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SUSTAINABILITY AND FUTURE TRENDS

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1.1 INTRODUCTION

The 70th session of the General Assembly has opened with a towering achievement: the adoption of the 2030 Agenda, including 17 inspiring Sustainable Development Goals, the SDGs.

Our aim is clear. Our mission is possible. And our destination is in our sights: an end to extreme poverty by 2030; a life of peace and dignity for all.

What counts now is translating promises on paper into change on the ground.

We owe this and much more to the vulnerable, the oppressed, the displaced and the forgotten people in our world.

We owe this to a world where inequality is growing, trust is fading, and impatience with leadership can be seen and felt far and wide.

We owe this to 'succeeding generations', in the memorable words the Charter.

In this year in which we mark the 70th anniversary of the United Nations, we must heed the call of the Charter, and hear the voices of 'we the peoples.' That is how we can overcome the grim realities of the present and seize the remarkable opportunities of our era.

The Millennium Development Goals made poverty history for hundreds of millions of people.

Now we are poised to continue the job while reaching higher, broader and deeper.

Sustainable Operations and Supply Chain Management, First Edition. Valeria Belvedere and Alberto Grando.
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The new framework does not just add goals. It weaves the goals together, with human rights, the rule of law and women's empowerment as crucial parts of an integrated whole.

The global goals are universal.

You, the world's leaders, have committed to leave no one behind and to reach those farthest behind, first. We can build on the momentum this December in Paris with a robust agreement on climate change.

Remarkable changes are under way to reduce harmful greenhouse emissions. I have seen and visited vast solar power installations bringing a new energy future into being. There is wind in the sails of climate action.

Yet it is clear that the national targets submitted by the member states will not be enough. We face a choice: either raise ambition or risk raising temperatures above the degree Celsius threshold, which science tells us we must not cross.

Reaching our sustainable development goals means organizing ourselves better. Let there be no more walls or boxes; no more ministries or agencies working at cross purposes. Let us move from silos to synergy, supported by data, long term planning and a will to do things differently…

Source: Excerpt from speech by Ban Ki-moon at 70th UN General Assembly, 28 September, 2015. Available at http://gadebate.un.org/sites/default/files/gastatements/70/70_SG_en.pdf.

As highlighted in the speech of Secretary Ban Ki-moon, sustainability is a global goal, encompassing several different areas: environment protection, climate change, social inequality, human rights, poverty and nutrition.

In the first part of this Chapter, the definitions of *sustainability* and *sustainable development* are introduced, and the major issues related to the imperative of nutrition are presented; in the second part of the Chapter, the impact of some *mega-trends* on these phenomena is underlined, and the main *pay-offs* and *reasons why* governments, institutions and companies are required to focus on sustainable objectives are pointed out. This Chapter aims at providing the general picture in which the main topics covered in this book – operations and supply chain management – have to be framed in the light of sustainability.

1.2 SUSTAINABILITY BEFORE SUSTAINABLE OPERATIONS AND SUPPLY CHAIN MANAGEMENT

To speak of sustainability, even from the specific perspective of Operations and Supply Chain Management, means confronting the question of how to pursue the objectives of the present – whether they are those of a company, an institution or a wider socio-economic system – while ensuring that adequate standards of development are also guaranteed in the future.

The subject of sustainability is therefore intrinsically connected to a vision of the future that postulates *intergenerational equity* and it is for this reason that we have decided to start our discussion with an analysis – albeit brief – of several scenarios that, most probably, will form the backdrop for the choices to be made by those that must make governance decisions, such as managers, entrepreneurs or heads of government. The socio-economic context in which future generations will live and companies and institutions will operate will largely be the result of the decisions made today and, in particular, of the actions to be taken due to these decisions. It is in the knowledge of this great responsibility, therefore, that it seems appropriate to rethink management choices, placing attention on a more extensive, complex, objective function than the one that traditionally characterises company operations, which is often summarised in the objective of value creation for shareholders. It involves, in fact, devising decision-making processes based on the values of responsibility, ethics and sustainability, within a time frame that is consistent with the ability of the system to generate and regenerate adequate resources for sustaining its development. The subject is complex and has both micro- and macroeconomic implications. It transcends the boundaries of a single discipline, encompassing aspects connected to the economy, management, economic policy, sociology, demographics and so on.

It therefore seems appropriate, right from the very beginning, to clearly define the specific perimeter in which the considerations contained in this work will be developed. This book focuses on some of the most important managerial processes – Operations and Supply Chain Management – and in this regard we have decided to examine the subject of corporate sustainability as systematically as possible. Indeed, it is not the intention of this study to thoroughly analyse the subject of corporate sustainability as a whole, which is why reference is made to many of the literature contributions (Benn et al., 2014; Tencati and Perini, 2011; Craig Smith and Lenssen, 2009), but rather to limit our analysis to the organisation and management of operations and supply chain processes, examined from a broad perspective (Cooper et al., 1997), and their interaction with the imperative of sustainability.

It may appear strange to start the discussion that will lead us to the subject area of this book, namely the topic of Sustainable Operations and Supply Chain Management, by looking at two factors considered to be available commodities today, at least in one part – the most fortunate part – of our planet: food and water.

The decision to dwell upon the growing scarcity of food and water, which are essential for survival, is based on a threefold consideration:

- First, because, however much it may appear obvious, these are two factors that are essential for the survival of the planet, the scarcity and unfair distribution of which already require an urgent response today in terms of global policies that guarantee the access and the availability of them to an increasing number of people.
- Second, because these two elements, food and water, are intrinsically dependent on one another: to produce food, a large quantity of water is consumed, and therefore raising the quality and quantity of food offered to those who need it, given current technology and lifestyles, will lead to an rapid shortage of water resources.

- Third, because the solutions that may be advised today to deal effectively with these problems concern the productivity of the agro-food system, the technology required for increasing the aforesaid productivity, the fight against waste and the responsible management of the connected supply chains – the main topics of this work.

We will attempt to develop these three points briefly next.

The global food system today is capable of producing 2800 calories per day per person compared to an average daily requirement of approximately 2550 calories. This means that today the planet would be capable of feeding its population of approximate 7 billion and, according to some studies, of sustaining 9 and even 11 billion people (Stuart, 2009; Hanley, 2014).

Nevertheless, about 2.5 billion people today live on less than $2 a day; the poorest families spend more than 70% of the their income on food (WB, 2010); 36 million people die every year due to malnutrition and undernourishment; about 870 million people are hit by malnutrition, 852 million of whom live in developing countries; and approximately 1.1 billion people are undernourished (FAO, 2012). At the same time, in a dramatic food paradox, more than 1.5 billion people are obese or overweight, a problem that is increasingly widespread, and almost 30 million people die each year from diseases linked to excess food (BCFN, 2012).

According to reliable projections (UNPD, 2015), demographic growth will drive the current 7.3 billion inhabitants on Earth to 8.5 billion by 2030 and more than 9.5 billion by 2050[1], meaning an increase of 30% in thirty-five years, who will have to be fed by extending agro-food production. Agriculture, however, is responsible today for 70–80% of the water consumption destined for food production and 33% of the global production of greenhouse gases – the main factors at the crux of climate change. Within the same time frame, it is estimated that arable land will be reduced by between 8% and 20% due to the effects of climate change, with the consequent modification of the geography of farming, which will lead to the conversion of tropical, subtropical and temperate forests into farmland. It is estimated that approximately 45% of these forests will be lost. More than 240 million people (most of them in rural areas) are projected to lack access to an improved water source by 2050, and almost 1.4 billion people will not have access to basic sanitation (OECD, 2012).

