

The main characteristics of the Bauhaus are:

- The search for extreme functionality.
- Formal simplicity.
- The absence of ornamentation.
- The reduction to the essential components.
- The reduction in the range of materials used.
- A strong relationship between form, function and technology used.
- The expression of lightness in its forms.
- The predominance of line over volume.

The Bauhaus was a school of art created in 1919 by Walter Gropius in Weimar, Germany. It was one of the most interesting creative experiences in 20th century in art and design, keystone of industrial design.

In a technical context and inspired by rationalism, the Bauhaus movement searched for the simplification of forms reducing objects to their geometric elements and reappraising their function. It was influenced by De Stijl and by Russian constructivism.

It was active for just 14 years in three cities: Weimar, Dessau and Berlin, where it was finally closed by the Nazi regime in 1933.

WEIMAR

In its origins, the Bauhaus was imbued with the spirit and principles of the Arts and Crafts movement, which advocated a revival of the handicraft production. This was contradictory to Gropius's progressive ideas before the Great War. However, post-war conditions in Weimar justified this apparent change of attitude: from a tactical point of view, he needed to engage the conservative Weimar craftsmen with the aims of the Bauhaus.

Initially the Bauhaus was no other than a modernised school of Arts and Crafts, which was reflected by their offer: blacksmith, ceramist, lathe operator, glass painter, wood engraver and similar training courses. Thus, it proposed a dual qualification: masters of the form (artists) and masters of the workshop (craftsmen).

In 1923, an exhibition was organized to showcase the school's productions. This exhibition marked a change in the Bauhaus, as the creation of prototypes for industry was set as its main objective. The title of Gropius' speech during the event ("A new unity between Art and Technology") reflected this change and a strong influenced by De Stijl movement and Russian constructivism were part of the driving force behind it.

In 1924, the right and extreme right won the regional elections, and the school was forced to move due to political pressure at the end of the school year.

DESSAU

The Bauhaus was relocated to Dessau as a university institution. There, any connection with handicrafts disappeared, and architecture studies were incorporated. The school courses acquired a technical-scientific orientation that guaranteed a theoretical-practical education.

Eventually the seed of an idea was materialised in the industrial designer profession in 1926, as these lines reflect: "In these workshops, the Bauhaus tries to train a new yet non-existent type of employees for industry and handicraft who master technology and form in equal measure".

Figure 5.1.19 Wassily chair

Figure 5.1.20 Breuer chair produced by Thonet

Figure 5.1.21 A design from 2nd stage

Figure 5.1.23 Cradle by Peter Keler (1922)

Figure 5.1.22 Walter Gropius office

1.2.7 Art deco

Art Deco was an art movement that appeared in the early 20th century. There are two main styles: a classical revival Deco style and a style with an emphasis on aerodynamics. Art Deco influenced architecture, interior design, industrial design, graphic design and visual arts, such as engraving, painting, cinematography.

ART DECO RETRIEVING CLASSICISM

This line, a neoclassical and neo-archaic revival, rescues the volumetry of Napoleonic furniture, but without its decoration, and mixes it with archaic elements inspired by Egypt, Mesopotamia and pre-Columbian America. The great evolution of archaeology in those years nourished designers with new forms and languages. In addition, relationships with avant-garde movements are found in Cubist, Constructivist and Futurist features and indeed it has an evolutionary link with Art Nouveau. In architecture, it was translated into an imprint of robustness, monumentality and elements of strong presence in his compositions.

In interior design and furniture, parallel straight lines inspired by Doric grooves and triglyphs are the most frequent ornamental motif. However, interior design does not recover columns and entablatures, but introduces them surreptitiously with curtains or grooved frames, as the quintessence of the image of classicism, but avoiding their literal reproduction. One of the most influential figures was Émile-Jacques Ruhlmann.

Much of the interwar institutional architecture conforms to Art Deco neoclassicism, and it was also taken over by totalitarian regimes such as Stalin in the USSR, Hitler in Germany, Mussolini in Italy, Franco in Spain. It is acquired as a regime style for two main reasons:

- Naturalistic figuration, due to its easy interpretation, is more likely to become propaganda than the distorted figuration of the avant-garde.
- Classic architecture produces understandable buildings for the people (mostly illiterate). Its monumental and solemn language coincides with the messages of nationalist grandeur from dictators.

ART DECO INSPIRED BY AERODYNAMIC DESIGN

Named Streamline in English-speaking countries, due to its decoration of parallel and zigzagging lines, as well as its pointed volumes suggesting the air penetration of the vehicles themselves. It had its origins in the interwar period, which saw the great technological development of the means of transport: trains, ocean liners, planes, zeppelins, among others. They aerodynamical style or streamline mostly belongs to the American industrial design developed from 1920 to 1960.

In the 1920s, air and sea navigation and the automobile became cult objects as they represented the realisation of a collective technological dream. The carcasses and bodywork took on projectile shapes and ornamentation of parallel lines, as an anagram of speed, fractioned, crystalline forms, cubist blocks that resulted in a significant geometrization of shapes. The preferred materials were aluminium, stainless steel, lacquer, inlaid wood and sharkskin. As motifs, the straight or broken fretwork line, chevron patterns and the Sunbrurst (sun disc) ornament should again be emphasised.

Not having any philosophical basis with political intentions, it is considered a bourgeois style, as it is purely decorative. Despite its eclecticism, Art Deco has a clear identity. It hints at the futuristic vision resulting from the Industrial Revolution, its meaning revolves around progress, order, the city and the machine.

As far as industrial design is concerned, the new streamlined aircraft, locomotives and automobiles were the starting point for aerodynamic forms that were transferred to household goods and office equipment.

Figure 5.1.24 Art Collector's Hotel, furnished by Ruhlmann (1925)

Figure 5.1.25 Chair by Eilel Saarinem

Figure 5.1.26 Bureau by Ruhlmann

Figure 5.1.27 Pencil sharpener by Loewy

Figure 5.1.28 Loewy next to one of his own designs

Figure 5.1.29 Iron by Henry Dreyfuss

Figure 5.1.30 Bar in Carrión building, Madrid

1.2.8 Modernity and international style

The remarkable widespread of avant-garde ideals took place in the decades after the Second World War and remains an everyday style for many of us. Modern designers became so abundant that they could be studied locally (Scandinavian, Italian, American, and so on).

MODERNITY: FUNCTIONALISM

Functionalism is the most influential architectural thought in the history of architecture. Beauty ceases to be the purpose of creation and is achieved by manipulating the structure. Underlying this aesthetic ideal is a socialist ideal of producing well-designed objects accessible to the whole of society.

Key features are neutral colours, pure geometric volumes, economical industrial materials, as well as machine and factory aesthetics, making functionalism a very important style nowadays.

Regarding a conceptual level, its ideals are as follows:

- Ornament is a crime.
- The truth of materials.
- "Form follows function".
- The idea of housing as "machines for living".

Regarding formality, emphasis on orthogonality characterises functionalism:

- Smooth, polished surfaces, devoid of ornamentation.
- Visual appearance of lightness: cantilevered construction.
- Use of new techniques and materials: reinforced concrete to create large interior spans.

Figure 5.1.33 T3 Transistor designed by Dieter Rams

"A HOUSE IS A MACHINE FOR LIVING" (LE CORBUSIER)

Le Corbusier pursues the maximum economy of lines in undeniably functionalist solutions. His vision of architecture for housing can be summed up in these points:

- Elevation of the building so as not to damage the natural habitat.
- The playful roof (garden, swimming pool).
- The continuous window.
- Free floor plans and façades thanks to the load-bearing structures.

His first exponent is Villa Saboya, 1928, and his most emblematic residential building is the Marseille Housing Unit, 1946.

Figure 5.1.31 Marsella Housing Unit

Figure 5.1.32 Table designed by Breuer

1.2.9 Modernity: neoplasticism and expressionism

In modern culture, there are some styles that look for the prospection of messages, distancing from the more functionalist silence and neatness. Examples are neoplastic modernity and expressionist styles.

NEOPLASTIC MODERNITY

Neoplastic modernity draws directly from the avant-garde De Stijl movement and is expressed through a language based on simplicity and constructive ingenuity, argued with pure, childish colours and simple geometric surfaces.

EXPRESSIONIST-CONSTRUCTIVIST MODERNITY

In Expressionist-Constructivist modernity, the main feature is volumetric juxtaposition, which could be considered as a "Baroque of Rationalism", a dynamic and somewhat extravagant style.

Figure 5.1.34 Interior of a textile shop

Figure 5.1.35 Side table by Eileen Gray

Figure 5.1.36 Rusakov Theatre, by Konstantín Melnikov

Figure 5.1.37 Inga Lamp, by Aleksandr Rodchenko

1.2.10 Modern movement: organic style

INDUSTRIAL DESIGN

Within industrial production, the organic style is the most important of the formal languages. In housing and airframe design, it is used to reflect a certain appearance on the industrial product and in machines, which are initially noisy and threatening, and serves to alleviate these undesirable aspects.

In the interior of transport, organic design offers enveloping spaces that convey comfort, and such shapes, with their lack of angles and edges, are much safer in case of an accident.

In appliance casings, the excessive industrial connotations are supressed by organic elements, making them ornaments.

Figure 5.1.38 Citröen DS

Figure 5.1.39 Boeing 787

ARCHITECTURE AND INTERIOR DESIGN

In order to create buildings and constructions that are representative from modern movement, organic or expressionist styles are often used.

In the 21st century, organic interiors are becoming more accessible thanks to synthetic coatings, with lower prices and fewer technical difficulties.

In relation to furniture, a remarkable advance in this style is the use of bending techniques for wood or plywood sheets to produce chairs. Moreover, as the 20th century drew on and plastic manufacturing techniques were introduced, the organic became more important.

Figure 5.1.40 Coffee machine for Braun by Henry Dreyfuss

Figure 5.1.41 Our Lady of the Heights by Le Corbusier

Figure 5.1.42 Sidney Opera House by Utzon

Figure 5.1.43 Shoe shop in Hong Kong by Zaha Hadid

Figure 5.1.44 Lounge Chair by Eames (1940)

Figure 5.1.45 Stacking chair by Werner Panton (1960)

1.2.11 Modern movement: high tech or structural expressionism

At the end of the 1970s, the fascination for technology inspired this aesthetic. It began with the project for the Charles Pompidou Art Centre, designed by Richard Rogers and Renzo Piano, who left all its technological "guts" visible, attached to the façade, without the need to add any decorative elements, within the maxim of the modern movement of zero decoration.

High Tech aesthetic can be considered a mannerism of the modern functionalist style, since it employs the same materials and colours, but avoiding the timidity and silence of canonical functionalism in favour of expressiveness through technological display.

Figure 5.1.46 Centro Georges Pompidou, París

Figure 5.1.47 Richard Rogers, Lloy's

The use of glass and transparent surfaces means that the container influence the inside of buildings – interior architecture is practically cancelled out.

In furniture, synthetic materials with chrome-plated chassis and transparent surfaces made up furniture in line with high tech.

Figure 5.1.48 Nomos Collection by Norman Foster

Figure 5.1.49 Tizio lamp by Sapper

During this period, and exactly in 1974, at the "Meeting of the Group of Experts on Barrier-Free Design" held in New York, the first precedents were established on the need to eliminate physical barriers that make it difficult for people with disabilities to fully participate in society on equal terms and in which the need to train architects, engineers, urban planners and landscapers is established.

1.2.12 Modern movement: minimalism

Minimalism is the coldest and most silent aesthetic within the Modern Movement. Its abstraction aims to be contemplative silence. Compositionally, it exploits the shape of the rectangle, repeating it so that redundancy itself suppresses any message.

There is a preference for using white, the most neutral and pure colour.

In commercial interior design, it has had a great impact. This aesthetic can be seen in many of today's department stores. In domestic interior design, the kitchen is one of the spaces that has been influenced the most.

Figure 5.1.50 Kursaal in San Sebastián (1989)

Figure 5.1.51 Universal series, Capellini, by Jasper Morrison

Figure 5.1.52 Interior of a shoe shop

Figure 5.1.53 Contemporary kitchen

1.2.13 The ULM school of design

IN A NUTSHELL

- The Ulm School of Design based its philosophy in the integration of science in design.
- It was the leading centre of scientific design pedagogy, from where it spread worldwide.
- It set out to redefine the role of design in modern culture by integrating creativity and a social purpose.

The Ulm School of Design (Hochschule für institution created in Ulm, Germany, in 1955. It was born from the Scholl Brothers Foundation, which was created in memory of these brothers executed by the Nazi regime, and promoted by a group of young German intellectuals, with the aim of creating a teaching and research institute to collaborate with the cultural reconstruction of post-war Germany. The school was inaugurated by Gropius, who referred to it as the "university of form".

In the mid-1950s, a successful collaboration between the HfG and Braun AG began, leading to the Braun style.

Figure 5.1.55 Electric shaver by Hans Gugelot

Figure 5.1.54 SK4 radio and record player by Braun

Figure 5.1.56 KM 321 blender by Braun

1.2.14 Scandinavian design

Scandinavia has a particular love for nature and a sense of social equality that are present in its culture and daily activity. This is reflected in its technical-aesthetic manifestations.

These aspects had an important influence when design began to be incorporated into industrial products, giving rise to a creative expression based on criteria of simplicity and beauty, proposing a socialisation of aesthetic values, seeking to create a happy society through the beauty of everyday life.

In creative design environments, a new current appeared linked to the design of daily objects, which proposed aesthetically resolved and low-cost objects for a society based on equality. Thus, products based on a humanist interpretation of the formal, technical and aesthetic principles of the Modern Movement were created.

For most of the Scandinavian population, design is part of their lives and an effective element of social change. This concern for the human being and the environment characterises Scandinavian design, which is warm and tailored to the human being. Its aim is therefore human well-being and not so much industrial competitiveness.

Characteristic of Scandinavian design are wooden furniture and the use of curved plywood, which allows for flexible and strong organic forms linked to nature.

Design for All or Universal Design has its roots in the Scandinavian functionalism of the 50s and in the ergonomic design of the 60s. The Swedish social policy of the late 70s was also influential, where the concept of "One Society for All" referring fundamentally to Accessibility.

Figure 5.1.57 Paimi chair by Alvar Aalto

Figure 5.1.58 Series 7 chair by Arne Jacobsen

Figure 5.1.59 Balans variable by Peter Opsvik (1979)

Figure 5.1.60 Koare Klint (1933)

POSTMODERNITY

During its expansion, the modern movement became increasingly dehumanised and cold. It also had too many formal prejudices. From 1970 onwards, certain designers revived past styles, such as Art Deco, and returned to the use of applied decoration and colour. Inspired by Semiotics as a philosophical current, post-modernism promotes communication with users and spectators through the plastic arts in order to overcome the non-emotional universal language, which is the basis of Rationalism.

Postmodern criticism accuses modern architects of turning cities into strange monoliths that are not understood by the population. If Modernity focused on syntax, Postmodernity focuses on semantics, i.e. on the symbolic dimension of forms.

An alternative design emerged, highly influenced by pop art, which also rescued some aspects of cultures submerged by the modern world. Led by Ettore Sottsass, the Memphis Group appeared, which brought together important designers from all over the world. Their common denominator was to emphasise the formal content of their products, creating experiences inspired by a diversity of cultural contexts, seeking to go beyond the traditional categories of form, function and technique.

In terms of furniture, anything that departs from rationalist styles by cultivating classical aesthetics, pop colours, unusual materials and a sense of humour is a component of the new designs. In some cases, furniture acts as decorative sculpture.

IN A NUTSHELL

Its general characteristics are as follows:

- Semantically suitable materials. Wood and brick for housing, recovery of marble and luxurious materials for their representative value in public architecture.
- A sense of humour. Anecdotes, syntax tricks, incorrectness and flaws as elements of design.
- Individual and customised design.
- Picturesque spaces. The oblique and baroque projections that hide surprises are recovered.
- Recovery of ornamentation and colour. Overcoming modern prejudice.

Figure 5.1.61 Robert and Vanna Venturi house (1968)

Figure 5.1.62 Café Costes by Philippe Starck (1984)

Figure 5.1.63 Rococo armchair by Alessandro Mendini

Figure 5.1.64 Chair by Rovert Venturi

Figure 5.1.65 Hotel Delano Hall by Philippe Starck

1.2.15 Current situation

The most remarkable feature of the first two decades of the 21st century was the fusion of structuralism and decorativism, named as ornamental structuralism, in which the very structure of objects turned into something ornamental.

From the continuation of late Modernism trends, the most current is the organic hybrid with High Tech. A maximalist style, with a neoplastic base, has also emerged in which the seriation of geometric figures is repeated, but overcoming the restriction of neutral chromatism. On the other hand, classical styles have always been at the basis of Western culture and continue to have some use.

1.2.16 Postmodernism

Within postmodernism, eclecticism has become more virulent. Some façades are regaining their decorative application. In addition, originality is in vogue and custom-made, exclusive, personalised pieces are sought after. Some of the pieces produced are essentially conceptual.

Figure 5.1.66 Apartment in Madrid by Izaskun Chinchilla

Figure 5.1.67 Swiss Museum of Transport by Gigon Guyer

Figure 5.1.69 Nimrud chairs by Marc Newson (1997)

Figure 5.1.68 Leaf furniture by Tejo Remy

1.2.17 Late modernism

DECORATIVE STRUCTURALISM

Its maxim is the fusion of structure and ornament, where the underlying idea is to decorate without applying ornamentation.

With this aim in mind, the solution is for the structure itself to become an ornament, with the cladding being die-cut.

Figure 5.1.70 Artwall shopping mall

Figure 5.1.71 Matsumoto Performing Arts Centre

Figure 5.1.72 Antonietta coffee tables by Alessandra Pasetti

Figure 5.1.73 Flower chair by Marcel Wanders

ORGANIC HIGH-TECH STYLE

Within the modernist styles, the organic style is the one that has the greatest presence thanks to the use of new, inexpensive synthetic materials. Its organic-technological variant stands out for its suggestion of perfection and immortality.

Figure 5.1.74 Tel Aviv Opera by Ron Arad (1988)

Figure 5.1.75 Gingko table by Ross Lovegrove

ORGANIC POP STYLE

Organic meets pop and takes on a seventies flavour. Decoration with undulating lines brings pop culture closer to modernism. Furniture here looks like toys and rooms become toy libraries.

Figure 5.1.76 Oaza Zdravjla Pharmacy by Karim Rashid

Figure 5.1.77 HI Niza Hotel (2003) by Matali Grasset

Figure 5.1.78 Olivia chair (2004) by Raúl Barbieri

ORGANIC MONUMENTAL STYLE

The monument of today's society is always a civil monument. Among the most distinguished, there is the international airport – the representative value of an airport is incalculable. Another important civilian building, which is treated as a monument, is the great art museum.

Figure 5.1.79 Elephant stool

Figure 5.1.80 Incheon Airport in Seoul by Tony Farrell

Figure 5.1.81 Gare do Oriente in Lisbon by Santiago Calatrava

1.2.18 Perpetual classicism

The luxurious continues to be conveyed through classical style. The reproduction of classicism is not literal, but in many cases ironic, in line with the modern spirit.

Figure 5.1.82 Azzedyne Alaia store by Marc Newson (2006)

Figure 5.1.83 Casino de Madrid restaurant Jaime Hayón (2009)

Figure 5.1.84 Peninsula chair by Philippe Starck

Figure 5.1.85 2008 Ikea collection

1.2.19 Short history of age-friendly design

The theme of developing age-friendly spaces, cities and communities emerged from a series of policy initiatives set in motion by the World Health Organization (WHO) during the early 2000s. A leading idea running through these initiatives is related to active ageing. This notion was originally developed in 1999, during the United Nations's Year of Older People. It was further detailed by organisations as the European Union and the WHO. The WHO stated that the term "active" in active ageing reflects the idea that people should be able to continue to participate in all spheres of life in old age – social, cultural, civic, spiritual and economic. Active ageing policies and programmes were regarded to require a diversity of interventions and actions to improve aspects of both the social and physical environment.

The ideas of active ageing were taken further in 2006. In that year, the WHO launched its "Global Age-friendly Cities" project. As part of this project, a number of focus groups with older people, carers, and service providers were conducted in 33 cities in 22 countries around the world, with the aim of identifying those factors that could make urban environments more "age-friendly". The project defined an "age-friendly city" (AFC) as encouraging "active ageing by optimising opportunities for health, participation and security in order to enhance quality of life as people age".

The study resulted in a guide which identified the key characteristics of an AFC in terms of three main areas. These areas are service provision, the built environment, and social aspects. This Global Age-Friendly Cities guide has since become the most frequently used document to promote and evaluate the goal of age-friendliness.

The WHO launched the "Global Network of Age-friendly Cities and Communities" in 2010, in an attempt to stimulate the implementation of policy recommendations from the 2006 project. Since its inception, the Network has seen a rapid growth in membership, extending to more than 1100 cities and communities in 2021. The aim of this network is to support its members in becoming more age-friendly.

