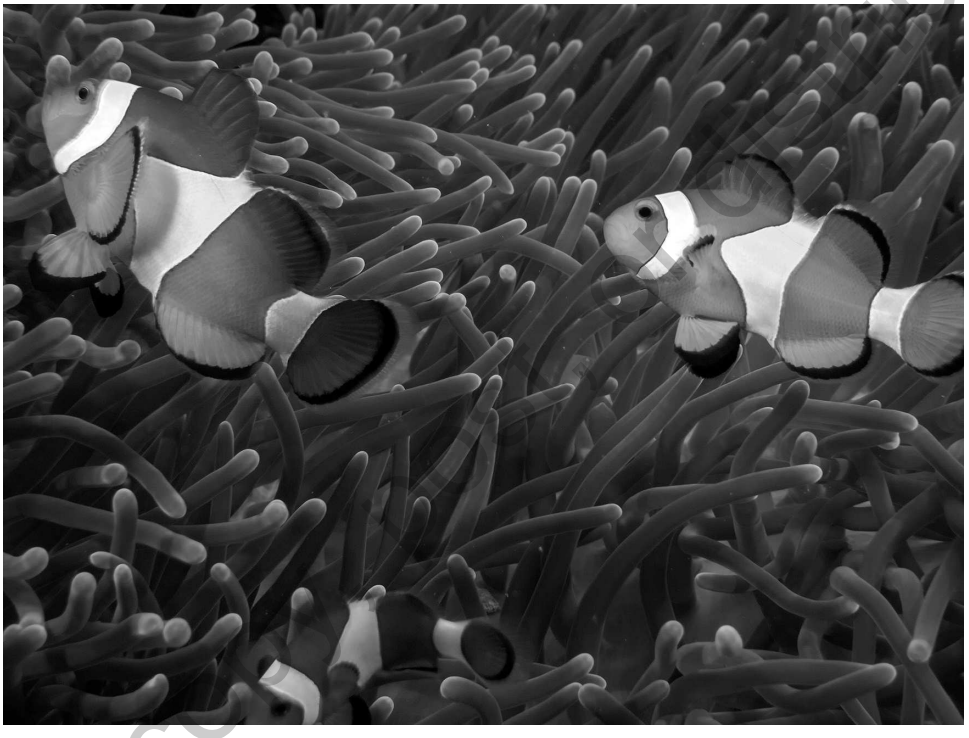
1 INTRODUCTION TO SUSTAINABILITY MANAGEMENT: THEORY



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LEARNING OBJECTIVES

After reading this chapter, you should be able to do the following:

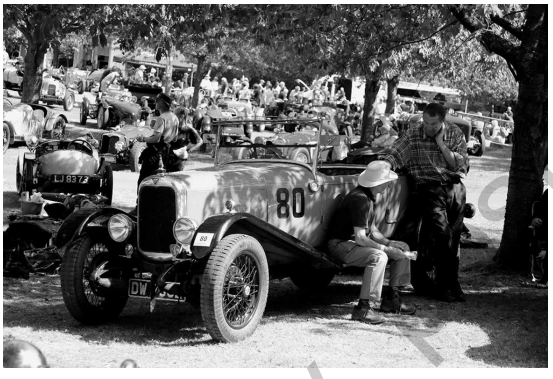
1.1 Define sustainability and sustainability management in the context of the Anthropocene and contemporary global challenges.

1.2 Define and illustrate key concepts and principles of a systems approach to sustainability and sustainability management.

"From Little Things Big Things Grow"[1]: The Carbon Recovery Initiative of the Vintage Sports-Car Club

Vintage cars evoke enthusiasm and spark a passion; since 1934 the Vintage Sports-Car Club (VSCC) UK has provided an arena for people to enjoy pre-1940s cars competitively and socially. Welcoming participation by all regardless of background and active in every aspect of motoring and motorsport, the VSCC[2] is perhaps the largest, best regarded vintage motoring club in the world. There is plenty of scope to become involved, whether as a car owner, marshal, competitor, enthusiast, or spectator.

In late 2021, the then-president of the club Paul Tunnicliffe approached a retired academic who volunteers in the club library, to ask his help to render the club environmentally sustainable. Tunnicliffe also recognized the importance of the club's social benefits, explaining that the Prescott Short-Course Hillclimb, the Club's 2-day centerpiece summer event of the year welcoming over a thousand spectators, is "just an excuse for a great big picnic!"



Source: Credits to Phil Jones. Permission granted by the VSCC.

In close consultation with the Schumacher Institute,[3] a sustainability strategy was developed.[4] As part of this strategy, UK carbon capture and international offset providers engaged in a comprehensive due diligence exercise and used carbon emissions calculators to work out the carbon footprint of all VSCC events, of mileages driven on the open road by members, as well as of the inbuilt footprint of manufacturing the cars themselves.[5] Based on these calculations, the team was able to achieve four-to-one (4:1) recovery—that is, a doubly-balanced approach whereby, for every ton of CO_2 emitted, two tons are offset via carbon credits derived from accredited overseas projects and two tons are captured in the UK, again via accredited projects. Importantly, these two tons captured in the UK are themselves balanced between environment-to-species matched tree planting and peatland restoration (peatland is an excellent carbon sink).

The VSCC leadership knew that global warming is a massive international challenge, so what difference could such a niche organization like this make? Besides, nothing financially sustainable could possibly be done about past emissions. All of this could be paralyzing. But no—the VSCC decided to draw a line in the sand and declared: "Start immediately!" The club's commitment to global sustainability saw it forward-purchase, in a bespoke arrangement with Tree-V,[6] three years' worth of 4:1 recovery up-front, thereby both fixing the price and ensuring the tree-planting and the peatland restoration would be done and carbon credit offsets retired in advance of the CO_2 being emitted. According to its calculations, the club's events annually produce around 70 tons of CO_2, but the club recovers 280 tons. The club 1:1 captures commuting emissions and 10,000 business miles a year, and donates

one pound from every spectator entry ticket to carbon capture. The latter initiative alone captured over 140,000 miles-equivalent of CO_2 in 2023.

In addition, the VSCC has put in place a range of deliverable reductions on its operating emissions, which include changing its paper supplier, promoting genuine synthetic fuels, and a move to new offices selected to reduce commuting emissions and improve the environmental efficiency of the offices themselves. Through its sustainability outreach program, the club advises numerous other motoring clubs including the Bugatti Owners' Club, as well as the leading restorer of original Bentley motorcars Vintage Bentley. Its work and results have been recognized with Motorsport UK sustainability accreditation and the 2023 Sustainable Club of the Year Award. The VSCC is now well known as a leading influencer and change agent in the international vintage motoring industry.[7]

WHAT IS SUSTAINABILITY MANAGEMENT?

LEARNING OBJECTIVE

1.1 Define sustainability and sustainability management in the context of the Anthropocene and contemporary global challenges.

Today, it is estimated that over 80% of companies around the world have strategies in place to become more sustainable from an environmental, social, and governance perspective.[8] We hear that sustainability has become mainstream,[9] we hear about sustainability markets and sustainability careers. But what does it all mean? Does it look the same for a membership association like the VSCC (see the opening case) as it does for a multinational corporation like Unilever? In this chapter, we define sustainability and sustainability management, and discuss the global economic and social context that has led to the soaring interest of organizations in pursuing and achieving sustainable development. We also call for a rethinking of the relationship between the economy, society, and the Earth biosphere.

The Concept of Sustainability

Sustainability has become one of the most cherished goals of our time. Yet its meaning is ambiguous and disputed, and varies widely across different fields of inquiry and practice. Deciding which meanings of sustainability gain ground and dominate is a political battlefield, with some social actors managing to influence, more than others, how sustainability should be understood. Despite its controversial history, the concept of sustainability has become increasingly prominent over the last seven decades, marking a trend that has been recognized as the modern sustainability movement.[10] And despite variations in meaning, one stable central idea remains: being **sustainable** refers to the ability to maintain oneself over time. For example, achieving sustainable performance in an organization means being

able to maintain the same level of performance over many consecutive assessment cycles. Or, a sustainable employee culture is one that "keeps employees engaged to the level needed to perform their jobs capably."[11]

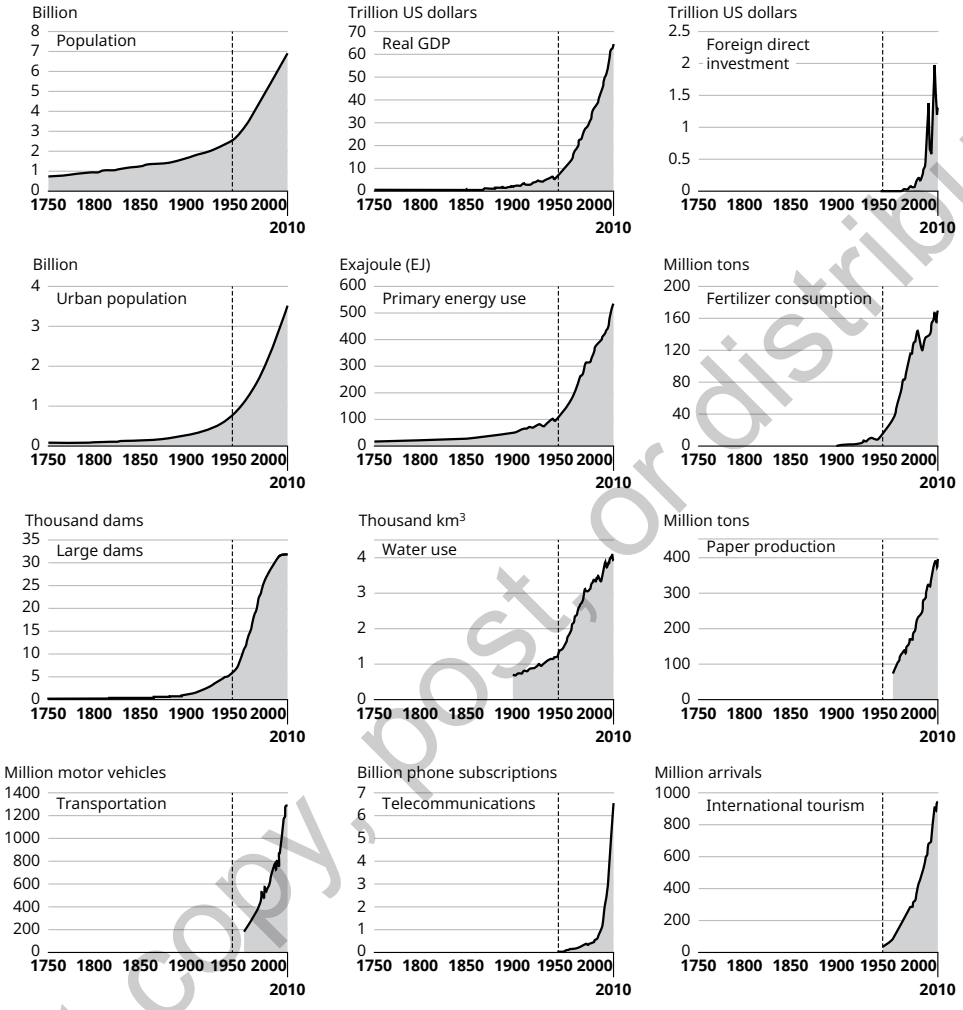
In the context of humankind's interaction with its natural environment, **sustainability** refers to the ability of (organized) human activity to maintain a balanced and harmonious relationship with planet Earth's natural systems (the **biosphere**) and among social groups over an indefinite period of time. The predominant purpose of sustainability referred to in this textbook is "maintaining **global life-support systems**"[12] and pursuing equitable relationships among diverse human communities—that is, ensuring that the ways of maintaining life on Earth function well in addition to addressing the improvement of social conditions. As shown here, understanding systems and how they work is central to understanding, planning and achieving sustainability. For this purpose, in this book we are adopting a **systems approach**, which seeks to understand how different but inter-related elements interact and contribute to the functioning of a whole domain of reality.[13] For example, the ecological system of a particular geographic area such as the Amazon Rainforest can be looked at as a set of interconnected elements (such as soil, water, air, plants, animals, and human communities) that function together to maintain and perpetuate life in the region with satisfactory levels of abundance and flourishing over time and across changing realities. We define and discuss sustainability management below.