As already stated, there is a close interdependence between food production and water consumption. Currently 70% of freshwater withdrawals are destined for farm irrigation, whereas 22% are used by industry and the remaining 8% by domestic consumption (BCFN, 2012, p. 160)[2]. The consumption of freshwater is closely

[1] According to the most recent forecast, the world population will stabilise at around 11 billion people at the end of the century. The growth rate of the world population, which 10 years ago was 1.24% per year has dropped to 1.18% today; 83 countries, which represent 46% of the world population have a fertility rate lower than the rate of replacement, namely 2.1 children per woman, and in other countries, which represent a further 46% of the world population, births are slightly decreasing. Half of the predicted growth by 2050 will be in only nine countries, the majority of which are extremely poor (UNPD, 2015).

[2] These percentages refer to average consumption; the impact of agriculture is significantly higher in low/medium income countries or developing countries, where it may reach 95%, whereas in industrialised countries consumption linked to industry reaches 59% (BCFN, 2012).

connected to the food production chain and consumption behaviours in the most populated areas of the planet. For instance, it is enough to recall the impact of the above in terms of Water Footprint (also known as Virtual Water Content), which analyses different types of food, measuring the consumption of water expressed in litres for each kilogram or litre of food produced (cultivated or raised), handled, packaged, transported and made suitable (e.g. cooked) for consumption (BCFN, 2012). One kilogram of beef requires 15,500 litres of water, rice 3400, bread 1300, milk 1000, potatoes 900 and so on.

Table 1.1 below contains a summary of the environmental impact of several foods, expressed in terms of their carbon, water and ecological footprints.

It appears obvious that the demand for food implied in the social imperative to reduce the problem of malnutrition, or more simply induced by the evolution of the quality of consumption models, combined with the demographic developments described previously and in the absence of appropriate action, will risk producing a disastrous impact on the availability of resources such as water, which are also being diminished due to the effects of climate change and the gradual pollution of the groundwater caused by the growth in population.

Re-examining the data stated before, the expectation that several million consumers in other rapidly developing countries, in escaping situations of poverty, will gradually adopt 'western' eating patterns, translates into an easy prediction in terms of the Water Footprint, which may lead first of all to an increase in the price of this fundamental element – the blue gold – and then to much more dramatic scenarios. In the last twenty years the consumption of meat in China has doubled, and it is estimated to double again by 2030. Giving up one kilogram of rice and replacing it with one kilogram of beef translates into a consumption of resources expressed in a Virtual

TABLE 1.1 Carbon, water and ecological footprint of most common foodstuffs

Food	Carbon footprint (gCO_2 eq./kg or l)	Water footprint (Water kg or l)	Ecological footprint (m^2/kg or l)
Beef	26,000	15,500	109
Cheese	9500	5000	93
Butter	8600	5000	86
Eggs	4540	3300	16
Pork	4250	4800	28
Fish	3900	n.a.	71
Rice	3850	3400	12
Poultry	3600	3900	25
Oil	3200	5555	40
Pasta	3000	1775	15
Pulses	1600	3160	19
Milk	1300	1000	15
Bread	900	1300	7
Fruit	670	930	4
Vegetables	665	240	3
Potatoes	600	900	4

Source: Reproduced with permission of Barilla Center for Food & Nutrition.

Water Content that is 4.5 times higher, a Carbon Footprint that is 6.7 times higher and an Ecological Footprint that is a good nine times higher! By 2050, the need for water and its uneven distribution among countries will have dramatic effects on the 9 plus billion inhabitants of the planet, located in concentrated areas due to the growing phenomenon of urbanisation. In fact, some estimates predict that of the 9.3 billion inhabitants on earth, 67% will live in cities and the remaining 33% in rural areas (Van Audenhove et al., 2014).

Furthermore, it must be emphasised that, regardless of developments that will be introduced by technological innovation, current methods for managing production, distribution and food consumption processes hide enormous recovery margins and generate waste that, due to its extent, is extremely unacceptable, from an ethical point of view more so than an economic one. It is sufficient to quote the FAO: 'the global volume of food wastage is estimated to be approximately 1.6 billion tonnes of 'primary products equivalent' while the total wastage of edible part of food is 1.3 billion tonnes' (FAO, 2013, p. 6). This means that one third of global food production is lost, destroyed or wasted during conservation, transformation, distribution and consumption processes (FAO, 2011).

Once again, the unfair distribution of wealth and its connected models of production and consumption produce a clear difference between waste and scarcity. The waste produced along agro-business supply chains is known as *food loss* when dealing with the losses that occur upstream, and as *food waste* when dealing with waste that takes place during the industrial processing, distribution and final consumption processes. Food losses, or spoiling, take place at production, postharvest and processing stages in the food supply chain. Food losses occurring at the end of the food chain (retail and final consumption) are rather called 'food waste', which relates to retailers' and consumers' behaviour (Grolleaud, 2002; Parfitt et al., 2010[3]). In this case the causes and the distribution of losses and waste also differ depending on the countries: food losses mainly occur in developing countries due to limits in their cultivation, harvesting and preservation techniques and methods, or due to the lack of adequate transportation and storage infrastructures. Food waste, on the other hand, is more common in industrialised countries, notably during the final consumption phase (household consumption and catering), and in these countries there are significant wastes also during the production process (selection and packaging)

[3] A definition of food waste was given by the UN Food and Agriculture Organisation (FAO): 'Food losses refer to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, post-harvest and processing stages in the food supply chain' (Parfitt et al., 2010). Food losses occurring at the end of the food chain (retail and final consumption) are rather called 'food waste', which relates to retailers' and consumers' behaviour (Parfitt et al., 2010). 'Food' waste or loss is measured only for products that are directed to human consumption, excluding feed and parts of products that are not edible. As per the definition, food losses or waste are the masses of food lost or wasted in the part of food chains leading to 'edible products going to human consumption'.
Therefore, food that was originally meant for human consumption but which gets out of the human food chain is considered as food loss or waste, even if it is then directed to a non-food use (feed, bioenergy etc.). This approach distinguishes 'planned' non-food uses to 'unplanned' non-food uses, which are hereby accounted under losses (FAO, 2011, p. 2).

TABLE 1.2 Global food losses and waste along the supply chain

Supply chain stage	Million tonnes of food	%
Agricultural production	510	32
Post-harvesting and storage	355	22
Industrial processing	180	11
Distribution	200	13
Consumer	345	22
TOTAL	1590	100

Source: adapted from FAO, 2013, p. 13.

phase, due to the assertion of questionable sizing and aesthetic standards, and product quality or production surplus regulations. It has been estimated that Europe and the United States consume an amount of food that is equal to double the nutritional requirement of their population and, between food losses and food waste, approximately half of the food supplied is wasted along the cycle described previously (Stuart, 2009).

The quantity of food that is dumped in industrialised countries, estimated at 222 million tonnes, matches the food production available in sub-Saharan Africa, which amounts to 230 million tonnes (FAO, 2011).

Much of this waste is the result of incorrect purchase and management models related to the consumer in terms of excess purchasing, excess portions prepared, errors in food storage, and so forth; but a good part is also linked to errors in 'product planning stage', such as in the case of oversizing portions that produces waste, or the assertion, as already mentioned, of sizing and aesthetic standards that cause high levels of waste upstream, or supply chain management in terms of conservation technology and methods, packaging, transportation and distribution – the main subject of the following pages. As summarised in Table 1.2, in fact, of the 1.6 billion tonnes of primary products equivalent lost/wasted stated previously, more than 45% takes place during the stages linked to the Operations and Supply Chain Management, such as post-harvesting and storage, industrial processing and distribution.

Going back to the relationship between the consumption of water and food, it is sufficient to think, as effectively reported, that the quantity of water necessary to produce the quantity of food wasted every year on a global scale is estimated at 250,000 billion litres, equivalent to the current domestic water requirement of a city like New York for 120 years (Segré, 2015). In addition to this, the food produced but wasted requires 1.4 billion hectares of land per year, the equivalent of about 30% of the world agricultural land area and generates a carbon footprint of 3.3 billion tonnes of carbon dioxide. If food waste was a country it would be the third top emitter after the United States and China (Segré, 2015; FAO, 2013).