Between 2012 and 2015, the WHO conducted a series of literature reviews, expert consultation meetings and pilot studies which generated input from over 50 communities across 25 countries. This resulted in a report published in 2015 which set forth a framework and set of indicators to monitor and evaluate progress in improving the age-friendliness of urban environments.

The efforts made on age-friendly cities and communities have been underwritten by a range of other age-friendly organisations, including international NGOs such as the International Federation on Ageing. In North America these include the American Association of Retired Persons (AARP) Livable Communities, and the National Association of Area Agencies on Aging sponsored Livable Communities Initiative.

1.3 AGE-FRIENDLY PRODUCT DESIGN WITH METHOD

1.3.1 Introduction

Designing becomes easier when you know how to design. Problem solving becomes easier when you know what you must do to get to the solution.

Simply put, the design methodology consists of a series of operations in a logical order to efficiently achieve a design solution. This sequence is based on experience and there is no single method. Moreover, with the acquisition of one's own experience, the sequence is modified and individually adapted and to the needs of one's own project.

The following is one of the methodologies for projecting. Its aim is to serve as a basis on which each student can experiment and gain experience in solving design problems. This experience will give him a way to create his own method adapting it to the needs and way of working. It should not be forgotten that the design methodology is not an absolute and definitive, but modifiable and adaptable thing.

Design is a discipline with an important social impact and associated responsibilities. Throughout the design process, the designer must be aware of social, ethical and environmental commitments to foster a more egalitarian, harmonious and sustainable society. Within the design methodologies, aspects that allow breaking social paradigms with respect to ageing should be contemplated, using them as another ingredient that allows us to obtain a solution with the widest possible social range. These aspects will be weighted more highly in design problems that are circumscribed to these social groups.

1.3.2 Design methodology

Designing without method, in an exclusively intuitive way, looking for a solution without having carried out a previous study of the design problem to be faced is not the way.

Creativity is not improvisation. As mentioned above, the method is flexible but necessary.

The proposed methodology is a framework, a guide that is adaptable to the project and to the design team's own way of working. It is, therefore, an elastic scheme, flexible and able to change depending on the situation, needs or preferences of use.

Further on, some methods that complete this framework will be detailed, such as people-centered design or design thinking; methods that can be integrated into this scheme enhancing and adapting it to a specific perspective.

1.3.3 Design method scheme

PROBLEM

The design process is born from a need, from a design problem to be solved. This problem can either be detected by the designer and proposed to the industry or it can be the industry that proposes the problem to the designer.

DEFINING THE PROBLEM

Next, we need to define the design problem. Doing so will provide the designer with boundaries to move within. This problem definition will be the basis of our concept of the design problem to be solved.

In order to define the problem, a product briefing can be used, a document whose purpose is to obtain as much information as possible from the project promoter. In addition, a reflection must be made on everything related to the project and an attempt must be made to reflect this in the definition.

SCHEME FOR PREPARING A BRIEFING

The scheme consists of five information cores and, if they are related to the project, they should include considerations for: dimensions, materials, weight, manufacturing techniques, cost, packaging, usability, functionality, noise, maintenance, ergonomics, finishes, workability, durability, toxicity, aesthetics, social value, essentiality.

THE COMPANY:

Brief description of its history, its activities, its organisation and corporate visual identity or design standards, if any.

The company and the market: Its situation in the market, competition, the image it conveys, its positioning and future strategies must be understood.

THE PROJECT:

How the idea came out or the necessity arose. Taking the opportunity. Why now?

What is to be achieved? Objectives and expectations of the project.
How does this project fit into the company's strategies?

THE PROJECT AND THE MARKET:

Target market segment.
Consumer/user/recipient profile.
Circumstances and mode of use of the product or service.
Advantages, benefits, differential aspects provided by the new product.
Distribution system. How does it reach the public?
Is there any trend in the market with respect to the project?

THE COMPANY AND THE PROJECT:

Specific requirements that may have an impact on the design. For example, technologies and/or manufacturing materials predetermined by the company.
Project schedule or timing, the expected time of execution and when the first units are expected to be available.
Number of units planned. Costs.
Production inside and outside the company. Suppliers and own resources.
Regulations or legislation affecting the product or design.
Additional documentation to the project that may be of help, such as market studies, examples of previous projects, success stories, etc.
Internal team that will collaborate in the project. Maximum responsible person and description of the approval process of what is presented by the designer in the different phases of the project.

ELEMENTS OF THE PROBLEM

From the definition of the problem, a decomposition into its elements (or smaller problems) must be carried out. This operation will facilitate the designer's work, helping

him to reach a deeper understanding of the problem by decomposing it into more easily solvable small problems. Each of them has an optimal solution, but these different solutions may contradict each other. The most complex part of the designer's work is the reconciliation of the different solutions to the subproblems in the solution to the global project. This phase of problem decomposition is reflected in the list of project specifications.

This list should be reflected in a table of specifications, which will serve to analyse the compliance of each of the solutions provided to each subproblem and how they are articulated in the overall project solution.

SPECIFICATIONS		OK	Criteria
	MOUNTING HEADBOARD / FEET BED		You must allow immediate access in a certain time according to 201.15.4.101
	MATTRESS RETENTION		You must keep the mattress in position according to 201.15.4.102
STRENGTH AND DURABILITY			Take into account the tests of durability and effects on the load on the outer edge Annex B.B2
DIMENSIONES			
	GENERAL		It is necessary to take into account the maximum minimum height and the variable length per extension
	BB.3.2 Height adjustment		They would not comply for E4, it is informative both would be outside the adjustment range taking into account that it is taken from the mattress
	OF HANDLES AND PEDALS		They must comply that all handles and pedals must be achievable from normal work and the location and configuration of controls must prevent unintentional activation. Annexes BB.3.3.1 and BB.3.3.2
			BB3.3.4. distance> 35mm from any handle to construction structure // check the CPR handle must exert a force of less than 1 kgr
			BB.3.3.5 Steinco pedals do not work // Shapes will use an end-to-end lever on the outside of the lower frame
			BB.3.3.6 In central areas of piezero headboard it complies, in the upper part of railings it complies, is it enough?
			BB.3.3.7 the pedals are less than 300 mm from the ground
FUNCTIONALITY			
	COMBINATION MEDICAL BED WITH LIFT TRUCK		BB.4.2 Average height under bed> 150 mm. at any height greater than 400mm.
	COMBINATION OF MEDICAL BED AND MATTRESS		The height of the mattress must be 20 mm higher than any element of the mattress support platform. BB.4.3
	MOVING PARTS ADJUSTMENT RANGE		The angle criteria according to section BB.4.4 should only be saved, indent 3 and indent 5
	PROPER FUNCTIONING		The system should work effortlessly and should be easy to maintain
MATERIALES			
	ESTRUCTURA		
	BARANDILLAS PROTECCIÓN		

Figure 5.1.86 Partial example of a table of specifications

DATA COLLECTION

Data should be collected regarding the overall problem and its elements.

DATA ANALYSIS

In data analysis, information should be filtered in an agile way. For this purpose, Key Factors are established for the analysis of the project, generally no more than ten. They show a conceptual synthesis of the specifications. These usually include important specifications such as cost, aesthetic concepts and others that are easily measurable in the data collection.

The result of the data collection is analysed using a table of factors. Data can be weighted according to their importance. This factor analysis will provide us with two or three solutions to the proposed design problem, allowing us to analyse them in detail. If you want to learn more about the research methods to understand the needs and perspective of your clients better, read the Module 1, unit 5.

KEY FACTORS	Value	ANALIZED PRODUCTS											
		ARJO		DESAN FLEX		MALVESTIO		MEDICALIBERICA		PARDO		STIEGELMEYER	
Tranquility / Serenity	3	1	3	1	3	2	6	2	6	1	3	2	6
Formal simplicity	3	1	3	1	3	1	3	2	6	2	6	2	6
Adaptation possibility	2	1	2	1	2	1	2	1	2	1	2	2	4
Safety of use	2	1	2	1	2	2	4	2	4	1	2	2	4
Hardiness	2	3	6	2	4	2	4	2	4	2	4	2	4
Price < 2.000 €	3	0	0	1	3	1	3	0	0	3	9	1	3
Easy cleaning	1	1	1	1	1	2	2	3	3	1	1	1	1
		17		18		24		25		27		28	

Figure 5.1.87 Example of a table of factors for analysis

CREATIVITY

At this point, we have enough information and material to project. The solutions derived from our creative process will stay within the boundaries of the problem. From an intuitive idea, we replace the solution with a creative idea framed within the boundaries derived from the data analysis and design subproblems.

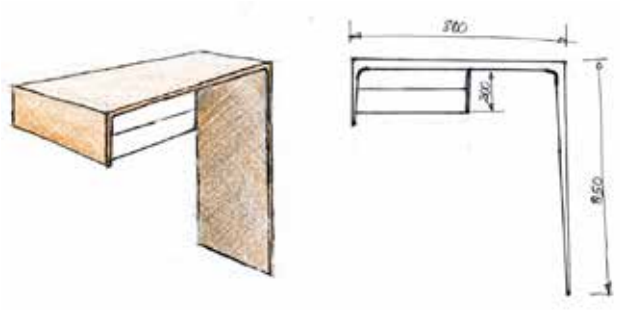

Figure 5.1.88 Sketch of a furniture proposal

SKETCHES

We can make quick sketches in order to shape our solutions, whether partial or global, to structure and bring together the different solutions that our creative process offers to the design problem.

TECHNICAL DOCUMENTATION

At this point, we proceed to the development of all the technical documentation required to produce the product. Drawings, three-dimensional models and construction plans, specifications and materials will be produced here.

VERIFICATION

Each of the proposed solutions will have to be analysed and verified. First, we will analyse them through the Key Factors and then we will carefully check that they meet all the specifications. In case there is more than one solution, this analysis of specifications must be weighted in order to detect strengths and weaknesses that will facilitate decision-making for the final proposal.

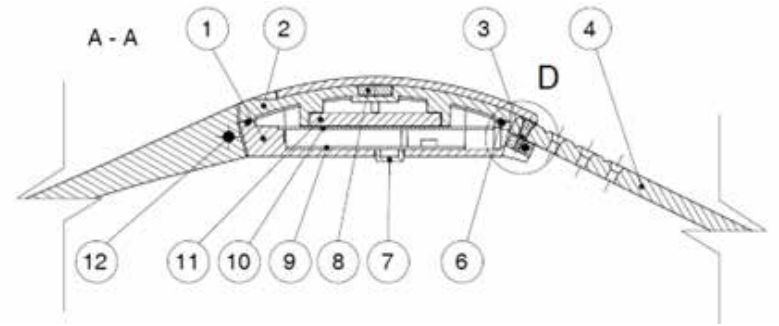

Figure 5.1.89 Detail of a blueprint for a blood-monitoring wristband for elderly people

1.4 CREATIVITY AND CONCEPT

1.4.1 Introduction

Following the different stages according to the design methodology proposed, just before reaching the creativity phase, our concept of the design problem is defined. This conceptualisation becomes the framework within which our creative process will be developed, defining our creative objectives (our challenge). It will also serve to verify the different solutions provided in our creative process.

It is within this framework that we execute our creative process, which acts as a "transparent box". In order to diversify the solutions, we can turn to some of the techniques that foster creativity.

1.4.2 Concept

The concept is the mental abstraction of the problem, and through it, decisions and proposals are justified. It is shaped through the design methodology, has its basis in the definition of the problem, continues its configuration through research and data analysis. Before creativity, our concept must be formed, as it will help in the decision making and generation of ideas and will end up giving rise to a proposal.

Creativity can be defined as the ability to generate ideas that blossom into original solutions. Although the creative process may seem an alchemical and complex activity, it is a deliberate, conscious and manageable process.

IN A NUTSHELL

Stages for creativity
Generally, there are four stages in the creative process:

1. **Preparation.** It consists of studying the subject/problem to be solved, informing and analysing its current state (state of the art or technique, data collection and analysis) and defining our objectives.
2. **Incubation.** The conscious and sub-conscious mind think about the problem and prepare for the generation of solutions.
3. **Illumination.** After incubation, the creative idea jumps from inner to conscious processing.
4. **Verification.** The ideas generated pass a first intuitive feasibility analysis and are assigned a degree of innovation or priority.

1.4.3 Creativity techniques

The incubation and illumination stages can be enhanced using techniques that foster creativity. These techniques make us reflect on our way of thinking, help us to break mental patterns, eliminate prejudices and open our minds to new ways of understanding problems and coming up with solutions.

Some of these techniques are summarised below:

BRAINSTORMING

Brainstorming is a group-work tool that facilitates the emergence of new ideas on a given problem. It is based on the following basic rules:

1. **Suspend judgement.** To eliminate all criticism during the brainstorming phase and to reserve evaluation for later.
2. **Think freely.** To feel free to come up with any kind of idea, no matter how impossible or crazy it may seem.
3. **Quantity.** The more ideas you come up with, the better, as this will help to generate more creative solutions.
4. **Multiplier effect.** The combination of several ideas may offer an improved idea, or an idea may emerge from improving or evaluating a previous one.

DELPHI METHOD

Another creative technique that involves two types of subjects: the coordinator and the experts. The coordinator is in charge of centralising the experts work and the experts must be people who know the design problem well and, if possible, who come from different fields in order to enrich the visions.

It consists of the following stages:

1. **Problem statement.** The problem is presented to the experts.
2. **First solutions.** The solutions provided by each expert are sent to the coordinator, who in turn passes them on to other experts anonymously. Each expert responds to the solutions provided by the coordinator with new answers.
3. **Closing.** The coordinator oversees closing the problem after the different cross answers that have been obtained.

SYNECTICS

This technique aims to overcome certain blocks when generating ideas:

Perceptual block: not seeing what the problem is or what is wrong/not working.

Cultural block: it refers to any social force that have shaped our lives, which draw rules of behaviour and thinking that hinder creativity.

Emotional block: it is internal and caused by insecurities and the stress of everyday life.

The stages for synectics method are:

1. **Turn the strange into familiar.** In any situation where a problem is posed and a solution is attempted, individuals involved are responsible for understanding the problem. This is an analytical phase in which all the ramifications and foundations of the problem must be explored.
2. **Turn the familiar into strange.** It is about distorting, inverting or transposing the everyday ways of seeing and responding that make the world a safe and familiar place. It is a deliberate attempt to achieve a new vision of the world, people, ideas, feelings and things we know. Making the familiar strange requires the use of four metaphorical mechanisms: personal analogy, direct analogy, symbolic analogy and fantastic analogy.

MORPHOLOGICAL FRAMEWORKS

This method can be used individually or in groups. It is very simple: taking advantage of much of the work carried out through the methodology proposed in the course. After the initial analysis, the problem is broken down into its essential elements. Once its elements

have been identified, a matrix is constructed to combine them and multiplying the relationships between them.

The five steps to follow are:

1. **Defining the problem.**
2. **Identification and characterisation of parameters.** Parameters are the essential elements that form the overall structure of the problem. We must identify those that are relevant and sufficiently relevant to be considered. We can start from our key factors identified for the analysis and expand them with some parameters if necessary.
3. **Construction of the morphological box.** We build a matrix whose combinations include all the possible solutions. In a basic way, after defining the parameters, all the variations we can think of for each parameter or attribute are identified.
4. **Combine possibilities.** With the complete matrix, we run through the parameters and narrow the combinations that we think are of most interest.
5. **Evaluation and analysis of the best possibilities.**

1.4.4 Case studies

DO YOU WANT TO KNOW MORE ABOUT...

MOBILITY

The urbility bicycle and mobility concept finds completely new solutions for the road safety of elderly people by focusing on stability, orientation and visibility, without being stigmatising. It was developed by students at the Muthesius Kunsthochschule, a university in Germany, with the aim of developing solutions to preserve and promote the elderly's mobility and independence. From the user research carried out, the strong preventive effect of bicycle mobility on certain diseases was highlighted, as well as its influence on an active lifestyle with social participation.

The group of students followed the principles of geronto-design by conducting user research based on the demands and needs of older adults.

This bicycle has a screen on the handlebars that acts as a rear-view mirror, avoiding the need to make sudden movements and keeping their vision in the direction of traffic. It also has two compartments at the rear to place shopping and to carry objects, among others. These compartments have a system that provides stability when the storage space is enabled, activating a mechanism that provides two additional wheels.

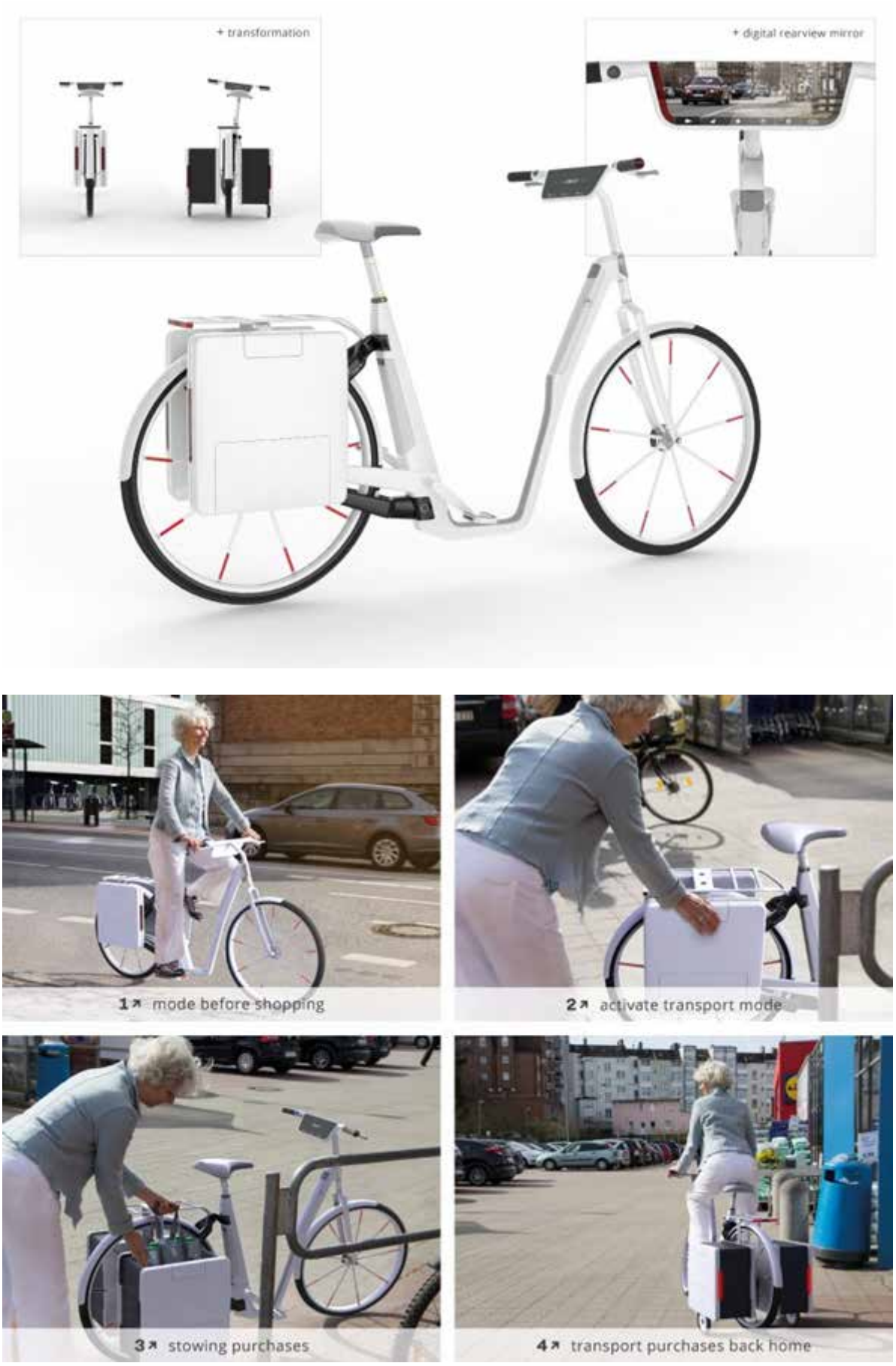

Figure 5.1.90 Urbility by Muthesius Kunsthochschule University (Muthesius Kunsthochschule University)

DO YOU WANT TO KNOW MORE ABOUT...

UNIVERSAL TABLEWARE

There is a significant part of users who have difficulty in using certain basic utensils, such as cutlery. The Eatsy tableware system, designed by Jexter Lim, aims to solve this problem improving the dining experience for people with different difficulties. The tableware set has a unique feature: a silicone flap that can be folded to increase ease of use and reduce stigma when mixed with existing tableware.

The product does not focus exclusively on the elderly, but seeks to integrate any user in need. The silicone flap helps to feel the rim of the containers, improves the visualisation of the items and makes them much easier to hold and use. It offers a particular function depending on the utensil.

Figure 5.1.91 Eatsy tableware by Jexter Lim (designboom)

DO YOU WANT TO KNOW MORE ABOUT...

FURNITURE THAT ASSISTS

The aging process brings about a natural decline in muscle tone and bone density, which contributes to a decreased stability, strength and endurance. Actions that were once simple may become more difficult with age. For example, simply standing up from a chair can be difficult for some seniors. Assunta chair assists in getting up by using the user's own body weight.

