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# SUSTAINABLE CONSTRUCTION IN THE DIGITAL AGE: SPECIAL REFERENCE TO THEORIES OF SUSTAINABILITY AND SDGS IN GREEN BUILDING*

Khariyah Mat Yaman**

Zuhairah Ariff Abd Ghadas***

## ABSTRACT

Most industries are on the edge of revolution owing to the rise of automation and disruptive technologies. Like other industries, the construction industry is also undergoing a substantial transformation due to digitalisation. Amidst the revolution, the nature of the construction industry in its practices and activities, coupled with the industry players' paucity of environmental consciousness, has significantly contributed to the decline of ecosphere health. Finding a balance between rapid growth in the economy, widespread digital adoption, increase in population, and environmental threats is critical. At its core, sustainable construction processes adhere to the sustainable development philosophies as outlined by the World Commission on Environment and Development in the Brundtland Commission's report, *Our Common Future*, published in 1987. This paper discusses the theoretical framework upon which sustainable construction practices and green building principles were conceptualised. The analysis of the heuristic approach to philosophical foundations demonstrated the critical nature of making correct policy decisions (on development) and its significant implications, particularly

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** PhD candidate, Faculty of Law and International Relations, Universiti Sultan Zainal Abidin, 22200, Terengganu Malaysia. Email:khariyah_matyaman@yahoo.com/khariyah@hsk.com.my (Corresponding Author)

*** Professor, Faculty of Law and International Relations, Universiti Sultan Zainal Abidin, 22200, Terengganu Malaysia. Email: zuhairahariff@unisza.edu.my.

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towards nature. Additionally, this paper examined and identified the construction industry's potential contributions to attain the global agenda of the 2030 Sustainable Development Goals. The findings in this article will assist policymakers in the construction industry in balancing between the interests of the stakeholders and the protection of the environment in the technological epoch.

**Keywords**: Green building, sustainable construction practices, sustainable development, 2030 sustainable development goals.

## PEMBINAAN MAMPAN DALAM ERA DIGITAL: RUJUKAN KHUSUS KEPADA TEORI-TEORI KELESTARIAN DAN MATLAMAT PEMBANGUNAN MAMPAN (SDGs) DALAM BANGUNAN HIJAU

## ABSTRAK

Kebanyakan industri berada di ambang revolusi akibat peningkatan automasi dan teknologi distruktif. Seperti industri lain, industri pembinaan sedang mengalami transformasi yang besar disebabkan oleh pendigitalan. Di tengah-tengah revolusi, sifat industri pembinaan dalam amalan dan aktivitinya, ditambah dengan kekurangan kesedaran pemain industri terhadap alam sekitar, menyumbang dengan ketara kepada kemerosotan kesihatan ekosfera. Mencari keseimbangan antara pertumbuhan pesat dalam ekonomi, penerimaan digital yang meluas, peningkatan penduduk, dan ancaman alam sekitar adalah kritikal. Pada terasnya, amalan pembinaan mampan mematuhi falsafah Pembangunan Mampan yang digariskan oleh Suruhanjaya Dunia mengenai Alam Sekitar dan Pembangunan dalam laporan Suruhanjaya Brundtland, *Our Common Future,* yang diterbitkan pada tahun 1987. Makalah ini menyorot kerangka teori di mana amalan pembinaan mampan dan prinsip bangunan hijau dikonsepsikan. Analisis pendekatan heuristik terhadap asas-asas falsafah menunjukkan sifat kritikal dalam membuat keputusan dasar yang betul (mengenai pembangunan) dan implikasinya yang ketara, terutamanya terhadap alam semula jadi. Di samping itu, makalah ini mengkaji dan mengenal pasti potensi sumbangan industri pembinaan untuk mencapai agenda global Matlamat Pembangunan Mampan 2030. Dapatan dalam makalah ini akan membantu penggubal dasar dalam industri pembinaan dalam mengimbangi antara kepentingan pihak berkepentingan dan melindungi alam sekitar dalam zaman teknologi.