1.3 THE IMPACT OF CLIMATE CHANGE

The prospect of an increasing scarcity of resources, such as food, fuel, metals and farmland, and their unequal distribution throughout the world, will change the

geopolitics of the planet and is already forcing many countries to take action, such as China, which is taking the lead in investing in the areas richest in resources, as well as many areas of Africa. For other needs the battle is well underway to gain the rights to exploit the resources preserved in the Arctic areas.

According to some interpretations, most of the recent wars, as those in Northern Africa and in the Middle East, occurred also because of the extreme poverty of the local communities, which has been worsened by a severe drought caused in turn by climate change, as in the case of Syria. A similar interpretation can be given to the root causes of the exponential growth of migration flows from these countries, which are resulting in a huge humanitarian emergency. The impact of climate change has been deeply analysed in the last ten years and several studies have predicted the effects on our lives (Lewis et al., 2001; Rockström et al., 2009; Monastersky, 2015). A recent study, developed thanks to the contribution of several research centres, institutes and universities from all over the world (Steffen et al., 2015), highlighted the impact of human development on the Earth System in terms of changes in biosphere integrity (ozone depletion, air pollution etc.), ocean acidification, biogeochemical flows (resources depletion, impact on biodiversity etc.), land-system change (land degradation, solid waste impact etc.) and freshwater use (water pollution and scarcity).

As is well-known, *climate change* is caused by the increase in the emissions of so-called greenhouse gases linked to the use of fossil fuels, which have led to progressive global warming. In 650,000 years there have been seven ice ages, and the level of carbon dioxide has never exceeded 300 parts per million; since 1950 this threshold has been exceeded, reaching 400 parts per million in just a few years from now. Global warming has increased significantly since the 1970s; this growth trend is dramatically demonstrated by the fact that the twenty hottest years ever recorded have occurred from 1981, ten of which in the last twelve years (NASA, 2015).

Unless changes are made through the radical alteration of the lifestyles of the world's population or through technological innovations capable of replacing the technologies that have the greatest impact or through policies aimed at limiting their use, it is estimated that emissions will double within fifty years, with irreversible consequences for the planet. Some scenarios (OECD, 2012) estimate an increase in gas emissions that could reach a concentration of 685 ppm – parts of CO_2- equivalent per million, which would cause an increase in the mean temperature of more than 2.5 °C at the middle of the century and between 3 and 6 °C by 2100, with possible catastrophic consequences for many areas of the planet. If it were possible to stabilise the concentration of gases below the threshold of 450 ppm, there would be a 50% chance of limiting the increase in the average temperatures to 2 °C, producing significant, but manageable, effects in terms of climate change.

The impact of these changes, the majority of which are already visible, will manifest themselves in terms of the progressive desertification of large areas of the planet, consequent deforestation, caused by the need to find new lands to cultivate, impact on biodiversity and the disappearance of many current species of flora and fauna.

Furthermore, the increase in the amount of polluting agents in the atmosphere, water and ground will have an increasing impact on the health of humans and animals. Warming seas will also intensify extreme meteorological phenomena, such as

tornadoes and floods, the cost of which will be extremely high as measured in terms of human and animal lives, destruction of crops, impact on infrastructures and the flooding of extensive populated areas.

If most countries set themselves the objective of limiting the increase in average temperatures to 2 °C above the average temperatures registered in pre-industrial times (UNFCCC, 2010), current growth trends, although extenuated by the effects of the crisis, seem to exceed these values. The effects in terms of desertification, reduction of precipitation, increase in the number of hurricanes and other extreme meteorological phenomena would be felt more in the poorest areas of the world, which are located in the most exposed band of the planet, in medium and low latitudes. The melting of the glaciers and the consequent raising of sea levels, would consume thousands of kilometres of coastline, atolls would disappear, and approximately 150,000,000 people living in cities and coastal settlements would be affected. According to some studies (Church and White, 2006), the sea level has already risen by about 17 cm in the last century, with an increase in the last decade of double the amount recorded in the previous hundred years.

The progressive deforestation of vast green areas and the increasing pollution of the soil and water resources, together with expected demographic changes, risk speeding up the evolution of the trends and the phenomena stated earlier and generating further imbalances, which without widespread and decisive intervention, appear difficult to remedy.

The topics dealt with in this book, motivated by the knowledge that it is necessary to review operations and supply chain management processes in light of the imperative of sustainability, constitute only one component of an ever more urgent and general need, which must be embraced and converted into coherent action, not only at the level of national and supranational policy, but also in the daily actions of companies and their managers, and in the behaviour of consumers and all those that understand the importance of responsible behaviour.

1.4 MEGA-TRENDS AND SUSTAINABILITY

The scenarios and tendencies described previously may be accelerated or delayed and produce effects that are accentuated or mitigated by the parallel occurrence of other phenomena capable of significantly, if not radically, transforming the social, economic, political and cultural context in which people, companies and institutions will be forced to live and do business.

In particular, we are referring to trends and forces of change whose trajectory appears to be interconvertible – at least from the viewpoint of reliable forecasting – and capable of significantly modifying the framework of reference in which society develops. These trends, starting from the contribution of Naisbitt, who defined a ‘megatrend as a general shift in thinking or approach affecting countries, industries and organisations’ (Naisbitt, 1982, p. 3), have been given various names: Mega Trends (Naisbitt, 1982; Naisbitt and Aburdene, 1990; Singh, 2012), Global Forces (McKinsey G.I., 2010), Global Shift (Dicken, 2003; 2012), Global Trends (Malnight and Keys, 2013), to name but a few contributions.

Regardless of the differing definitions offered, a common trait emerges: Megatrends are global, sustained and macroeconomic forces of development and transformation (Singh, 2012). In the pages that introduce the main theme of our work, by drawing attention to the most relevant ones, we will highlight how the aforesaid mega-trends have a crucial impact on the topics described previously, as they are capable of aggravating or extenuating the alarming trends of unsustainability we have summarised.

1.4.1 Demographic Evolution

As already mentioned, the current world population is estimated at approximately 7 billion and is expected to grow to around 9.3 billion by 2050. According to recent estimations, the current population consumes approximately the equivalent of something between 1.5 and 1.8 planets of resources per year in terms of food, water, energy and other resources, and, given the current level of technological development and lifestyles, the destruction process of our natural resources will increase to two planets per year by 2030, growing to a little less than three planets by 2050. Likewise, the impact on the planet in terms of pollution, waste and other negative effects will rise. The world's population will grow (70% in less developed countries) at different rates depending on geographical area. In particular, it is estimated that China will remain almost stable, unless the effect of the recent abolishing the one child policy proves significant. Europe and Japan will see reduction or stability in their populations, and there will be a significant increase in Africa and India. The trends in terms of increases and decreases in population are linked, in addition to migratory phenomena, to the fertility rate of the different countries. Although different sources make forecasts that do not always coincide, the phenomenon of the progressive ageing of the population in several countries, linked to the increase in life expectancy, shows Incontrovertible trends. The number of people in the world aged over 60, is expected to rise from 510 million in 2011 to 1.6 billion by 2050 and to 2.4 billion by 2100 (Malnight and Keys, 2013). The over-65 population will double to 1 billion by 2030, once again with a marked geographical difference. In European countries the phenomenon will be accentuated, increasing the problems of growth in labour productivity and the sustainability of public spending linked to social welfare and health care. In general, in fact, older people save less, causing a decline in wealth accumulation and the consumption of more public spending. This fact, when faced with a progressive cut in public spending due to spending review policies, will offer many opportunities to private operators in many sectors linked to welfare that offer products and services dedicated to the ageing population. The working population, conventionally aged between fifteen and sixty-five years old, started to shrink in Europe and Japan in this decade, and it will shrink by 2020 in China too. By contrast, in some countries the number of young people will continue to grow. It is estimated in fact that, taking the Global Population into consideration, in 2015 there were 1.2 billion youth (aged between 15 and 24); by 2030 the number of youth is projected to grow by 7%, to about 1.3 billion. Nevertheless, even if Asia remains the most relevant region in terms of youth, the number of young people is projected to decline from 718 million in 2015 to 711 million in 2030 and 619 million in 2060. In contrast,

Africa shows a strong trend: 226 million youth in 2015 (19% of the global population) with a projected increase of 42% in 2030 (UNDESA, 2015). The impact of these trends on the capacity of the different countries to increase their growth rates is huge. It is enough to think that demographics alone explain 60% of GDP growth and 40% labour productivity growth (McKinsey G.I., 2010).