Figure 5.1.92 Assunta chair (Lanzavecchia + Wai)

DO YOU WANT TO KNOW MORE ABOUT...

FILMS AS ENTERTAINMENT

Nowadays, the digital age and entertainment services such as Netflix or HBO are making the playback of multimedia content from physical devices increasingly obsolete. Among seniors, there are a certain number of users who do not even have the knowledge or attitude to use a computer or a smart TV.

With this problem in mind, industrial designer Chen Zhigang developed a DVD player in 2020. The aim is to generate ease of use and that the user's interface and experience revolve around this concept of simplicity. The product has physical buttons that are sized for ease of use, both in terms of being located and operated by the user. In addition, their layout is determined by the function that each button performs. Finally, Zhigang labelled each action of the device with words on the back, including how to place the DVD or how to turn the volume up or down. With this clear and understandable design, he integrates senior adults and opens the door for them to become familiar with new technologies.

Figure 5.1.93 DVDISC, DVD player for senior people (yankodesign)

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MODULE 5

AGE-FRIENDLY PRODUCT DESIGN

UNIT 2

SAFE AND INCLUSIVE FURNITURE FOR EVERYBODY

Miguel Ángel Silvestre Botella • Juan Carlos Bañón Guillén • María Sánchez Melero

DESIRE

DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.

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AGE-FRIENDLY PRODUCT DESIGN

The goal of this module is to give an overview of product design with a focus on older adults and their household environment. Design matters and is one part of the solution to a more inclusive world in which all people will have equal opportunities for independence, autonomy, and participation.

Within this module, the participant will learn how to incorporate age-friendly product design into their projects given the importance of the group to an ageing or special needs population. The module is designed to involve other types of publics apart from the product designers themselves who may be interested in these issues such as older adults, their relatives or caretakers so that they themselves can create or adapt their homes.

UNIT 2 – SAFE AND INCLUSIVE FURNITURE FOR EVERYBODY

In this unit, we will explain the importance of designing and manufacturing age-friendly furniture products and how to make them safe focusing on the main concepts such as shear and pinch, moving parts, articulated elements, gaps, accessible holes and openings, corners and edges, etc. The topic is broad and covers many areas of the industry, but we will explain the main regulations that affect seats, tables, support products, beds, outdoor furniture, container furniture, etc. Furthermore, we will talk about plural, accessible and flexible design applied to containers, seated, auxiliary furniture & elements in bathrooms and kitchens.

2.1 IMPORTANCE OF MAKING SAFE FURNITURE

Safety features apply to almost every furniture you can imagine. From chairs, beds, office furniture, to children furniture, the furniture industry manufactures products all the time that surely affects to our safety and quality of life.

For ensuring safety in furniture, manufacturing companies must know about the requirements and considerations regarding the safety, that appears in every furniture standard. These standards include a lot of very different kind of tests, including static, dynamic, and stability. But also, the standards include some safety requirements. To review the most important concepts about safety concerns in furniture regulations, this list of definitions and requirements is presented:

STANDARD

Security (according to **EN 12520** – Furniture – Strength, durability and safety – Requirements for **domestic seating**)

Requirements of the standard: This are the general safety requirements of this standard:
All the parts of the seat in contact with the user during normal use must be designed so that every damage and physical injury is avoided. This requirement is fulfilled if:

- Arms, back and seat edges, in contact with the user when sitting, must be rounded or chamfered. All other accessible edges must be free of burrs or cutting zones.
- Ends of hollow components must be closed or covered.

Movable and adjustable parts shall be designed so that injuries and inadvertent operation are avoided.

It shall not be possible for any load bearing part of the seat to come loose unintentionally.
All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use.

STANDARD

Shearing and pinching points (according to **EN 12520** – Furniture – Strength, durability and safety – Requirements for **domestic seating**).

Definition: Shearing and pinching points exist if the distance between two accessible parts that move relative to each other is greater than 7 mm or less than 18 mm, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stop them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there should be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.

STANDARD

Security (according to **EN 16139** – Furniture - Strength, durability, and safety - Requirements for **non-domestic seating**).

Requirements of the standard: These are the general safety requirements of this standard:
Seats must be designed so user damage is reduced to the minimum. This requirement is fulfilled if:

- Reachable corners are rounded or chamfered.
- Edges of seat, backrest, and arms, in contact with the user when sitting, are rounded or chamfered.
- Handle edges are rounded or chamfered in the direction of the load application.
- The rest of edges do not have burrs and are rounded or chamfered.
- The ends of the hollow components are closed or covered.

Movable and adjustable parts shall be designed so that injuries and inadvertent operations are avoided.

It shall not be possible for any load bearing part of the seat to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use.

STANDARD

Shearing and pinching points (according to **EN 16139** – Furniture – Strength, durability and safety – Requirements for **non-domestic seating)**.

Definition: Shearing and pinching points are produced when distance between two accessible parts that move relative to each other is less than 25 mm and greater than 8 mm, for adults and children up to 3 years old, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there should be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.

Figure 5.2.1 Examples of domestic and non-domestic seating furniture

STANDARD

Security (according to **EN 1129-1** – Furniture – **Foldaway beds** – Safety requirements and testing – Part 1: Safety requirements)

Requirements of the standard: This are the general safety requirements of this standard:

- Construction: all accessible contours and protruding parts shall be rounded and free of burrs or sharp edges. If tubes are used, their ends must be closed.
- Articulated elements: there should be no shear and snag points unless access is protected.

STANDARD

Security (according to **EN 747-1** – Furniture – **Bunk beds and high beds** – Part 1: Safety, strength, and durability requirements)

Requirements of the standard: This are general safety requirements of this standard:

- Accessible edges and corners must be rounded or chamfered and free of burrs and sharps edges.
- There must not be tubes with open ends.
- Manufacturer must perform all connecting and guide holes.
- It must not be possible to disassemble the bed or any of its components without using a tool.

This standard also gives indications (in terms of dimensions) for any part of the bunk bed or high bed that stands out above the top part of the top bed.

- Regarding holes, gaps and accessible openings, the standard gives some dimensions to fulfil, like that any of these must not have a diameter or width more than 7 mm or less than 12 mm, unless the depth is less than 10 mm. Depending on

the analysed zone of the bed, these values will change a little bit.

- Head entrapment on the exterior of the bunk or the high bed. The standard defines a "V" tool needed for checking this safety requirement:

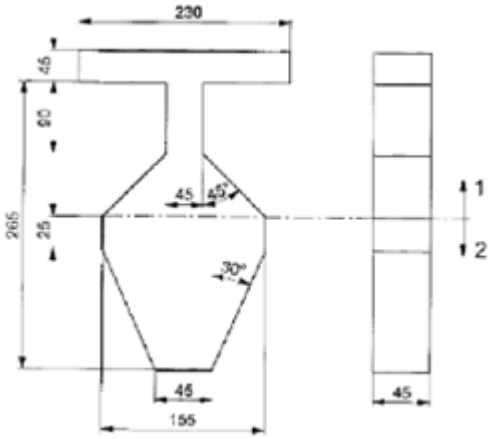

Figure 5.2.2 Template for "V" shaped openings

Finally, this standard gives some safety indications regarding the bed basis, in terms of tests and dimensions to fulfil, as well as for safety barriers and stairs or any mean of access.

Figure 5.2.3 Example of bunk bed

STANDARD

Security (according to **EN 1725** – Domestic furniture. **Beds and mattresses**. Safety requirements and test methods)

Requirements of the standard: This are general safety requirements of this standard:

- All bed components or parts that can contact the user in a normal use, must not have any burr and/or sharp edge, or tubes with open ends.
- When the bed is fully assembled and ready to use, all accessible mechanisms that ease the bed structure movement, must have a safety distance between any two elements that moves relative to each other, of ≤ 8 mm or ≥ 25 mm.
- When there is a specific danger for feet to get trapped in a mobile part, safety distance must be ≥ 100 mm from the floor.

Figure 5.2.4 Bed and mattress

Figure 5.2.5 Example of an office screen

STANDARD

Security (according to **EN 1023** – Office furniture – **Screens** – Part 2: Mechanical safety requirements)

Requirements of the standard: This are general safety requirements of this standard:
Screens must be designed so that the injury risk to the user is reduced.

All parts of the screen the user can contact in normal use conditions must be designed so that the risk of body accident or material damage is minimal. These requirements are fulfilled if:

- Accessible corners are rounded with a minimum radius of 2 mm.
- Edges that can contact the user are rounded with a minimum radius of 2 mm.
- The rest of edges are polished and have no burrs.
- The ends of hollow elements are closed or covered.
- Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

Also, the standard indicates that the manufacturer must suggest in the instructions the way of using screens in combination with additional elements, as well as the admissible charge for each kind of screen.

STANDARD

Security (according to **EN 12521** – Furniture – Strength, durability and safety – Requirements for **domestic tables**)

Requirements of the standard: This are general safety requirements of this standard:
The table must be designed so that the injury of damage to the user is reduced to the maximum.

All those parts of the table that can contact the user in a normal use, must be designed so every physical injury and damage is avoided. These requirements are fulfilled if:

- Edges of the table top in direct contact with the user are rounded or chamfered. All other accessible edges in a normal use must be free of burrs or cutting zones.
- The ends of hollow elements are closed or covered.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part of the table to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the table.

STANDARD

Shearing and pinching points (according to **EN 12521** – Furniture – Strength, durability and safety – Requirements for **domestic tables)**

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is less than 18 mm or more than 7 mm in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation, or when moving the table.

STANDARD

Security (according to **EN 15372** – Furniture – Strength, durability and safety – Requirements for **non-domestic tables**)

Requirements of the standard: This are general safety requirements of this standard:
The table must be designed so that the injury of damage to the user is reduced to the maximum.

All those parts of the table that can contact the user in a normal use, must be designed so every physical injury and damage is avoided. These requirements are fulfilled if:

- Edges of the table top in direct contact with the user are rounded or chamfered.
- All other accessible edges in a normal use must be free of burrs or cutting zones.
- The ends of hollow elements, with diameter greater than 7 mm and smaller than 12 mm, and accessible depth greater than 10 mm, are closed or covered.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part of the table to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the table.

STANDARD

Shearing and pinching points (according to **EN 15372** – Furniture – Strength, durability and safety – Requirements for **non-domestic tables**)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is less than 18 mm or more than 7 mm in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation.

- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation, or when moving the table.

Figure 5.2.6 Domestic tables

STANDARD

Security (according to **EN 16121 – Non-domestic storage furniture** – Requirements for safety, strength, durability and stability)

Requirements of the standard: This are general safety requirements of this standard:
The storage furniture must be designed so that the injury of damage to the user is reduced to the maximum.

All those parts of the furniture that can contact the user in a normal use, must be designed so every damage is avoided. These requirements are fulfilled if:

- Accessible parts are rounded or chamfered, and all accessible edges during normal use, do not have burrs or cutting edges.
- Feet of tubular components must be covered or closed in any way.
- Open ends of tubular components, reachable during normal use, must be covered or closed in any way.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the product.

If they can produce any damage, tambour doors and vertical sliding doors, including those built with hinged elements, must not be able to move by themselves from any position placed at a height above 200 mm measured from the closed position.

To avoid point in where feet can be trapped, safety height for mobile parts of vertical displacement must be greater or equal to 100 mm from the floor.

No removable element or tray can be detached from the furniture when a extraction force of 200 Newtons is applied to the handle of the loaded removable element or tray.

This standard also mentions special requirements for:

- Horizontal hinged covers
- Glass vertical components

STANDARD

Shearing and pinching points (according to **EN 16121 – Non-domestic storage furniture** – Requirements for safety, strength, durability and stability)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is less than 25 mm or more than 8 mm in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation, except for doors, folding covers and removable elements and their fittings.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation, except for doors, folding covers and removable elements and their fittings.

Figure 5.2.7 Storage furniture

STANDARD

Security (according to **EN 1729** – Furniture – **Chairs and tables for educational institutions** – Part 2: Safety requirements and test methods)

Requirements of the standard: This are general safety requirements of this standard:

- Arms, backrest and seat edges, in contact with the user when sitting, must be rounded with a minimum 2 mm radius, or chamfered.
- Edges of handles must be rounded with a minimum 2 mm radius, in the direction of the application of the force.
- All other accessible edges and corners that can contact the user in a normal use must be soft, rounded, or chamfered, and free of burrs.
- Distance between accessible mobile parts, actuated by the action of energy accumulation mechanisms, like gas cylinder for example, must be always < 8 mm or ≥ 25 mm.
- There must not exist accessible gaps > 8 mm and < 25 mm, produced in normal use, except during colocation and folding of tables and chairs.
- Regulation controls must not be activated inadvertently or accidentally.
- Open edges and ends of tubular components must be covered or closed.
- The different parts of the furniture must not be possible to disassemble without using the proper tools.
- Those parts of the furniture that are lubricated, must be covered to avoid stains.
- The finishing of the work surface must not exceed matt-silky (which is 45 units of brightness or an inferior value of 20 determined by a reflectometer at 60°), in order to reduce to the minimum, the specular reflection according to EN 13722 at 60°.

Standard also defines safety stability, strength and durability tests for both chairs and tables.

Figure 5.2.8 Chairs and tables for educational institutions

STANDARD

Security (according to **EN 581-1** – Outdoor furniture – **Seating and tables for camping, domestic and contract use** – Part 1: General safety requirements)

Requirements of the standard: This are general safety requirements of this standard:
For avoiding physical damage when the product is in use configuration, all edges and corners must be rounded, chamfered, or protected in any way. This applies to:

- Seats: Edges of seat, backrest and arms, and any part of the inferior side of the seat positioned at a distance lower than 120 mm of any edge, where a finger can easily access.
- Tables: Top of the table, any part of the inferior side of the top of the table positioned at a distance lower than 500 mm of any edge below the table, where the knee and/or the arm can easily access.

The rest of the furniture parts must be free of burrs and cutting zones.

Moving and regulable parts are designed so the accident risk and involuntary operation is avoided.

It shall not be possible for any structural part to come loose unintentionally.

All parts that are lubricated to assist sliding, shall be designed to protect the user from lubricant stains when in normal use of the product.

Tubular components. The standard also gives some requirements for these components:

- There must not be accessible holes in the ends of tubular component with diameter between 7 mm and 12 mm, and depth more or equal to 10 mm.
- The end of tubular legs in contact with the floor must be covered or closed. However, holes are allowed if there are not between 7 mm and 12 mm.

The standard defines some test probes so all these requirements can be checked:

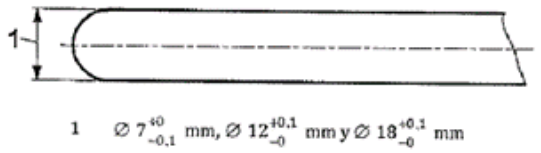

Figure 5.2.9 Definition of measurement test probes

Figure 5.2.10 Example of the three measurement test probes

STANDARD

Shearing and pinching points (according to **EN 581-1** – Outdoor furniture – **Seating and tables for camping, domestic and contract use** – Part 1: General safety requirements)

Definition: Shearing and pinching points are produced when the distance between two accessible elements that move relative to each other is greater or equal to 7 mm and lower or equal to 18 mm, in any position during movement.

Requirements of the standard: Requirements are divided into:

- Shearing and pinching points during assembling and folding. The standard considers here that shear and pinch points are acceptable, because the user can control

the movements and stopping them anytime.
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation. Test probes must be used for checking this requirement.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.

Figure 5.2.11 Outdoor/camping chair

STANDARD

Security (according to **EN 1335-2** – Office furniture – **Office work chair** – Part 2: Safety requirements)

Requirements of the standard: This are general safety requirements of this standard:
Chair must be designed so the risk of injuries to the user is minimized.

All those parts of the chair that can contact the user in a normal use condition, must be designed so physical injuries and material damage are avoided. These requirements are fulfilled if:
- Armrests, backrest and seat edges in contact with the user when sitting are rounded with minimum 2 mm radius.
- Edges of adjustment mechanisms are rounded or chamfered in the direction of the applied force.
- All other edges and corners are free of burrs and are rounded or chamfered.
- Ends of tubular components must be covered or closed.

Mobile or adjustable parts must be designed so injuries or involuntary operation are avoided. It must be possible to actuate the adjustment devices from the sitting position in the chair.
It must not be possible to involuntary lose any load support part of the chair.

STANDARD

Shearing and pinching points (according to **EN 1335-2** – Office furniture – **Office work chair** – Part 2: Safety requirements)

Definition: Existing point if the distance between two accessible elements that move relative to each other is lower than 25 mm and greater than 8 mm, in any position during movement.

Requirements of the standard: Requirements are divided into:
- Shearing and pinching points produced for the action of energy accumulation mechanisms. Standard says there must be no shear and pinch points in this situation.
- Shearing and pinching points during use. Standard says there should be no shear and pinch points in this situation.

Figure 5.2.12 Office furniture, and office work chairs

2.2 FURNITURE STANDARDS

All kind of furniture are shown in showrooms, retails and fills all kind of commercial and also residential spaces. We use furniture to help our homes, offices, etc. to be more liveable, comfortable and also functional. At the same time, we trust these products meet our expectations of performance, comfort, safety and wellness.

For that, it is necessary to navigate local and national regulatory requirements, meet customer specifications and efficiently respond to market demands. Collectively, these efforts help manufacturers remain competitive and help to make a safer, more sustainable future for the furniture industry.

2.2.1 What is a standard?

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Definition of standard: A standard is a technical document of repeated or continuous application, which establishes the conditions and characteristics to be met by a product for its acceptance in the market. In principle, they are not mandatory, but it may be, as they are referred to some directive or regulation.

Furniture contributes to the functionality and usefulness of every inhabited space, including commercial and institutional settings, residential environments, and retail establishments, as well as outdoor recreational areas. As general living standards continue to improve for billions of people around the world, the global demand for furniture and furniture products is expected to experience continued strong growth and provide important business opportunities for furniture manufacturers.

However, to effectively capitalize on these market opportunities, furniture manufacturers today are required to meet a broad set of compliance challenges that may include safety, product performance and environmental considerations to gain market acceptance. Specific compliance issues may include performance and mechanical requirements, flammability, exposure to potentially harmful chemicals, and product safety. Furniture products intended for specific user groups such as children are often subject to additional testing and evaluation. And specific procurement requirements and buyer expectations may further add to the testing and assessment that furniture manufacturers must address.

The furniture industry produces a wide range of products used in commercial and residential settings. The major categories of furniture include:

- Office Furniture. Including desks, seating, storage units, etc.
- Household furniture
- Bedding and mattresses
- Children furniture. Including beds, cribs, bunk beds, mattresses, etc.
- Commercial displays and retail furniture

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Organisation in charge of making standards:

- ISO, of international level.
- CEN, for CEE and EFTA countries.
- National organisms for other countries, like AENOR, for Spain.

Among normative texts, ISO standard is the most universal one. Also, there are national organisms for making standards:

- AENOR (Asociación Española De Normalización y Certificación).
- BSI (British Standard Institution).
- AFNOR (Association Française de Normalisation)
- ANSI (American National Standards Institution)
- Etc.

2.2.2 Types of furniture testing and assessments

All the existent furniture standards are referred to one of these aspects: dimensions and shapes, suitable materials, testing (strength, stability, quality, durability…).

The scope of testing and conformity assessment applicable to a specific furniture product is determined by several factors and can vary significantly from product to product. However, there are several important types of testing to which most furniture products are subjected. The following sections describe a little bit each of these tests:

- **Performance:**

This kind of testing is intended to evaluate a furniture product's ability to withstand wear and tear under normal, anticipated use. A good example of these tests can be durability tests.

DO YOU WANT TO KNOW MORE ABOUT...

EN 13759 – Furniture – Operating mechanisms for seating and sofa-beds – Test methods. The scope and field of application of this standard is to stablish he test methods for establish the durability of the tilting, both manual and automatic, of seating for adults, and also the durability for converting sofas into beds.

Figure 5.2.13 Some furniture material tests

- **Mechanical Testing:**

They are intended to evaluate the mechanical aspects of a furniture product and to identify product aspects that could lead to mechanical failure, thereby posing a potential safety risk to consumers. While not a specific regulatory requirement, mechanical testing can demonstrate a manufacturer's commitment to safety and provide a defense against claims of unsafe products. For example, structural tests can assess a furniture product's static and dynamic load-handling ability, deflection characteristics, swivel duration, and general strength and stability.

In this category they are included mechanical safety testing, that assesses risks associated, for example, with sharp points and edges, entrapment of fingers and others, shearing and pinching points, etc.

DO YOU WANT TO KNOW MORE ABOUT...

EN 1022 – Furniture – Seating – Determination of stability. The scope and field of application of this standard is to determine the stability of all kind of seats for adults up to 110 kg, regardless the use, materials, design or manufacturing process.