Over the last seven decades, scientists have observed and reported significant changes in the Earth's natural conditions, which have been mostly attributed to increased production and consumption levels of activity by a rapidly growing human population. This has led some scientists to mark this very short period in the planet's history as a distinct geological era, called the **Anthropocene**.[14] The main concern raised by these observations is a trend that has been named "the **Great Acceleration**" This trend marks the most recent period of the Anthropocene era and is characterized by a significant increase of the rate of impact of human activity on the Earth's geology and ecosystems.[15] Figures 1.1, 1.2, and 1.3 depict some examples of data illustrating the Great Acceleration:[16]

As you can see, there is a strong correlation between the rapid increase of human activity since the 1950s (in most areas, from manufacturing, transport and population mobility to consumption of various materials and energy resources) and the degradation of the natural environment (such as increase in greenhouse gas emissions and **global warming,** depletion of the ozone layer protecting the Earth's atmosphere, increase of acid levels in the ocean waters, pollution of air and land, deforestation and loss of biodiversity, and reduction of fertile soil areas) in the same period of time. In this context, achieving **global sustainability** (in other words, maintaining a healthy balance between human activity, the planet's ecological systems, and equitable social conditions) has become the most important goal of humankind and "the greatest challenge of our time."[17]

A crucial factor in global sustainability is, therefore, our ability to develop human society in harmony with nature—in other words, to achieve **sustainable development**. Although disputed and contested over the last five decades, *sustainable development* has been defined as "development that meets the needs of the present without compromising the ability of future

FIGURE 1.1 ■ The Great Acceleration

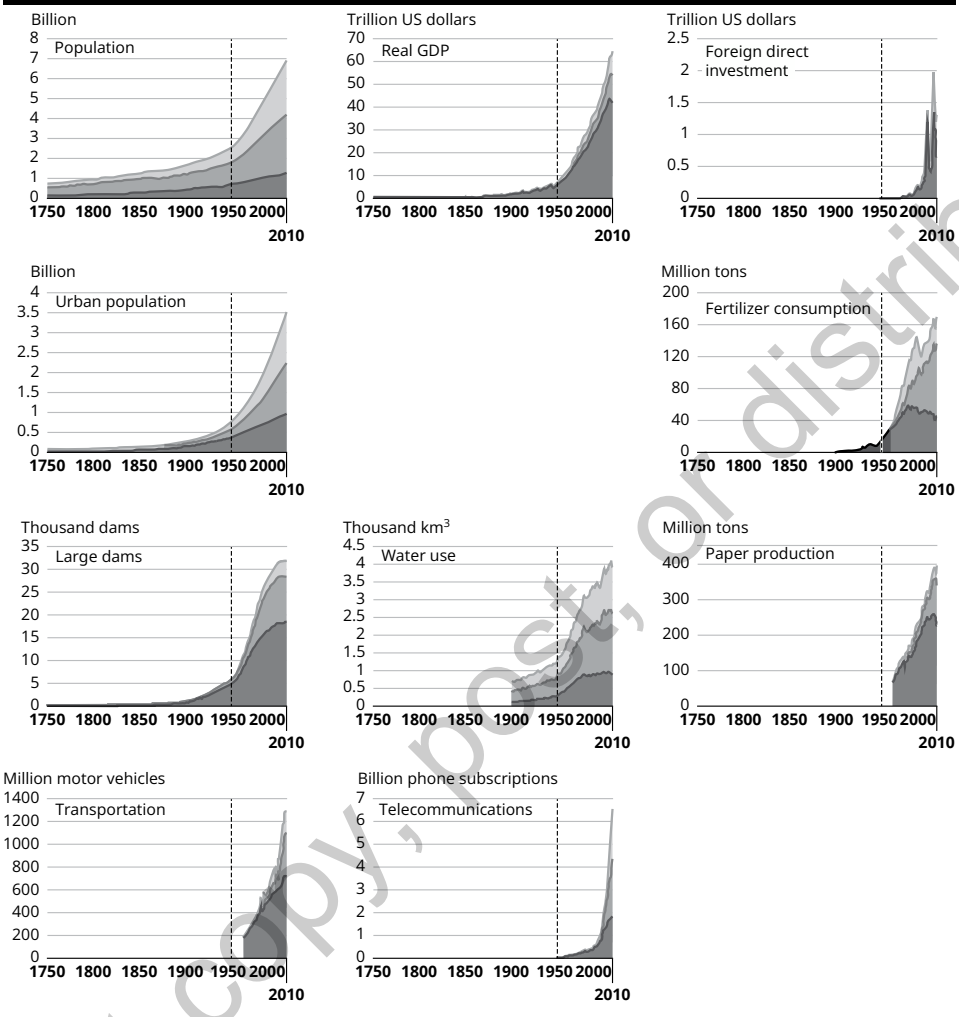


Source: Steffen et al. (2015)

generations to meet their own needs."[18] Produced by an expert investigation commissioned by the United Nations (commonly referred to as the Brundtland Report) in 1987, this early but resilient definition has become the predominant way of understanding economic development in the context of global sustainability because it emphasizes the importance of meeting human needs across generations—a (still) urgent and complex task that requires a significant amount of effort, planning, resources, and coordinated action to succeed.

The main dispute over the concept of sustainable development has been about its compatibility (or otherwise) with economic growth. As long as traditional economic models

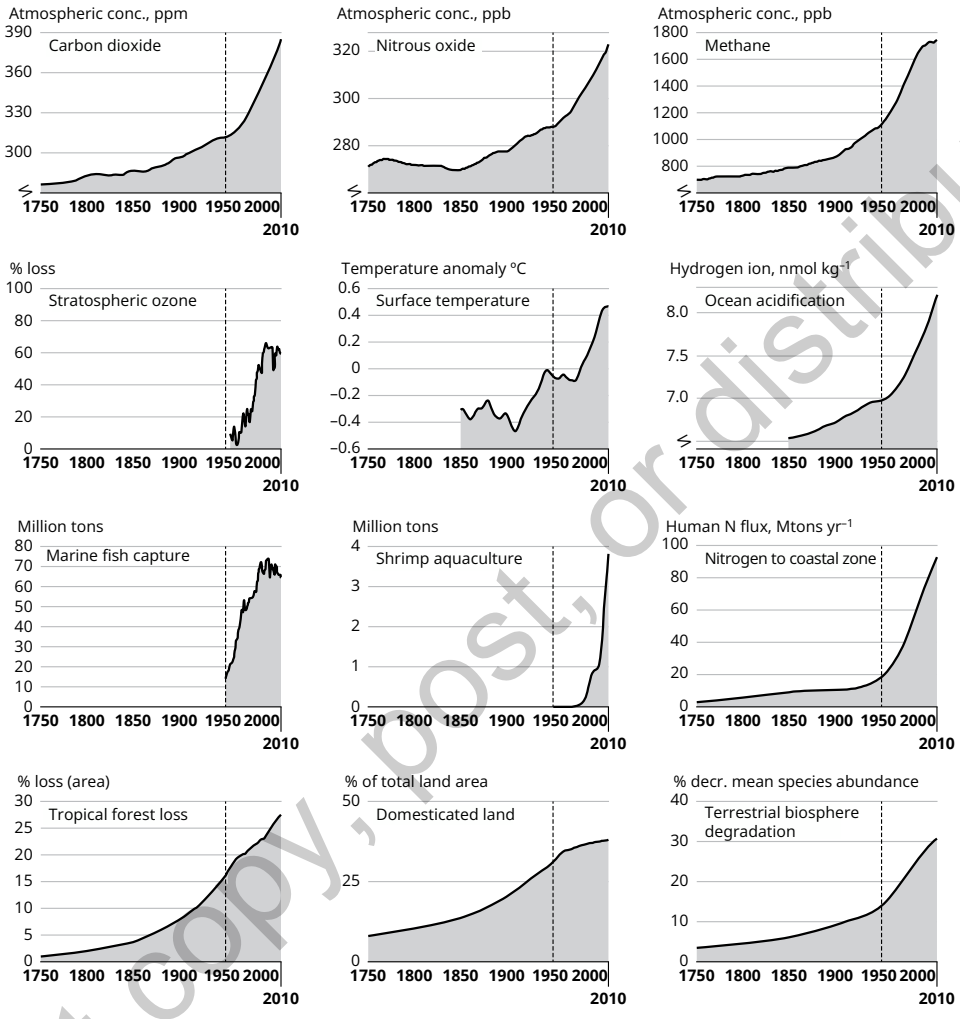
FIGURE 1.2 ■ The Great Acceleration



Source: Steffen et al. (2015)

maintain the assumption that economies can grow indefinitely, without taking into consideration environmental boundaries, economic development cannot be sustainable. We therefore need new models, where economic growth can be part of sustainable development but only in limited forms, constrained by requirements for maintaining the health of ecosystems.[19,20] The assumption of unlimited economic growth, based on the belief that natural capital can be replaced by human-made capital in the long term, has been referred to as **weak sustainability**, whereas the assumption that natural capital cannot be replaced and therefore biophysical boundaries are crucial to understanding the limits of growth[21] has been referred to as **strong sustainability**.[22]

