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M2 – Next-Generation Strategies for Sustainability: Technology and Innovation

Course description:

In order to be able to design products and services that have the greatest possible impact on society; while maintaining strong innovation and technological characteristics, it is no longer possible nowadays to think of planning oriented to single impact areas. To clarify, the products and services referred to here fall into the fields of facilitating and enabling people's lives and interaction, stimulating interaction and ensuring methods that enable anyone to be able to participate fully in social life. The fields of reference are therefore by their very nature extremely broad and varied and can range from the technological field, such as the production of apps and smart devices, to the field of sustainability (which remains a widespread and necessary prerogative of any type of product and service), whether this is environmental, economic or social, such as the production of new products from recovered raw materials and the development of products based on raw materials derived from waste. It should also be specified that products and services facilitating the full participation of everyone in social life do not mean the production of types specifically targeted at disadvantaged groups, but rather a reformulation and extension of the paradigm that leads to the production of products and services that are inherently suitable for everyone by their nature, not through standardization, but through customization and responding to broader needs, however specific.

As to achieve these objectives, one must opt for the implementation of intersectional planning, which allows for the simultaneous analysis of different aspects of the characteristics that products and services must have and to achieve a multidimensional perspective that allows what is offered to have an impact on multiple areas of social concern. In fact, as much as this type of planning may be more time-consuming and complex because of the larger number of basic perspectives to be taken into account simultaneously, it allows for analyses that do not dwell on an unreal and ideal situation of simplicity but consider the actual and real plurality of the social world.

Course Objectives:

I. Understand the basics of the different types of technologies that are available for social entrepreneurship (mobile and wearable; Artificial Intelligence; Extended Realities).
II. Understand the basics of the User interfaces.
III. Understand and familiarize with the concepts of Usability and User Experience.
IV. Understand the basic concepts behind Accessibility and Inclusivity perspectives.
V. Familiarize with the present production approaches: AGILE; SCRUM; LEAN and SLOW.
VI. Understand innovative concepts like Green perspectives and leadership and teamwork perspectives.

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Summary

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1. Technologies for innovation and sustainability: What are our best solutions

> **Innovation**: *The creation of a new way of doing something, whether the enterprise is concrete (e.g., the development of a new product) or abstract (e.g., the development of a new philosophy or theoretical approach to a problem).*
>
> **Creativity**: *The ability to make or otherwise bring into existence something new, whether a new solution to a problem, a new method or device, or a new artistic object or form.*

From observing the given definitions, innovation and creativity may appear as two completely overlapping concepts. Contrary to what may transpire; however, these two concepts have different and complementary functions, going on to compose the two sides of the same coin. While innovation can be defined almost as the end result of the design process, and thus corresponds to the actual putting in place of a product or service that introduces a new way of providing a solution to the problem for which they were created, creativity is the engine behind that process, that is, it corresponds to the set of all the processes, observations and reflections that led to the design and the birth of the product or service.

For our purposes, understanding the way in which innovation and creativity move and through which they produce their results is of extreme interest.
Innovation moves along a multidimensional dichotomous axis that represents the speed with which it occurs and the impact it has on society and culture, therefore we may have:

Gradual Innovation:	**Radical Innovation**:
It is based on continuous and reiterated processes of testing and refining what already exists, bringing about its continuous improvement. It thus results in processes that are often slow and last at least decades, and that do not bring disruptive alterations to people's daily lives. Examples are the evolution of Computers, medical progress and automotive technology as they behave in the 21st century.	It is based on processes from scratch and thus lacks a stable foundation to return to if it fails. It produces what will later be perfected by gradual innovation. The processes are very rapid and unexpected and have the characteristics of bringing about upheavals in people's daily lives, capable not only of changing modes of behaviour but even of altering people's perceptions of the world. Examples include the invention of the steam engine, of the microscope and of the Internet.