Figure 5.2.14 Office chair being mechanically tested

- **Electrical safety:**

Many furniture products incorporate electrical or electronic components to provide more functionality, like illumination, operation, control of features, etc. These products are subject to mandatory testing for electrical safety in most jurisdictions. The goal of electrical safety testing is to identify potential electrical hazards, and to evaluate how a product's design or construction eliminates or minimizes the risk of fire or shock. Testing for electrical safety is typically conducted in accordance with the requirements of those standards applicable to specific categories of furniture products.

DO YOU WANT TO KNOW MORE ABOUT...

IEC 60335-2-116:2019 – Household and similar electrical appliances – Safety – Part 2-116: Particular requirements for furniture with electrically motorized parts. This part of IEC 60335 deals with the safety of furniture with electrically motorized parts intended for household and similar purposes, their rated voltage being not more than 250 V.

- **Flammability:**

Furniture products are usually composed of materials that are potentially flammable, such as wood and upholstery fabrics, adhesives, paints and varnishes. As a result, furniture products can serve as a primary ignition point or fuel source for indoor fires. For these reasons, most jurisdictions require flammability testing for fabrics and upholstered furnishings. Flammability testing evaluates the suitability of materials for use in furniture products by assessing their resistance to the effects of heat or flame as well as their burn and heat release characteristics. Specific types of flammability testing can include:

- Ignition testing. It determines a furniture material's resistance to ignition when exposed to heat or open f lame.
- Flame spread testing. It evaluates the speed at which fire spreads from first ignition.
- Heat-release characterization. It assesses the amount of heat build-up contributed by burning furniture.

DO YOU WANT TO KNOW MORE ABOUT...

EN 1021-1 – Furniture – Assessment of the ignitability of upholstered furniture – Part 1: Ignition source smouldering cigarette. This standard describes a test method for evaluating the flammability of different combinations of materials, when the source of ignition is a smouldering cigarette.

- **Environmental Sustainability:**

Increasingly, product specifiers, procurement specialists and consumers are demanding "green" furniture products, i.e., products made with more sustainable materials, or products that have been produced using methods and processes that have reduced environmental impact. Furniture that has been evaluated for environmental sustainability can contribute qualifying points under several green building certification initiatives. Further, evidence of environmental sustainability can address the interests of consumers and help manufacturers distinguish their furniture products in a competitive marketplace.

- **Chemical Content and Chemical Emissions:**

The use of chemicals in furniture and the control of chemical emissions from furniture products are tightly regulated in most jurisdictions worldwide. European Union (EU) Regulation (EC) No. 1907/2006, also known as the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) Regulation, is applicable to most chemicals and chemical containing products manufactured, imported, or sold in the EU.

Given the wide range of furniture products and the complex and sometime confusing and conflicting regulatory process, manufacturers can be confused as to how to evaluate their own furniture. It is highly advised to **understand regulatory requirements and market demands**, because Furniture and furniture products are subject to varying regulatory requirements that differ from jurisdiction to jurisdiction. The regulatory landscape is further complicated by the various types of furniture products and how individual products are categorized under the applicable requirements.

To successfully navigate this complex landscape, furniture manufacturers should develop a thorough understanding of the regulatory requirements applicable to their specific products in any targeted jurisdictions, and continuously monitor regulatory developments to avoid surprises.

It is also important to **know the required and recommended testing when products are being developed**. Identifying applicable tests and assessments at the earliest possible stages of the product development process can result in product design and materials selections that contribute to better test outcomes and reduce the likelihood of unexpected setbacks that require product redesign.

Furniture manufacturers should consider to partnering with independent test laboratories, that are depth involve in furniture testing field.

2.3 PLURAL AND ACCESSIBLE DESIGN

2.3.1 Social design

Since the origins of design as a profession, visions of design as a mode of action focused on solving problems. People and society's needs have been linked to the evolution of the discipline.

The role of design as a social actor has been transformed in parallel with the changes that society has undergone. Design is directly related to the technical and industrial development that has caused profound changes in the social environment and is associated with market forces, but since its beginnings, proposals, orientations and initiatives have emerged that reflect an awareness of the problems and needs of society. Design recognises its responsibility for the future of humanity and the planet's resources, and therefore proposes approaches that go beyond satisfying the needs of the market. Thus, design becomes a social, environmental, cultural and political actor.

This design orientation has been named "social". Different definitions can be attributed to the term social design, as there is no common language to unite ideas among the professionals themselves.

Undoubtedly, design is a social activity as it is intrinsically a collaborative action involving several groups of people among the design team itself, such as clients, users, manufacturers or consultants. Moreover, the aim of designed products is to be of use and to become part of the dynamic structure of our daily activities, but in this perspective, the social is only approached from the materiality or the physical.

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The main objective of social design is to satisfy human needs, as opposed to market design, whose main objective is the creation of products for sale. The term "social" in design stands for being at the service of society. Therefore, it refers to a design practice or area of design committed to solving social problems.

It should be noted that, although many of the products designed from a market approach may satisfy a social need, this is not their priority, leaving out of their range some groups of people, either because of their income level or because of their specific needs delimited by their conditions of age, health, disability or habitat.

The term social design brings together different approaches that direct their efforts towards the same objective: to find solutions or provide creative responses to the problems that afflict a community, being of a diverse social nature, such as the dissatisfaction of needs or the expression and demand for their rights and freedoms.

METHODS. HUMAN-CENTERED DESIGN

Since the end of the 20th century, a humanistic vision of design called Human-Centered Design (HCD) has been consolidated. This vision focuses on the design of experiences rather than the design of objects. Its foundation is the deep understanding of people's needs and aspirations to be impacted through design actions in design. According to IDEO.org (2014), HCD is a process and a set of techniques used to create innovative solutions, which include products, services, spaces, organisations and modes of interaction.

The desirability dimension is assumed as a perspective throughout the design process and, based on its identification, proposals are constructed and evaluated in the light of what is technically feasible and economically viable.

It is one of the most common methods when considering a project from a social design perspective by seeking various ways of understanding the members of a community and their needs, creating innovative responses and implementing them, considering financial, technical and social sustainability.

The process of this method starts with the identification of a specific challenge to be solved and goes through three main phases: listening, creating and delivering. During the process, it iterates between specific observations, abstract syntheses and the design of concrete solutions.

- In the listening phase, the design team collects stories, anecdotes and inspirations and prepares the research and fieldwork.
- The create phase is the most robust phase of the process and involves gathering what has been observed in people and putting it into theoretical frameworks, opportunities, solutions and prototypes, moving from concrete thinking to more abstract thinking in identifying issues and opportunities, and then back to the concrete through solutions and prototypes.
- In the delivery phase, solutions are defined and evaluated in the light of financial modelling, resource and capacity assessment and implementation planning.

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SOCIAL DESIGN FUNCTIONS

Social Innovation

Generate and strengthen the abilities of people, institutions and societies to perform their functions, solve problems and achieve objectives in a sustainable way, fostering joint learning and the exchange of resources between all the actors involved in social dynamics. It also favours the creation of opportunity structures to empower citizens in the creation and organisation of spaces for dialogue and action that reinforce their basic rights and freedoms.

From a Social Design perspective, it should be about triggering and supporting social change and thus promoting social innovation. Design for social innovation implies a socio-technical transformation driven by social change. The designer must use empathy to recognise and understand the contributions and complexity of the environment in which their reality develops, from their place in a multidisciplinary team, he must contribute his integrating vision and promote the exchange of knowledge.

Social responsibility

From the perspective of social design, one of the main handicaps is to find coherence and balance between the ethics and social and environmental responsibility of the designer's profession, with innovation and technological and scientific development.

On most of occasions, the professional practice is driven by the demand of a client with the aim of obtaining an economic response. However, every designer should have the social awareness to understand that his or her product provides qualities that go beyond marketing, beyond the impulse of a commercial transaction, and must, therefore, provide added value to the product in relation to its usability. The challenge lies in reconciling and articulating the two qualities of design, the impulse of consumption and the social value of the product.

John Thackara (2005) called this challenge "conscious design". It has the following features:

- Pre-implementation analysis of the consequences of actions, paying particular attention to the natural, industrial and cultural systems present in the context in which the actions are carried out.
- Consider materials and energy resources involved in the systems to be designed.
- Treat content as what we make, not what we sell.
- Work with place, time and cultural differences as positive values.
- Focus on services rather than things, and refrain from flooding the world with meaningless artefacts.

Activism

In this context, activism is understood as the promotion of actions that involve the public expression of criticism, dissatisfaction and dissent against the government, regime or system and that seek to create conditions for change. As a citizen, the designer is called to participate in the political, social and cultural spheres. From the perspective of activism, the designer must influence and intervene in decision-making.

In this case, it is difficult for social design to take on an activist function, as it is a product that is the result of a commission and must build tools for the education and participation of citizens, propose new forms of social welfare, serve as a channel for critical expression and social denunciation, present, comment on and make visible issues that are ignored or blocked by the dominant system or regime.

2.3.2 Design thinking

Design thinking is a process for creative problem solving and solution creation with the intention of achieving a better future outcome. It is a solution-focused (not problem-focused) way of thinking and solving that emerges with the establishment of a goal.

This approach differs from the analytical scientific method, which starts with the definition of the problem's parameters in order to devise a solution. Both known and ambiguous aspects of the current situation are identified and investigated in order to uncover hidden parameters and open up alternative pathways. Design thinking is iterative, as it looks for different starting points and paths to find alternative solutions, including redefining the initial problem.

Design thinking is especially useful for tackling problems that are not defined correctly or are very complex. This definition fits well with the nature of social problems, where it is difficult to determine solution paths and requires much more than specific, technical knowledge about a situation.

According to Amalio Rey (2011), it is an anthropological approach that does not focus on the person or their role as a client, but rather on appreciating them from an integral approach that allows us to understand what they experience, how they experience it and how it affects their lives, what is designed or proposed as a solution.

The process starts with a problem statement and an analysis of the needs, the relationship to the context and the behaviour of the people involved. Then, ideas are developed, and solution paths are proposed without setting limitations. These, once selected, filtered and/or mixed, are expressed through rapid prototypes or sketches where, after successive feedback, an innovative and sustainable solution will be obtained. According to Herbert Simon (1996), this method can be summarised as follows: define, research, devise, prototype, choose, implement and learn.

2.3.3 Strategic design

Strategic design is the application of systematic challenge-oriented design principles, which enhances an organisation's innovative qualities and competence for the future. It redefines how to address problems, identifying opportunities for action and leveraging more comprehensive and resilient solutions.

According to Prodintec (2009), strategic design is a new way of designing in a mutant context, where the boundaries of disciplines and typologies of problems to be solved are in permanent hybridisation and interaction. It is based on the analysis of external and internal data and trends, which allows for fact-based design decisions. As such, it is considered an effective way of connecting innovation, research, management and design.

Strategic thinking makes it possible to detect the connections, signs and rituals in the relationships between actors, natural and artificial systems, and thus to mediate and link private, public, political and community

entities. It proposes the establishment of common objectives among the actors involved and a language that allows them to work and cooperate. It is understood as a process that is not only carried out by designers but has a transversal orientation.

These characteristics mean that strategic design is used as an instrument for the development of social projects, as it gives priority to a systemic vision of both the problem and the organisation, and promotes the transfer and exchange of knowledge, cooperation, commitment and sustainability.

2.3.4 Participatory design

Faced with the need to address social problems and needs, participatory design emerges as a way of linking and integrating users in the planning, decision making and implementation of solutions. The opinion of social groups has the power to give meaning to and reflect their needs and thus contribute to the implementation of better solutions based on collective decisions.

Participatory design can be understood as the articulation of factors in favour of the construction of a solution through a process that links design and planning professionals with users or beneficiaries for the collective construction of a solution in which, directly or indirectly, they will be involved or affected.

This work dynamic requires the designer to acquire and implement skills and knowledge that allow him to be a promoter, advisor and negotiator between the members of the community and the entire organisational or productive bureaucratic apparatus.

DIVERSITY OF USERS

The design of a product, system or service is not simply a case of designing to the specifications required for a "standard" person, as there is no exact equality between any human being. Some differences between people are innate and last a lifetime, some may be occasional, while others develop slowly over time. Whatever the reason, differences between individuals must be taken into account in any design.

When creating, designing or proposing a product, object or service, the user is one of its fundamental pillars, since it is up to him to keep it 'alive'. When considering the needs approach, the greatest possible integration of the different groups of people should be the objective. The non-integration of a group of people harms both sides of the system; on the one hand, the company misses the opportunity to generate profits from as many users as possible, on the other hand, there is a group of users who do not benefit from the product or service.

USER RESEARCH

When researching a user group, different techniques can be used to derive the needs of the users. By means of research techniques, habits, behaviours, needs, desires or demands can be found out. The different research techniques can be surveys, interviews, expert analysis, forums or assemblies, where users or specialists discuss within the parameters of the research, social indicators, being these the main ones (Moreno, 2007).

DIFFERENCES BETWEEN PEOPLE

The normal distribution governs most of the quantifiable human attributes (especially physical characteristics). This distribution is found throughout nature and is represented by the figure below:

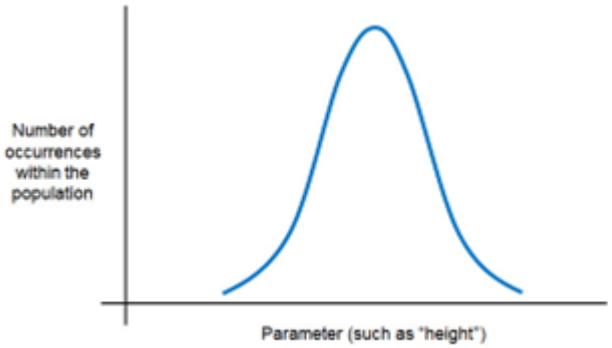

Figure 5.2.15 Average value of the parameter height within the population

This shows that the average value within a population will be the most common, with more extreme values progressively less common. There is no such thing as a so-called "normal person", as it is almost certain that no living being is exactly average in all possible parameters. Instead, the population is made up of individuals who may be above or below in the distribution of some parameters.

AGE-RELATED DIFFERENCES

As people age, their senses and faculties change. Senses such as sight and hearing are affected, but also aspects such as mobility or mental speed. In younger users, senses generally work well, but cognitive abilities may not be at an adequate level, which can affect decision-making.

To learn more about different characteristics that influence our perspective on older people read the Module 1, Unit 2.

SOCIAL AND CULTURAL DIFFERENCES

Such differences are often noticeable and more difficult to quantify than age-related differences. Their impact can be predicted up to a certain level.

DO YOU WANT TO KNOW MORE ABOUT...

CONSIDERATIONS.
WORST-CASE SCENARIO DESIGN

In the design of a door, it would be an absurd mistake to use the average height of the distribution, as it would exclude almost half of the users. In this case, the door should be designed to accommodate the tallest users, as this does not limit any of them.

2.3.5 Design for all

Sometimes it is not possible to provide a joint solution. A percentile solution is often adopted in order to provide a solution to the largest number of users, trying to find a range centred on the distribution. For example, with a percentile from 5th to 95th that would provide a solution to 90 % of the population, it should be evaluated how it affects the people who have not been covered and see if they are acceptable or if a complementary solution should be provided or a totally different solution should be sought.

To learn more about different design paradigms, read Module 3 Unit 1.

2.3.6 Universal design

As we have studied in Module 3, unit 1, Universal design is a paradigm for the inclusion of the greatest number of people without the need to adapt or redesign them in a special way, being the access to design for all the society.

Universal Design can be defined as the activity of conceiving or designing environments, processes, goods, products, services or objects so that they can be used by all people, or at least by as many people as possible.

According to Ron Mace (1990), things that most of the population can use, regardless of ability or disability, can be considered universally usable. Universal design guides the scope of accessibility and suggests making all elements and spaces accessible and usable by all people. Its goal is to simplify daily tasks by making products, services and environments more user-friendly and effortless, considering all ages and abilities, and not by separating people, but by making products suitable for all.

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UNIVERSAL DESIGN PRINCIPLES

Some principles guiding the concept of universal design have been established by the groups involved in products, goods or services design:

- Equality of use: the design should be easy to use and suitable for all people regardless their abilities and skills.
- Flexibility: the design should be adaptable to a wide range of individual preferences and abilities.
- Simple and intuitive: the design should be easy to understand regardless of the user's experience, knowledge, skills or level of concentration.
- Easy-to-perceive information: the design should exchange information with the user, regardless of their sensory capabilities or the environmental conditions.
- Error tolerant: the design should minimise accidental or chance actions that could have fatal or unintended consequences.
- Low physical effort: the design should be used efficiently and with as little effort as possible.
- Appropriate dimensions: sizes and spacing should be appropriate for the user's reach, handling and use, regardless of size, position and mobility.

Figure 5.2.17 Variable sink

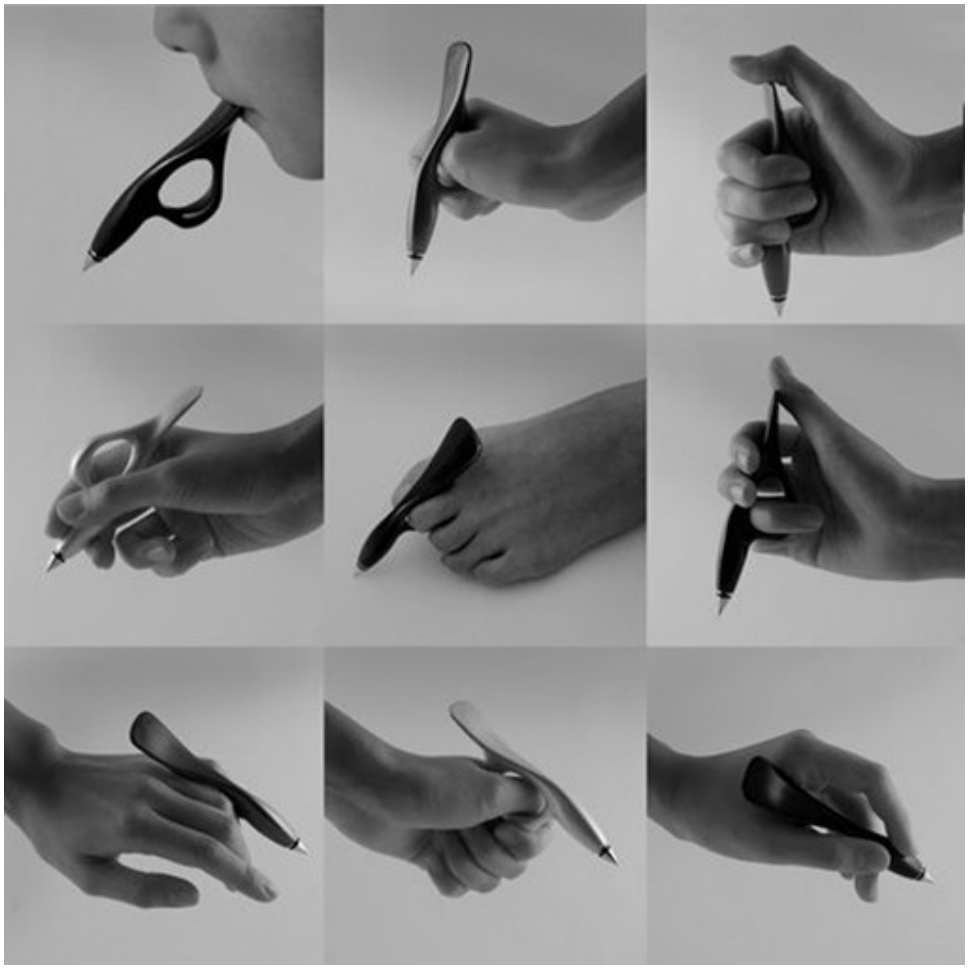

Figure 5.2.18 U-Wing pen

Figure 5.2.16 Hinged hangers

LINK WITH AGE-FRIENDLY DESIGN

The first link between universal design and age-friendly design is transgenerational design. James Pirk (1984) defines it as the practice of making objects and spaces that do not restrict people with physical and sensory impairments associated with aging in their daily activities.

The main objective of transgenerational design is to improve the quality of life of people of all ages by promoting optimal aging, softening its impacts and extending independent living. In more detail, it seeks to help a broad age group by bridging the different stages of life, offering a variety of means to perform daily activities, helping to maintain self-esteem, enabling social interaction and supporting intergenerational relationships.

5.4 FLEXIBLE FURNITURE. VERSATILE SYSTEMS

Quality multifunctional furniture is versatile in its ability to adapt to many situations. Modular, reconfigurable elements provide freedom in arranging your home's decor.

In this chapter student will learn about flexible and versatile furniture from several practical and real examples. Here are these examples:

DO YOU WANT TO KNOW MORE ABOUT...

UNIO PROJECT

Unio is the given name to the winner furniture in the International Furniture Industrial Design Award of 2020, organized by CETEM.

Unio is a dynamic and modular furniture system that seeks interaction between the user and the furniture and allows the customization and adaptation of spaces.

Composed of three types of pieces so that users can adapt and personalize their spaces, making Unio a modular, flexible, long-lasting, sustainable, interactive, and up-to-date system.