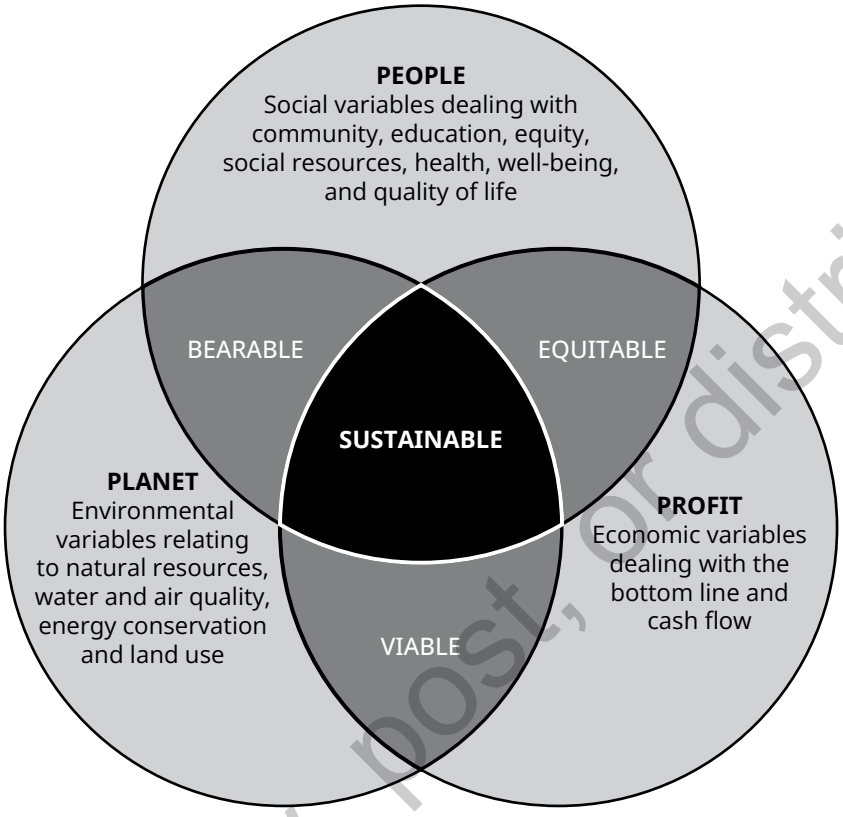
FIGURE 1.3 ■ The Great Acceleration



Source: Steffen et al. (2015)

At the level of individual organizations, sustainability is most commonly understood and accounted for in terms of the **Triple Bottom Line** (see Figure 1.4),[23] a framework that connects the economic, social, and environmental spheres in ways that allow productive organizations to monitor their outputs and appraise the impacts and value they create not just in economic terms (profits) but also in social terms (equity for all people) and in environmental terms (healthy planet). It has become clear that harmonizing only two of the three goals, in whichever combination, is no longer enough. Aiming to have a viable business (which is environmentally friendly but may fail to achieve social justice), or an equitable business (which delivers on social goals but may have negative impacts on the natural environment), or a merely bearable business

FIGURE 1.4 ■ The Triple Bottom Line—Planet, People, Profit



Source: Research Gate (2024). https://www.researchgate.net/figure/The-interconnection-of-the-elements-of-the-Triple-Bottom-Line-concept_fig1_329185478, licensed under CC BY 4.0 https://creativecommons.org/licenses/by/4.0/[24]

(which protects both the environment and social welfare but fails to maintain financial resilience) is not going to lead to achieving sustainability. According to this framework, a **sustainable business** plans for and achieves results with respect to all three Ps (profits, people, planet). In sum, the concept of Triple Bottom Line emphasizes that business can no longer be just about economic growth and profits. It has to be about achieving a healthy balance between our relationship with the natural environment (e.g., water and air quality, energy conservation, land use), our societal objectives (e.g., equitable social resources for education, well-being and quality of life for individuals and communities), and the economic resources needed to support these objectives.

Although the Triple Bottom Line framework has catalyzed significant interest in sustainability in organizations, it also has limitations. One important limitation is that it does not reveal the complex relationships that exist between human economic activity, human society, and the natural environment. As a consequence, even when applying and pursuing the Triple Bottom Line organizations still tend to consider economic systems as operating somehow in isolation, independently,

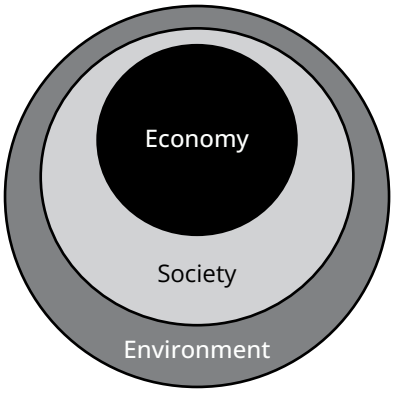
decoupled from their social and natural contexts. The last three decades of environmental movement have shown that no significant progress can be made in practice if operating businesses continue to consider human economy outside of (and in tension with) the Earth ecosystem, as the traditional perspective on environmental sustainability implies. For this reason, the Triple Bottom Line approach is a case of weak sustainability, as in practice it has often allowed companies to prioritize one of the three Bottom Line areas over the others, and tends to interpret the economic dimension as company profit rather than wealth and capital for wider society or for humanity. While this approach may slow down economic activities that damage the natural environment, it is unlikely that it will manage to divert the global economic system away from its current unsustainable path.

To avoid the destruction of our own **habitat** within the natural environment, we need to change our perspective and conceive of our lives and everything we do as embedded in nature. This perspective (commonly referred to as the three Es) can be visually represented as three concentric circles (with the Economy embedded in social Equity, which is in turn embedded in the natural Environment). The three-Es perspective "places the environment at the foundation of the model. It emphasizes that human society and the economy cannot exist without the environment, and therefore it takes conceptual priority."[25] This perspective is an exponent of strong sustainability, as it treats its three components as integrated and inseparable, taking into account how changes in one component will affect the others, and recognizing that long-term solutions, if they are to be effective, cannot address these components in isolation (see Figure 1.5).

This transition from a traditional (instrumental, anthropocentric) to an **ecological perspective**—namely, from weak to strong sustainability—has received significant conceptual and practical support from **Raworth's doughnut model** (see Figure 1.6), which illustrates how an ecological economy and society are supposed to function.[28] We will discuss this model in more detail in the context of **planetary boundaries**, later in this chapter.

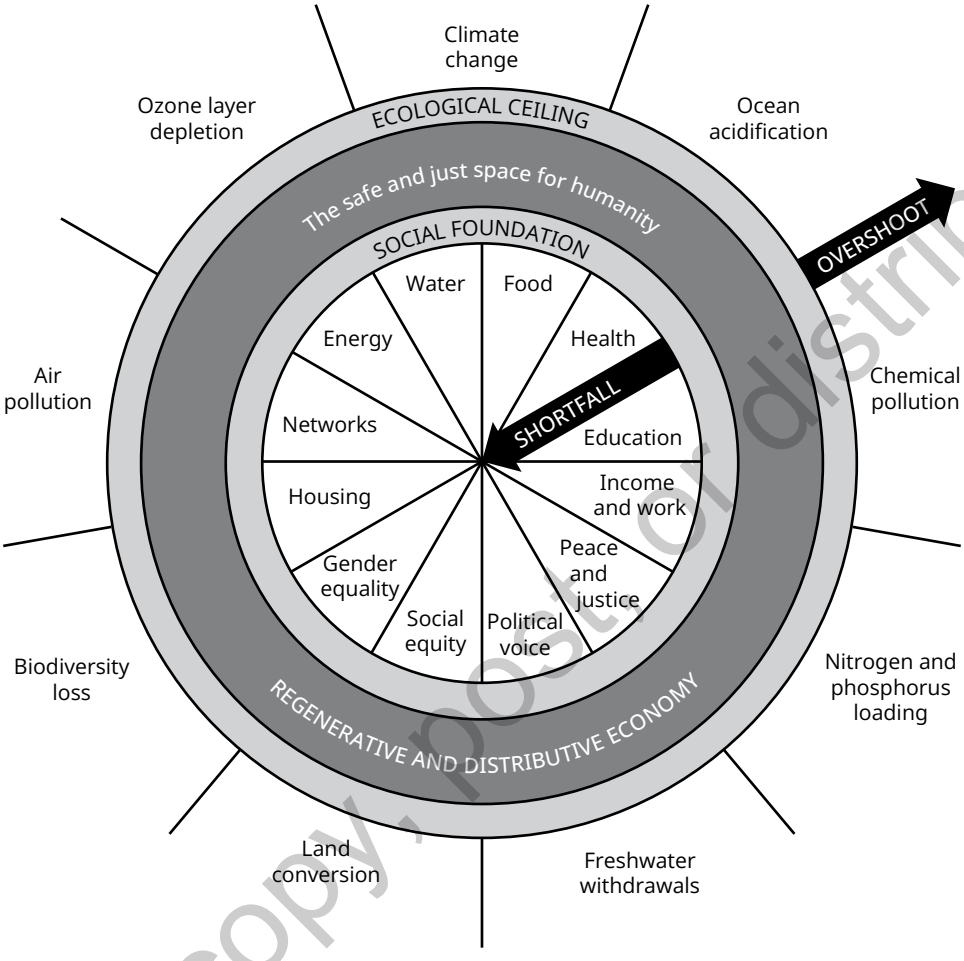
Accordingly, from an ecological perspective, *global sustainability* can be defined as "the persistence of all components of the biosphere, including ensuring all humans have a quality of life beyond mere survival."[30] Inspired by the Triple Bottom Line framework, analyses of global

FIGURE 1.5 ■ The Human Economy and Society, Embedded in Nature



Source: Adapted from Giddings et al. (2002)[26] and Mitchell (2000)[27]

FIGURE 1.6 ■ Raworth's Doughnut Model of Global Sustainability



Source: Wikipedia Commons (2024). https://en.m.wikipedia.org/wiki/File:Doughnut_%28economic_model%29.jpg, licensed under CC BY 4.0 https://creativecommons.org/licenses/by/4.0/[29]

sustainability often refer to three dimensions: environmental sustainability, social sustainability, and economic sustainability. However, as the Triple Bottom Line was originally conceived to guide how individual organizations should pursue, attain, and account for sustainability goals, we need to look beyond this framework to better understand

(a) what it means (for organizations) to assume that the human economy and society are embedded in the natural environment (first pre-condition of global sustainability)

(b) what it means for environmental sustainability to take conceptual priority, in the sense that that the scope and boundaries of human action need to be framed by requirements of environmental sustainability (second pre-condition of global sustainability)

To make sense of these two key principles and apply them effectively for transforming human organizations to become more sustainable, we need to explore sustainability management as a distinct area of management practice, and to take a systems approach when undertaking this exploration. The remaining sections of this chapter provide an overview of what is involved in engaging in sustainability management through a systems approach.

Managing Organizations for Sustainability

The imperative to coordinate human action in deliberate, integrated, well-planned ways in order to achieve sustainability has given rise to the practice of sustainability management. ***Sustainability management*** has been defined as "the formulation, implementation, and evaluation of both environmental and socioeconomic sustainability-related decisions and actions (. . .) and (. . .) includes decisions and actions at the individual, organizational, and societal levels."[31] Corporate sustainability management is now recognized as a key function in a company's operations. As a consequence, plans for achieving sustainability goals are (and should be) developed at all levels of management—be they normative, strategic or operational.[32] Later in this section we outline what each level of management entails in the context of pursuing sustainability goals. Corporate sustainability can be described on a historical or evolutionary continuum, from compliance to co-evolutionary, as illustrated in Table 1.1.

