Table of Contents

Ethical and Deontological Concerns 3
Introduction 3
Engineering Ethics 3
Sales and Marketing Ethics 3
Environmental Ethics 4
Liability 4
Summary 5

Ethical and Deontological Concerns

Introduction

Ethics plays a central role in engineering design, ensuring that technological solutions contribute positively to society while avoiding harm. In a context where technological developments and professional responsibilities are constantly evolving, ethical and deontological issues have become essential in guiding decision-making and professional conduct. Beyond technical skills, engineers are expected to act in accordance with moral principles, legal frameworks, and the broader interests of society.

This is especially important in healthcare environments, where user safety, well-being, and trust are critical. This chapter examines the ethical and deontological aspects of the multisensory cocoon concept, designed to improve patient experience through immersive projection technology.

The analysis is based on engineering ethics principles and sustainable development frameworks. Key topics include engineering ethics, ethical considerations in sales and communication, environmental responsibility, and liability. Special attention is given to user well-being, sustainability, accessibility, and safety. Finally, this chapter also connects ethical considerations to the Life Cycle Assessment (LCA) and Design for Sustainability (D4S) approach used in the project.

Engineering Ethics

Engineering ethics is part of business and corporate ethics and focuses on the responsibilities of engineers toward society, the profession, and stakeholders. Engineers must ensure that their work contributes positively to people and the environment, while minimizing risks and harm.

According to principles of sustainable engineering, engineers must aim to maximize positive impact and minimize negative impact on both people and the environment **[1]**. This is especially relevant in healthcare-related projects, where user safety and well-being are critical.

For this project, the following ethical duties are particularly relevant:

- Duties to the profession: The team must ensure that the design is safe, reliable, and based on sound engineering principles. The system should not create additional risks for patients or healthcare staff.
- Duties to the community: The solution aims to improve patient well-being by reducing stress and anxiety. This aligns with the ethical responsibility to contribute positively to society.
- Duties to the employer/client: The design must be feasible, realistic, and aligned with healthcare needs and constraints. It should provide real value and not just a conceptual benefit.
- Duties to colleagues: The project requires collaboration across disciplines (design, healthcare, technology). Ethical behavior includes clear communication, respect, and shared responsibility.

Sales and Marketing Ethics

The marketing approach for the multisensory cocoon concept is based on ethical principles of honesty, transparency, and responsibility **[2]**. As the system is designed to improve patient well-

being, it is essential to communicate its benefits without exaggeration or misleading claims.

While immersive environments have been shown to reduce stress and anxiety, it would be unethical to present the solution as a guaranteed medical outcome without sufficient scientific evidence. Therefore, the concept is positioned as a supportive tool that enhances the patient experience, rather than a replacement for medical treatment.

The communication strategy focuses on clearly presenting both the strengths and limitations of the system. By providing accurate and realistic information, the design builds trust between designers, healthcare professionals, and patients. This approach ensures that expectations remain aligned with the actual capabilities of the product, while maintaining ethical integrity in a healthcare context.

Environmental Ethics

Environmental responsibility plays a key role in the development of the multisensory cocoon concept. In line with principles of sustainable engineering, the design aims to balance environmental, social, and economic aspects throughout the product's life cycle **[3]**.

A major environmental consideration within this project is energy consumption. The system relies on components such as projectors, sensors, and potentially a small Heating, Ventilation and Air Conditioning (HVAC) system, which together contribute to the overall environmental impact during the use phase. Based on the Life Cycle Assessment (LCA), this phase represents the most significant environmental burden. Therefore, reducing energy consumption is a primary design focus, for example by selecting energy-efficient components and minimizing unnecessary system activity.

Material selection is another important aspect of environmental ethics. The cocoon structure is primarily based on materials such as aluminum, which is durable and recyclable, combined with functional materials like technical Polyethylene Terephthalate (PVC) and foam. While some of these materials have environmental drawbacks, they are chosen for their performance and longevity. By prioritizing durability, the design reduces the need for frequent replacement and therefore minimizes waste over time.

In addition, the project considers the end-of-life phase of the product. The cocoon is designed with disassembly in mind, allowing different materials and components to be separated and recycled more easily. This approach helps to reduce electronic waste and supports a more circular use of resources.

Overall, the environmental strategy of the project follows a life-cycle approach ("cradle-to-grave"), ensuring that environmental impact is considered at every stage of the design. By combining energy efficiency, responsible material selection, and end-of-life considerations, the cocoon concept contributes to a more sustainable and ethically responsible healthcare solution.

Liability

Liability refers to the responsibility engineers have for the safety, reliability, and legal compliance of their product. In healthcare-related applications, this responsibility is especially important, as failures can directly impact patient safety and well-being.

For the multisensory cocoon concept, several potential risks must be carefully considered. These include electrical hazards related to components such as projectors, sensors, and wiring, as well as

fire risks associated with electronic systems in a semi-enclosed environment. In addition, physical safety plays a key role, as the structure must remain stable and accessible for all users, including patients with reduced mobility.

To minimize these risks, the design follows established safety principles and regulations. Electrical components are intended to operate at low voltage where possible and must be safely enclosed to prevent user contact. The structural design is developed to ensure stability and safe use, while also allowing easy and secure access. Clear instructions for use and maintenance are necessary to prevent misuse and ensure correct operation.

Compliance with relevant European regulations is essential to ensure legal safety and product reliability. These include directives such as the Machinery Directive, Low Voltage Directive (LVD), EMC Directive, and RoHS Directive. By adhering to these standards, the product can meet the requirements for CE marking and be safely implemented in healthcare environments **[4]**. Failure to address these safety and regulatory aspects could result in harm to patients, damage to property, and legal consequences. Therefore, liability considerations play a crucial role in guiding the design toward a safe, reliable, and responsible solution.

Summary

The multisensory cocoon concept integrates ethical, environmental, and legal considerations throughout the design process. The project focuses on improving patient well-being by creating a safe, non-invasive, and supportive environment.

Environmental responsibility is addressed through a life-cycle approach, with attention to energy consumption, material use, and end-of-life. Insights from the LCA led to a focus on energy efficiency, supported by Design for Sustainability (D4S) strategies.

Marketing is based on transparency, presenting the cocoon as a supportive tool rather than a medical solution. In addition, the design considers relevant EU directives to ensure safety and compliance.

Overall, the project demonstrates how technology can be designed responsibly by balancing user needs, environmental impact, and legal requirements.

The following chapter presents the project development and final design.

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[1] Catherine N. Mulligan, 2019. *Sustainable Engineering: Principles and Implementation.* CRC Press, Taylor \& Francis Group, ISBN 978-1-498-77458-1.
[2] Philip Kotler, Kevin Lane Keller, 2016. *Marketing Management.* 15th Global. Pearson Education Limited, ISBN 978-1-292-09261-4.
[3] Michael F. Ashby, 2009. *Materials and the Environment: Eco-Informed Material Choice.* 1st. Butterworth-Heinemann, ISBN 978-1-85617-608-8.
[4] Charles E. Jr. Harris, Michael S. Pritchard, Michael J. Rabins, Ray James, Elaine Englehardt, 2019. *Engineering Ethics: Concepts and Cases.* 6th. Cengage Learning, ISBN 978-1-337-55447-3.

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