Figure 5.2.19 How Unio can be used

LEVELS PROJECT

Levels is an individual seat that can be configured to adapt to the needs of the user. This project won the second prize in the International Furniture Industrial Design Award of 2020, organized by CETEM.

It covers the functions of chair and stool, its morphology varies depending on the preferences established by the user (height, footrest, backrest, etc.).

Levels is a fully customizable seat. A single product for up to six different seat versions. It is made by a seat and a backrest, made of pine wood and a metal structure. The structure is divided into four pieces that, joined together, can be adjusted in height and comfort of many types of users.

Figure 5.2.20 Different configurations of "Levels"

Unio components are:

- The main structures, which are large static pieces that do not usually move.
- Complements, which enhance and add functionality to the main bodies.
- The unions, which act as a fastening between the complements and the main bodies. Its 5 varieties allow the user to join and disjoin the complements and adding or modifying the functionalities.

The materials chosen for its production are versatile and easy to handle. All the pieces are manufactured with the same diameters and processes, thus allowing serialization.

TWO BE PROJECT

Two Be is an innovative hybrid concept between a sofa and auxiliary furniture: it is a versatile and flexible piece that allows multiple and functional configurations to be created. It is a modular system made up of a wooden structure that acts as auxiliary furniture and several upholstered modules (seats, poufs and backrests).

The goal of the project was to create a user-adapted product that “can be” what he needs at any time. Thanks to its modular design, different compositions are created by moving the seat and backrest modules.

The solution solves the problem of small spaces, optimizes each room and allows different daily activities to be carried out. It can be a space for leisure, reading, receiving visitors, working, etc. and it allows the creation of flexible and personalized environments.

Two Be also has a wide space for storing and the possibility of adding container accessories.

Figure 5.2.21 Two Be furniture composition

Figure 5.2.22 Different kind of compositions. Versatile and flexible

2.5 FUNCTIONAL DIMENSIONS AND THEIR MEASUREMENTS METHODS

When designing furniture, functional dimensions must be considered, that with other factors, determine the user posture and the ergonomic adequation.

For measure functional dimensions in furniture, it is needed a standard procedure that allow to obtain repeatable measurements. That implies that furniture is measure in use conditions, so dimensions are taken like the user is experimenting them. And it also implies to have some unmistakable reference points, for knowing exactly where to measure.
For that, it is used, according to standards, some chair charge simulator and similar equipment. Problems appear once the chair is charged: to know where to measure is not always easy, because the shape of chairs and their elements, for example.

So, according to several European, but also International Standards, there are methods for taking measurements on some specific furniture. Normally, if any standard indicates dimensions and so on, it will also indicate how to perform the measurements.

Here there are some examples of measurements methods and functional dimensions.

2.5.1 Seats. Determination of backrest inclination angle, angle between seat and backrest and seat inclination.

This measurement method appears in EN 1728 standard, Furniture – Seating – Test methods for the determination of strength and durability. It also appears in some other standards, such as EN 1022.

For doing some tests it is necessary to measure these angles with some special equipment.

It should weight 20 kg. It is also used for determining the points in which loads and forces are applied to seat and backrest.

This is a solution for this equipment:

Figure 5.2.23 Loading points template. Solution for the equipment

The inclination angle of the backrest is measured by determining the inclination of the right part of the template, like this:

As it can be seen on the figure, the angle between seat and backrest is also measured with this method. Also, seat inclination may be measure.

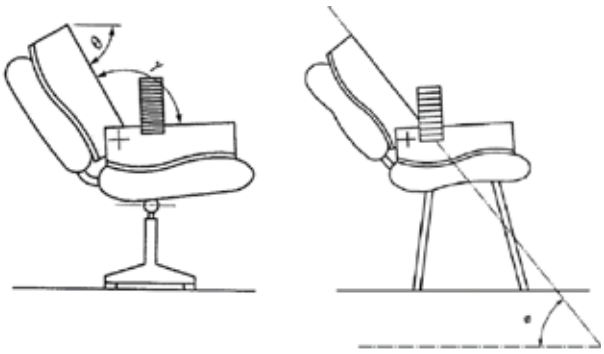

Figure 5.2.24 Chairs with the template on them, and the angle to measure

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RECOMMENDED VALUES

For multipurpose chairs, some recommended values for the angle between seat and backrest are:

- Between 105° and 110°, for the posterior-middle posture.
- Between 100° and 105°, for the anterior-middle posture.

For multipurpose chairs, some recommended values for the seat inclination are:

- Between 7° and 10°, for the posterior-middle posture.
- Between 3° and 5°, for the anterior-middle posture.

For relax furniture, the recommended relations between seat inclination and the angle between seat and backrest are:

- Seat inclination: 0°. Minimum seat-backrest angle: 125°.
- Seat inclination: 5°. Minimum seat-backrest angle: 123°.
- Seat inclination: 10°. Minimum seat-backrest angle: 120°.
- Seat inclination: 15°. Minimum seat-backrest angle: 115°.
- Seat inclination: 20°. Minimum seat-backrest angle: 110°.

For resting armchairs, for more upright postures, recommended values are:

- Seat inclination: between 8° and 15°.
- Seat-backrest angle: between 105 and 115°.

For relax armchairs:

- Seat inclination: between 15° and 25°.
- Seat-backrest angle: greater than 115°.

For armchair with regulable angles:

- Seat inclination: between 5° and 25°.
- Seat-backrest angle: between 105 and 140°.

For armchairs for elderly:

- Seat inclination: 10°
- Backrest inclination: 20°

2.5.2 Office chairs. Determination of dimensions

EN 1335-1 – Office furniture – Office work chair – Part 1: Dimensions – Determination of dimensions, specifies the dimensions of 4 different office chairs and the test methods for its determination.

To implement this standard to an office chair, it is necessary to have available the following standard: ISO 24496 – Office furniture. Office chairs. Methods for the determination of dimensions, that specifies methods for the determination of the dimensions of office chairs.

ISO 24496 defines the test equipment for doing all measurements in any office chair. It is needed just one equipment, which name is the Chair Measurement Device or just CMD.

The completed CMD, installed and well positioned in an office chair looks like this:

Figure 5.2.25 Examples of CMD placement fixture with chair and CMD

It is necessary to implement some steps for setting-up the chair correctly. It is also necessary to implement some steps for placing the CMD on the office chair correctly, before starting measures:

With the CMD correctly positioned in the office chair, it is possible to start measurements, which are supposed to be in this order:

1. Lumbar support protrusion and height. Distance from the backrest line to the most prominent segment (or segments) of the lumbar support as determined by the measuring indicators on the CMD, measured perpendicular to the backrest line.

It is possible to measure maximum horizontal protrusion, minimum horizontal protrusion, maximum vertical height and minimum vertical height, and vertical lumbar adjustment mechanism travel.

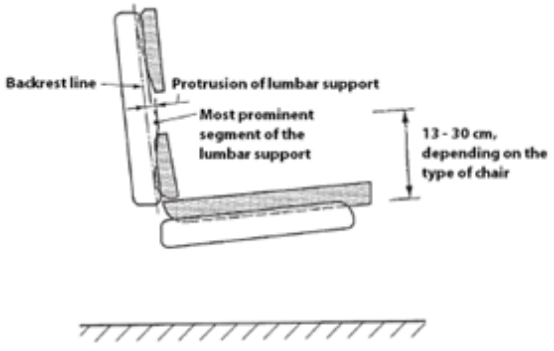

Figure 5.2.26 Lumbar support. Protrusion

Key
1 pressure gauge
2 pressure pump
3 lumbar support protrusion and height measurement vertically stacked segments
4 lumbar support protrusion scale
5 lumbar support height scale

Figure 5.2.27 Lumbar support protrusion and height measurement (overall view)

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for lumbar support height are:

- For simple office chair: 15 – 25 cm if regulable, 19 – 21 cm if not.
- For computer office chair: 15 – 30 cm if regulable, 20 – 23 cm if not.
- For multipurpose chairs, for the posterior-middle posture: 13 – 15 cm.
- For multipurpose chairs, for the anterior-middle posture: 15 – 17 cm.
- For resting armchairs: 13 – 18 cm.

2. Inclination of seat, and backrest and angle between seat and backrest.

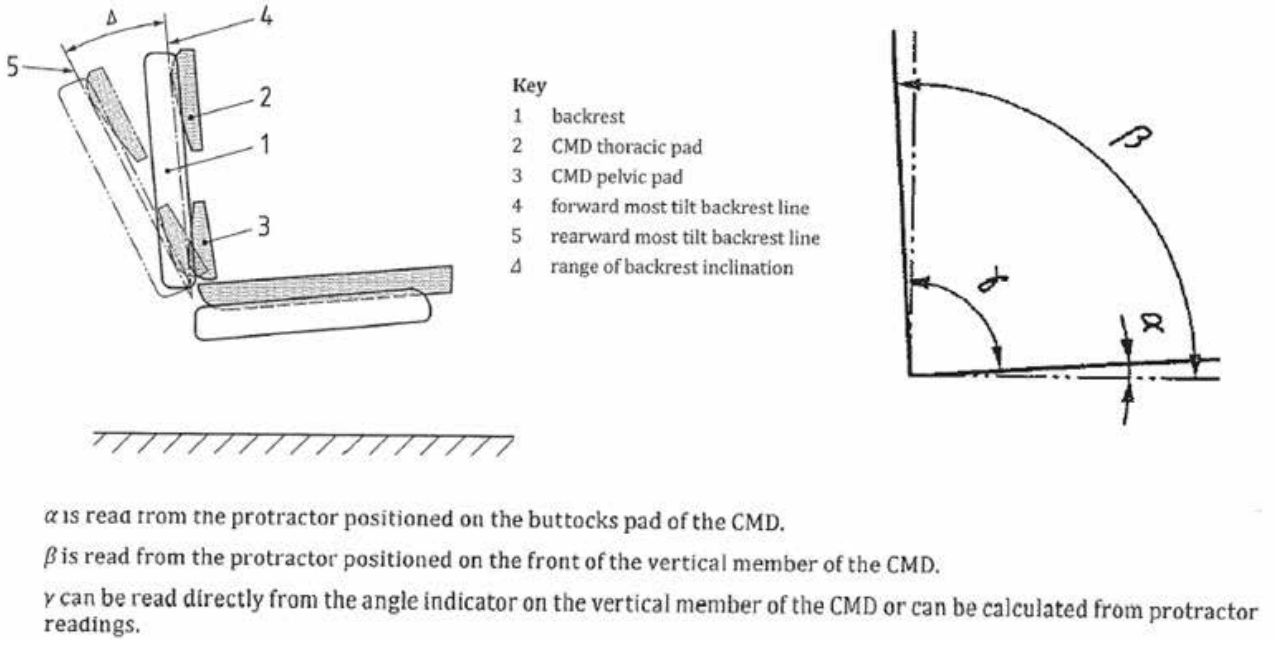

Figure 5.2.28 Angles of the office chair

3. Back to seat movement ratio. This measurement applies only to chairs that have angles between the seat and back that vary as the chair tilts.

4. Seat height and sitting height. Measure the seat height as the vertical distance from the underside of the CMD to the floor on a measuring scale placed through the seat height slot of the CMD at the front of the seat. Measure the sitting height (3.24) by measuring the height of the top of the CMD buttocks pad at the sitting height point marked on the buttocks pad to the floor, and then subtract 60 mm from the measurement to obtain the sitting height value.

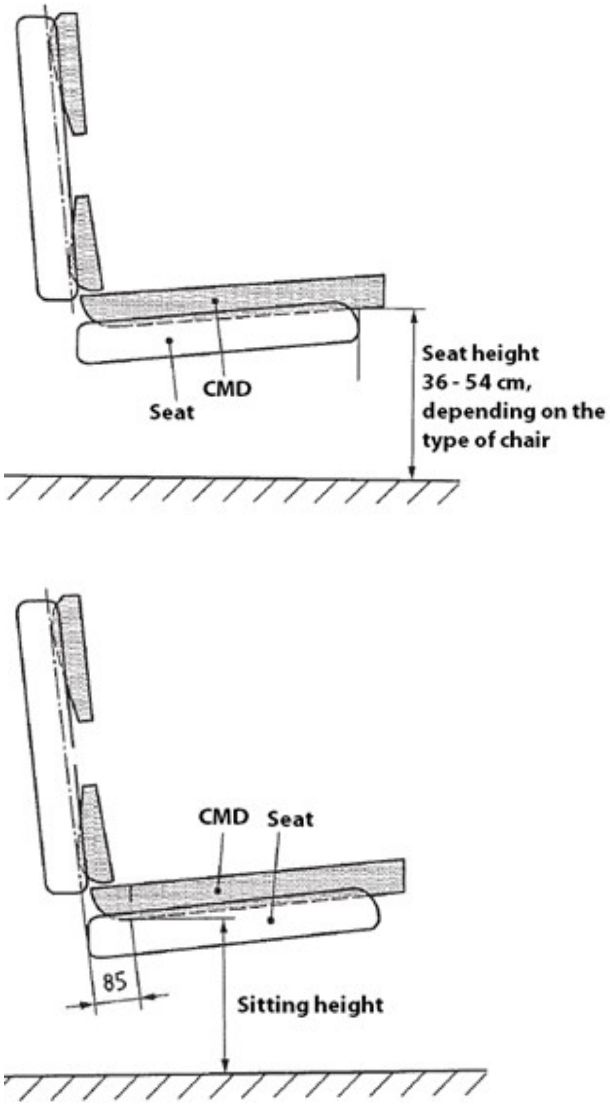

Figure 5.2.29 Seat height and sitting height

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for seat height are:

- For simple and computer office chair: 38 – 54 cm if regulable, 41 – 43 cm if not.
- For multipurpose chairs, for the posterior-middle posture: 39 – 41 cm.
- For multipurpose chairs, for the anterior-middle posture: 41 – 43 cm.
- For resting armchairs: 36 – 40 cm.
- For elderly armchairs: 38 – 44 cm.

5. Seat depth. Read the seat depth from the measuring scale on the top of the buttocks pad.

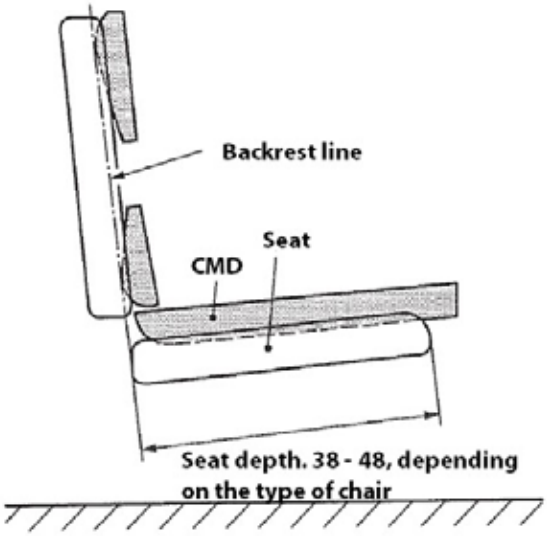

Figure 5.2.30 Seat depth

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for seat depth are:

- For simple and computer office chair: 40 – 44 cm.
- For multipurpose chairs, for the posterior-middle posture: 42 – 44 cm.
- For multipurpose chairs, for the anterior-middle posture: 42 – 47 cm.
- For resting armchairs: 45 – 48 cm.
- For elderly armchairs: 38 – 44 cm.

6. Backrest height. Slide the backrest height gauge until it touches the top of the backrest. Read the height on the scale.

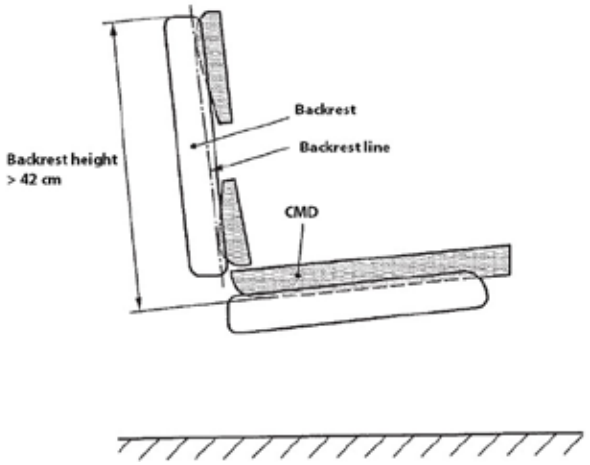

Figure 5.2.31 Backrest height

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for backrest height are:

- For simple office chair: > 45 cm
- For computer office chair: > 50 cm
- For multipurpose chairs > 42 cm
- For resting armchairs: > 55 cm
- For elderly armchairs: 50 – 80 cm

7. Front of armrest position.

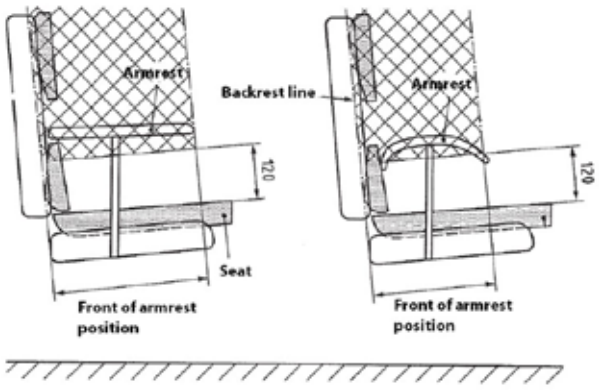

Figure 5.2.32 Front of the armrest position and how to measure it

8. Armrest set back. Calculate the armrest set by subtracting the front of armrest position value from the seat depth value.

9. Armrest height.

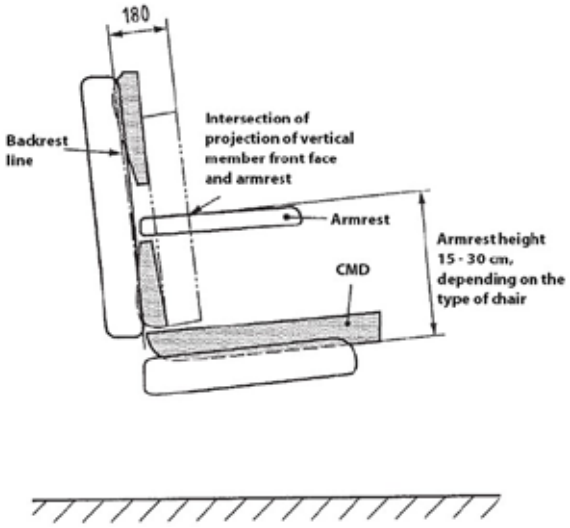

Figure 5.2.33 Armrest height and how to measure it

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for armrest height are:

- For simple office chair: 19 – 25 cm if regulable, 21 – 23 cm if not.
- For computer office chair: 18 – 30 cm if regulable, 23 – 25 cm if not.
- For multipurpose chairs, for the posterior-middle posture: 22 cm.
- For multipurpose chairs, for the anterior-middle posture: 24 cm.
- For resting armchairs: 15 – 23 cm.
- For elderly armchairs: 19 – 23 cm.

10. Neck/head rest height and protrusion.

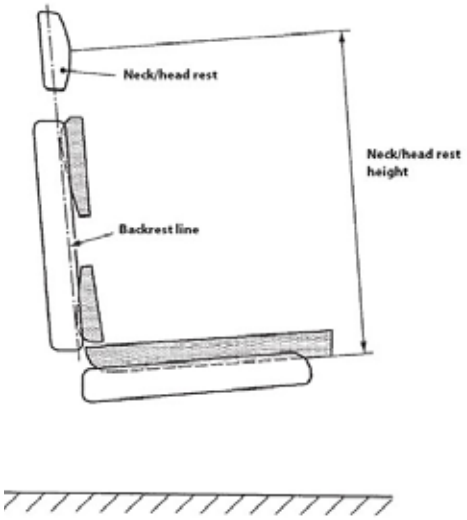

Figure 5.2.34 Neck/head rest height and protrusion and how to measure them

All these measures must be taken with the chair components adjusted to their minimum positions, as well as in their maximum positions, so it is possible to stablish ranges.

Then, it is necessary to remove the CMD equipment from the chair, and do some more measurements:

11. Seat surface width. Measure the narrowest seat surface width within the seat surface plane width zone.

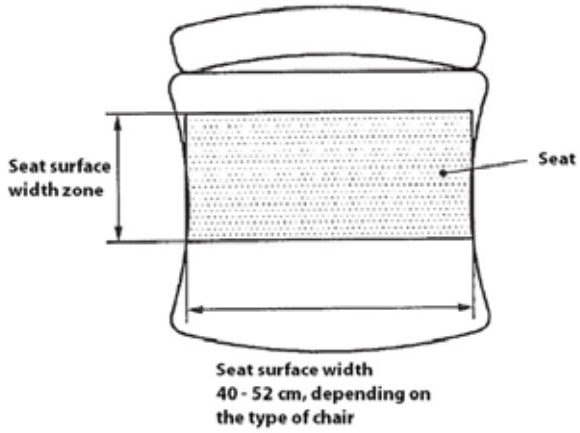

Figure 5.2.35 Seat surface width

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for seat width are:

- For simple and computer office chair: > 40 cm.
- For multipurpose chairs: 46 – 52 cm.
- For resting armchairs: 48 – 52 cm.
- For elderly armchairs: 45 – 51 cm.