As highlighted previously, achieving progress toward global sustainability requires understanding that human economy is embedded in human society, which is in turn embedded in the natural environment. It also means understanding that the scope and boundaries of human action need to be framed by principles of environmental sustainability. To establish a solid

TABLE 1.1 ■ Stages of Corporate Sustainability

Stage	Compliance	Business-Centered	Systemic	Regenerative	Coevolutionary
Strength	Very Weak	Weak	Mixed Weak + Strong	Strong	Very Strong
Focus	As required by law or other regulatory bodies. *Do what is required.*	For the benefit of the company, employees, and/or immediate stakeholders. *Do less bad.*	Advance change within the larger system for the benefit of extended stakeholders or the stakeholder network. *Do more good.*	To repair, generate, or restore system damage without self-gain but for intergenerational gain (for future generations). *Do repairs.*	For all, even non-stakeholders, for intergenerational gain, only seeks to control self to work in balance with others. *Do what nature does.*

Source: Landrum (2018)[33]

foundation for the three levels of sustainability management, we first need to redefine the three dimensions of sustainability in light of these two preconditions of global sustainability.

Global sustainability can be achieved by managing and enhancing three types of capital[34,35,36]:

- **Environmental capital**, which includes the totality of natural resources, understood not only in terms of what is directly useful for human production and consumption but also what allows the planet's natural systems to be balanced and develop harmoniously (such as ecological resilience, biodiversity, and abundance).
- **Social capital**, which refers to the value inherent in human beings and their communities, as it develops both in individuals (such as knowledge and skills, health, well-being) and in the interactions between individuals and groups (such as shared cultures, common welfare and public good).
- **Economic capital**, which refers to the value generated through human productive activities and processes, and further engaged to maintain production of goods and services needed for human consumption. *Economic capital* can be defined at the level of a whole economic system or of individual organizations, and comprises tangible assets (such as equipment and raw materials), intangible assets (such as intellectual property, brand value, and goodwill), and financial capital and resources (such as equity, profits, cash flow).

An ecological perspective enables us to go beyond a human-centric standpoint, in which **capital** is viewed as a resource valued primarily for its direct capacity to satisfy human needs and wants (from goods and services to the safety provided by a resilient natural environment)—and to value nature in its own right, as the home of a wide range of living forms, including humans as an important part. The importance of humans is derived not from their power to control and modify nature for their own purposes (the instrumental perspective) but from their capacity to use their power responsibly, to live in harmony with other species and nurture a healthy planet, in this way protecting their own habitat.[37,38,39,40,41] Accordingly, the redefined three dimensions of sustainability are

- **Environmental sustainability**—the ability to maintain and support life on Earth, in its various forms, having regard to the circular nature of **value** and **waste** exchanges between organisms sharing the same **ecological system (ecosystem)** For humans, this means protecting (and, if possible, enhancing) nature's capacities to absorb and assimilate waste (energy and matter discarded by humans' production processes), as well as protecting (and, if possible, enhancing) nature's capacities to regenerate energy and matter needed for maintaining healthy, well-balanced ecosystems (including raw materials needed for humans' production processes).[42]
- **Social sustainability** The ability to maintain and nurture a society that provides conditions for human (individual and collective) well-being, inclusion, and social

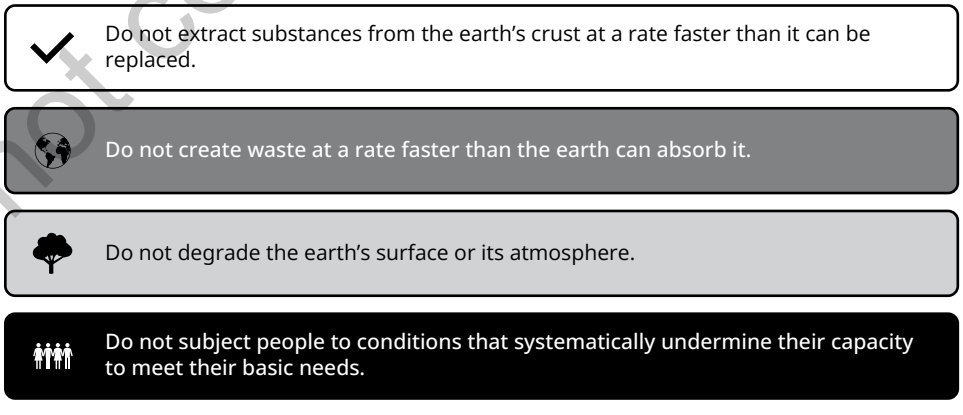
justice without systematically challenging the limits of natural habitats (e.g., without overexploiting beneficial materials, proliferating toxic materials, eroding or destroying physical conditions for life, or undermining some humans'—including future generations'—capacity to meet their needs).[43,44]

- **Economic sustainability**—The ability to achieve economic prosperity while maintaining all economic systems as effective "subsystems within the big biophysical system of ecological interdependence."[45] This presupposes the ability to reduce and even avoid negative impacts of market transactions on third parties (known as a **negative externality**)—whether these impacts affect specific individuals and communities (a **localized externality**) or the natural environment considered globally (a **pervasive externality**).[46] Systems, interdependence and externalities will be discussed in the next section of this chapter.

By applying the above definitions, we can better understand the biophysical limits that must be respected by a sustainable economy, which then becomes the productive core of a sustainable society, which in turn provides a safe habitat for humankind in a sustainable natural environment. Translated into management actions, achieving global sustainability can therefore be summed up into four key "DO NOT" principles that highlight what outcomes should be avoided, as outlined in Figure 1.7.

Sustainability management can be exercised at individual, organizational, and societal levels.[48] These three levels are also central to understanding systems and the systems approach, which will be discussed in more detail in the next section. As individuals, we can manage for sustainability by taking decisions and actions that reduce overconsumption of materials and energy in all aspects of our everyday lives, from purchasing goods and services to using transport and utilities in ways that are environmentally friendly and responsible. At the other end of the spectrum, human society as a whole can manage for sustainability

FIGURE 1.7 ■ Four Principles of Sustainability



Source: Based on The Natural Step (2012)[47]

by aligning the inputs, processes, and outputs of major institutions in all sectors (business, government, civil society), in all regions on the planet, with long-term environmental goals of global sustainability.[49] This may involve coordinated and integrated efforts in improving the environmental performance of globalized trade, global mobility and transport systems, major infrastructures, and the transnational production and supply chains (from primary extraction and manufacturing to service delivery to end users). In between individuals and society, organizations function as connectors or mediators: They are vehicles for coordinating the intentions, decisions, and actions of individuals to produce outcomes that can then be aggregated across industries and sectors, and across various geographic regions, and can become significant at societal level. Within organizations, planning and acting toward sustainability goals involves doing different things at each of the three different levels of management (normative, strategic, and operational), and at the same time aligning the three levels to work together harmoniously within an integrated framework.

The **normative level of management** "encompasses the basic management philosophy: the values, attitudes, beliefs and judgments, which together make up the organizational culture." At this level, both decision-makers and implementers are united by a shared understanding of the basic principles that underpin the rationale of the organization they manage (the reason why it exists), the goals they set to achieve together, and the ways in which they agree to work together toward these goals. The typical **policy** statements at this level are the organization's **vision** (which projects what the organization is aiming for and what it will look like when it succeeds) and **mission** (which sets up the general approach and the pathways to reaching the organization's aims). In an organization that manages for sustainability, its vision and mission statements tend to make explicit reference to the value of embedding economic sustainability into social and environmental sustainability. Successful sustainability management means that such policy statements are not mere declarations of intent but are consistently reflected into the **practices** of the organization—that is, in the ways people at all organizational levels (from the shop floor to the top management) routinely carry out their activities in the way(s) they "live and breathe" the guiding purpose of the organization and the values they share in working together. In a sustainability-aware and sustainability-sensitive organization, people make a deliberate effort to reflect on the potential and actual impacts of their work (both core and supporting activities) on nature and on the harmonious development of human society within nature. When these practices become habitual, it can be said that the organization has developed a mature **culture** of sustainability management. Having a strong sustainability management culture makes it much easier to leverage and scale up sustainability values across the organization, and to prepare the most appropriate work/internal climate for achieving its strategic and operational goals.

The **strategic level of management** defines the "long-term goals and product/service-market combinations"[50] that the organization should pursue, and involves designing, developing and implementing plans that set the direction of the organization's progress over a longer period of time, beyond and above successive performance reporting quarters. Strategy steers the organization on its journey to success, helping it to avoid dangers and avert threats, to overcome obstacles and barriers, and to seize opportunities. All along this journey,

it also allocates the resources required to succeed.[51] Having a successful **sustainability strategy** means ensuring that the organization's long-term goals, activities, and results and outcomes avoid harm to human communities and the natural environment and, where possible, nurture and enhance both society's and nature's capacities to regenerate and support life, for humans and other species. It means achieving "compatibility between the content of the strategy and the needs of society and the biosphere."[52] Without strategic planning and implementation, there can be no progress toward sustainability. This is because strategic management processes are responsible for integrating sustainability goals, as well as approaches to reaching these goals, at all levels of organizational activity. They translate the values and culture of the organization (the normative level) into plans for carrying out its day-to-day tasks and projects (the operational level). Research has identified three dimensions of strategic management that, together, "clarify how corporate sustainability management can help create economic, environmental and social value"[53] namely, content, context, and process. The content dimension refers to the kind of value that the organization creates and delivers. Unlike traditional approaches, managing for sustainability is not just about value for customers and the firm but value for society considered as a broader system. The context dimension is about the specific ways in which the organization produces goods and services, and includes its business model, relationships with key **stakeholders**, market positioning and competitive features, and its capacity for innovating its operations to achieve sustainability goals more effectively and efficiently. Accordingly, the context dimension refers to how value is created, delivered to stakeholders, and captured by the organization itself to regenerate resources for further development toward sustainability. The process dimension provides the blueprint for what can be done, and how, to design and develop a sustainable organization. It connects the normative and operational levels through strategic plans that include appropriate allocations of resources and responsibilities, a strong sustainability culture with commitment to shared goals and values, and a capacity to self-reflect and learn from past experiences.[54]

The **operational level of management** establishes short-term goals and performance targets, and oversees the day-to-day operations of a business.[55] To fulfill its purpose, a sustainable organization needs to align all its functions and operations with the sustainability goals set up in its strategic plans. This alignment has to be achieved by core functions such as production, marketing-sales, human resources, and accounting-finance—as well as supporting functions such as procurement, logistics, research and development, occupational health and safety, workplace and facilities maintenance. Sustainable operations management means, for example, ensuring that, in all processes and procedures

- Waste is reduced to a minimum and resources are regenerated wherever possible (environmental sustainability achieved by maintaining and growing environmental capital)
- Value is created and distributed fairly, in ways that contribute positively to enhancing the well-being of all stakeholders (social sustainability achieved by maintaining and growing social capital)

- The organization's assets and resources are allocated and used appropriately to maintain its functions and operations in ways that increase its production of social and environmental value (economic sustainability achieved by maintaining and growing economic capital)

To understand management practice from a sustainability perspective, it is important to also understand the organization itself not just as a set of functions and operations but as a network of stakeholders.[56,57] In other words, production of goods and services as **value creation** for sustainability cannot be understood without focusing on the relationships between the various actors and resources involved.

