

Realistic Constraints – Key Concepts

1. **Economic:** Determining whether a project should be carried out from a financial perspective. Primary considerations are the cost of making a product (including fixed and variable costs), the pricing of a product (can it compete in the marketplace), and the cost of ownership for both producer and consumer.
2. **Environmental:** Giving consideration to the ways that a product impacts the environment, from its manufacture to its use to its disposal. Often manifested in terms of how the adoption of environmental constraints (e.g. use of only organic cotton and dyes for clothing) affects design.
3. **Health and Safety:** First, engineering is about application of knowledge for the betterment of humanity. Products should be designed such that their everyday use does not cause harm. Indeed, engineers have literally helped better the lives of thousands, even millions, through their designs. Second, designing a “safe” product it does not mean that it cannot fail or that we cannot get hurt or killed by the product; it means that the degree of risk is considered to be acceptable. Finally, designers must acknowledge that all products have lifetimes, and therefore modes of failure (material fatigue, poor design, environmental degradation, and/or human error), associated with them.
4. **Manufacturability:** Concerned with designing a product in such a way that it can be “manufactured” (e.g. parts made and then assembled into the product) efficiently, reliably and within acceptable costs. This can include redesigning a product to reduce the number of parts, simplify fabrication, or utilize common parts and materials.
5. **Sustainability:** The process of developing engineering devices, products, and systems that use the resources available to it to meet the needs of the present without compromising the ability of future generations to also meet their own needs. Specific points include:
 - Does the manufacture and/or use of the product employ renewable resources?
 - In what ways can the product be reused and/or recycled at the end of its lifetime?
6. **Social:** Developing projects that are designed to meet human needs and/or to address social issues. The psychologist Abraham Maslow argued that there is a hierarchical structure to human needs where the higher needs come into focus only when the lower needs are met. In ascending order:
 - **Physiological:** includes basic human needs such as breathing, drinking, eating.
 - **Safety:** includes mechanisms that provide for a predictable, orderly world: shelter from the elements, personal security from crime, financial security, health maintenance, etc.
 - **Love/Companionship:** humans need to feel a sense of belonging and acceptance; we like to have friends, belong to groups, join clubs, organizations, churches, etc.
 - **Esteem:** comes from a human need to be respected and to respect both oneself and others. Feeling good about what we have accomplished in life is a driving force – we also feel good if others appreciate our contributions.
 - **Self-actualization:** developing a sense of fulfillment in one’s life through building upon strengths, overcoming weaknesses, and growing in skills and knowledge.

7. **Political:** One needs to understand how engineering and political activities interact, and how to work effectively in this environment. Key points to examine are:
 - Government as a regulator.
 - Government as a customer.

8. **Ethical:** Engineers need to be aware of codes of conduct that provide standards of proper behavior in our interactions with others, both inside and outside of the profession. This should not be confused with what we feel is right, what our religious beliefs are, what the law states, or what are the socially accepted norms of behavior.