12. Seat surface depth. Measure the least seat surface depth within the span, 115 mm either side of the median plane.

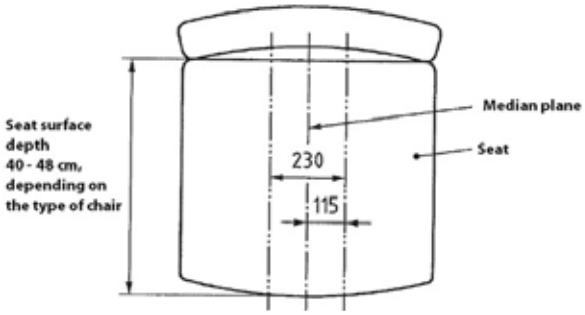

Figure 5.2.36 Seat surface depth

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for surface depth are:

- For simple and computer office chair: 40 – 44 cm.
- For multipurpose chairs, for the posterior-middle posture: 42 – 44 cm.
- For multipurpose chairs, for the anterior-middle posture: 40 – 42 cm.
- For resting armchairs: 45 – 48 cm.
- For elderly armchairs: 42 – 47 cm.

13. Backrest width. Measure the narrowest backrest width within the lumbar zone.

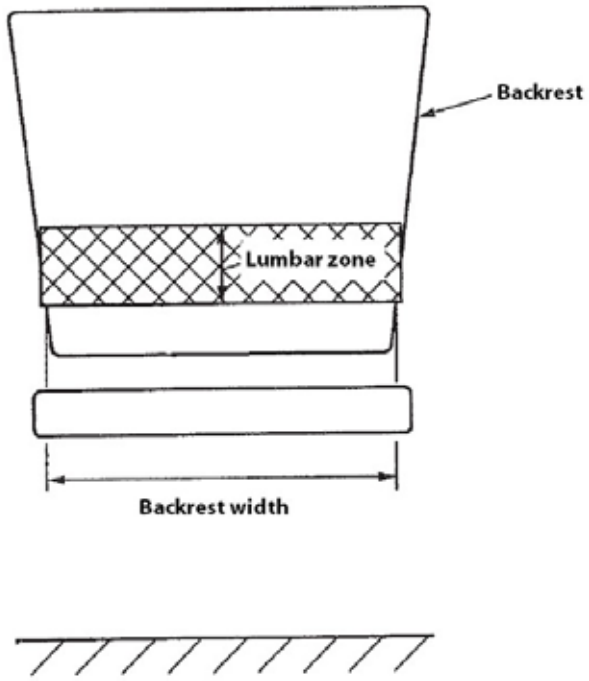

Figure 5.2.37 Backrest width

14. Backrest horizontal radius. Measure the backrest radius of the chair at the lumbar zone. For office chairs, 40 cm is the recommended value.

15. Armrest length. With the armrest pad surface in the most horizontal position, measure the greatest length in the fore and aft direction of the armrests horizontally within 20 mm below the top surface using callipers with jaws 20 mm long.

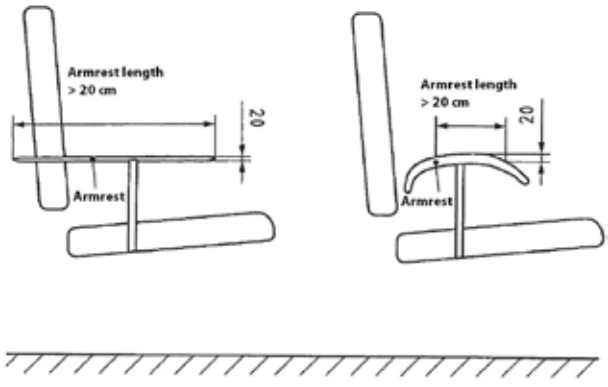

Figure 5.2.38 Armrest length and how to measure it

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for armrest length are:

- For simple office chair: 22 cm.
- For computer office chair: > 22 cm.
- For multipurpose chairs: 20 cm.
- For resting and elderly armchairs: > 35 cm.

16. Width of armrests. With the armrest pad surface in the most horizontal position, measure the greatest width in the side-to-side direction of the armrests horizontally within 5 mm below the top surface using callipers with jaws 5 mm long.

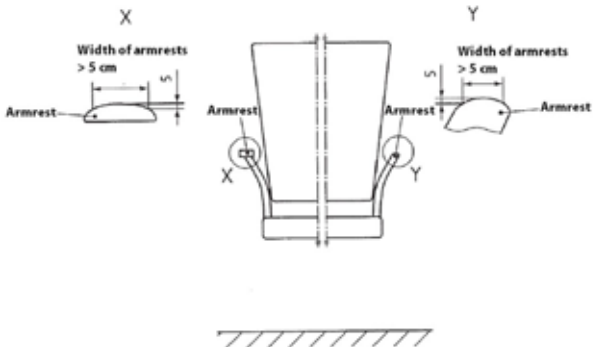

Figure 5.2.39 Width of armrests and how to measure it

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for armrest width are:

- For simple office chair: 5 cm.
- For computer office chair: > 5 cm.
- For multipurpose chairs: > 5 cm.
- For resting armchairs: > 5 cm.
- For elderly armchairs: > 8 cm.

17. Hip breadth clearance.

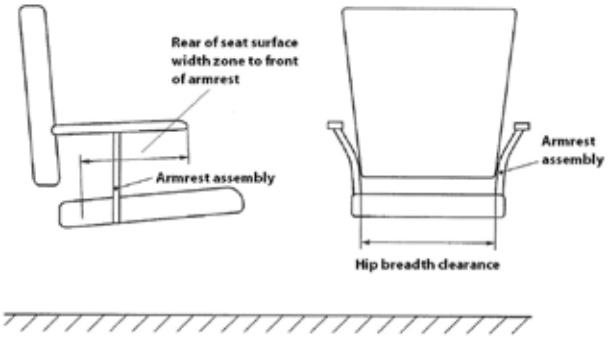

Figure 5.2.40 Hip breadth clearance

18. Distance between armrests.

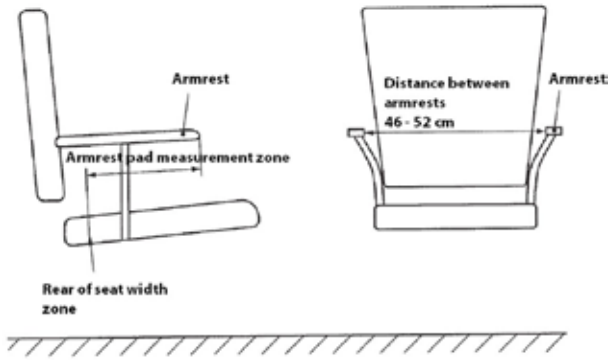

Figure 5.2.41 Distance between armrests

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values for distance between armrests are:

- For simple and computer office chair: 46 – 52 cm.
- For multipurpose chairs: 46 – 52 cm.
- For resting armchairs: 46 – 52 cm.
- For elderly armchairs: 45 – 51 cm.

19. Maximum offset of the underframe. Measure the maximum offset of the underframe as the distance from the axis of chair rotation to the outermost point of the base/castor/glide.

2.5.3 Chairs and tables for educational institutions. Determination of functional dimensions.

EN 1729-1 – Furniture – Chairs and tables for educational institutions – Part 1: Functional dimensions, stablish the functional dimensions for chair, stools and tables in educational institutions.

For doing most measurements in chairs, the standard defines an equipment, called in Device for Measuring Scholar Chairs, or DMSE. This is the DMSE:

There are several functional measurements performed using the DMSE, but there are out of the scope of this project.

Figure 5.2.42 DMSE in a scholar chair

2.5.4 Tables

There are several functional measurements to implement regarding tables. Some recommended values for tables in general are given:

1. Table height.
   It is measured from a point of the upper plane to the floor. 69 – 73 cm is adequate. For office tables, it is advisable to be adjustable.
2. Seat – chair height.
   It is measured from the upper face of the table plane to the most pressed point of the chair seat. 30 – 32 cm is fine.
3. Width and depth of the table plane.
   They are de dimension of the accessible space of the user. In rounded tables it's the diameter.
4. Free height under the table.
   There should be enough space for leg and armrest's chairs under the table. This dimension should be greater than 65 cm.
5. Free width under the table.
   The minor width under the table should be measured.
6. Free depth under the table.
   It should be taken into account the depth at knee height. This dimension should be greater than 45 cm.

DO YOU WANT TO KNOW MORE ABOUT...

RECOMMENDED VALUES

Some recommended values, specifically for office tables, are:

- 65 – 72 cm for the table height.
- > 60 cm for the depth.
- > 120 cm for the width.
- > 65 cm for the free height under the table.
- > 60 cm for the free width under the table.
- > 45 cm for the free depth under the table (knees).
- > 60 cm for the free depth under the table (feet).

Some recommended values, specifically for computer tables, are given. As it can be seen, a lot of them are the same that above.

- 70 – 72 cm for the table height.
- > 60 cm for the depth.
- > 120 cm for the width.

2.5.5 Sofas

The sofa is a piece of furniture intended to seat two or more people, so when sizing the widths, not only the acceptable anthropometric width for chairs and armchairs must be considered, but also a higher value, that allow freedom of movement for users, without interferences.

Minimum width for each user must be 55 cm. As an example, width of sofa or seating bench, for 2, 3 and 4 users must be: 100, 155 and 210 cm.

2.6 TYPES OF FURNITURE

Standards, both national, European, or global, also defines the types and different kind of furniture. Here in this chapter, some definitions regarding types of furniture will be given. It is important to take into account that inside a category of furniture, for example, seats, it is possible to find different kind of furniture. For example: office chairs, outdoor seating, swivel chairs, loungers, etc.

Definitions given here are directly taken of European standards. They are also available in terminology database from ISO and IEC.

- **Lounger:** Seat intended for the user to be reclined, in which in at least one position, the backrest forms an angle less or equal to 45°, and that is provided with a leg rest that is part of the product, and that can withstand all the weight of the user body.

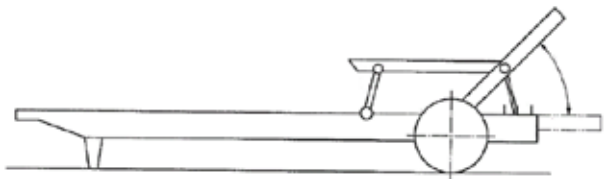

Figure 5.2.43 Example of lounger

- **Swivel chair:** Seat whose upper part, which includes the seat and backrest, rests on a single column and can rotate in the horizontal plane.
- **Office chair:** Swivel chair, with or without arms, for intended use in an office for a adult person, whose upper part, that includes a seat and a backrest, rests on a single column and can rotate in the horizontal plane, and can be regulated in height at least. Some definitions, like included in EN 1335-1 may add that an office chair is normally used along a working surface. Also, an office chair may have or not elements such as armrests and/or headrests.
  - **"Ax" type office chair:** Office chair with the greatest variety of adjustments.
  - **"A" type office chair:** Office chair with great variety of adjustments.
  - **"B" type office chair:** Office chair with a variety of adjustments.
  - **"C" type office chair:** Office chair with limited adjustments.
- **High office chair:** Office chair with a greater seat height, measured from the ground, than 540 mm, and provided with a with a foot support.
- **Working chair:** Chair, with or without arms, for intended use in a company office or in a private home (for example, for working with a computer), whose upper part, that includes seat and backrest, rests on a simple column and can rotate in the horizontal plane and can be regulated in height at least.

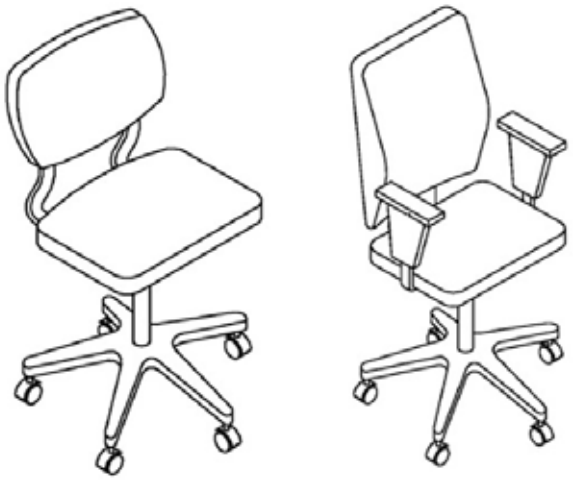

Figure 5.2.44 Examples of working chairs

- **Confidant chair:** Individual seat that is used as a complement of the working chair, in an office environment. It is used for meetings or consulting, as well as reading, writing, listening, or waiting.
- **Reclinable chair:** Seat provided with a backrest that can be adjusted from a normal vertical position to a reclined position.
- **Reclinable and liftable chair:** Seat that, in addition to its tilting function, is provided with mechanism for lifting so it is easy to stand up.

- **Dual tilt seat:** Seat that can be used for sitting, either in the front part of the seat (forward inclination), either in the back part of the seat (rearward inclination), resting feet in a footrest or in the ground.
- **Stool:** Seat without backrest and arms, intended for being used in short spaces of time.
- **High chair:** Chair which seat height from the ground is greater than 510 mm, and with a footrest.

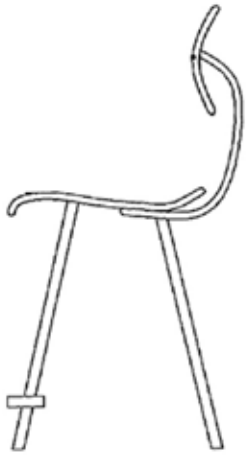

Figure 5.2.45 Example of a high chair, with footrest

- **Outdoor seating for public use:** Outdoor seat intended for a non-private use in public-accessible places, such as restaurants, swimming pools, beaches, and leisure and professional spaces.
- **Outdoor seating for domestic use:** Outdoor seat intended for a private use , in non-accessible places for public, like gardens, terraces, balconies, etc.
- **Outdoor seating for camping:** Outdoor seat, foldable or demountable and light, intended for using in camping and journeys.
- **Work table or desk ("A" Type):** Fully height-adjustable table; user can change the height during use.
- **Work table or desk ("B" Type):** Height-adjustable table; height can be adapted to the user during installation.
- **Work table or desk ("C" Type):** Fixed-height table.
- **Work table or desk ("D" Type):** Table that can be height-adjustable in a limited way.
- **Work table or desk for standing or sitting:** Height-adjustable table that allow working in different positions, from sitting to standing.
- **Foldaway beds:** Bed in which its surfaces undergo a rotation, in the horizontal axis at least, for achieving its use position.
- **Bunk bed:** Set of elements that can be assembled to form beds, one on the top of the other, so the upper face of the basis of the high bed is at 600 mm or greater from the ground.
- **High bed:** Set of elements that can be assembles to form a bed, so the upper face of its basis is at 600 mm or greater from the ground, regardless the use of the space below.
- **Medical bed:** Device for which the intended use is sleeping/resting that contains a mattress support platform and intended to assist in diagnosis, monitoring, prevention, treatment, alleviation of disease or compensation for an injury or handicap.
- **Bed-lift:** Height adjustable mechanism on which a mattress support platform can be mounted. The combination of a bed lift and a compatible non-medical bed as specified by the manufacturer is considered to be a medical bed.
- **Mattress support platform:** Structure which supports a patient surface, for example mattress.

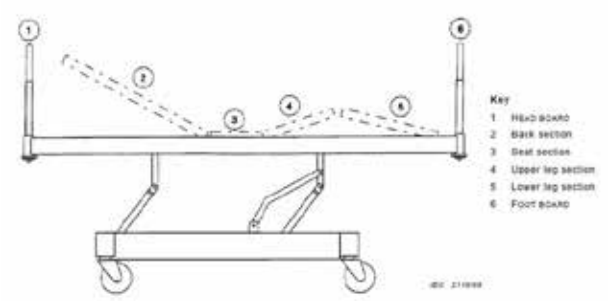

Figure 5.2.46 Example of medical bed, and its parts

- **Frameless sheet base:** Bed base composed by separated flexible sheets, connected by a textile, rubber or plastic tape.
- **Base with frame:** Bed base composed by sheets, springs, etc., connected by a frame.
- **Spring mattress with rigid frame:** Upholstered bed base composed by filled springs, over a rigid frame, for being used

on a bed frame or single.

- **Divan:** Upholstered bed base used without the need for a bed with crossbars. It can be done with springs filling or with a solid surface, and it can include drawers or storage space.
- **Convertible sofa-bed:** Seat that uses a mechanism for turning into a bed.
- **Storage furniture:** Complete furniture unit that includes structure and all components, such as doors, wardrobes, and the rest of storage elements.
- **Regulable furniture:** Furniture that the user can regulate without the need of using tools.
- **Variable-size furniture:** Furniture that can be regulated during its installation (not by the user), so its dimensions go from a size type to other.
- **Urban furniture:** Outdoor furniture for using in public spaces, permanently attached to the ground or to a structure (like bus stop, wall, etc.), or that can not be detached by hand.
- **Kitchen module:** Each of the independent furniture that integrates the fully furniture of a kitchen, and that are designed for working connected between them and/or the building elements.

2.7 BATHROOMS AND KITCHEN ELEMENTS

Accessible, functional, usable and safe furniture can of course be applied to environments such as bathrooms and kitchens. By reducing barriers, making it easier, safer, and more convenient for people of all ages with varying abilities or with different equipment requirements to perform everyday tasks and activities.

There are some basic considerations. There are minimum measures to be respected to ensure for example accessibility in kitchens and bathrooms. For allowing free access and movement of wheelchairs, the areas of circulation must have a minimum width of 80 cm, but it is recommended to increase this value.

Objects and utensils must be at the direct reach of users, incorporating handles or opening systems easy to use, like faucets with levers instead of valves.

The main lighting must be stable and uniform; mixing natural and artificial light if possible, plus the addition of directed light bulbs in specific zones while installing programmable automated systems and movement sensors would be ideal. The installation of anti-skit floors and choosing safe, easy to clean, and antibacterial materials is also advised.

Kitchens and bathrooms are wet environments, which makes it very easy to slip, trip and fall due to spills or simply lingering condensation. So, reducing the accident risk is key here: choose safe surfaces is crucial. Vinyl is a good floor covering for a surer step, as it is naturally slip resistant, but porcelain tiles often also come with anti-slip properties.

For bathrooms, there are a series of elements that will make these spaces safer, like seats, handles, support bars, etc.:

Figure 5.2.47 Accessories for a bathroom

Coming back to kitchens, it is a great idea to install adjustable countertops. There are systems capable to be adjusted according to each user's needs. They incorporate elevation columns that can stand up to 60kg of weight, allowing effective freedom throughout that space.

The extensible tables make it possible to increase the useful and habitable space of the kitchen, also easing the access for people in wheelchairs, for example. From perfectly hidden in a drawer, some of them can get attached and adjusted to the height of the countertop, while others unfold into dining room tables.

For both bathrooms and kitchens, it is also possible to incorporate cabinets that are closer within the reach of the user with just a simple movement and/or with a switch or button. One option for this could be to install it as a structure screwed to the wall, allowing the cabinet to move diagonally, downwards, and upwards. Another option is using columns of elevation that move the cabinet only in a vertical fashion.

Another good advice for both kitchens and bathrooms is to incorporate and consider sliding drawers in the lower furniture. Although these elements are used normally for keeping different utensils, in this way fixed cabinets that are too deep and difficult to reach are avoided.

It is also possible to eliminate doors with hinges of upper furniture and replace them with lift doors, which gives easy access to the artifacts and utensils while using the kitchen. This system also helps to clear the area, allowing free movement without the need to close the cabinets. This applies also for bathrooms and kitchens.

Figure 5.2.48 Adjustable countertop

Integration of all these elements and some more others allows to construct multifunctional kitchens and bathrooms, capable of being very safe and also adapting and adjusting to different users, and at the same time brings versatility, that can be increased by adding electronic systems that control movements in different directions and heights, and allowing to customize tables, storage spaces, etc.

Other interesting aspect for kitchen and bathrooms may be to go further into domotics and home automation. Through centralized control panels, motion sensors, etc., is possible to support older adults, disabled people, etc. It is possible to turn on lights at certain time of the day, or by presence sensors, among others.

Figure 5.2.49 On the left: fixed cabinets, deep and difficult to reach. On the right: sliding drawers, easy to reach

Figure 5.2.50 Lift door in a kitchen

An adapted kitchen or bathroom is designed so anyone can use it independently, which is best for households with mixed abilities or multi-generational homes. For example, a good choice for kitchens, for holding handy supplies or groceries, is the following pull-down cupboard. It has two levels of shelving to organise items and comes with two resistance settings to make the shelves easier to pull-down – great for multi-generational homes.

Figure 5.2.51 Pull-down cupboard.