Overall, *sustainability management* as a practice can be defined as "the integration of (and relationships between) a growing field of stakeholders dedicated to addressing **environmental stewardship** and sustainable development issues"[58] along with social responsibility. Managing for sustainability means, therefore, mobilizing all available means to preserve and grow both **manufactured capital** (i.e., resources modified and/or produced by human activity) and **natural capital** (i.e., resources generated by nature) as well as address the well-being of diverse human communities. This involves not only the economic activities (and impacts) of an organization but also its political, social, technological, environmental, and legal activities (and impacts).

Increasingly, sustainability management moves beyond traditional agendas of **corporate social responsibility** (CSR). CSR usually refers to voluntary corporate initiatives, beyond complying with legal requirements, for the benefit of society (and sometimes including the natural environment). Corporations tend to define their social responsibilities in relation to internal and external stakeholders, as illustrated in Chapters 3 and 9, and CSR projects may engage them in agendas that are not profit oriented, such as philanthropy, community development, environmental and human rights protection, employee well-being, and workplace diversity agendas. Through a systems approach to sustainability management, CSR becomes an integral part of creating and delivering environmental, social, and economic value to as many stakeholders as possible.

In this section, we have sketched a broad picture of what it takes to manage organizations for sustainability. In doing so, we have referred to entities such as ecological/ecosystems, economic systems, and human society as a system. This is because we have sought to emphasize the importance of the relationships between the various elements and levels of sustainability management, and to facilitate a dynamic view of how organizations and their practices emerge and evolve in interaction with their social and natural contexts. This perspective has been defined as the *systems approach*, and will be applied consistently throughout this book.

A SYSTEMS APPROACH TO SUSTAINABILITY MANAGEMENT

LEARNING OBJECTIVE

1.2 Define and illustrate key concepts and principles of a systems approach to sustainability and sustainability management.

A systems approach to sustainability and sustainability management recognizes that phenomena in nature and human society are not isolated from each other but closely interconnected. This understanding influences the ways we explain what is going on around us, the ways we perceive positive and negative impacts of various external phenomena on our lives, and the ways we tackle challenges and seek to overcome them. This chapter defines and illustrates the key concepts of a system approach, and then discusses key aspects and properties that characterize a system, as well as what is distinctive about analyzing facts and solving problems by using a systems approach. It also describes what is involved in managing for sustainability from a systems perspective, along three dimensions: space (planetary boundaries), time (long-term horizon), and sustainability values.

Key Concepts: System, Systems Theory, Systems Thinking

The very idea that human economic activities are nested within human society which is in turn nested within the natural environment suggests that the world we live in has a vast number of elements that are related to each other in many ways. The concept of system is key to understanding how these different elements interact, work together, and produce certain effects or results. In basic terms, a **system** is a set of elements that are interconnected in certain ways. These interconnections can often be described, explained, and (to some extent) predicted. There is a certain coherence between the elements of the same system, which is reflected in the way they tend to be positioned in relation to each other (hierarchical structure), the way they—and their relationships—change over time (emergent properties), the way they exchange information (communication) and the way they tend to maintain their collective functioning and respond to disruptions (control).[59] We are surrounded by systems every day—from our mobile phones and personal computers to the organized means of transport that take us to work, banks, and related institutions that provide credit and other financial services to us and to our employing organizations, markets driving the exchange of goods and services needed by billions of consumers, regulatory agencies of various kinds that help people live together peacefully in the same community or society, and the natural environment with its the interrelated resources (soil, water, air, energy) that support human habitat. Furthermore, our actions and behaviors form part of these various systems. Your own body, as a living organism, is a system that keeps you alive by making various other systems within it (**subsystems**) work well together—for example, the central nervous system (brain, spinal cord), the cardiovascular system (heart, blood vessels), the respiratory system (lungs, airways, blood vessels), and so on. Your body takes part in many other systems—such as the immediate environment in which you breathe and move (at home, at work, or anywhere you go), the wider community in which you lead your life, the natural environment that supports your community, and planet Earth itself (**supersystems**).

Understanding all these systems and the vast complexity of their interrelationships may be a daunting task. However, a first condition for success in attaining (global) sustainability is having a sound and practical understanding of how those systems that are vital to maintaining life on Earth—and, within them, humans' lives in society—work together well over long periods of time. To reach this understanding, researchers have developed **systems theory** as a way of explaining world phenomena as systems that depend on each other when functioning together and producing certain outcomes. In fact, the phrase *systems theory* is used as an umbrella term for a whole range of theories that seek to explain what systems are and how they work, using different perspectives.

No matter how different these perspectives are, what they have in common is **systems thinking** as a way in which these theories analyze phenomena. What makes systems thinking clearly distinct from traditional ways of studying reality is that it goes beyond breaking a complex phenomenon or entity into its components and focuses, instead, on how these components relate and function together, how the whole function evolves, and how it interacts with other groups of components with different or similar functions, also as part of larger systems. This emphasis on relations between elements helps us understand a system as more than the sum of its parts, and this understanding is an essential characteristic of systems thinking.

A systems approach is, therefore, a general perspective founded on systems theories and systems thinking as its core principles. This is the approach we are taking when investigating sustainability management and its various aspects, in each chapter. Adopting a systems approach makes a profound difference to understanding global sustainability challenges and opportunities, and to practicing effective sustainability management in an organization—as illustrated further in this chapter.

Key Principles of a Systems Approach

Our systems approach to global sustainability is informed by four groups of key principles. These principles frame the systems perspective in a way that distinguishes it from other perspectives on sustainability. They also introduce key concepts used to describe properties of most systems we encounter in nature, and guide our analyses to help us identify challenges, suggest solutions, and discover opportunities in pursuing global sustainability.

The key principles of a systems approach to global sustainability can be summarized as follows:

- *System definition:* Any system can be defined in terms of its principles of coherence, and structure, boundaries, and control mechanisms
- *System properties:*
  - *Nonlinearity:* Human and natural systems are assumed to interact with each other in **nonlinear** ways
  - *Complex adaptation:* Natural systems (and, within these, **human systems**) can be studied as complex adaptive systems
  - *Low predictability:* Change in natural systems can be best understood by examining the systems' **emergent** properties, internal and external **interdependencies**, and **feedback loops**
  - *Qualitative dynamics:* Critical/tipping points, thresholds, and transitions are common (to be expected) in natural systems
- *System analysis:* Global sustainability can be studied and pursued most effectively through **multilevel analysis**—i.e. the integrated analysis of interactions between systems at different levels—such as individual, organizational, societal, and planetary
- *Systemic problem solving:* Sustainability challenges are **complex problems** and **wicked problems**

Each of these points is explored in further detail in the following subsections.

System Definition

In order to identify a system in human society or in nature and distinguish it from other parts of reality, we need to be able to *define* it. For example, defining the ecological system of a particular region means capturing the essential aspects of the region that enable us to "see," observe and study it *as a system*—that is, as a set of distinct but interrelated elements that function together as a whole. First, we should be able to identify the system's **principles of coherence**,[60] which are usually reflected in the "purpose" or final outcome that guides and orients the system's elements to work together. The purpose of a clock, for example, is to measure time. But in natural systems, their "purpose" is not necessarily the result of someone's particular intention, desire, goal, or design. Rather than having an external agent organizing them, natural systems have the internal ability and resources for **self-organization**—that is, the spontaneous individual actions of the system's elements form regular patterns that govern the functioning and evolution of the system as a whole. Chemical reactions, metabolic exchanges within living organisms, collective animal behaviors such as insect swarming, and the formation and maintenance of life-supporting cycles in a rainforest are all examples of self-organization in nature. It has been observed that large-scale collective human behaviors form patterns that are very similar to those of other animals. Paul Ormerod's discovery that fluctuations in economic markets follow closely the movement patterns of a colony of ants[61] is a reminder that humans are, inevitably, part of nature. In this context, a human organization such as a company with a strategic plan is an interesting case, because it has both a dimension of intention and design (such as goals and plans deliberately set by human decision-makers) and a dimension of self-organization (such as the tacit, spontaneous evolution of individual behaviors that form the **organizational culture**). This hybrid reality was first observed and described by Henry Mintzberg,[62] whose studies have shown that an organization's realized strategy is in fact a combination of its deliberate (originally planned) strategy and unforeseen (emergent and internally evolving) factors that have become visible or relevant during the implementation process.

Second, a system has a **structure**, which refers to the relatively stable positioning and relationships between its elements or parts (internal structure) and between itself and other systems (external structure).[63] For example, the Amazon Rainforest's soil, air, water, flora (plants), and fauna (animals) function as parts within a regular pattern of exchanging matter (substance) and energy to maintain the forest and life within it, in its diverse forms. Each of these parts is, in turn, a system with its own parts, relationships and interactions, and features. The water circulation system, for instance, comprises networks of underground and overground water flows, vapors, clouds, and rain—all interacting in regular cycles of continuing regeneration of vital water supplies that feed the forest's plants and animals. We can say, therefore, that the water system is a subsystem of the rainforest ecosystem. At the same time, the Amazon Rainforest itself is part of larger systems, such as the overall ecosystem of South America, which includes mountain chains, plains, and other landforms supporting ecosystems such as grasslands, deserts, or estuaries. So, we can say that the South American ecosystem is a supersystem of the Amazon Rainforest.

Third, a system has **boundaries**—i.e., limits that separate what is inside it from what is outside or external to it;[64] or, in other words, what belongs to it (in that it forms its regular maintenance patterns) and what does not. For example, the Amazon Rainforest has geographic boundaries that can be clearly indicated on a physical map. Accordingly, its subsystems are located within its boundaries, while other ecosystems such as the East African savanna or the Great Barrier Reef are not.

Fourth, a system employs **control mechanisms**, which are the processes ensuring the system is maintaining the patterns that enable it to fulfill its function or "purpose." For example, an important control mechanism for human mobility is its vestibular system, the brain's sensory system whose role is to maintain balance of the human body. The Amazon Rainforest has a multitude of vital control mechanisms—such as light distribution and absorption, water recycling, and complementary breathing processes between plants and animals. In fact, the Rainforest is so effective in its control activities that it provides surplus resources (such as oxygen) to other ecosystems (such as the Earth atmosphere).[65]

Using the elements of system definition discussed above, a human organization managing for (global) sustainability can be studied as a hybrid system (both designed and self-organized) whose purpose (principle of coherence) is to create and manage economic, social and environmental value through activities that maintain and (where possible) enhance Earth's life-supporting systems. Its structure comprises its internal "parts" and their interrelationships (people, processes, resources, stock, artefacts, ideas, cultural symbols, and other subsystems), as well as its positioning in relation to other companies and within supersystems in which they are embedded (such as markets, industries, sectors, communities, human society, ecological systems, the Earth biosphere). The boundaries of the organization are defined by its physical location, strategic reach, and network of stakeholders. An organization engaged in sustainability management understands its boundaries to be porous and flexible, in dynamic flux (changing all the time), which helps her be more agile and resilient, and adapt more successfully to unexpected changes within their environment (within the ecosystems it is embedded in). An organization managing for sustainability also has control mechanisms that enable it to survive and flourish while pursuing and achieving its sustainability goals. Examples of such control mechanism are a viable business model that delivers value for humankind's sustainable development, an effective strategy implemented within sustainably managed operations, or a culture that fosters sustainability-enhancing practices.