Table 1: Types of innovation

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As for creativity, on the other hand, as originally theorized by Ame Dietrich, it moves on a plane formed by an axis at the extremes of which are the concepts of deliberate and spontaneous, and an axis on which are the concepts of cognitive (which here synthetically indicates reasoned, thought) and emotional. We thus obtain:

	Cognitive		
Deliberate	**Deliberate and Cognitive Creativity**: This type of creativity is characterized by the presence of a goal to be achieved and a deep and extensive knowledge of the issues that are being addressed. It also requires a great deal of effort to be accomplished.	**Spontaneous and Cognitive Creativity**: This type of creativity relies on an element of freedom of thought to allow possessed knowledge to be reworked by the mind in new ways without there being a conscious effort to manage the activity, allowing new connections and thoughts to emerge.	Spontaneous
	Deliberate and Emotional Creativity: The element of intentionality is present but there is also an element of emotionality, which colours the outcome. It is based on periods of reflection and analysis of one's feelings and sensibilities, which bring carefully thought-out results.	**Spontaneous and Emotional Creativity**: It is commonly called inspiration or enlightenment and involves the deactivation of conscious activity enabling the attainment of unique approaches divergent from known ones. It is based on the possession of a highly honed specific skill.	
	Emotional		

Table 2: Types of creativity (based on cognitive-emotional and delberate-spontaneous axes)

1.1. What is User Interface: Cognitive and Mental Models, Metaphors, Affordances, Signifiers, Constraints, Mapping, Feedback

All of the following concepts come together in a macroconcept that is fundamental to the development of products and services that have high social utility. The term referred to is originally coined by Donald "Don" Norman, and it is the User Experience (which we will focus on in section 2.2.5.). Starting from the details:

> User Interface (UI): *It is the surface layer through which users control and communicate with software or hardware. It's the space of interaction between a person and technology.*

Figure 1: User interface example - Windows 8 Start Screen
Source: https://www.conceptdraw.com/How-To-Guide/graphical-user-interface-examples

The user interface is a fundamental element in any device of electronic and digital nature. Despite the fact that it may be present in simplified forms even in devices that are not extremely advanced, its importance grows as the complexity of the object and the functions built into it grow. This importance manifests itself particularly in the fact that it can shape and define the modes of approach between user and device, making them all the simpler and more intuitive or abstract and obscure.
In relation to our topics, and on the basis of the five types of possible interaction with the user interface: give instructions; conversing; manipulate; explore; answer, the primary types of user interfaces that can be relevant to us are the following:

- Graphical User Interface (GUI).
- Touchscreen GUI.
- Menu-Driven Interface.
- Command Line Interface.
- Conversational UI.

In order for a user interface to be as effective and efficient as possible, and thus clear, intuitive, and simple, it is essential that the following elements be kept in mind and the relevant criteria met:

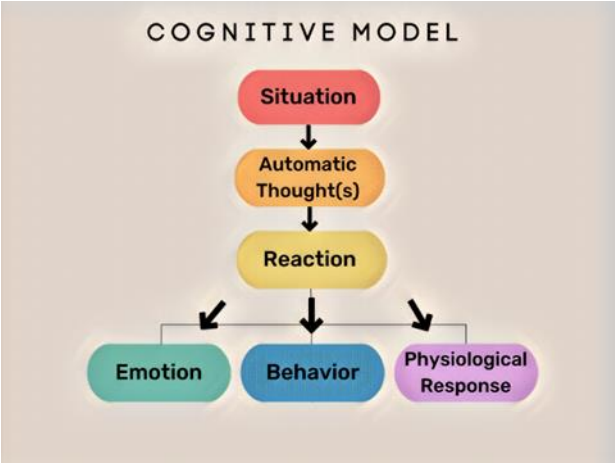

Figure 2: Simple cognitive model representation
Source: https://fbcbt.org/how-cbt-can-help/

Cognitive Models: *They are computational models that hinge upon psychological notions, demonstrating how people go about problem-solving and performing tasks. Its main objective is to predict users' behavior with regard to the tasks.* Computational here means a reasoning process, almost a person's operational algorithm, that indicates the possible operational choices and conditions that must be met to achieve a given result.