Another example of kitchen element may be this pull-out worktop runner:

Figure 5.2.52 Pull-out worktop runner

These runners offer added convenience by ensuring a counter can be pulled toward the user for easier access to the items on top. They can be fitted with standard sizes and can be used to pull out individual sections in cooking towers to make transferring heavy roasting dishes safe and simple.

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MODULE 5

AGE-FRIENDLY PRODUCT DESIGN

UNIT 3

ERGONOMIC PRODUCT DESIGN FOR OLDER ADULTS

Nastja Poderkar Loredan • Mária Šimková

DESIRE

DESIGN FOR ALL METHODS TO CREATE AGE-FRIENDLY HOUSING

DESIRE is a European project funded by the Erasmus+ programme.
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DESIRE will provide professionals in the building industry and home furnishings sector with the tools and skills to apply Design4All methods as an integral part of the design process, with the aim to create or adapt age friendly housing as a solution for the wellbeing, comfort and autonomy of the older adults or dependents at home.

The DESIRE training platform consists of six modules and 21 units.

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UNIT 3 – ERGONOMIC PRODUCT DESIGN FOR OLDER ADULTS

The unit provides an overview of ergonomics, specifically its meaning, related domains, and relevance across various scientific fields. Ergonomics supports an understanding of human variability in terms of performance, stress or tiredness in correlation with environment and product. Method of simulation illustrates its importance in design processes in order to achieve better ergonomic solutions. Various health conditions and needs focused on people with higher age are described. Special aids and assistive technology are presented.

5.1 INTRODUCTION

The term **ergonomics** originates from Greek, comprising the words **ergon** which means work and **nomos** which means law.

Ergonomics or human factors are terms which are used interchangeably or as a unit – Human Factors and Ergonomics (HFE or EFH).

The International Ergonomics Association (IEA) (2000) defines ergonomics as a scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance.

In addition to the IEA exists the Federation of European Ergonomics Societies (FEES) which is a network of various ergonomic societies mostly in Europe.

Experts hold a variety of views on the term ergonomics. Wojciech Bogumił Jastrzębowski presented the first definition of ergonomics in his work An outline of Ergonomics, or the Science of Work based upon the truths drawn from the Science of Nature in 1857.

Lubor Chundela (2001) states that ergonomics is an interdisciplinary systemic field that comprehensively deals with human activity and its links with technology and the environment, with the aim of optimizing its psychophysical load and ensuring the development of its personality.

Miroslav Šmíd (1977) understands ergonomics as a combination or integration of scientific knowledge from biology and scientific technical knowledge or intent to create harmony between man and his biology with the technical world. Šmíd collected definitions of ergonomics from several experts: According to professor Hywel Murell it is a scientific relationship between man and the environment. He understands the term in a broader sense (e.g. machines, tools, organization of work, etc.). Lawrence H. Fogel defines ergonomics as an interdisciplinary science which deals with man and machine systems. Wesley E. Woodson sees ergonomics as an approach to resource creation and design aimed at achieving greater performance, reducing errors and mistakes in use to achieve comfort and reduce fatigue. Alphonse Chapanis considers ergonomics to be an applied field of modern technology, dealing with the construction and design of machinery, work operations and work environments to adapt to human capacity and constraints (Šmíd, 1977).

Étienne Grandjean (1988) defines ergonomics as the adaptation of work to a person.

DO YOU WANT TO KNOW MORE ABOUT...

At the dawn of industrialization, manufacturers changed to factory production methods that lacked proper tools for the workers, leading to generalised approaches that worsened the ergonomic man-machine relationship. Chief engineer Frederick Winslow Taylor noticed that worker's performance was low because little attention was paid to their skills required for the job. He was searching for a scientific approach to increase the effectiveness of work. Taylor summarized his findings in the book The Principles of Scientific Management. Therefore, his system of scientific management is called Taylorism.

5.1.1 The meaning of care in the design profession

IN A NUTSHELL

Designers should "design for people's needs rather than their wants."
(Papanek, 1984, 219)

Designers, regardless of focus (product, graphic or interior) operate prolifically within the commercial sphere, in new media, advertising, and marketing, typically mainly focused on graphic design. They are hired to develop advertising and promotional campaigns – sometimes in contrast with values that speak of humanity and care. Design education often does not prioritise or value the benefit of the end user. Society itself is still not at the stage of development when people are naturally considerate to one other. Legislative and social norms are insufficient to present conditions for the development and integration of care for the disadvantaged fellow citizens. Developed countries offer examples of transformations towards a caring populace illustrated in the transition from a careless person to a caring person, from care to universal care, as claims Jiang Ying from Hong Kong Polytechnic University of China (Ying et al., 2018). Designers are often perceived as care professionals as they meet needs through design and user expectations.

Therefore, they should pay attention to the principles of human-centric creation, which are also enshrined in the ISO 9241-21036 standard.

According to Ying (2018) an example of an ideal relationship between designer and user can be summarized in 4 points which are the basis of a quality design approach capable of producing meaningful outcomes for people:

1. Designers have to know the meaning of care and cultivate themselves as caring people.
2. Designers convey care to users through design practice.
3. Users perceive and receive care.
4. Users react on care. They may care for themselves and others as a response.

5.1.2 The Ten Principles of Good Design

The goal of designers is the good of humanity; it is their duty to create products that do not endanger people in any way nor harm them. In the early 1980s Dieter Rams set out 10 principles of good design, also called the 10 commandments. He stated that:

1. good design is innovative – innovative design develops in cooperation with innovative technology, but should never be an end in itself;
2. good design makes a product useful – design emphasises the usefulness of a product whilst disregarding anything that could possibly detract from it;
3. good design is aesthetic – the aesthetic quality of a product is integral to its usefulness;
4. good design makes a product understandable – it clarifies the product's structure, at best, it is self-explanatory;
5. good design is unobtrusive – the design should be both neutral and restrained, to leave room for the user's self-expression;
6. good design is honest – does not make a product more innovative, powerful or valuable than it really is;
7. good design is long-lasting – it avoids being fashionable and therefore never appears antiquated;
8. good design is thorough down to the last detail;
9. good design is environmentally-friendly;
10. good design is as little design as possible – less but better.

In the study An Exploration of Designer-to-User Relationship from a Care-Oriented Perspective the designer argues that people can change if they come into contact with good design. Good design evokes a better state of mind in people and provokes changes through experience. Gradually, this can affect their mood and can affect their dealings with other people (Ying et al.,2018).

5.2 CORRELATION BETWEEN HUMAN, PRODUCT, AND ENVIRONMENT

The main goal of ergonomics is to optimise the system of relationships between humans, products and the environment. The most important part of this system is the human being. Ergonomics exists to ensure that the system's affects on humans is positive.

The **Human element** is characterized by physical (dimensions, weight, force) and neuropsychic (intelligence, memory, velocity of reaction) properties.

Product (or machine in the context of industrial ergonomics), is defined as any tool with which we achieve a desired result.

Environment is characterized as a summary of working conditions that affect the person and that results in his neuropsychological and physiological state and consequently, his performance.

DO YOU WANT TO KNOW MORE ABOUT...

To learn more about the environment we recommend that readers refer to Module 4.

Users of any devices should not be divided into capable (healthy) and incapable (with health impairment) because their level of capability is not dichotomic but continual as stressed by Pia Hannukainen a Katja Hölttä-Otto (2006). Their principle is that even a healthy person can be seriously impaired in non-friendly environment.

5.2.1 Physiological and psychological human variability

IN A NUTSHELL

Human performance is not a constant value. It is influenced by several factors: qualification, motivation, relationship to work, quality of work tools, suitability of the environment, etc.). Performance can change during the day, week, month, or a year. It can be also influenced by biorhythm or levels of stress.

At the beginning of every design project, it is very important to understand the target group as well as possible. Many human factors are influential and help us create a better result.

During the week our peak performance is typically in the middle (Wednesday). On Monday our performance tends to be subdued as a result of recovering from the weekend. On Friday tiredness can occur, and as a result we are less focused as we prepare for the weekend. Peak performance during the day occurs usually between 9 – 12:00 and 15 – 17:00. There are two types of people based on their maximum performance period during the day: “early birds” and “night owls”. Early birds can easily wake up early and their performance period is moved approx. 1 – 2 hours prior to the majority of people. They are active between the hourse of 5 – 6:00 in the morning. Conversely, night owls remain awake until late at night and become active later in the morning – around 9 – 10:00. Summer months are associated with higher physical performance, while in winter we see increased mental performance.

Biorhythm works as our inner clock. We should understand it and make the most of it. The better we understand it, the more effective we can be and our performance would be more optimised too. We should not fight it because it is an authentic reflection of who we are. Biorhythm does not relate only to the function of the body cells, tissues, organs but it relates also to the psychic – attention, memory, and thinking. The most important element of biorhythm is 24-hour circadian rhythm.

As people get older they tend to be more tired. Tiredness can affect our daily life and behaviour. Two types of tiredness are distinguished: acute tiredness and chronic tiredness. Exhaustion is an extreme case of chronic tiredness. The most common symptoms of tiredness can occur in poorer movement coordination (speed and accuracy of movements), decreased perception by senses (vision worsens) and emotional deterioration associated with growing tension (agitation, anger). We need to take this into account when designing furniture, electronic devices, infographics, displays, control panels, etc. to avoid errors.

Stress occurs in our lives more than we would like to admit. Various factors can contribute to a certain level of stress. The aim of the body's stress response is to mobilize its protective forces to prevent possible damage and to restore physical and mental balance.

DO YOU WANT TO KNOW MORE ABOUT...

There are 3 stages of stress response:

1. **resilience** – a person is still exposed to a stressful situation. The production of substances that help to adapt to stress increases.
2. **exhaustion** – the state of adaptation cannot be maintained, the ways in which the organism copes with stress have been exhausted. It is manifested by fatigue, anxiety and depression.
3. **alarm** – the organism is in a state of increased alertness, the defence against excessive load is mobilized. Physiological reactions are a warning but also a caution.

Stress can be manifested in various ways:

Physical – accelerated pulse and heart activity, higher blood pressure, accelerated and deepened breathing, sweating, slower intestinal activity, increased mental alertness, higher muscle tension, feeling tired, headaches. Hair loss or unreasonable itching of the skin can appear.

Psychological – irritability, nervousness, tension, anger, dissatisfaction, despondency, feeling of inferiority, feeling of hopelessness, helplessness, reduced ability to correctly assess the present situation.

Behaviour – sleep disorders, aggression, distraction, inability to rest, loss of sense of humour, nervous and exaggerated reactions to noise, reduced ability to deal with daily responsibilities, overeating, appetite, increased consumption (alcohol, cigarettes or coffee), insufficient concentration.

5.2.2 Interdisciplinarity of ergonomics

IN A NUTSHELL

An important feature of ergonomics is interdisciplinarity. It uses and applies knowledge from various scientific fields and disciplines, the combination of which can create a product or solution that approaches the ideal.

HFE takes into account physical, cognitive, sociotechnical, organizational, environmental and other relevant factors, as well as the complex interactions between the human and other humans, the environment, tools, products, equipment, and technology.

Examples of professions contributing to the design phase are: anthropology, psychology, sociology, typography, construction, statistics, cybernetics, materials science, production technology, prototyping, medicine (orthopaedics, ophthalmology, neurology, etc.).

DO YOU WANT TO KNOW MORE ABOUT...

If you want to learn more about anthropology we recommend that readers reference Module 1 Unit 2 Ageing and environment through the lens of anthropology.

5.3 DOMAINS OF ERGONOMICS

5.3.1 Cognitive, organisational, and physical ergonomics

Practitioners working in the field of ergonomics often work in specific sectors, industries or application areas. As described by the International Ergonomic Association (n.d), we can divide ergonomics into three main areas: physical, cognitive and organisational ergonomics .

Cognitive ergonomics deals with mental processes such as perception, memory, thinking and motor responses that affect interactions between people and other elements of a system. Relevant topics include mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training as these may relate to human-systems design.

Organisational ergonomics is concerned with the optimisation of socio-technical systems, including their organisational structures, policies and processes. Relevant topics include communication, crew resource management, work design, working time design, teamwork, participative design, community ergonomics, cooperative work, new work paradigms, virtual organisations, telework and quality management.

Physical ergonomics deals with the anatomical, anthropometric, physiological and biomechanical characteristics of humans in relation to physical activity. Relevant topics include working postures, material handling, repetitive movements, work-related musculoskeletal disorders, workplace design, physical safety and health.

Although we divide ergonomics into different areas the science and practice of ergonomics is not sector-specific, but a multidisciplinary, user-centred, integrated science. Ergonomics uses a holistic, systems approach to apply theories, principles and data from many relevant disciplines to the design and evaluation of tasks, workplaces, products, environments and systems. Ergonomics considers physical, cognitive, socio-technical, organisational, environmental and other relevant factors, as well as the complex interactions between people, the environment, tools, products, equipment, and technology.

5.3.2 Microergonomics and macroergonomics

The International Ergonomics Association distinguishes three broad categories of ergonomic specialisation described above. These three categories can be further divided into microergonomics and macroergonomics.

Microergonomics encompasses physical and cognitive ergonomics, which have traditionally focused on human-machine interactions. Activities on work or worker posture analysis, productivity estimation, work equipment design, work physiology, work biomechanics, physical environment, anthropometry, standard time and other topics fall within the scope of microergonomics (Panjaitan et al., 2019).

In contrast, **macroergonomics**, also known as organisational ergonomics, refers to sociotechnical systems theory and is concerned with the design of larger sociotechnical systems (Karsh et al., 2014; Waterson, 2013). Macroergonomics focuses on the design of overall work systems by providing the knowledge and methods needed to improve work systems and thus develop organisational effectiveness and performance.

In 2014 Karsh et al. (2014) proposed a model for the development of cross-level ergonomics studies that clarifies the inclusion of micro-, macro- and meso-level factors in any organisational study. So-called **mesoergonomics** is defined as an open systems approach to ergonomics theory and research in which the relationship between variables is examined at a minimum of two different system levels and in which the dependent variables are human factors and ergonomic constructs (Karsh et al., 2014).

Although ergonomics is usually associated with optimising workplaces, it is not limited to correcting seating in the workplace. When designing the built environment, ergonomics takes into account individual strengths, sensory abilities and other physical limitations that can play a crucial role in making life easier and safer – including for older people. Whether it is to mitigate the impact of a limited coordination ability or a visual impairment, senior-friendly ergonomics can help older people use household appliances or move around the house. For example, an ergonomically designed chair can help seniors relieve back pain. While there are many reasons for slips and falls in older adults, messy homes and inappropriate height of steps are one of them. Therefore, an ergonomically designed home, which considers all domains of ergonomics, can help prevent injuries and possible hospitalisation of older people.

5.4 ANTHROPOMETRY IN ERGONOMICS AND PRODUCT DESIGN

Anthropometry can be classified as part of physical ergonomics. The word **anthropometry** comes from the Greek language, where **anthropos** means man and **metrikos** means measurement. Today, anthropometry is defined as the scientific discipline concerned with measuring the size and mass of the human body, as well as body shape and composition. Anthropometry is broadly divided into static and dynamic anthropometry. Static anthropometry refers to static measurements of anthropometric variables when the body is at rest (standing, sitting, lying down). We can measure skeletal dimensions (length between two joints), soft tissue contours (e.g. waist circumference, fat, skin) and the naked body at rest. Dynamic anthropometry measures distances when the body is in motion. We can measure the reach of the body in space, the manoeuvring space that allows the required movement and the movement space that a person can reach in space.

5.4.1 Anthropometry and design

Anthropometry in design aims to make a space, furniture or any other product convenient for the user. The goal is to produce a design that suits the human body instead of the people adapting to the design.

To ensure that the built environment and products fit the user's body measurements, we must first define the user's body dimensions. In ergonomics, the results of body measurements are often presented using percentiles, where percentiles are whole numbers that divide the distribution of values into 100 equal parts. Each part therefore covers 1 % of the distribution. In ergonomics, anthropometry-based product design usually uses the 5^{th} and 95^{th} percentiles of measurements. The ergonomic design of a room or a product must take into account the minimum and the maximum dimensions of the user. The measurements of the largest user are used when designing door heights, determining legroom between seats, etc. The dimensions of the smallest user are used in designing reach, handle heights, etc. If we are talking about range of motion, we opt for the 95^{th} percentile, if we are talking about reach, we opt for the 5^{th} percentile. If we want to set upper and lower values for adjustable aids, we can use the 5^{th} and 95^{th} percentiles as thresholds. If the complexity of the task requires an extremely customised design, we use the 1^{st} and 99^{th} percentiles. When measuring users' measurements, we can refer to the anthropometric points proposed by the International Society for the Advancement of Kinanthropometry (ISAK). Commonly used anthropometric points are for example:

- Dactylion: tip of the ball of the third toe (the nail is not considered).
- Glabella: the part of the forehead in the middle between the eyebrow arches.
- Acromion: a bony projection on the shoulder blade.
- Pternion: the rearmost part of the heel bone when the person is standing.
- Vertex: the uppermost point of the skull when the head is in the Frankfurt horizontal.

The use of anthropometry in design is intended to ensure that people feel as comfortable as possible. In practise, this means that dimensions must be appropriate (kitchen sink at the appropriate height, doorways and corridors wide enough, chairs sufficiently tall and wide, etc.). Anthropometry plays an important role also when designing products and built environment for older adults.

5.4.2 Anthropometry for older adults in product design

Designers, architects and engineers who create built environments have a responsibility to ensure that the built environment is safe, comfortable, and accessible to everyone. This also applies to anyone with limited mobility, including older adults.

Anthropometric measurements are the first step when we want to make ergonomic products. A specially adapted environment and appropriate aids are required when the user has special needs, e.g. when designing for older adults, disabled people, etc. Hence, anthropometric standards derived from the adult population may not be suitable for older adults because body composition changes as we age. Before designing products for older adults, we need to analyse specific anthropometric databases. In addition, the anthropometric characteristics of older adults can differ significantly between men and women and between older adults with different medical conditions. For example, frail older adults often have lower body mass, or people with heart failure may have edema that increases the circumference of their limbs. Based on the anthropometric data specific to the end- user, we can design the built environment, interior design or assistive devices to specifically meet their needs.

As the proportion of older people around the world continues to increase, it is becoming even more important to create ergonomically designed living environments to ensure safe and comfortable independent living for older people. When designing such living environments, consideration of the anthropometric characteristics of older people is crucial.

5.5 SPECIFIC ERGONOMIC DESIGNS AND AIDS

IN A NUTSHELL

The market provides us with more assistive products and technologies than ever before. But this does not mean that every tool or aid can actually help people. Some products tend to be ageistic, are cheaply constructed, or on the other hand are too expensive because of use modern technology or specific materials. Such products do not improve people's lives but exclude them even more.

We can divide aids into multiple groups: **tools which help with movement** – e.g. handles, crutches, walkers, canes, wheelchairs; **tools for daily routines** – e.g. hair-brushes, grabbers, device for putting on socks, writing aids, medicine dispensers, indicators for visually impaired; **kitchen tools** – e.g. cups, knives or cutlery for people with grasp problems, plates which cannot be spilled, water level measurements.

We have new possibilities, new materials, and we have more knowledge. This could lead us to thinking that every problem in this field has its

solution. But the reality is different. Not every aid is useful and even can harm a person when using. Another issue is aesthetics. One might question why aesthetics have such importance for these people. We have to keep in mind that people use their aids daily and they are part of their everyday life, even part of how they dress. In fact many people do not use their aids or prosthetics because they are ashamed of how they look. They may even be more indicative of their disability and/or of limited utility, which can lead to psychological problems or isolation. These problems are the focus of professionals such as anaplastologists, who create personalised prosthetics for missing limbs or other body parts.

In an ideal case, every person would have personalised aids that are fitted precisely to suit their needs. 3D printers or moulds enable us to achieve that, but the associated costs may be prohibitive. If we want to create products which are ergonomically and anatomically correct and are not that expensive, we have to design aids which can fit more than one person and can be customized according to their needs.

Liftware products demonstrate positive combinations of function, ergonomics and aesthetics. Liftware created cutlery for people with tremor or grasp problems. Sufferers can find it difficult holding a spoon without spilling the contents. This may lead to them feeling ashamed about visiting restaurants and socializing because they spill their food, eventually resulting in isolation. Liftware's Level product connects cutlery to a handle with motors and via a flexible joint keep the cutlery in the right position. Meanwhile, Liftware Steady connects cutlery to a larger handle with gyroscopic motors which moves counter the tremor and prevents spilling.

Figure 5.3.1 Liftware Level and Liftware Steady (Liftware)

Figure 5.3.2 Liftware Level in use (Liftware)

Figure 5.3.3 Liftware Steady in use (Liftware)

Unfortunately, many ergonomically correct and aesthetically pleasing products are costly to purchase. Seniors or people with disabilities often cannot afford them. Many people are unaware that special products designed for their needs even exist. Establishing a connection between doctors and medical social workers can be a solution. Doctors themselves are frequently unaware of products or services designed for those with special needs or impairments. Connecting doctors with informed medical social workers, who can directly help people, would be a significant improvement.