System Properties

Our systems approach assumes that systems have four main properties: nonlinearity, complex adaptation, low predictability, and qualitative dynamics.

First, with regard to nonlinearity, it is important to emphasize that just realizing things have relating subparts does not mean we have engaged in systems thinking or a systems approach. Many systems in reality are (or can be) **linear systems**, which means that the total effect of changing two different components is the simple sum of the effects of changing the two different components independently. For example, if a contract employee has agreed to perform work that is to be paid $50 per hour for all hours worked, then we can easily predict that, for as long as the employee continues to work under this contract, any extra hour worked has earned

the employee an additional $50 in wages. Or if you know that the cab you are using to take you to town applies the rate of $0.99 per mile, then you will be able to work out your total cab fare depending on the number of miles the cab will make to reach your destination. This linearity is common in human-made systems—i.e., systems created by agreement between people, such as employment contracts and cab fares. In these cases, we can observe a predictable relationship between cause and effect, which is easy to calculate. However, scientists agree that natural systems (such as physical land and water systems, the Earth's atmosphere and its weather patterns, living organisms, and ecological systems that combine living and nonliving forms) are in fact nonlinear, in that the total effect of changes in various parts of a system is not equivalent with the sum of effects caused by the system parts considered separately. This makes nonlinear systems much more difficult to predict, and this is why we experience changes in these systems as disruptive, challenging, possibly uncontrollable. Despite these difficulties, nonlinear systems can be studied and understood well enough if we use appropriate perspectives and tools.

Second, while other approaches are also used for studying systems, recent research has shown that the most accurate approach is one that describes natural systems as **complex adaptive systems** (CAS).[66] Although a clock is made of many parts that act together in ways that seem complicated for those of us who are not clockmakers, it is in fact a simple system—because in a well-made clock, all its parts function as they are meant to, the clock's behavior is the sum of the behavior of its parts, and the result is highly predictable (in fact, with clocks it has to be entirely predictable, for this is precisely why we rely on clocks to tell us the time). But natural systems and large social systems are not like this at all. Think of trying to predict the weather or the stock market. Both systems are made of vast numbers of factors that act in independent, self-regarding, hardly predictable, and hardly controllable ways.[67,68] Furthermore, all of these behaviors interact with each other, aggregate and compound to form a whole whose behavior is not the simple sum of the actions of individual parts but would have to be described and explained differently. In other words, the principles that may explain the behaviors of components are not the same as the principles explaining the behavior of the whole. We say, therefore, that the weather and the stock market are complex systems. In addition, these complex systems are adaptive because they change continuously in response to their environments and adjust the way they work in order to continue to function and to maintain their stability. Unlike mechanical clocks, which use energy received from outside to move as designed until that energy runs out, complex adaptive systems are **open systems**, because they continuously exchange materials, energy, and information with their environments.[69] CAS are also self-organized and not designed by factors that are external to them (for self-organization, see *System Definition*). This means their overall behaviors are not designed in advance but emerge or result, in time, from the interactions of the vast number of their components which co-evolve to "fit" with each other enough to maintain the system's survival.[70,71] Emergence is essentially bottom-up (and not top-down) change, and this is the reason why CAS appear to us as unpredictable and uncontrollable.[72]

Third, due to these very low levels of predictability, change in CAS cannot be studied by traditional means but requires appropriate tools and techniques for examining emergence, interdependence, and feedback loops. Accordingly, **complexity theory** helps us understand how individual entities that act and behave based on simple rules create higher level, complex forms by interacting with each other (emergence). It also helps us understand and explain why these

entities cannot maintain their functioning in isolation from each other but actually depend on each other for their own survival or functioning (interdependence). And it helps us observe that, in order to maintain themselves over long periods of time—i.e., in order to be sustainable—cause–effect chains need to close up upon themselves somewhere, to form cycles that can be repeated—such as weather cycles or market cycles. These cycles are analyzed as feedback loops—that is, "chains of causal connections" that can be repeated over and over again.[73]

Fourth, despite their high capacity for repetition, CAS are not static and do not always engage in the same feedback loops. They have certain **qualitative dynamics** that enable them to change (and re-adapt) suddenly when major disruptions in their environments (are likely to) occur. This is why CAS can at times experience a **critical point**—i.e., a moment when effects of a large number of individual actions, accumulated over time, lead to a sudden change in the whole system. In plain language, a critical point (also called *tipping point*) is like the last straw that breaks the camel's back. The limit reached and then exceeded by the system at this point is called a **threshold**. Using **catastrophe theory,** we can then examine how systems change profoundly and transform rapidly until they become stable again, either by breaking down or becoming radically different, possibly by "adopting" new principles of coherence. The periods of rapid and abrupt change between two moments of stability are referred to as **transitions**. Some examples of transitions are the transformation of a caterpillar into a butterfly, or the beginning (and end) of an ice age (when Earth climate shifts away from, and back into, warm periods).

An organization is, therefore, a complex adaptive system because it is *nonlinear* (considered as a whole, it is more than adding up all its separate functions and operations), *open* (it is in continuous interaction and exchange with its environment), and (to a significant extent) *self-organized* (although it has predesigned strategies and deliberate decision-making and action processes, it also has a "culture" that allows it to evolve from the grassroots in ways that cannot be entirely controlled). The various elements that comprise an organization are *interdependent*, as they cannot act in isolation but have to rely on each other if the organization is to function properly. This is also why, no matter how much we plan in advance, an organization's progress and culture are *emergent* (namely, it is the result of the internally coordinated actions of its members, independently of one person's will). Furthermore, a well-managed organization has viable *feedback loops*—i.e., processes which support each other in ways that can be repeated over and over again, producing similar desirable results. For example, the production department requires support from the marketing and sales department so goods are sold on the market, thus securing the revenue needed to continue to supply the production department with new raw materials so production of new goods can be continued at levels that meet market demand. This is in fact an oversimplified feedback loop—as the operation of a business requires many other departments, such as human resources, procurement, distribution and logistics, accounting, legal, and so on. Like any other complex adaptive system, an organization is in dynamic coevolution with its environment, so it can experience *critical points* (such as sudden cash flow drain when too many creditors are late with their payments), *thresholds* (such as exceeding its production capacity as a result of highly successful sales, leading to an overhaul of production processes), and *transitions* (such as growing and transforming from a medium-size business to a large corporation).

An organization managing for (global) sustainability is particularly suited for adopting and applying a systems approach because it can better understand how its feedback loops can be improved to become more sustainable and, in turn, contribute to make its subsystems (internal

functions and operations) and supersystems (its industry, social community, natural environment) more sustainable as well. In this way, sustainability management can guide an organization to create most and best value for the benefit of its stakeholders, humankind, and the planet.

System Analysis

Because complex adaptive systems are made of many elements that may be systems themselves, and are in turn embedded in other systems, studying systems means being aware of the multiple levels of activity that exist within, between and around systems. In other words, the study of CAS requires multilevel analysis.[74] Multilevel analysis means, for example, examining how individuals behave within organizations, together with how organizations behave within society, together with how human societies behave within the Earth ecosystem(s). The level of individuals and groups has often been referred to as the **micro level**, while organizations represent the **meso level**, and human societies or large ecosystems are examples of the **macro level**.[75] In multilevel analysis, the emphasis is on "together with." It means investigating not only what happens at each level but, more importantly, how each level interacts and works with the other levels to ensure the system remains sustainable in relation to its subsystems and supersystems.

An organization that engages in sustainability management is aware of its position within a series of nested systems and is seeking to integrate the goals and actions of its subsystems (e.g., individuals, groups, and departments working within it) so it can create value and make a positive impact within its supersystems (such as industry, economy, society, and the planet). The organization can become more effective in reaching its sustainability goals if it employs a multilevel approach in the analyses and learning processes that inform its strategic planning, decision-making, and activities. Most importantly, the organization must align its goals (and those of its subsystems) with the overarching purpose of human society to attain sustainable development in a biosphere that supports life (and human life as part of it).

Systemic Problem-Solving

Real-life problems are situations that we are not happy with, which we want to act upon and improve. Solving a problem means creating a shift from an existing state of affairs which is undesirable to a new state of affairs which is desirable. For instance, my digital clock has stopped working, and I need it to continue to show me the time, so I can organize my day effectively. Whether the solution is replacing the battery or taking it to a specialist to repair it, there is usually only one cause (or a small number of causes) to the problem, which are relatively easy to find and to fix. These are typical examples of **simple problems**.

In contrast, global sustainability problems (such as global warming, ozone layer depletion, loss of biodiversity) have a large number of interrelated and interdependent causes that are difficult to find and to resolve. These are complex problems. Furthermore, they are referred to as wicked problems[76] because they are difficult to get a good grasp of and to control (to "tame"). It has often been observed that, in the case of wicked problems, trying to intervene in one part of the system may only shift the problem to a different part, or even make matters worse. We need to be aware that seeking to resolve wicked problems may have unintended consequences. For example, replacing fossil-fuel based

vehicles with electric vehicles for personal transport may be an important step forward in reducing greenhouse gas emissions (and thus slowing down global warming) but it also increases electricity consumption, which is not good news if more pressure on national power grids is dealt with by burning nonrenewable resources (such as coal or gas) to increase electricity production.

Wicked problems have certain distinctive features. At least some of their causes can be difficult to find, and how the causes produce the effects can be difficult to understand. This is why it can be hard to even know if and when the problem has been solved. We sometimes need to admit that some such problems may be impossible to solve. It is therefore more realistic and practical to try to manage wicked problems—i.e., try to contain their effects to some extent—rather than "solve" them. When seeking "solutions" (which may be better described as interventions or ways to manage), we are better off accepting that there is no clearly right or perfect way to intervene. Also, the problem and its context may be so new that no previous experiences can help us to address the unprecedented challenge in front of us. Table 1.2 summarizes the main differences between **tame problems** and wicked problems.

A systems approach to sustainability management allows us to not only better understand the wicked problems of global sustainability but also to develop the leadership and collaboration skills required to design and implement more effective interventions. A (global) sustainability-oriented organization will manage more successfully if it prioritizes and integrates the following goals:

- Enhance its own **resilience** (i.e., its ability to change, adapt and maintain its core purpose and functions in response to sudden, unforeseen, disruptive changes in its environment) by strengthening the resilience of its subsystems and supersystems
- Nurture and develop leaders who are more open, inquiry based, collaborative, and prepared to engage multiple stakeholders in the leadership process.[79]

TABLE 1.2 ■ Tame Problems Versus Wicked Problems

Tame Problem	Wicked Problem
• Has a well-defined and stable problem statement • Has a definite stopping point, i.e., when the solution is reached • Has a solution which can be evaluated as right or wrong • Belongs to a class of similar problems which are all solved in the same (or a similar) way • Has solutions which can be easily tried and abandoned • Comes with a limited set of alternative solutions	• Cannot be properly understood until a "solution" has been developed • Has no stopping rule • Has "solutions" that cannot be considered right or wrong (but simply better or worse, good enough or not good enough) • Every problem is essentially unique and novel • Every solution is a "one-shot operation" • Has no given alternative solutions, or may have an indefinite number of alternative solutions

Source: Adapted from Rittel & Weber (1973)[77] & Grundmann (2016)[78]

To achieve these goals, an organization that manages for sustainability will use a systems approach not to eliminate the inherent complexity of the problems it is confronted with but to make it more manageable.