1.4.2 Urbanisation

The demographic growth described previously is associated with other phenomena, namely growing urbanisation and migratory flows from rural areas to the global metropolises. Whereas at the beginning of the last century, a little more than 20% of the world population lived in cities and 30% in the 1950s, today this proportion has risen to more than 54%, and it is estimated that it could reach a level close to 60% by 2030 and about 66% by 2050. Considering also that the total number of world inhabitants will grow by 30% between today and 2050, a total of approximately 6.5 billion people will be concentrated in vast urban areas (UNPD, 2014). Some studies estimate a further acceleration of these trends, estimating urbanisation levels at 60% of the world population by 2025 (Singh, 2012).

This migratory flow, comparable to the urbanisation of the nineteenth century, but on a much larger scale, is leading to the creation and development of urban mega-agglomerations, known as mega-cities, and more extensive areas with high population density, creating mega-regions and mega-corridors. Mega-cities, according to the definition of UN Habitat (2006), are urban agglomerations with more than 10 million inhabitants, such as Tokyo, Istanbul, Cairo, Mumbai, Delhi, Mexico City, London, Paris, Shanghai, Peking, São Paulo, Rio de Janeiro, Buenos Aires, Teheran, Calcutta, Jakarta, Manila, Moscow and Seoul. By 2025 there will be more than thirty-five mega-cities, the majority of which will be located in developing countries. It is also predicted that the first 600 world cities will generate 60% of the world GDP growth by 2025 and the first 100 approximately 35% of it. Of these 600, about 420 (about 70%) will be 'Emerging-market mega- and middleweight cities' that 'together are likely to contribute more than 45 percent of global growth from 2007 to 2025' (McKinsey G.I., 2011). Mega-cities like Bogota and Seoul account for more than 50% of the GDP of their countries, and Budapest and Brussels for 45% (Singh, 2012). Mega-regions with more than 50 million inhabitants are developing around these centres, consisting of a series of smaller cities and suburbs that are nonetheless strongly integrated with a mega-city, such as those around Pretoria, Lagos or Kinshasa, or greater Los Angeles and New York City. In particular, the number of mega-cities in old Europe will remain very small, whereas its geographical concentration has produced areas that are characterised by high population density and the significant ability to produce wealth that may be compared to mega-regions[4].

[4] This phenomenon has already been observed and analysed: for example, already at the beginning of the last century, Amsterdam–Rotterdam, Ruhr–Cologne, Brussels–Antwerp and Lille, with 59.2 million people and producing nearly $1.5 trillion in economic output or that of London–Leeds–Manchester–Liverpool–Birmingham combined, with about 50 million people and responsible for $1.2 trillion in economic output (Florida, 2008).

Mega-corridors are also being developed, or rather communication corridors between mega-cities, along which more than 25 million inhabitants settle, such as, for example, the Hong Kong–Shenzhen–Guangzhou corridors, which accounts for a population of 120 million inhabitants within an area of 120 km, or the industrial Delhi-Mumbai corridor, which is estimated to reach more than 200 million inhabitants by the year 2025 along its 1480 kilometres (Singh, 2012). These aggregates are the source of development of many nations, and will be even more so in the future, and at the same time they will be places of enormous and unacceptable inequality, with sections of the privileged population with immense wealth and much broader sections of the population seeking to survive, living within close proximity of one another. In many of these mega-cities, between 20 and 70% of the population will live in slums, favelas and bidonvilles.

The described changes appear to be huge, as illustrated in the following examples (Sander, 2012).

- São Paolo–Rio de Janeiro is a mega-region with 43 million inhabitants.
- New York has a GDP comparable to that of Spain and Canada.
- Ibadan–Lagos–Acra is an urban corridor extending for 600 km through Nigeria, Benin, Togo and Ghana, the economic engine of western Africa.
- Cape Town is a 100 km large city-region.
- Mumbai-Delhi is an industrial corridor, which may reach 1500 km as it develops.
- Bangkok is a city region, which in 2020 is expected to expand for 200 km from its current centre, going beyond the current population of 17 million.
- Hong Kong–Shenzhen–Guangzhou is a corridor hosting 120 million people.
- Tokyo alone represents almost 2% of the world GDP.
- From Beijing to Tokyo, via Pyongyang and Seoul, there is a 1150 km belt connecting at least 77 cities with a population of over 97 million people that actually merges four megalopolises of four different countries.
- Budapest represents almost half of Hungary's GDP.
- Brussels has a GDP percentage that is 4.4 times higher than the incidence of its population of Belgium.
- London has a GDP higher than that of Switzerland or Sweden.

1.4.3 Emerging New Consumers

The rise of developing countries (in Asia, Eastern Europe and Africa) is creating a new class of consumers, characterised by growing discretionary spending, but with different needs from consumers in the Western countries. This requires the ability to adapt the offer and adopt lower-cost business models. With reference to this phenomenon, several studies (McKinsey G.I., 2010) have already recently estimated the emergence of 300 million new middle-class/upper middle-class households, with a growth rate of 8% in ten years. In the upper-middle category, which accounts for 40 million households, approximately 40% are from eastern European countries

and 20% from China. Within the range of a minimum annual income of $3200 (lower-middle-class), and a maximum of $4400 (upper-middle class), it is estimated that 864 million people, the equivalent of 62% of its population, will fall into this category in India alone by 2020, whereas China will see an increase in this band of the population from 65 million in 2005 to 949 million by 2020, Russia will witness an increase of the middle-class share of between 40 and 70% out of its population of 140 million by 2020 (Singh, 2012).

The increase in the number of these new consumers will have a significant influence on the offer models of all the companies involved in serving them (Court and Narasimhan; 2010). It is not a simple case of adapting or localising products and services, but often a case of completely rethinking them, both from the point of view of their functional features, as well as their positioning and pricing in order to respond to an enormous demand, quantitatively speaking, with price/performance features, however, that differ greatly from those experienced by consumers in western countries. In low-income markets it is therefore necessary to develop coherent product and distribution strategies that, for example, allow products also to be offered in rural areas with a modest population density and limited spending power. This, therefore, concerns making changes to product and distribution processes that may at times be radical, developing new business models, based on low prices, low margins and enormous volumes, aimed at the bottom of the pyramid (Prahalad and Hart, 2002; Prahalad and Hammond, 2002a; 2002). The development of these strategies makes it possible for economically sustainable results to be achieved only if a very high market penetration rate is reached. In many cases, distribution costs in rural areas are prohibitive and may counterbalance the margins generated by large economies of scale. In these situations, critical issues arise with regard to operating costs, distribution systems and the need to have local sales networks capable of developing the market through personal contact (Simanis, 2012). Therefore, it seems that there are various options in terms of supply and distribution strategies: in the cases where a company has a pre-existing logistics infrastructure that is designed to sustain other products aimed at richer market segments and where potential clients are aware of the purchase and usage models of the products and services offered, a distribution strategy based on low margins and high volumes may be sustainable. This possibility, together with the absence of costs for making customers aware of the product and teaching them how to use it, means that only the difference in costs linked to the distribution of the new products aimed at weaker segments of the market need to be covered. There are multiple examples of success stories, such as the Wheel detergents distributed in India by Unilever at a price that is 30% lower than the average price of its similar products or the case of Manila Water in the Philippines. In contrast, if the company has to develop its own distribution logistics in rural areas, in which the scale is based on the individual village and it is necessary to educate the customer on the purchase and consumption process, it is often necessary to significantly change the company's supply strategy. In this case a different option based on three elements is practicable, which are illustrated in detail by Simanis (2012), aimed at raising prices and margins and exploiting communication and training linked to the use of products. This option is based on:

1. *Localising and bundling base products*, or rather creating products that can reduce variable costs through the options of postponement and increasing prices and margins thanks to a richer value proposition. On the one hand, this means offering a basic product whose final processing prior to sale is done as close to the target market as possible, such as in the cases of packaging or bottling of detergents, the mixing of ingredients or the dilution of chemical elements for fertilisers, with the objective of exploiting low local labour costs. On the other hand, it involves proposing a sales bundle, offering more products, services and features in a single purchase, thus saving the consumer time and money, such as in the case of the sales bundles of several personal hygiene products or home-cleaning or multifunctional products. The idea of developing a family of products and reusing containers is the basis of the project developed in Ghana by S.C. Johnson with the support of the Bill & Melinda Gates Foundation, which is aimed at low-income consumers in two rural districts. On the one hand, the project focused on the concept of bundling, proposing several categories of products, such as insect control, home clearing and air care; on the other hand, it reduced distribution costs through the design of localised containers and filling systems.
2. *Offering an enabling service*, with the objective of sustaining pricing policies and higher margins and giving customers the knowledge and skills needed to maximise product features. Simanis (2012) quotes the case of Cemex, a Mexican company that supplies building materials to families, offering a service that costs $14 a week to help them to maximise the use of the products and to build their own homes at a lower cost.
3. *Cultivating customer peer groups*, in order to reduce communication and training costs related to the use of the products, and even their design. The use of customers, located locally, who inform, demonstrate and sell is a practice that was successful during the 1960s and 1970s in Europe and the United States. This policy is being successfully adapted and developed more and more often in emerging countries, allowing for low-cost widespread market penetration based on direct contact among users, such as, for example, the case of P&G sanitary products in Mexico (Hill, 2007) or the case of the distribution of pots and pans and kitchen utensils in India, or even the network of women that support the spread of Grameen micro-credit services in Bangladesh (Simanis, 2012). A different and more recent example is provided by the ChotuKool refrigerator, initially sold at less than $70 by the Indian group Godrej & Boyce in Maharastra, co-designed with the contribution of 600 women involved in different stages of its development, from concept development to the definition of its technical features and colour.

As clearly demonstrated in these brief notes, the development of these markets requires a complex rethinking of both the products and services on offer, as well as of underlying operations and supply chains.

1.4.4 Smart Technologies and the Digital Factory

It is estimated that by 2020 there will be more than 80 billion connected devices, 9 billion mobile phones, 5 billion Internet users and on average five connected devices for every individual, ten connected devices for every household and 500 devices with unique digital ID per square kilometre (Singh, 2012). The incredible development of the connectivity phenomenon between different applications and devices – the result of the diffusion of the Internet and new technology – will lead to the democratisation of information through collaborative platforms and knowledge-sharing, based on already widely distributed social media. The new archetypes of co-creation and knowledge-sharing will have an impact on all sectors, expanding the potential of increasingly sophisticated but less expensive hardware. The arrival and incredible development of the Internet has also led to the production and accumulation of enormous quantities of data. It is estimated that 2.5 quintillion bytes are created every day, 90% of the total bytes have been created in the last two years, and that in the next decade the amount of information managed by companies will increase by a good fifty times (Malnight and Keys, 2013). The demand to acquire new ways of extracting sophisticated information from this massive amount of data is leading to the development of new tools: analytics, capable of exploiting the information content of big data. At the same time, approaches concerning the co-creation of information among consumers and making this information available through the development of knowledge-sharing platforms in all fields will go through the roof.

The technological developments are also creating new waves of smart products[5]. Think, for example, that 'global smartphone penetration exploded from 5% of the global population in 2009, to 22% by the end of 2013. By 2017 more than a third of all people around the globe will be smartphone users' (Eagar et al., 2014, p. 15). Take also, for example, the new solutions such as innovations in smart home products, the evolution of the first home automation projects, called domotica, based on sensors capable of setting and adapting room temperature and lighting depending on the presence of people in the building and external environmental conditions, or guiding the use of electrical appliances remotely; as well as devices that suggest diets or nutritional adjustments and sporting activities depending on the evolution of vital and biological parameters, using smart tracker bracelets or smartwatches or even a fork that controls the speed and pace with which we eat that vibrates if food habits are incorrect, sending data to a smartphone app in order to suggest corrective action. Smart technologies are starting to form a part of the everyday life of a growing number of people in many fields of application, from remote medical diagnostics to home automation and smart buildings, from electrical network control systems or new generations of automobiles to machine-to-machine control devices.

[5] Smart products are products with an incorporated form of intelligence, made up of microprocessors, which allows them to connect to other devices, enabling two-way communication by transferring information in such a way as to allow them to modify their performance through corrective actions (Singh, 2012).

The success of this technology has created an exponential increase in the demand for connectivity and integration between the operators and the various parties, rendering the boundaries between competition and cooperation increasingly faint and stimulating the convergence of different industries.

With specific reference to the subject of this book, namely Operations and Supply Chain Management, the impact of ICT – Information and Communication Technologies on industrial processes has been translated into a series of revolutionary innovations that fall within what has been defined today as the 'Digital Factory' or 'Manufacturing 4.0' or 'Industry 4.0' (Lee et al., 2013; Brettel et al., 2014). Intelligence and connectivity, key features of the digital economy, are incorporated into equipments and machines defined as smart machines capable of interacting and cooperating with one another, producing and using a quantity of data and information flows that were unthinkable only a few years ago. According to a recent study (Manenti, 2014), new technologies supporting the digital factory are:

- *Systems capable of storing*, computing and networking unstructured and variable data, such as Cloud infrastructures, big data analytics, augmented reality software, a series of dedicated apps, for example 3D visualisation and simulation apps, which will enable business users to customise their business systems by downloading apps and integrating them in their IT platforms.
- *Systems capable of enabling connections between objects*, such as the Internet of things (or cyber-physical systems), or interconnecting devices equipped with intelligent systems, able to connect to the Internet and to communicate with one another. This is a business area that is showing enormous growth potential: the worldwide market for Internet of things is forecasted to grow from 1.9 trillion dollars in 2003 to 71 trillion by 2020 (Eagar et al., 2014).
- *Systems capable of using the received information and processing it* to produce goods, such as Advanced Robotics and additive manufacturing applications. The former are made up of machines capable of communicating and cooperating with other systems, and with one another, recognising parts, carrying out self-maintenance and changeovers and so on, making optimised decisions thanks to embedded sensors and intelligent systems on-board the machine. The latter, known as 3-D printers, are capable of producing complex pieces, with features that cannot be produced today, except for the assembly of components, such as, for example, pieces with internal cavities, thanks to stereolithography processes, laser sintering and coating processes applied to plastic materials and powdered metals.
- *Systems capable of guaranteeing the continuous traceability of data flows* and data collection in real time, such as RFID applications – Radio Frequency Identification Devices, mobile systems and the extensive use of well-known technologies, such as 2-D barcodes.

Another area that will certainly see very fast technological developments and applications that are useful to the farming, industry and service sectors is the use

of drones, which can be used for monitoring, mapping and analysing land and other areas, checking areas that otherwise are not easily accessible and possibly transporting light loads.

Furthermore, the innovations linked to Autonomous Vehicles – also known as autonomous cars, self-driving cars or robotic cars – may affect sectors like freight transport logistics and personal transportation in the future. The application areas of such technology are potentially enormous and are conditioned more by legal aspects linked to the safety of land and air transport and the requirement to think of compatible infrastructures, than by the development of the underlying technology.

