

Module 1. Concepts of Sustainability

The term “sustainability” is currently very popular. Industries and organizations realize the benefits of protecting the future while succeeding in the present. In the present, sustainability is most often defined as incorporating three pillars into design: economics, environmental, and social. However, the general concepts of sustainability have been in use for millennia. The design and construction of Roman aqueducts for drinking water distribution were so robust that they have lasted centuries, with dozens of aqueducts built as early as 300 BC still standing today and the “Roman Road” still being used for movement of traffic. Finally, today, there is a significant push for many sustainability initiatives, including more fuel-efficient vehicles on the roadway. Fuel-efficient vehicles address all three pillars of sustainability, by reducing fuel consumption (economics), decreasing emissions (environmental), and allowing more diverse transportation options for consumers (social, or society).

The UN, established in 1945 to avoid future conflicts on the scale of World War I and World War II, is an international organization made up of 193 member states as of 2016. Written in 1945, the UN’s charter (from www.un.org) contains four aims:

1. To save succeeding generations from the scourge of war, which twice in our lifetime has brought untold sorrow to mankind
2. To reaffirm faith in fundamental human rights, in the dignity and worth of the human, in the equal rights of men and women and of nations large and small.
3. To establish conditions under which justice and respect for the obligations arising from treaties and other sources of international law can be maintained
4. To promote social progress and better standards of life in larger freedom. In order to strive toward achieving these four aims, four guidelines (also from www.un.org) were also established:

1. To practice tolerance and live together in peace with one another as good neighbors
2. To unite our strength to maintain international peace and security
3. To ensure, by the acceptance of principles and the institution of methods, that armed force shall not be used, save in the common interest
4. To employ international machinery for the promotion of the economic and social advancement of all peoples

This basis of international cooperation provides a logical place to begin examining the development of the concepts of sustainability.

The first significant milestone for sustainability within the UN was the World Conservation Strategy, developed in 1980 (IUCN, 1980). In this document, sustainability was described through three goals:

1. Maintain essential ecological processes and life support systems
2. Preserve genetic diversity
3. Ensure the sustainable utilization of species and ecosystems.

These three goals mainly revolve around the concept of protecting the environment, with terms such as ecological processes, life support systems, genetic diversity, species, and ecosystems. However, 7 years later, in 1987, the UN released the Brundtland Commission Report, which is probably the most recognizable milestone in the UN’s sustainability development (Brundtland, 1987). Within the Brundtland Commission, a theme was developed to qualify sustainability. The theme reads that sustainability “meets the needs of the present without compromising the ability of future generations to meet their own needs.” This theme is independent of protecting the environment, but the concept of the environment is still woven into the fabric of the theme.

In 2002, the UN hosted a World Summit on Sustainable Development, which for the first time defined what are called the three pillars of sustainability: **economics, environmental, and social** (UN, 2002).

The UN developed a resolution in 2015 that went even further with quantifying the measures of achieving sustainability (UN, 2015). This resolution, titled “Transforming Our World: The 2030 Agenda for Sustainable Development,” broadened the scope of sustainability significantly with 17 metrics.

2015 United Nations Resolution on Sustainability Metrics

Metric	Brief Description
1. Poverty	End poverty in all its forms everywhere
2. Food	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3. Health	Ensure healthy lives and promote well-being for all at all ages
4. Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Women	Achieve gender equality and empower all women and girls
6. Water	Ensure availability and sustainable management of water and sanitation for all
7. Energy	Ensure access to affordable, reliable, sustainable, and modern energy for all
8. Economy	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all
9. Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10. Inequality	Reduce inequality within and among countries
11. Habitation	Make cities and human settlements inclusive, safe, resilient, and sustainable
12. Consumption	Ensure sustainable consumption and production patterns
13. Climate	Take urgent action to combat climate change and its impacts
14. Marine ecosystems	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
15. Ecosystems	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16. Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
17. Sustainability	Strengthen the means of implementation and revitalize the global partnership for sustainable development

In addition to these 17 metrics, a timeline was established in order to meet eight “Millennium Development Goals” (UN, 2007). The timeline goal is to achieve all eight by 2030. The eight Millennium Development Goals are:

1. Eradicate extreme poverty
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria, and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership

Key Concepts Covered in the Economic, Environmental, and Social Pillars of Sustainability

Economic

- Life cycle cost analysis
- Present/future/annual worth
- Rate of return
- Benefit/cost ratio

Environmental

- Life cycle analysis
- Ecological footprint
- Planet boundary
- Environmental product declarations

Social

- Existing civil engineering examples
- United Nations
- Oxfam Doughnut
- Human Development Index
- Social Impact Assessment