Organizations in Action: Sustainability Management From a Systems Perspective

Organizations that manage for global sustainability can be distinguished from traditional organizations in that they adopt a profoundly different perspective when they relate to space, time, and values. In this subsection we discuss how sustainability management differs from traditional management with respect to these three dimensions.

The Space Dimension: Planetary Boundaries

When referring to their environment, traditional organizations tend to include only those stakeholders with whom they interact directly, as well as the local community and the local natural setting in which they operate. In contrast, global sustainability-oriented organizations manage their activities while permanently mindful of the health of ecosystems at a global scale.

Earlier in this chapter, you learned about Raworth's doughnut model (see Figure 1.6, which illustrates how human economy and society are embedded in the natural environment[80]). But this is also a model for thinking about a "safe and just space for humanity" as a bandwidth between the "ecological ceiling" and the "social foundation."[81] The ecological ceiling is based on nine planetary boundaries that have been identified by scientists and describe the physical limits within which human life and society can be supported and maintained. This model has been adopted and applied by the United Nations in many of its global sustainability projects. It is also used as a guide for pursuing global sustainability in many countries worldwide.

The nine planetary boundaries refer to climate change, ocean acidification, chemical pollution, nitrogen and phosphorus loading, freshwater withdrawals, land conversion, biodiversity loss, air pollution, and ozone layer depletion. Table 1.3 provides a summary of the science behind each indicator. All these indicators describe the main global effects caused by humankind's activity, and they are interrelated. Together, they set the measurable limits within which we can continue to live sustainably on Earth, and beyond which human habitat would be significantly threatened and even destroyed.

The reality of planetary boundaries challenges profoundly our traditional economic theories and models, which have been built on the assumption that natural capital and resources are unlimited, and therefore have not taken into account the negative impacts of human economic activities on the Earth biosphere (pervasive externalities). Faced with this reality, we need to rely on assumptions and principles of **ecological economics**,[83,84] which support models such as Raworth's and emphasize the importance of managing for sustainability by taking responsibility for, paying for, and significantly reducing our externalities. Ecological economics can inform sustainability management by showing how individual organizations can align their economic activities (at micro and meso level) to contribute to environmentally sustainable outcomes within the planetary boundaries (at macro level). For example, scientific projections indicate that, to maintain humankind within favorable climate change limits, the Earth's atmosphere should not increase by more than 2 degrees Celsius by 2100.[85] This target has guided government policymakers in

TABLE 1.3 ■ Summary of Data on Planetary Boundaries

Code	Boundary name	Boundary definition	Negative consequences (e.g.)	Causes (e.g.)
PB1	Stratospheric ozone depletion	Stratospheric ozone layer filters out ultraviolet (UV) radiation from the sun. If layer gets thinner, more UV radiation reaches ground level.	• Increasing risk of skin cancer • Damage to land-based and marine biological systems	• Emission of halogen source gases (from refrigerators, air con systems, fire extinguishers—now regulated by Montreal Protocol)
PB2	Loss of biosphere integrity	Loss of genetic biodiversity results in extinctions and reduction of number of species on Earth.	• Destruction of plant and animal species' habitats	• Human demand for food, water, and other natural resources (from agriculture)
PB3	Chemical pollution (incl. release of novel entities)	Release of high quantities of (nonnatural) chemical compounds in the atmosphere makes air unhealthy.	• Reduced fertility • (Permanent) genetic damage • Reduction in species populations	• Emissions of synthetic organic pollutants, heavy metal compounds, radioactive materials • (from plastics, pesticides, nuclear waste)
PB4	Climate change	Rapid global warming causes climate patterns to change and become less stable and predictable.	• Loss of summer polar sea ice • Rapid rise of ocean water levels • Extreme weather events	• GHG emissions (from fossil-fuel-based transport and production) • Destruction of rainforests (from unregulated logging industry practices)
PB5	Ocean acidification	Increased CO_2 in atmosphere dissolves in ocean, thus increasing carbonic acid in water.	• Loss of coral, shellfish, and plankton species • Loss of fish stocks	• GHG emissions (from fossil-fuel-based transport and production)
PB6	Freshwater consumption	Global hydrological cycle is affected by general warming of atmosphere and can change unpredictably.	• Severe shortage of drinkable water • Severe and prolonged drought • Desertification	• Human modification of water flows • Land use (changes in vapor flows)

Code	Boundary name	Boundary definition	Negative consequences (e.g.)	Causes (e.g.)
PB7	Land system change	Natural wildscapes (e.g., forests, grasslands, wetlands) are extensively converted to agricultural land.	● Rapid reduction of biodiversity ● Change of water flows ● Hindered natural cycling of carbon and nitrogen	● Destruction of forests (from deforestation activities linked to extensive agriculture)
PB8	Nitrogen and phosphorus flows into biosphere and oceans	Natural cycling of nitrogen and phosphorus is being altered by human activity.	● Barriers to natural growth of plants ● Chemical rains polluting land and waterways ● Growth of algae and reduction of oxygen in water, leading to loss of marine species and ecosystems destruction	● Production and use of fertilizers ● Aggregate effects of many industrial and agricultural processes
PB9	Atmospheric aerosol loading	Aerosols interact with water vapors and affect cloud formation, global air circulation, reflection and absorption of solar radiation, and climate patterns.	● Unhealthy air (high levels of dust and smoke) ● Premature (human, animal) deaths	● Emission of chemical pollutants (from industrial processes) ● Changes in land use (from agriculture)

Source: Adapted from Stockholm Resilience Centre (2020)[82]

their efforts to regulate, for instance, the release of **greenhouse gases (GHG)**, which are considered to be one of the main causes of accelerated global warming, the core aspect of climate change. Accordingly, regulatory agencies have been able to set carbon emission limits for productive processes in organizations and for individual use of fossil fuel based vehicles.[86]

The Time Dimension: Long-Term Horizon

When planning their activities, even when thinking strategically over one to several decades, traditional organizations understandably tend to work with timeframes that do not go beyond the goals of one generation of leaders, one leadership culture, or one strategic cycle—based on trends they can reasonably foresee. In contrast, when managing for sustainability, organizational

decision-makers need to act not only as "leaders of and for their own time" but as visionary leaders who take into account the well-being of future generations as well.

One important feature of macro-level phenomena is that there is a significant time lag (**latency**) between causes and effects. For example, GHG releases that occur today may take decades to compound and climate change disruptions, and extreme weather events we experience today are the result of aggregated activities that occurred decades or even centuries ago.[87] Given that organizations are the most advanced and sophisticated instruments that humans can create in order to coordinate their individual and collective activities and behaviors, it means that managing for global sustainability requires organizations to think, plan, and act using more expansive, intergenerational time frames.[88,89] Taking sustainability seriously means being prepared "to make intertemporal trade-offs to safeguard **intergenerational equity**"[90] This means, for example, that an organization would be prepared to reduce its net profits during this decade in order to invest and introduce green technologies that would protect land, air, and water from pollution for generations to come. It is only fair for each generation to take responsibility for the consequences of its actions and not leave negative impacts to affect future lives—that is, the lives of people who had no say in economic decisions that were made before their time. Failing to adopt a **long-term horizon** in strategic management leads to **short-termism**—i.e., the tendency to subordinate all management decisions to immediate priorities such as quarterly or yearly performance targets and, as a result, to overlook longer term priorities. On the other hand, research has shown that "organizations with a longer planning horizon, higher tolerance of uncertainty, and greater ability to learn from the past" are more innovative in reducing severe trade-offs between economic, social, and environmental goals, and in developing more creative ways to reconcile and integrate these goals to achieve strong sustainability.[91]

Although we humans cannot change the passage of time, we can certainly change the way we think and value time. Accordingly, organizations can make decisions about how they will prioritize different timeframes that shape their strategic actions. They can plan and act to avoid short-termism and favor the long-term goals of global sustainability.[92] We can say that long-term horizon is an important sustainability value. More sustainability values are discussed below.

The Values Dimension

In general, we call *values* those deeply held assumptions about what is important and worthwhile in our lives. **Values** are what makes us tick or get up in the morning; they give meaning to our actions and orient our behaviors. Values, therefore, reflect what we desire, and what we want to do.[93,94] **Sustainability values** are those aspects or criteria we need to consider worth pursuing if we are to have a chance in attaining global sustainability. There are many sustainability values, and the list is open to improvement—but we can categorize the most prominent ones as follows:

- Biological values for sustainability—such as survival, enhancement of life-supporting systems, proliferation of living forms, species well-being, and inter-species balance and flourishing (of which human survival, well-being, and flourishing is an important part)

- System performance related values—such as resilience, the ability of a natural or human system to overcome various kinds of stresses caused by disruptive experiences and to recover from any harm or damage
- Preventive values—such as **mitigation** (the ability to reduce a serious risk, threat, or harm) and **adaptation** (the ability to change internally in interaction with the external environment, to maintain or recover the balance needed for survival), which humans can improve considerably through information, foresight, and planning
- Resource management values—such as **efficiency**, which from a sustainability perspective is not limited to maximizing useful output/input ratio in human economic processes but extends to maximizing the social and environmental value relative to the amount of resources used to create it. Humans have a lot to learn from nature and other species about improving their **biophysical efficiency**—i.e., the amount of waste we create relative to the natural resources we use up in our economic activities (more about this is discussed in Chapter 2)
- Environmental care/protection values—such as preservation, conservation, and restoration of sustainable human and natural ecosystems. While **preservation** requires humans to abstain from doing things that harm the environment (e.g., stop dumping waste in rivers or polluting the air), **conservation** requires taking action to ensure that existing natural habitats and ecosystems are maintained in a healthy condition, and **restoration** means taking action to reverse damage and return (severely) harmed ecosystems to a healthy condition comparable to their previous state
- Behavioral values for sustainability—such as innovation, learning, collaboration, empathy; many of which we can observe in nature and not only in humans, and which are more likely to nurture the ability to interact harmoniously with one's environment and cohabit in mutual symbiosis with other species
- Ethical values for sustainability—such as responsibility and justice, which are specifically allowing human actors to account for, and care about the consequences of their actions on the following:
  - The sustainable health of the natural environment
  - The lives and well-being of other humans, within their own generation or across future generations[95]

Many of these values (e.g., resilience, risk mitigation, efficiency, innovation, learning, and responsibility) are familiar to organizations with traditional goals as well—but for organizations seeking to support global sustainability these values acquire different meanings, as they combine with biological values, respect for the biophysical limits of natural capital, and authentic care for the Earth's ecosystems. This also marks an important shift from an anthropocentric (human-centric) perspective, which assumes nature as subordinate to the needs and control of humans, to an ecological perspective, which values nature for its own sake, as a complex reality in which humans are an important (but not central) part. In an ecological perspective, acting

at micro and meso levels to make a difference at macro level may appear as a daunting (and, at times, hopeless) task for an organization. But sustainability management empowers the organization to understand its role within the panorama of global sustainability and, as a consequence,

- To design its production processes to ensure its outcomes are supporting and nurturing (or at least not harming) natural ecosystems
- To take responsibility (and pay or compensate) for its negative externalities
- To collaborate with other organizations to increase coordination of human actions as close to the macro level as possible (e.g., aiming to initiate and/or participate in global policy, governance, and social movements)

By adopting a systems approach in their data analysis, thinking, planning, decision-making and actions, organizations managing for sustainability can overcome challenges that not too long ago may have been considered impossible to tackle. We will discuss some of these challenges, together with more specific solutions and opportunities, in Chapter 2.