Moreover, from the perspective of consumer habits and purchasing patterns, models based on the so-called Sharing Economy are fast becoming more popular, such as the sharing of means of transport, holiday homes, or even actual production structures. In this regard, take, for example, the popularity of the phenomenon of 'makers', based on sharing equipment, machineries and tools to produce products, which are speeding up 'servitisation' processes (Beuren et al., 2013; Baglieri and Karmakar, 2014; Lay, 2015), in which users substitute the purchase of goods with the purchase of their utility function. These trends have significant repercussions in terms of environmental and social impact, as they increase the rate of saturation of the available production capacities or the utilisation rate of existing goods, limiting the creation of new ones and reinforcing sharing and solidarity phenomena.

1.5 MEGA-TRENDS, SUSTAINABILITY AND SUPPLY CHAIN MANAGEMENT

The mega-trends summarised here are only some of the most relevant examples of the many global forces that are remodelling the socio-economic profile of our planet. These trends combine with one another, producing different effects: in some cases, the overlapping of these tendencies may generate an increase in the phenomena that threaten sustainability; in others they produce compensatory and mitigation effects that may minimise adverse impacts. It is enough to think that, as reported by Bastein et al. (2013), it is estimated that the effects of urbanisation and changes in middle-class consumer habits, especially in developing countries, may lead to a tripling of consumption by 2050 (UNEP, 2011). Take, for example, that in the twentieth century, due to the impact of population growth, the extraction of construction materials increased by a factor of 34, minerals by a factor of 27, fossil fuels by a factor of 12 and biomass by a factor of 3.6 (UNEP, 2011). In contrast, it is to be highlighted that, as far as the quest for prosperity and the growth in population are concerned, these are inevitable trends that lead to an increase in consumption. However, technology and the growing attention paid to respecting natural resources have made great progress and will make even greater progress in future years. Just think, for example, that 'the world economy used approximately 30% fewer resources in 2005 to produce one unit of GDP than it did in 1980' (Bastein et al., 2013, p. 4).

Limiting our discussion to the implications linked to Operations and Supply Chain Management, the subject of this book, the possible scenarios generated by the statements previously have been taken into consideration.

The combined effects of demographic growth, especially in developing countries, and the phenomenon of population concentration in mega-cities, mega-regions and mega-corridors will give rise to a considerable increase in the demand for goods and services, starting from consumption goods, assessable in physical flows that have never been experienced before, with very important implications in terms of the supply chain, logistics and retailing. New procurement, transportation, storage and distribution models must be tested in order to be able to continuously and reliably feed the flow of goods from huge industrial areas to enormous consumption centres. Likewise, it will be necessary to design sustainable solutions for efficiently supplying populations that live in scattered rural areas.

The effects of climate change, the progressive desertification of arable land and the simultaneous increase in the world's population will strain the relationship between the demand and supply of food, water, fuel and other materials, where only technological innovation, the dissemination of new methods for producing agro-foods and greater attention to conscious consumption will be able to achieve sustainability. In this regard, investments in Research and Development and new technology aimed at increasing the productivity of agricultural cultivation and the reduction of waste in processing, preservation and distribution processes may be able to offset the deficit that is currently predicted.

The environmental impact caused by the growth in populations, their needs and their consumption, may be softened thanks to the development of clean technologies and the issuing of new environmental standards by supranational regulatory bodies. As far as the main subjects of this book are concerned, this will lead to the drafting of new methods for measuring the value created, or destroyed, by companies, sectors and nations, through the identification of metrics and key performance indicators (KPIs) capable of rating not only economic performance, but also the social and environmental impact of the managed processes.

New generations, called Z generations or digital natives, will partially make up for the loss in traditional occupations, thanks to the new opportunities offered by connectivity, which will enable alternative forms of employment and lifestyles to be developed, compensating for the difficulties of inter-urban mobility in mega-cities. The pressure of the regulators and the increased sensitivity of the new generations towards the subjects of sustainability will lead to an increase in low-impact urban mobility initiatives, such as the use of fleets of mini electric cars, car-sharing platforms, the tendency to purchase and consume green products and greater attention to more environmentally and social-conscious behaviour. This will lead to an increase in waste separation systems and implicit requirements during product design and two-way (forward and back) logistics flows (see Chapter 7).

The development of new technologies and the progression of connectivity trends will greatly increase the effectiveness and potential of instruments that have already been used today with success. In order to limit ourselves once again to the field of investigation of this book, take, for example, the potential of RFID – Radio Frequency Identification technology and satellite geolocation systems already in use today to

optimise the routing, tracking and tracing of transport and logistics flows, and their possible integration with information, which is becoming increasingly sophisticated, accessible with ease and cost-effective. Or even the impact of 3-D printing, nowadays widely used for prototyping and also the production of parts in many sectors, such as aeronautics, which shows huge potential also from the perspective of economic and environmental sustainability; the use of additive manufacturing logics that makes it possible for waste and production leftovers to be minimised as only the material necessary for the manufacture of the product is used; the possibility of building spare parts on demand, for example, which reduces investments in stock and related risks of obsolescence and overproduction; the use of printed material in the proximity of users, which may contain the transportation costs of goods, reducing the connected environmental impact; and the production of complex, lighter parts and cables that will simplify several industrial processes, containing maintenance and production costs.

Another area in which new technology will produce considerable increases in productivity that can contribute to reducing environmental impact is defined as Precision Farming (Stafford, 2000; Auernhammer, 2001; Phillips et al., 2014). Take, for example, the studies underway using machine-to-machine protocols for interfacing drones that use specific sensors to assess the areas on agricultural land that require more water or fertiliser. This information can be transmitted to tractors and farming machinery that can plough, water and fertilise the same field using satellite navigators and digital maps, optimising the use of scarce resources such as water, as well as minimising the use of fertilisers and consequently producing a higher level of efficiency and lower environmental impact. The use of drones with cameras or infrared optical tools also makes it possible today to map forest areas and to detect fires or areas susceptible to landslides or, with the use of computer tools, the levels of atmospheric pollution and air quality.

The growing complexity linked to globalisation, together with a greater understanding of the finiteness of the resources guaranteed by our planet, may lead to increasing conflict or, hopefully, forms of international cooperation between different public and private stakeholders, as is already happening in many cases between consumer associations, producers and distributors, regulatory bodies and so on, such as, for example, the multiple local production and consumption initiatives, those linked to the recovery and redistribution of unsold products or, again, those linked to the minimisation of the environmental impact of waste and packaging. In this regard, efforts focusing on the design of reverse logistics systems, the recovery and use of products and their components to the end of their life cycle and design for environment logics, that is, products designed to have minimum environmental impact, will be intensified.

1.6 SUSTAINABLE DEVELOPMENT AND CORPORATE SOCIAL RESPONSIBILITY

The picture described here highlights how the topic of sustainability will be of increasing importance on all levels: in the choice of government policies and national and supranational regulatory bodies, in the managerial decisions of public and private

companies, in the actions of many not-for-profit organisations, in purchase and consumption patterns and in people's lifestyles.

The development of awareness in this important field has led, mainly, to the different origin of the concepts of Sustainable Development, which for the most part refer to environmental impact and attention to the ecosystem, and Corporate Social Responsibility, which concerns guidelines on social matters for business managers. The two tendencies, however, have found elements of convergence and integration over time, in the sense that CSR is becoming an important tool that public actors and companies can use to pursue sustainable development objectives.

The most widespread definition of Sustainable Development is, in fact, the one that refers to the possibility of promoting development by looking not only at current needs, but also future ones. More precisely, Sustainable Development is defined as the:

> '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*' (Brundtland, 1987, p. 54).

According to the Commission work, this definition *contains within it two key concepts*:

- *the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and*
- *the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs* (Brundtland, 1987, p. 54).