Mental Models: *They are both conscious and unconscious representations of the world that help us understand complex concepts and make better decisions by providing a framework for thinking and problem-solving, allowing us to view problems from different angles and generate creative solutions, and helping us become more effective thinkers and problem solvers.* They are created through our past experiences, beliefs, and assumptions to understand how the world works.

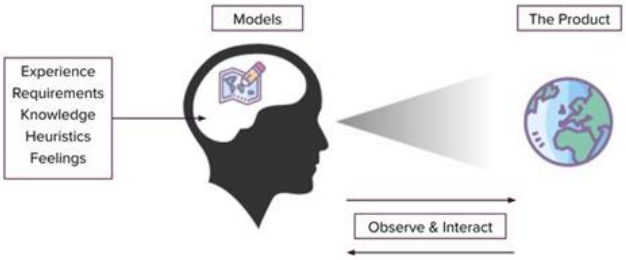

Figure 3: Mental Models
Source: https://www.quora.com/What-is-a-mental-model

Thus, the concepts of cognitive model and mental model are intrinsically related to each other and contribute together to the smooth functioning of the user interface. Since the mental model is a simplified and functional representation of how the world works, it underlies the functioning of the cognitive model, which, on the other hand, represents the set of steps necessary to achieve a goal through interaction with the world. It follows then that, an inaccurate or incorrect mental model will bring devastating outcomes on the cognitive model to which it is connected, This is because, acting together, the cognitive model and the mental model behave almost as a heuristic, thus as a standardized and normalized operational process that can be employed in any circumstance the conditions are encountered that allow its manifestation. It is precisely from this risk of automation that the need for the most precise and accurate definition of models arises.

Metaphors: *A figure of speech in which an expression is used to refer to something that it does not literally denote in order to suggest a similarity.* In this specific case, the metaphor goes to represent a model a mental and cognitive model that is already known or easily intuited with the purpose of facilitating understanding of how the device works.

Metaphors are of utmost relevance in the design of user interfaces as it is precisely these that allow for an intuitive and simplified understanding of how the device works through an immediate and direct connection between the structure of the device, one's mental model and one's cognitive model. The implementation of an appropriate metaphor thus allows one to easily connect their understanding of how the world works to their knowledge of how to achieve a particular goal; the outcome of this connection will then integrate with the knowledge provided by the metaphor, allowing for the achievement of the goal.

Affordances: *They are the properties of an object that help a user understand that they can interact with it, and the type of interaction that may be involved. Designing user experiences with affordance in mind is crucial in order to ensure a user understands what they can do across sections of a product or app.*

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Signifiers: *They are perceptible cues that designers include in (e.g.) interfaces so users can easily discover what to do. Signifiers optimize affordances, the possible actions an object allows, by indicating where and how to take action. Designers use marks, sounds and other signals to help people perform appropriate tasks.*

Affordance and signifiers thus interact complementarily to facilitate the user's experience in using the device. Between them they differ primarily on the basis of their origin: while affordances are dependent on the nature of the device itself, and are therefore naturally integrated into it because of its structural characteristics; signifiers have a more artifactual nature in that they are implemented in the device in situations in which the affordances present are not sufficient to indicate all possible functions or to make explicit the meaning of affordances that might be hidden.

Constraints: *Constraints are an aspect or element of design that prevents a user from taking a certain action.*

Constraints are therefore crucial in that they act as natural indicators along with affordances of the possibilities of using the device. There are four types, which act on different levels:

- Physical Constraints: They limit the possible interactions.
- Semantic Constraints: They rely upon the situation to enforce a decision.
- Cultural Constraints: They are based on existing cultural conventions.
- Logical Constraints: They are based on logic related to the device.