The main differences between traditional and sustainability-oriented organizations with respect to space, time, and values are summarized in Table 1.4.

TABLE 1.4 ■ Traditional vs Sustainability-Oriented Organizations

Organization/ Dimension	Traditional Organization	Sustainability-Oriented Organization
Space	• Social and natural environment understood as local • Impacts of interest are direct	• Social and natural environment understood as interaction and integration of multiple nested systems (from local to global) • Impacts of interest include indirect effects of complex/wicked problems
Time	• Time frames for strategic planning do not exceed several decades, and short-term goals may take priority over longer term goals (short-termism) • Impacts of interest are immediate and/or observable within the same generation	• Time frames for strategic planning take into account natural system supporting goals that can span centuries or longer, and short-term goals are aligned to a much longer-term horizon • Impacts of interest can be latent, not easily observable and spanning across generations
Values	• Defined from an anthropocentric/ human-centric perspective • Impacts of interest are subordinated to human needs and desires	• Defined from an ecological perspective • Impacts of interest include the sustainability needs and intrinsic value of natural ecosystems

SUSTAINABILITY AND YOU

Picture yourself

(a) at home, with your family
(b) in a group of friends, perhaps spending your leisure time with your favorite hobby
(c) in your local community, perhaps at an event
(d) at work

Consider how your role, in each case, is made of parts that constitute a system.

Also consider examples of systems you (in your respective role) are involved in, where your thoughts, words and/or actions form part of an integrated whole, to perform a certain function or achieve a certain purpose.

For example, a customer service officer's role requires certain knowledge, skills, performance of certain tasks, and liaising with other people in other roles (in your organization), in order to perform those tasks—all integrated for the core purpose of the role, to deliver quality service to customers. At the same time, the role itself is part of a customer service team, a customer relations department, a service-oriented culture in the organization, and the multidimensional performance of the organization as a whole.

Draw a map of your role (in each case) as a system that coordinates and integrates multiple subsystems, while at the same time forming an intrinsic part of multiple suprasystems. Identify the various functions or purposes that your role may play within different suprasystems.

SUMMARY

This chapter has focused on setting the context for understanding the importance of sustainability management in tackling global social and environmental challenges today. It has defined the concept of *sustainability*, explained the key features of a systems approach, and broadly applied this approach to sustainability management in organizations. The chapter has illustrated how systems thinking can help organizations to better understand the global challenges and the main international response trends to these challenges. Supported by this understanding, organizations can develop more effective solutions to adapt to a rapidly changing environment and to also make valuable contributions to global sustainability.

Learning Objective 1.1: Define sustainability and sustainability management in the context of the Anthropocene and contemporary global challenges.

- Sustainability is the ability of (organized) human activity to maintain a balanced and harmonious relationship with its social and natural environment over an indefinite period of time. Global sustainability means the persistence of all components of the biosphere, including ensuring all humans have a quality of life beyond mere survival.
- Global sustainability has become a primary concern for humankind, following scientific findings that show how human activity impacts our planet and its climate in major ways.

The Anthropocene is the most recent period in the evolution of the Earth and is characterized by a sharp increase in the rate of impact of our socio-economic activities on the global natural environment (this sharp increase is called the Great Acceleration).

- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. An organization can develop sustainably by pursuing the Triple Bottom Line (environmental-social-economic capital and value, or planet–people–profit). Shifting our mindsets from a human-centric to an ecological perspective means understanding that human economy and society are embedded in nature and not separate entities developing in a vacuum.
- Sustainability management is the discipline and practice that enables organizations to manage their resources, processes and outcomes in ways that nurture environmental, social, and economic sustainability. Managing for sustainability involves taking decisions and actions to create environmental, social, and economic capital and value at normative, strategic, and operational level.
- Corporate social responsibility (CSR) refers to organizations' voluntary initiatives to go beyond legal compliance and deliver benefits to various stakeholders and society. Optimizing CSR projects to create environmental, social, and economic value for as many stakeholders as possible forms an integral part of a systems approach to sustainability management.

Review Questions 1.1

- What does sustainability mean? What is global sustainability?
- Why has global sustainability become a major concern for humankind? What is the Anthropocene?
- What is sustainable development? How can an organization develop sustainably?
- What is sustainability management, and what does it involve? What are the three levels of managing for sustainability?
- What is corporate social responsibility (CSR) and how does it relate to sustainability management?

Learning Objective 1.2: Define and illustrate key concepts and principles of a systems approach to sustainability and sustainability management.

- A system is a set of interconnected elements that function together and depend on each other to produce a certain outcome. A systems approach is a general perspective that explains the world in terms of interrelated systems (systems theories) and analyzes how a system behaves in ways that represent more than the sum of its parts (systems thinking).
- The main aspects that define a system are the following: the overall outcome or orientation that guides the system's elements to work together (principles of coherence); the relatively stable positioning and relationships between the system's parts, as well as

between the system and other systems (structure); the limits that distinguish what lies within the system from what is outside (boundaries); and internal processes that enable it to withstand disruptions, adapt to changing conditions in its environment, and maintain its functioning to survive and flourish (control mechanisms).

- The main properties of a system are the following:
  - The total effect of changes in various parts of the system is different from the sum of effects caused by the system parts considered separately (*nonlinearity*)
  - These nonlinear effects and behaviors enable the system to change continuously in response to its environment, to withstand disruptions and maintain its stability (*complex adaptation*)
  - Change in the system is characterized by *low predictability*. This is because change is emergent, which means it is induced internally, from the simpler, lower level elements to the more complex, higher level ones (bottom-up, not top-down); the system's elements are highly interdependent, in that they depend on each other in vital ways in order to maintain their functioning; and this ongoing functioning is supported by internal cause–effect relationships that form repetitive cycles (called feedback loops)
  - The evolution of a system can be described as *qualitative dynamics*. It is marked by moments when effects of a large number of individual actions, accumulated over time, reach a limit (threshold) and lead to a sudden change in the whole system (critical points), forcing the system to experience periods of instability (transitions) until it finds a new, relatively stable way of functioning.
- A system's properties can be examined using multilevel analysis. For an organization analyzed as a system, this means integrating explanations of how individuals behave within the organization (the micro level), with how organizations behave within society (the meso level), and how human societies behave within the Earth's ecosystem (the macro level).
- Wicked problems are problems whose cause–effects relationships are difficult to understand, where there are no "right" solutions as the success of solutions is difficult to evaluate, where past experiences may be of little help to address an unprecedented challenge, and where there is hardly any opportunity for trial and error. A systems approach helps us to understand that wicked problems should be managed not by trying to eliminate their inherent complexity but by trying to enhance the system's resilience, openness and ability to work together (collaborate) with other systems in order to overcome and contain the disruptive capacities of wicked problems.
- From a systems perspective, there are three main dimensions of sustainability management:
  - The *space* dimension: Pursuing global sustainability requires a sound understanding of the planetary boundaries—i.e., the physical limits of the Earth biosphere within which a safe operating space for humanity can be maintained.

- The *time* dimension: Pursuing global sustainability requires organizations to set their strategic goals for a long-term horizon that embraces intergenerational equity, thus overcoming short-termism, i.e., the tendency to sacrifice later benefits for short-term gains.
- The *values* dimension: Pursuing global sustainability requires organizations to shift their mindsets from a human-centric perspective (which subordinates everything to human needs and interests) to an ecological perspective (which pays regard to the sustainability needs and intrinsic value of natural ecosystems). Typical sustainability values are biological (survival, life enhancement), system performance related (resilience), preventive (mitigation, adaptation), resource-managing (biophysical efficiency), environment protective (preservation, conservation, restoration), behavioral (innovation, learning, collaboration, empathy), and ethical (responsibility, justice, care for others).

Review Questions 1.2

- What is meant by *system*? What is a systems approach?
- What are the main aspects that define a system?
- What are the main properties of a system? How can we analyze these properties?
- What is meant by "wicked problems," and how can such problems be tackled using a systems approach?
- What are the three main dimensions of sustainability management from a systems perspective?

DISCUSSION QUESTIONS

- Read more about the planetary boundaries at https://www.stockholmresilience.org/research/planetary-boundaries. How has human performance relative to the planetary boundaries evolved over time? What is the current situation and where are the most vulnerable areas? Which production and consumption patterns should be changed—where, by when, and how?
- Select an organization you are familiar with, from your work or study, and sketch a sustainability management mini-plan, with recommendations for improving its orientation toward global sustainability at all three levels—normative, strategic, and operational. Use a systems approach to develop your recommendations.
- Identify a global company that has been recently criticized for unsustainable business practices. Imagine a reform plan to assist this organization in transitioning from its current business-as-usual (BaU) to a sustainability orientation. Use Table 1.5 to map the mindset shifts and actions needed along the space, time, and values dimensions.

TABLE 1.5 ■ Business-as-Usual (BaU) to Sustainability Orientation

Organization/ Dimension	BaU Barriers to Sustainability	Mindset Shifts for Sustainability	Actions for Sustainability
Space			
Time			
Values			

KEY TERMS

adaptation
Anthropocene
biophysical efficiency
biosphere
boundaries
capital
catastrophe theory
complexity theory
complex adaptive systems
complex problems
conservation
control mechanisms
corporate social responsibility
critical point
culture
ecological economics
ecological perspective
ecological system (ecosystem)
economic capital
economic sustainability
efficiency
emergent
environmental capital
environmental stewardship
environmental sustainability
feedback loops
global life-support systems
global sustainability
global warming
Great Acceleration
greenhouse gas (GHG)
habitat
human system
interdependencies
intergenerational equity
latency
linear systems
localized externality
long-term horizon
macro level
manufactured capital
meso level
micro level
mission
mitigation
multilevel analysis
natural capital
negative externality
nonlinear
normative level of management

open systems
operational level of management
organizational culture
pervasive externality
planetary boundaries
policy
practices
preservation
principles of coherence
qualitative dynamics
Raworth's doughnut model
resilience
restoration
self-organization
short-termism
simple problems
social capital
social sustainability
stakeholder
strategic level of management
structure
strong sustainability
subsystem
supersystem
sustainability
sustainability management
sustainability strategy
sustainability values
sustainable
sustainable business
sustainable development
system
systems approach
systems theory
systems thinking
tame problems
threshold
transition
Triple Bottom Line
value
value creation
values
vision
waste
weak sustainability
wicked problems