With reference to the 'needs' component, apart from increasing awareness of the topic of waste, consumer choices and methods for the use of goods, specifically in relation to food (food and water), which companies can certainly contribute to in terms of awareness and communication, little can presumably be done from a corporate perspective. With regard, on the other hand, to the subject of limitations, namely the development of technology, processes, products and practices that enable current limitations to be overcome, the responsibility of companies and institutions seems paramount. Nevertheless, it is important to emphasise how empirical evidence has shown that the greatest environmental impact, and also social impact, occurs upstream, along the stages of the supply chain and during consumption, depending on the more or less conscious behaviour of the consumer/user. This evidence, within the context of this work, clarifies why, in addition to internal or 'end-of-pipe' checks carried out by the focal company dominating a supply chain, performing checks inside the entire supply chain becomes important, which, in general, occurs less and less frequently as one moves slowly upstream towards the extraction or cultivation of raw materials (Tencati and Pogutz, 2015).

In this regard, the role that the company ought to promote responsibly is that of developing business strategies, technology innovations and practices that enable business and sustainability objectives to be pursued together from a dual social and environmental perspective, in the interest of all stakeholders, in a broad sense and in the long term.

The increasing attention of society to the subjects of sustainability and sustainable development has led to progressive attention, also on the part of companies, to the integration of CSR – Corporate Social Responsibility – objectives and practices in the formulation of their development strategies and their pursuit of objectives. The literature has coined several definitions of CSR, and there are numerous studies that have analysed the origins and evolution of the concept of sustainability over time and its implications on a corporate and public policy level (Perrini et al., 2006). From among the many, keeping the aims of this book in mind, we will only dwell upon on a few, focusing on their basic elements, to be considered as an overall framework, within which the subjects of Sustainable Operations and Supply Chain Management can be developed.

- *CSR is a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on voluntary basis* (EC, 2001, p. 6).
- *CSR is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large* (WBCSD, 1999, p. 3).

Whereas initial definitions, such as the one developed by the World Business Council for Sustainable Development (1999) or the one drawn up by the European Commission following the Lisbon Summit of 2000, focused on clarifying the concept of CSR, over time attempts have been made to place greater emphasis on its strategic implications and clear methods for the implementation of CSR practices. From the point of view of the policy maker, this translates into the possibility of pursuing three priorities, namely the promotion of best CSR practices, giving credibility to CSR claims and the development of coherent public policies (Perrini et al., 2006). From a corporate point of view, on the other hand, this translates into the imperative to integrate socially responsible objectives and conduct into the formulation and implementation of business strategies and consequent business choices.

More recently the European Commission (2011) produced a new definition of CSR, as *the responsibility of enterprises for their impacts on society.* In the same document the Commission specifies:

Respect for applicable legislation, and for collective agreements between social partners, is a prerequisite for meeting that responsibility. To fully meet their corporate social responsibility, enterprises should have in place a process to integrate social, environmental, ethical, human rights and consumer concerns into their business operations and core strategy in close collaboration with their stakeholders, with the aim of:

- *maximising the creation of shared value for their owners/shareholders and for their other stakeholders and society at large.*
- *identifying, preventing and mitigating their possible adverse impacts*' (EC, 2011).

It is within the framework of this definition that the interaction between business, environmental and social objectives is discussed next, with specific reference to the role played by Operations and Supply Chain Management.

1.7 THE DEVELOPMENT OF SUSTAINABLE OBJECTIVES FROM THE TRIPLE BOTTOM LINE PERSPECTIVE

Sustainability objectives therefore refer to three performance levels, defined as the Triple Bottom Line (Elkington, 1994; 1997; Kleindorfer et al, 2005; Pagell and Wu, 2009; Pagell, Wu, Wasserman, 2010; Gimenez et al., 2012), or the 3P, illustrated in Figure 1.1, which each company must try to jointly maximise:

- *Profit:* expression of the performances that lead to economic and financial sustainability and its development prospects in the medium to long-term.
- *Planet:* refers to the performances that guarantee environmental sustainability, in terms of environmental protection and the overall impact of the business on the environment.
- *People:* connected to the performances that measure the social impact of the business, in terms of social equity and cohesion, economic prosperity and the protection and promotion of fundamental rights.

Unfortunately a deep-rooted vision in several business contexts may be in contrast with these objectives, a vision that presumes that the maximisation of profit may justify paying less attention to the subjects of environmental and social sustainability, as well as to conduct that does not respect these imperatives. The trade-off between

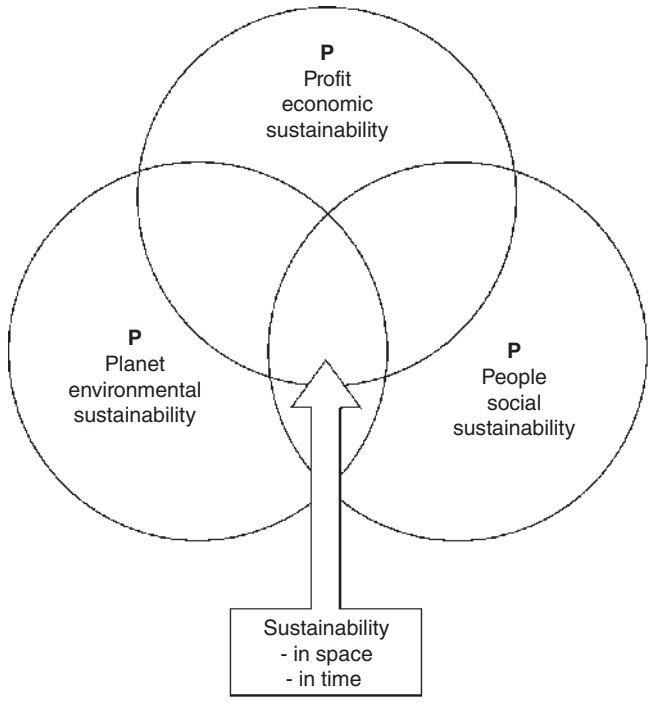

FIGURE 1.1 3Ps and Triple Bottom Line.

these objectives must, however, be rejected, first of all for ethical grounds and, second, by extending the scope of the analysis of the results attainable by each company, with reference to both the time frame of the aforesaid results subsequent to managerial or public policy decisions and the type of stakeholders that the achieved results are measured against.

If economic and financial sustainability is the main objective of value creation and it is connected to the interest of shareholders, the support of the other two sets of performances, linked to environmental and social sustainability, extend the ultimate purpose of the company to all stakeholders, be they current or future, with the objective of guaranteeing an overall quality of life on the planet and fairness in standards of living in terms of time and space:

- *In space*, in terms of the better distribution of the value created between more fortunate populations, located in the areas that, although representing a minority (20%) of the world population, absorb far greater wealth (80%) and the remaining part that find it hard in many cases to reach the threshold of survival.
- *In time*, with reference to the need to guarantee intergenerational equity, offering future generations the same opportunities that are offered to those of today's generations and progressively encouraging balance in all forms of growth and development.

In this regard, economic and financial sustainability must not only refer to the economic entity capable of producing it, that is, the company, but to society as a whole, which, by hosting and interacting with it, contributes to its creation and must therefore benefit from it. The concept of the Triple Bottom Line therefore refers to broad objectives, which must be summarised nevertheless using performance, metrics and specific indicators, as will be described in Chapter 8. From this point of view, the interdependence of the economic and financial, environmental and social profiles of sustainable development recurs in many models and guidelines developed to support companies and institutions in the implementation of best sustainability practices.

1.8 SUSTAINABILITY: THE REASONS WHY

The main advantages of an approach oriented towards sustainability are ascribable to Sanders (2012):

- *Financial pay-offs*, connected to the possibility on the one hand of reducing business costs, administrative costs and invested capital and, on the other hand, increasing returns and market appreciation.
- *Consumer-related pay-offs*, linked to the ability to increase customer satisfaction, market share and the reputation of the company, as well as developing product innovation and new business development.
- *Operational pay-offs*, connected to process innovation, aimed at increasing productivity and the yield of the used resources, reducing process times and minimising waste.

- *Organisational pay-offs*, deriving from increased employee satisfaction, better relationships with stakeholders, the reduction of risk and interventions of regulatory bodies, and an increase in organisational learning.