Mapping: *It refers to when the relationship between the controls and the object being controlled is intuitive and obvious. It is defined as Natural Mapping when the controls positioning mimics the positioning of what is controlled.*

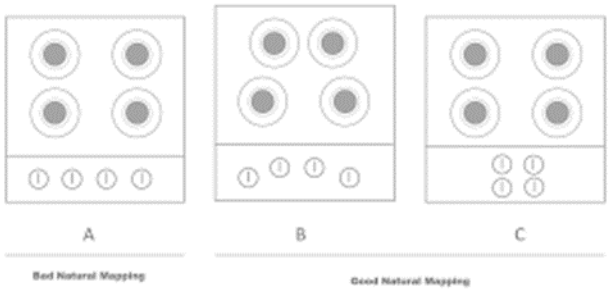

Figure 4: Designed vs. natural mapping
Source: https://medium.com/@nakuldhaka/natural-mapping-62b90ba6a79

Mapping is highly relevant in situations where affordances and signifiers do not effectively clarify the mode of use of the device and when there is no availability of displays that give clear directions. Mapping is also highly relevant in situations where the physical distance between the controlled object and the control is such that there is no clear connection between interaction and feedback.

Feedback: *A reaction to a process or activity, or the information obtained from such a reaction.*

Feedback is very important as it is this element that allows the user to understand whether or not the actions, they are taking are right. To this end, the timeliness of the feedback is of utmost importance, as incorrect timing would lead to confusion regarding the understanding of the relationship to the activity and thus undermine the effectiveness of the learning process.

1.2. Mobile and wearable devices: Quantified self and Sensors

The two concepts explained below are of particular importance in contemporary society as technology has been progressing steadily and rapidly in recent decades toward a reduction in the size of devices and their increasing integration and permeation into people's daily lives, even into the person themselves:

Mobile Technology: *It is technology that goes where the user goes. It consists of portable two-way communications devices, computing devices and the networking technology that connects them.*

Figure 5: Mobile technology
Source: https://www.cynergytech.com/stories/mobile-technology-definition-uses-types/

Figure 6: Wearable technology
Source: https://www.tigahealth.com/does-wearable-technology-improve-health/

Wearable Technology: *It is a category of electronic devices that can be worn as accessories, embedded in clothing, implanted in the user's body, or even tattooed on the skin. The devices are hands-free gadgets with practical uses, powered by microprocessors and enhanced with the ability to send and receive data via the Internet.*

In addition to the obvious influence that mobile and wearable technologies bring to people's daily lives, the most relevant change we can detect is the emergence of a phenomenon that is nowadays extremely widespread and brings extremely important consequences in private life, social life and business environment, namely:

> **Quantified Self**: *It is the term that embodies self-knowledge through self-tracking. The list of things that we can measure about ourselves is endless. However, not all important things in life can be measured and not everything that can be measured is important. It really revolves around finding personal meaning in your personal data.*

In this perspective, extreme importance is assumed by:

> **Sensors**: *A sensor is a device that detects and responds to some type of input from the physical environment. The input can be light, heat, motion, moisture, pressure or any number of other environmental phenomena. The output is generally a signal that is converted to a human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.*

Following is a non-exhaustive list of categories of sensors that can be most useful in direct reference to humans: temperature; pressure; touch; image; motion; light; vibration; proximity; position; gas/smoke; accelerometer; tilt.

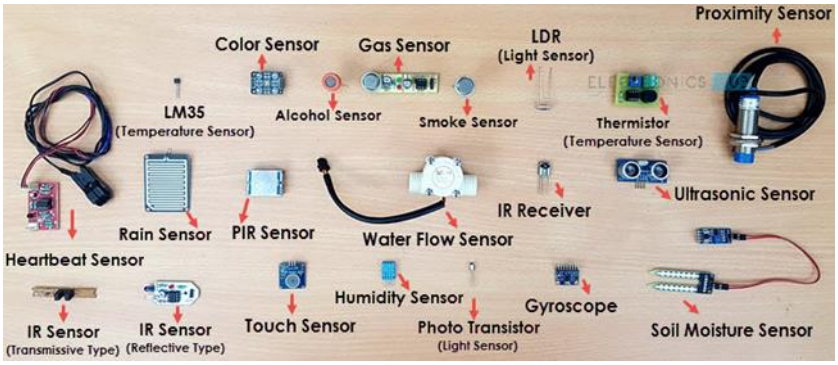

Figure 7: Different Types of sensors
Source : https://www.electronicshub.org/different-types-sensors/