5.6 VISUAL ERGONOMICS IN PRODUCT DESIGN

IN A NUTSHELL

Humans perceive most information via their visual sense. Visual impairments require particular approaches when designing and specific rules must be applied in order to communicate information as clearly as possible.

Vision is very important because it is known that sight is of great importance in human life. We perceive 70 – 80 % of the information about the surrounding world through our visual sense, which does not mean that the loss of vision or its significant weakening leads to changed living conditions, which have an impact on further development and overall functioning of the personality and the social environment in which a visually impaired person lives with a disability (Požár, 2012) . The most common vision problems are trouble focusing on close or distance objects and are a normal part of the process of ageing. These problems can be solved by using dioptric glasses, contact lenses, permanent artificial lenses or surgical correction. In higher age groups various causes of vision loss could appear, including injury or progression of a disease.

5.6.1 Age-related vision diseases

IN A NUTSHELL

Any visual impairment has significant influence on daily life. Some people are born blind, some people lose their vision during life, some visual impairments occur as a results of untreated health issue or they can be caused by injury. As people get older various visual impairments can occur.

Age-related macular degeneration –affects the central part of the retina (macula). It results in a loss of a person's central vision, therefore reducing the ability to see fine details. The most common symptoms are blurry or fuzzy vision, straight lines appear wavy, empty areas or blind spot appearing in the centre of vision. Those that suffer from this condition can lose the ability to operate vehicles, see faces or read smaller print.

Cataract – clouding of lens of the eye which is normally clear. It is caused by breaking down of the proteins and fibres in the lens which clump together. The progress is slow and can develop in both eyes but not at the same stage. The most common symptoms are faded colours, blurry or double vision, halos around light sources, trouble with bright lights or difficulties seeing at night. People may have problems with driving, reading and recognizing faces. This disease can be easily surgically fixed.

Glaucoma – eye condition that damages the optic nerve. It is often caused by an abnormally high eye pressure. After the age of 60 it is one of the leading causes of blindness. Unfortunately, the progression of disease is such that one may not notice until the condition is at an advanced stage. Vision loss by glaucoma cannot be recovered. The most common symptoms are patchy blind spots in one's peripheral vision, and in advanced stages this can progress to even tunnel vision.

Diabetic retinopathy – pathological retinal changes in prolonged (5 – 20 years) Diabetes mellitus disease. It begins as a non-proliferative form (microaneurisms, hemorrhage, capillary depletion), continues as a preproliferative form causing the growth of new and abnormal blood vessels in the retina (leading to secondary retinal detachment and complete loss of vision).

5.6.2 Ergonomic principles and aids for people with visual impairment

IN A NUTSHELL

In order to help people with visual impairment precise rules should be applied. They concern font selection, colour combinations, contrast or tactile graphics. By respecting the requirements, we create quality design products which make people's lives easier and better.

FONT

When creating text or graphics for people with vision impairment, we should choose a proper font to communicate the information as comprehensibly as possible. Italic, cursive and decorative fonts are typically not suitable. One should preferably aim to use Tiresias family of TrueType sans-serif typefaces, or as an alternative from sans-serif group Calibri, Arial, Helvetica, Verdana or Tahoma. Tiresias is a font family which was designed considering the needs of visually impaired people at the Scientific Research Unit of the Royal National Institute of Blind People in the UK.

The European Blind Union suggests the use of a minimum font size of 12 points for standard documents, potentially even up to 16 – 20 points font size. They also recommend against the use of all-caps for continuous text.

Braille font is used by blind people. It is a special font created by Louis Braille, French educator and inventor. It consists of 6 points divided into a grid of 3 points each in 2 columns, called the braille cell. This is the size of the fingertip of regular index finger.

COLOUR COMBINATIONS

The vast majority of aids (digital magnifiers, computer software) have accessibility pre-sets for the most suitable colour combinations according to the characteristics of vision diseases. These combinations are:

- blue background with yellow;
- black background with yellow;
- white background with black;
- black background with white.

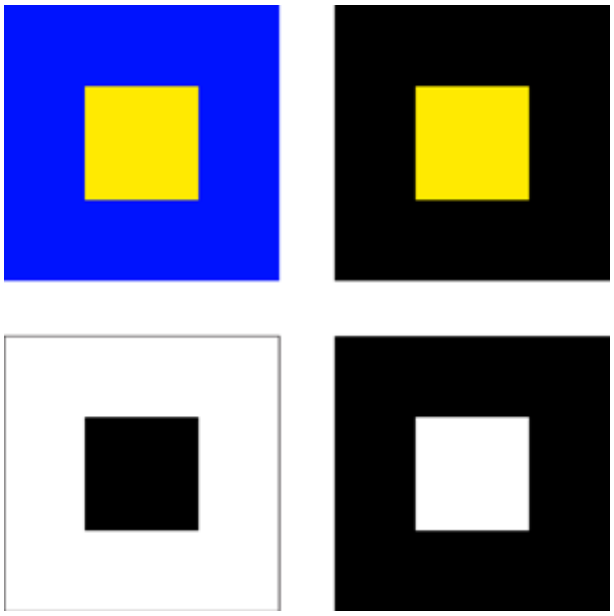

Figure 5.3.4 Most suitable colour combinations (Šimková)

Apart from colours, the next most important thing is contrast. When creating a graphic it is recommended to convert it into shades of grey in order to determine whether the contrast is sufficient or not.

TACTILE GRAPHICS

Tactile graphics deals with relief graphics for the visually impaired. This includes graphic editing of texts (segmentation, line skipping, framing, underlining, highlighting, dividing paragraphs), textbooks (displaying geometric shapes, graphs, parts of the human body) and images (illustrations).

When creating images some specific rules should be applied. For example, objects, animals, or people must be presented anterior or from the side. One should avoid the use of perspective effects because this leads to comprehension challenges for visually impaired people. For example, when one creates a relief image of a chair in perspective, a visually impaired person may “read” it with their hands and discover that two legs of the chair appear shorter. But when they touch the real chair, they discover that all the legs are the same length, resulting in confusion.

PRODUCTS

The first product to be widely available for use by people with visual impairments are magnifiers. The most basic examples are analogue devices which come in various formats and level of zoom. Beyond this are electronic or digital magnifiers, typically around the size of a smartphone. A user can set an exact level of zoom, change colour combinations or even make photos of documents. The lens is accompanied by a light diode. There are also desktop/table video magnifiers. These consist of a display, camera and control panel and can provide magnification to a whole book or magazine . Their usage can extend beyond simply reading – they can also facilitate knitting, the completion of crossword puzzles, painting, and writing, etc.

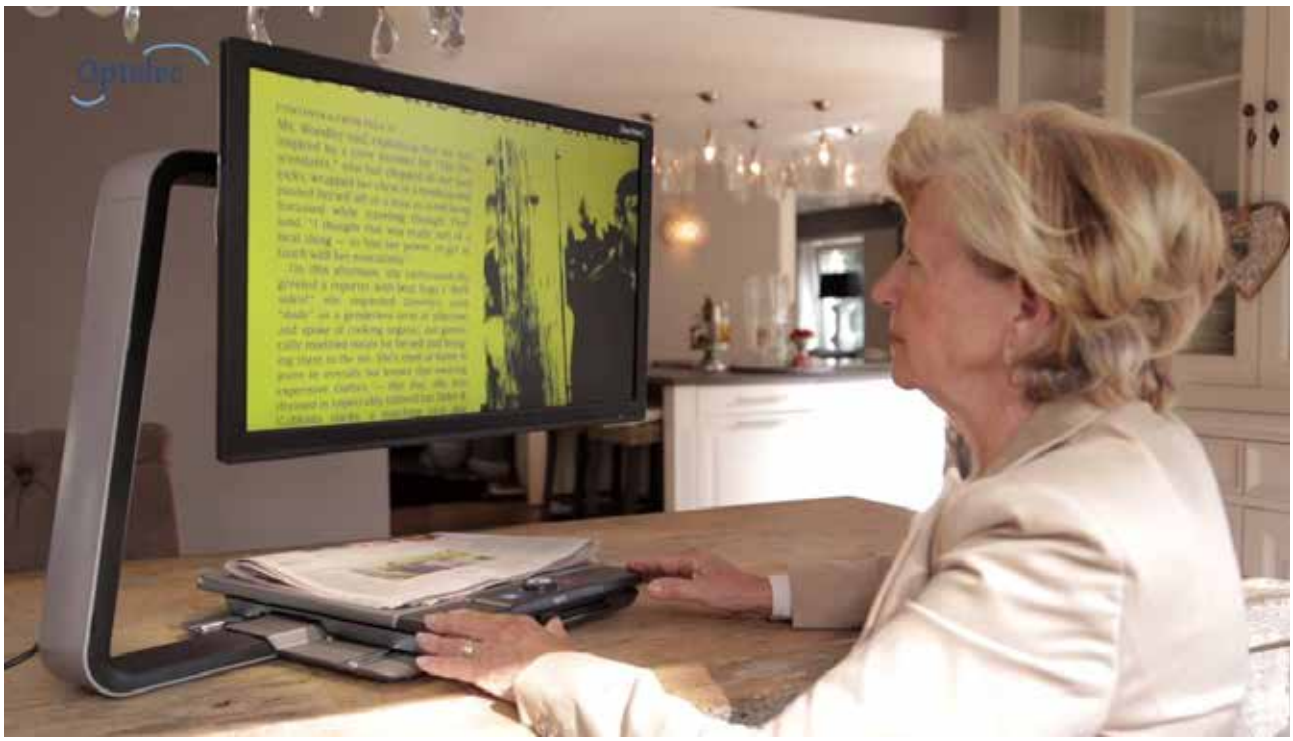

Figure 5.3.6 Desktop electronic magnifier Optelec ClearView (YouTube)

Figure 5.3.5 Portable electronic magnifier Zoomax Luna S (Tyflocomp)

When using computers people can use a braille keyboard or have access to a range of accessibility various software. Software features include text to speech tools which are able to read out loud text documents and electronic books and assist with desktop and Internet navigation. Unfortunately, synthesised voices can be difficult to understand for novice users but experienced users have fewer difficulties. Software can also zoom the screen or change it to a desired colour combination. Examples of the most common software include Jaws, Fusion and ZoomText.

For orientation in space, white canes are often used. Newer technologies offers additional functionality, including the use of radar and vibrations to detect and assist people to avoid obstacles. In some public spaces or buildings acoustic beacons are installed which can help with orientation via acoustic information and instructions.

To help with daily living various aids have been developed. For example, water level measuring tools help people to pour correct volumes of liquids into cups or pots. Various measuring tools for kitchen are in use. Colour identifiers help with task such as getting dressed or searching for specific items. Money dividers or identifiers helps to differentiate denominations of coins or bank notes. To assist with telling the time there are 2 types of watches – analogue ones which have tactile points on the watch face or digital with synthesised voices that speak the time information out loud.

Figure 5.3.7 Tactile and speaking watches (Tyflocomp)

For writing in Braille special typewriters are used. The most widely used mechanical writer is the Perkins Brailler. It is easy to use, durable and multipurpose for any kind of document.

Since the modern technology era, electronic writers and displays are available – we can speak of a form of alternative keyboards. For example, the Braille Display Focus 40 Blue can be connected via Bluetooth to 5 devices (iOS and Android smartphones and tablets or computer). It contains similar keys as a mechanical writer for writing and a Braille line for reading text.

Figure 5.3.8 Perkins Brailler (Perkins)

Figure 5.3.9 Focus 40 Blue (Freedom Scientific)

DO YOU WANT TO KNOW MORE ABOUT...

Specific principles for designing graphics for visually impaired in architectural space can be found in Module 3 Unit 2 Multisensory environment and wayfinding in subunit 2.7 Signage and graphic symbols.

5.7 CONTACT COMFORT AND HAPTICS IN PRODUCT DESIGN

Tactile interaction between people and elements of the built environment, such as furniture, is often deprioritised, with visual aesthetics often taking precedence over tactile interaction between people and elements of the environment. However, contact with different materials can have an impact on personal comfort and thus on physical and mental well-being.

Comfort is by definition a subjective perception. There are different definitions of comfort and discomfort. Some authors see comfort and discomfort as antonyms, while Zhang et al. (1996) point out that discomfort is primarily associated with physiological and biomechanical factors that cause feelings of pain, soreness, numbness and stiffness, while comfort is primarily associated with aesthetics, feelings of relaxation and well-being. When we talk about contact comfort, we usually also refer to haptics, which is the science of transmitting and understanding information through touch.

Comfort is the most important feature that should be considered when developing a new product. When analysing the comfort of a product, we can distinguish different types of comfort, such as musculoskeletal comfort, thermal comfort, contact comfort, etc. Contact with different materials can cause different physiological reactions and influence comfort. For example, contact with acrylic plastic can cause unpleasant sensations associated with a significant increase in blood pressure (Ikei et al., 2017). In general, contact with materials such as marble, tiles and stainless steel has been shown to increase feelings of coldness and discomfort, while no such effect has been found for contact with wood. We can apply these findings to design process. For example, handles in corridors made of wood have better tactile properties than handles made of aluminium. Consequently, older adults would walk down the corridors and use the handles more often. Various assistive devices for older adults, also called haptic technologies, are also based on haptic perception (Arab et al., 2015). When designing products for older adults, the decline of haptics sensitivity and the sense of touch should be taken into account.

It is important to consider the contact comfort and haptic properties of materials used in product design for older adults. To promote the well-being of older adults in the built environment the correct choice of materials and consideration of the declining haptic sensation of older adults should be part of the design process.

DO YOU WANT TO KNOW MORE ABOUT...

If you want to know more about the anatomy of a hand and tremor we recommend to reading Module 2 Unit 2 – subunit 2.4.3 Peripheral neuropathies and tremor.

5.8 METHOD OF SIMULATION AS AN IMPROVEMENT TOOL FOR DESIGN PROCESS

IN A NUTSHELL

At the beginning of every design project, it is very important to understand the target group as well as possible. Theoretical knowledge is important but sometimes insufficient. Various combinations of health impairments or age-related difficulties are difficult to account for solely theoretically. By simulating these conditions one can gain new perspective on the issue – the result of such a process are products that better reflect user requirements.

Simulation exercises have proven crucial at the beginning of every design process. When designers create products for people it is vital to understand not only the anatomy of the human body, but also human needs, difficulties and various impairments. Methods of simulation even increase levels of empathy. After such experiences designers are equipped to suggest better design solutions. The goal is to ease people's lives and assisting everyday situations. It is particularly important when designing for an impairment that the designer themself is unfamiliar with.

The use of simulation improves and accelerates the quality of the student's educational process if it is systematically integrated into the pedagogical process. Litwin (2018) of the University of Buenos Aires understands simulation as a teaching method aimed at familiarizing students with situations and features similar to those in the real world, but which are synthesized.

In our research project Importance of Simulation in Design Process (Šimková, 2017), we tried to determine if the simulation method is suitable for designers and how much the process can affect them. To determine the suitability, we chose Neil Fleming's VARK questionnaire (1987). This questionnaire determines the best learning method for a person. One can be Visual, Aural/Auditory, Read/Write and Kinesthetic learning type. Results confirmed that the simulation method is a suitable learning method for designers. To determine how much can the usageof simulation tools affect their design Emphatic Experience Design (EED) method was used. This methodology consists of five stages:

1. defining designer problem;
2. defining typical users;
3. designing of emphatic experiences/exercises;
4. simulation of emphatic experiences/exercises;
5. generating concepts.

At first participants were briefed about people with various impairments and which aids they use and based on that re-designed those existing aids. Later they were able to experience how a person with such impairment feels through simulation exercises. After this experience they were given the opportunity to change their design if necessary. Every designer made significant or minor enhancements. Most of them were surprised when they experienced new or unexpected perceptions, even gaining higher levels of empathy. One participant stated that at first the whole simulation experience was fun, but after she realized that people with such impairments could not control the manifestation of their disease she would feel pretty hopeless and embarrassed in society.

Figure 5.3.10 a, b Simulation exercises (Šimková, 2017)

Various types of simulation tools are available. For example, simulation glasses simulate visual impairment, earphones simulate hearing impairment or tremor simulator simulates various tremors. Simulation suits were developed to combine various impairments together. By wearing them a person can instantly get a preview how their body might behave at the age of 70 and can experience difficulties connected to higher age. However, such Instant Aging methods can present those undergoing the simulation with a type of shock, which may not be shared by people whose health problems or limitations have developed over a long time period and to which they have been able to adapt.

Figure 5.3.11 Simulation suit Genworth R70 – detail of the carousel changing of visual degenerations (Genworth)

Figure 5.3.12 Simulation suit Third Age Suit (Ford)

DO YOU WANT TO KNOW MORE ABOUT...

One of the first simulation suits was created in 1994 by the Meyer-Hentschel institute and is called AgeSimulator. Scientific results from many international research projects and interdisciplinary knowledge of for example gerontology, ergonomics, physiology and medical technology were applied when creating the suit. The manufacturer concedes that ageing is an individual multidimensional process and precise age simulation is not possible. Therefore their newest simulation suit is called AgeExplorer – a suit that explores the process of ageing. It is used in many countries and institutions (Meyer-Hentschel Institut, 2017). This suit consists of a single (overal) or two-piece (top and bottom) combination with orthoses on knees and elbows to restrict movement. Under the suit is a 10 kg vest. A shield similar to a helmet is placed on the wearer's head restricting peripheral vision and an orange visor placed over the eyes that alters the visible colour spectrum and blurs vision. Headphones reduce hearing sense by up to 30%. Gloves simulate reduced tactile sense and on the back of the hand is a specific surface to imitate arthritis.

5.9 ASSISTIVE TECHNOLOGY AND PRODUCT DESIGN

IN A NUTSHELL

Ambient assisted living (AAL) use information and communication technologies to enable older people stay active longer, socially connected, to make their life easier and more independent. In addition, they also help their family and caregivers to monitor health parameters in order to provide quick help if required. Lonely people can benefit from the possibilities of technology that helps them to communicate with friends and loved ones even if they cannot be present.

Aging is a multidimensional process that presents individual circumstances and challenges to each person. People are living longer and should have the opportunity to maintain high standards of health and quality of life for as long as possible. Additional years of life can provide opportunity for further education, starting a new hobby or returning to long-neglected passions.

Many older people live alone and have very little social contact. Some do not have many friends, and circumstances may present challenges for making new friends. Causes of social isolation can be various, such as children/family living abroad, being ashamed of their physical or mental health condition, etc.

To maintain one's independence various technologies have been developed. But the development is so fast that some people may be unfamiliar with new technologies or be unaware of their existence because older people are generally considered as late adopters. Despite the fact that many technologies have been developed to help,

some people do not know how to use them, are afraid of them or are frightened of losing their privacy.

EMERGENCY SYSTEMS

Nowadays many people have a smartphone. There are many apps and gadgets which can be paired to provide essential information about people's needs. We can configure these to receive notifications if a person falls, has a low blood pressure, or low level of sugar. These parameters can be crucial if anyone is in need while away from caregivers.

All caregivers (medical facilities or family members) can be informed of noteworthy occurrences and they can provide appropriate assistance or escalate the request for help. Such technologies can be bracelets, rings, wearable devices or patches. Some garments can automatically contact emergency services in specifically defined situations.

Emergency situations can also emerge within the household. Obvious examples include outbreaks of fire, gas or water leaks, or even burglary. All these situations can be monitored via technology and one can take necessary steps in response. Even in non life-threatening situations, smart technologies may enable one to close windows, deactivate cooking devices, or lock doors, interventions that an elderly person may forget.

MEDICATION MANAGEMENT

Older people are more likely to use various medications. It is not uncommon that they may forget to take a dose or be uncertain whether they have medicated already. Automatic medicine dispensers can play a vital role in such situations. These systems dispense individual doses of medicine at a certain time and activate alarm sounds to attract the attention of the person taking the medication. If a person fails to take the dose a caregiver can be notified via a corresponding app.

Figure 5.3.13 Breyslet – bracelet which monitors person's vitals and has integrated button for emergency situations (Breyslet)

ASSISTIVE ROBOTS

Personal robots can be very helpful. They can provide a useful solution for people who do not get along with others and cannot be placed in caring facilities. Other people want to maintain an independent life without requiring dedicated care. Robots can provide 24-hour companionship, but many people are uncertain, anxious or scared of them or understand them only as a piece of technology. Designers are trying to find a balance between how a robot should look to be more appealing and trustworthy to older people but at the same time not making them too real to confuse people.

Robots can help in situations such as assisting mobility, retrieving dropped objects, detection, personal grooming, shopping, etc. Specially programmed robots can even help with food preparation. Others are used for telepresence or monitoring when relatives or caregivers are not present.

Some robots were created to be only a person's companion and take part on emotional well-being. They usually look like pets or toys. For example robot PARO was created in Japan to use in hospitals or in nursing homes and looks like a baby harp seal. It has various sensors capable of perceiving human presence and its environment.

Figure 5.3.14 PARO – therapeutic robot (Robots)

Figure 5.3.15 PARO used in therapy (PARO Robots USA)

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LIST OF PICTURES