The possibility of obtaining these benefits depends on the ability to jointly and deliberately pursue economic, environmental and social sustainability objectives, as mentioned in reference to the Triple Bottom Line. The drivers that may lead a company to increase its compliance with the principles of sustainability differ from one another, even if overlaps among them can be found. In particular, a distinction can be made between the various reasons, examples of which are given next in reference to the area being examined in this book (Fiksel, 2012; Sanders, 2012):

- *Legal reasons:* in many national and supranational contexts, laws and regulations that impose consistent behaviour and that sanction elusive or illegal behaviour are drafted. For example, with regard to environmental impact, there are regulations that impose the use of systems to reduce polluting emissions, such as filters, catalysers and other equipment or those that prohibit the use of materials that are toxic and dangerous for health and the environment, such as asbestos, Freon gas and plastic packaging waste. Similarly, with regard to social impact, there are laws that are aimed at resisting forms of social dumping and child labour, those that impose the installation of protective systems for accident prevention in the workplace or alarm and isolation systems in the event of toxic gas leaks or leaks of radioactive substances. These regulations are mainly aimed at preventing the risk of occurrences that may cause damage to people or the environment or that may create situations of social injustice during the design of a production and logistics system (industrial assets used, such as buildings, systems, machinery, storage and transportation systems) and the processes and practices that may be adopted within them (safety procedures, accident prevention regulations, laws that protect workers etc.). Alongside these are the laws and regulations aimed at guaranteeing the monitoring of system performance (measurement of polluting emissions, characteristics of waste water etc.), the use of appropriate input (materials, energy, labour etc.), the maintenance and adaptation to new system standards, as well as the communication of these regulations and training of workers. Over time, the regulatory bodies have progressively acknowledged the urgency of responsible behaviour and have expanded the regulatory framework regulations and inspections in this field.
- *Compliance reasons with regard to specific certifications and accreditations:* A second reason originates from the will of the company of its own accord to respect the regulations issued by certification or accreditation bodies, such as ISO standards. In this case the choice to adapt behaviour and internal processes to the regulations of the aforesaid systems may be due to competitive opportunities, such as the need to possess certain certificates in order to be admitted to the supplier portfolio of certain clients, or to participate in tenders or, even, to obtain licences in order to set up business in certain areas or countries. In other

cases, it concerns adapting to industry practices or using the visibility linked to certifications and accreditations for internal and external communication purposes, the revision of internal processes aimed at improving quality or recovering efficiency, or for the actual practical implementation of boosting values and ethical motivations. In these cases, the compliance choices are used to pursue objectives that can be classified in one of the three categories stated next:

- *Reasons connected to relationships:* with particular reference to the community of stakeholders. The need to maintain high levels of reputation in the markets, to encourage dialogue with local governments or the workers' or consumers' representatives, especially in the case of companies exposed to greater environmental and social risk, may force the top management of the company to set up sustainability projects. From this point of view, many companies develop codes of conduct and systems for measuring and reporting their sustainability performance, inspired by the principles of transparency and accountability. This the case, for example, of the Sustainability Reporting Guidelines released by the GRI – Global Responsible Initiative, or, in the field of education the PRME – Principles of Responsible Management Education.
- *Reasons linked to profitability opportunities:* In many cases setting up sustainability projects is accompanied by clear objectives to increase economic and financial performance, through actions that may reduce costs or increase returns, such as, for example, investments in clean technology that reduces energy consumption or replaces conventional energy sources with renewable sources or has low environmental impact, or design for logistics and design for packaging choices, aimed at minimising or rationalising packaging in order to increase the value density of transported goods and consequently reducing transport flows.
- *Ethical or values-based reasons:* these concern initiatives that start 'from the bottom up', that is, from the community of employees or the sensitivity of top management. They often involve projects that are created from the will of enlightened entrepreneurs and managers, aware that success also comes from the opportunities offered by the community and who want to give something back. The cases of companies that invest in company welfare through the setting up of day-care facilities for the children of their employees, the distribution of incentives and bonuses (e.g. practices of matching funds) linked to sustainability projects, the financing of works and promotion of donations for the local community, the creation of foundations for social or cultural purposes or environmental recovery, the involvement of employees in philanthropic projects, or the provision of their know-how in kind for not-for-profit organisation initiatives, are become increasingly frequent.

It goes without saying that the reasons stated here, far from being secluded, often mix, overlap and reinforce one another, resulting in sustainability projects and models each with their own unique character and effectiveness.

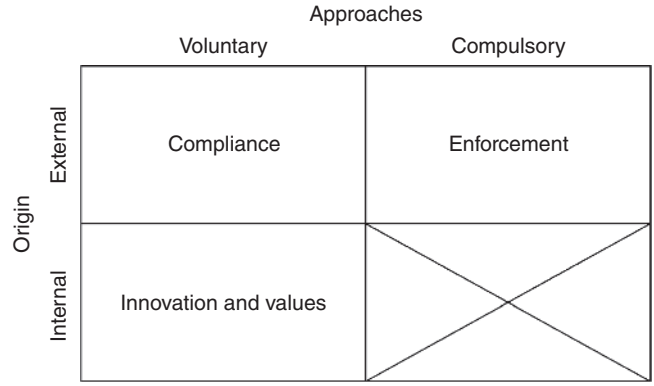

FIGURE 1.2 Origins and approaches in the development of sustainability projects. *Source:* Sanders 2012. Reproduced with permission of John Wiley & Sons.

In summary, the adoption of sustainability models in corporate environments may therefore be due to voluntary compliance or compulsory obligations and may have internal or external origins, as illustrated in Figure 1.2.

- The first case – *Enforcement* – refers to an external and binding obligations linked to laws and regulatory requirements on environmental and social responsibility imposed by regulatory bodies or national or supranational governments, such as, for example, the EU 2001 Polluter Pays Principle asserting that who pollutes pay (OECD, 2002), the Extended Producer Responsibility, affirming that the producer is responsible for the product throughout its entire life cycle (OECD, 2001), the WEEE directive – Waste Electrical and Electronic Equipment (Goodship and Stevels, 2012), which requires each nation to set collection, recycling and recovery targets for electronic products or the RoHS, Restriction on Hazardous Substances, to phase out the use of lead, mercury, cadmium, hexavalent chromium and other toxic materials, as well as the related variations to these regulations in the different countries of the European Union. With reference to social sustainability, the labour standards and the legislative body promoted by ILO – International Labour Organisation – on the prevention of child labour and all forms of discrimination is a prominent example.
- The second case – *Compliance* – originates from the voluntary choice of a company to comply with practices and models generally linked to sector certifications or accreditations with bodies that propose environmental and social responsibility systems, such as, for example, voluntary compliance with the family of ISO 14000 standards and the EMAS certification – Eco-Management and Audit Scheme regarding the requirements for appropriate environmental management, or the SA 8000 certification concerning the voluntary universal standard for companies interested in auditing and certifying social performance, or even the GHG – Greenhouse Gas Reporting Program created by the U.S.

EPA – Environmental Protection Agency – and so on. As already mentioned, more and more frequently companies are undertaking to develop codes of conduct inspired by the guidelines of third parties, such as, for example, the GRI – Global Reporting Initiative – which has developed guidelines relative to labour rights and decent work practices, human rights, society and product responsibilities, or the standards promoted by the United Nations and the CEDAW – Convention on the Elimination of all Forms of Discrimination Against Women.

- The third case – *Innovation and Values* – is based on a voluntary choice of the company and is inspired by internal reasons linked to improvement objectives in terms of internal efficiency or external visibility and presence on the market, or again, as has already been stated, by choices based on basic ethical values. This is the case in companies that set up process innovations aimed at reducing polluting emissions or energy consumption, or product innovations to reduce the use of toxic materials, or management innovations, such as, for example, vendor selection methods that take the environmental and social practices of its suppliers into account, or projects linked to company welfare or philanthropic investments.