For a better understanding of the various types of sensors, and for more sensor types (which here have not been included due to relevance matters) please consult the following link: https://www.thomasnet.com/articles/instruments-controls/types-of-sensors/

1.3. AI and all its wonders

> **Artificial Intelligence (AI)**: *The ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience.*

Artificial intelligence is thus a fundamental element in many everyday technologies, albeit in different entities and with different degrees of complexity. In fact, AIs play an analytical and operational role in a great many devices.
One of the greatest peculiarities of AIs is a capability they possess that, coupled with their expertise in device control through the analysis of various data, allows them to get better and better and become more and more accurate and efficient. We are talking about their ability to learn.
To learn, artificial intelligences can follow two processes:

> **Machine Learning**: *It describes an approach to developing algorithms and statistical models that enable machines to make decisions and predictions based on previously collected data samples, all without being explicitly programmed to do so beforehand.*

> **Deep Learning**: *It is a subset of machine learning, which is essentially a neural network with three or more layers. These networks attempt to simulate the behaviour of the human brain allowing it to "learn" from large amounts of data. A single layer neural network can still make approximate predictions, but additional hidden layers help to optimize and refine for accuracy.*

The main difference, other than the multiple layers of deep learning processes, is in the methodology they apply in the structuration of the data they analyse.
One of the capabilities of artificial intelligences with the greatest interest in direct human-device interaction is their ability, still in the early stages of development, to simulate human emotions, which allows them to better interact with people, and to adjust their decision-making behaviours on more human criteria. more specifically:

> **Affective Computing**: *Also known as emotion AI, is an emerging technology that enables computers and systems to identify, process, and simulate human feelings and emotions. It is an interdisciplinary field that leverages computer science, psychology, and cognitive science.*

1.4. VR, AR and MR

> **Extended Reality (XR)**: *It is defined as the spectrum of virtual and augmented experiences, which merges the physical and virtual worlds to create engaging and immersive environments where users can interact with computer-generated elements in real-time.*

Thus, XR is not a single technology, but a multiplicity of technologies that use different mechanisms and processes to bring to life their artificial or mixed environment with whom the user can interact. Specifically:.

Virtual Reality (VR): *The use of computer modelling and simulation that enables a person to interact with an artificial three-dimensional (3D) visual or other sensory environment. VR applications immerse the user in a computer-generated environment that simulates reality through the use of interactive devices, which send and receive information and are worn as goggles, headsets, gloves, or body suits. In a typical VR format, a user wearing a helmet with a stereoscopic screen views animated images of a simulated environment.* You can find more at the following link: https://www.youtube.com/watch?v=HRzobEK03mY

Figure 8: Example of VR
Source: https://www.thecave.nz/virtual-reality

Figure 9: Example of AR
Source: https://www.forbes.com/sites/theyec/2019/02/06/augmented-reality-in-business-how-ar-may-change-the-way-we-work/

Augmented Reality (AR): *It is the integration of digital information with the user's environment in real time. AR users experience a real-world environment with generated perceptual information overlaid on top of it.* You can find more at the following link: https://www.youtube.com/watch?v=XX993jgeQ0M

Mixed Reality (MR): *It refers to the blending of the physical world with the digital world. It allows the superposition and interaction between digital elements and the real-world environment to varying degrees. MR experiences can fall anywhere between the ends of the virtuality continuum. In MR experiences, the user is not bound to a screen and can interact with both the digital and the physical elements.* You can find more at the following link: https://www.youtube.com/watch?v=P_l873tL3jw

Figure 10: Example of MR
Source: https://www.augray.com/blog/what-is-mixed-reality/

Each of these technologies and the related environments they go on to create perform extremely useful functions in human-related fields, even going so far as to enable the learning of potentially dangerous or costly processes, thereby reducing risks to users.

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1.5. Usability and User Experience approaches: How to design for Accessibility and Inclusivity, and how to limit Frailty

> **Usability**: *It is a measure of how well a specific user in a specific context can use a product/design to achieve a defined goal effectively, efficiently and satisfactorily. Designers usually measure a design's usability throughout the development process-from wireframes to the final deliverable-to ensure maximum usability.*
>
> **User Experience (UX)**: *User experience (UX) design is the process design teams use to create products that provide meaningful and relevant experiences to users. UX design involves the design of the entire process of acquiring and integrating the product, including aspects of branding, design, usability and function.*

These criteria must be met in the production of any product or service, and in the case of the social sector they acquire even greater importance.
In order to meet both Usability and UX criteria, creating an experience that is cohesive and unified, designers in their activities must consider the following 5 usability characteristics, which are also reflected in the UX which were originally defined by Don Norman:

- Effectiveness: It supports users in completing actions accurately.
- Efficiency: Users can perform tasks quickly through the easiest process.
- Engagement: Users find it pleasant to use and appropriate for its industry/topic.
- Error Tolerance: It supports a range of user actions and only shows an error in genuine erroneous situations.
- Ease of Learning: New users can accomplish goals easily and even more easily on future visits.

One of the best design approaches to enable the achievement of high UX and Usability values is the:

> **User Centered Design (UCD)**: *It is an iterative design process in which designers focus on the users and their needs in each phase of the design process. In UCD, design teams involve users throughout the design process via a variety of research and design techniques, to create highly usable and accessible products for them.*

On the other hand, while maintaining the focus on users, but shifting the perspective to a more direct orientation to the activity itself, which is necessary to achieve a goal:

> **Activity Centered Design (ACD)**: *It is about the actions people need or want to take to reach a goal.*

Two concepts of utmost importance regarding Usability and UX, in particular when they are declined toward social sector impact, are:

> **Accessibility**: *Accessibility is the concept of whether a product or service can be used by everyone, however they encounter it.*
>
> **Inclusivity**: *Inclusivity means making sure everyone feels welcome, valued, and respected, no matter who they are or where they come from.*

It is important to state that for obvious reasons depending also on the magnitude of the semantics of Accessibility, Inclusivity is inherently included and present when a product or service Is Accessible.
Moreover, many types of accessibility and inclusivity practices, technologies and mechanics are available nowadays and they are designed as to allow for the maximal customizability of the product or service.

The previous concepts have greater relevance when they relate to the issue of fragile categories. Although a person with some form of disability is usually understood as belonging to the fragile categories, and this is usually the case, the construct has a multidimensional characterization. In fact, it is necessary to point out that the concept of frailty is relative to context, as its influence and weight are strictly dependent on the context in which we find ourselves and therefore characteristics that are fully functional in some contexts become dysfunctional in others. It is precisely for this reason that categorization should not be limited to disability alone but should be extended to all individual characterizations that can make one even temporarily part of a minority, regardless of the type of minority. Thus, each of us at some time in our lives has been part of a fragile category, depending on the tasks at hand and the relative context.

1.6. Accessibility and Inclusivity perspectives: What does it mean to design for “everyone”

Because of current production systems, the vast majority of products on the market today are affected by a characteristic innately necessary for mass production, namely, standardization. By this term is meant the characteristic of the product to be conceived and designed for a general user with average characteristics.

However, this characterization makes the products extremely unsuitable for anyone who does not respect the average characterization necessary for their use. Therefore, in order to make products accessible and inclusive, the solution lies in:

> **Flexibility**: *This approach to production allows certain product characteristics to be left as alterable, so that they are adaptable to specific individual characteristics, limiting the discrimination exercised toward users.*

2. Strategies for innovation and sustainability: An overview of the AGILE, SCRUM, LEAN and SLOW approaches

One of the major changes that have taken place in recent decades is the maturation of production approaches that differ from the classical ones. These new approaches are based on different backward philosophies, which allows them to be used according to the different production needs encountered and changed as those needs change. They differ primarily on the basis of the speed with which the product is brought to market, on the basis of the final quality and finalization of the product at the time of bringing it to market, and on the basis of the match between product characteristics and user demands.
The approaches that have been most successful are primarily two, plus one framework and one sub-approach derived from one of them, and they are:

AGILE Approach: *The Agile methodology is a project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement. Teams follow a cycle of planning, executing, and evaluating.*

SCRUM Framework: *Scrum is an agile project management framework that helps teams structure and manage their work through a set of values, principles, and practices.*

LEAN Approach: *Lean is a set of management practices that produces value for customers quickly through a focus on reducing delays and eliminating waste, which results in increased quality and lower cost.*

SLOW Approach: *Theorized by Daniel Kahneman, this approach is the temporally most recent one and aims to return production to less rapid and more reasoned and logical paths.*

2.1. What is the right approach for me?

What remains now to be considered, and which allows to identify which of the previous approaches is the best for the situation encountered, is the set of production characteristics. In order to obtain this information, it is very useful to conduct a SWOT analysis, so as to understand which elements to alter and which to leave intact in order not to alter the balance of the resource-cost-time triangle, thus leaving the actual quality of the products unchanged.

3. Human behavior shifts for innovation and sustainability: New perspectives

Over the past 60 years, many perspectives have changed globally about human behaviour, and these changes have affected all fields of relevance to human beings. Among the many, the following two have brought the greatest impact from social and business perspectives.

3.1. Green perspectives: What does it mean to design "zero-impact" products

Sustainability is a term with multiple meanings, despite the fact that they all pertain to the same root. the meaning we are most interested in is the sustainability of production and products and consequently the emergence of the:

> Green Economy: *It is defined as low carbon, resource efficient and socially inclusive.*
>
> Circular Economy: *is a system where materials never become waste and nature is regenerated.*

These two mindsets turn out to be fundamental in enabling the production of goods that are impact-zero and waste-zero, that is, products that can be reused, recycled or upscaled..

3.2. Leadership and Teamwork: what are the necessary skills

Regarding leadership and teamwork, what has changed over the years is the composition of the skill set required for their proper performance. In fact, if we consider the following definitions:

> Leadership: *It is a set of behaviours used to help people align their collective direction, to execute strategic plans, and to continually renew an organization.*

For leadership roles, the following have become of utmost importance: communication; negotiation; conflict resolution; adaptability; critical thinking; decision-making; problem-solving; relationship building; time management; reliability and trust; creativity; strategic approach; and finally, self-awareness.

> Teamwork: *It is a work done by a group acting together so that each member does a part that contributes to the efficiency of the whole.*

As for teamwork roles, on the other hand, the skill set is composed as follows: communication; responsibility; honesty; active listening; empathy; collaboration; awareness; goal setting; decision making; problem solving; emotional intelligence; and lastly, growth mindset..

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4. Conclusions

To briefly summarize the many different concepts covered so far in the module, what is fundamental for the purposes of effectively implementing the processes that enable the development of adequate and proper social entrepreneurship are concerning an intersectional approach, which goes to considering people not as composed of individual and non-interrelated elements, but rather as systems of individual elements and characteristics, which considered as a whole grant the individual visibility and recognition of their unique selves.
It is precisely for this purpose that the aforementioned technologies, approaches, and social behaviors have been considered, as each of them has a certain degree of importance and functionality in defining products and services that are suitable for anyone, regardless of their individual characteristics. Exactly for this reason, production approaches and paradigm shifts on environmental sustainability and the working environment were also taken into consideration: these are not only useful in safeguarding the natural and social (working) environment, but also go to bring an impact on the production environment, as they go to orient the sensibility of designers and entrepreneurs, generating environments that really go to meet emerging social needs.

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