**Kata kunci:** Bangunan hijau, amalan pembinaan mampan, pembangunan mampan, matlamat pembangunan mampan 2030.

## INTRODUCTION

Among the world's major environmental challenges include deforestation, biodiversity loss, and pollution, all of which contribute to climate change and global warming.Unfortunately, the construction industry was identified as a considerable contributor to these environmental issues. It has been pointed out that the construction industry's non-ecological structure in its methods and processes, combined with the lack of environmental consciousness amongst many building professionals, has contributed to earth's declining ecological health.[1]

In retrospect, this has resulted in the recognition that the construction industry must evolve. There has since been a paradigm shift from traditional earth hazard building construction practices to adopting more sustainable approaches and methodologies in building design and construction, dubbed by the industry as 'green building'.The paradigm change targets equilibrium between rapid growth in the economy, widespread digital adoption, growing population, and environmental threats.This new approach, coupled with technological transformation, invites breakthroughs and innovations.

The construction industry, which has a reputation for resisting change, appears amenable to embracing the digital revolution.[2] This may have been catalysed by the introduction of new methodologies and approaches which suit the aims of sustainable design and construction. The most glaring example is the introduction of a software system known as building information modelling (BIM)into building and construction processes to assist in the planning and management of a project.The potential of BIM to act as a centralised coordination

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1 Peter. Graham, *Building Ecology : First Principles for a Sustainable Built Environment* (Blackwell Science, 2003), 1.

2 David Kaufmann Xavier and Ruaux Michael Jacob, "Digitalization of the Construction Industry: The Revolution Is Underway," Oliver Wyman (New York, 2018), https://www.oliverwyman.com/our-expertise/insights/2018/sep/digitalization-of-the-construction-industry.html.; Romed Kelp and David Kaufmann, "Construction Machines in the Digital Age," Brink Conversation and Insights on Global Business, 2017, https://www.brinknews.com/construction-machines-in-the-digital-age/.

terminal on a real-time basis could significantly impact how time, quality, costs, and safety are managed throughout the construction value chain.[3]

The time is ripe for the industry to explore new inventions and innovations owing to this technological epoch. However, it remains to be seen whether the change in paradigm coupled with technological transformation and advancement can guarantee built environment sustainability. What are the conditions that might cause the industry to revert to being a non-ecological structure? To address these concerns, it is necessary to first establish and understand the core philosophies of sustainability theories and the foundations that underpin the concept of sustainable design and construction.

The analysis hopes to provide valuable insight on global efforts in achieving sustainable development (SD), as envisioned by the World Commission on Environment and Development (WCED) in the Brundtland Commission's report, *Our Common Future*, published in 1987 (WCED's SD).[4] The discussion will further examine the global agenda of sustainable development goals (SDGs), their relevance to the construction industry, and the industry's potential contributions in achieving the SDGs through green building.The findings of this paper will assist policymakers in the construction industry to balance stakeholder interests and preserve the environment in the digital age.

## THE CONCEPT OF SUSTAINABILITY AND ITS EVOLUTION

The broader concept of sustainability and its evolution must first be examined to comprehend the present-day concerted global efforts towards SD. The concept is said to emerge in the late 1960s and early 1970s.[5] This is a period marked by new global environmental

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3 Xavier and Jacob, "Digitalization of the Construction Industry: The Revolution is Underway," 2018, 7.

4 WCED, "Report of the World Commission on Environment and Development: Our Common Future," *World Commission on Environment and Development*, 1987, 1–300, https://doi.org/10.1080/07488008808408783.

5 Maristella Bergaglio, "The Contemporary Illusion: Population Growth and Sustainability," *Environment, Development and Sustainability* 19, no.

awareness and development issues.[6]Albeit the widespread use of the term, literature appears to be unanimous in concluding that the term has no binding definition.[7] Approaches to sustainability vary considerably, particularly on how development is measured, how environmentalism correlates to justice and participation,[8] with many forces influencing the evolution of the concept.[9]

It follows with the advancement of numerous theories in the bid to crystallise sustainability into a cogent concept. One of the theories advocated is the'systems theory', which was advanced in 1972 by the Club of Romein a report entitled *The Limits to Growth*. The report drew attention to factors that were believed to determine and limit growth and expressed concern about the alarming depletion rate of natural resources. The identified factors were related to exponential growth in population, agricultural and industrial production, overconsumption and drawdown of natural resources, and pollution. If the trends continue, the world's capacity for development would be exhausted

5 (2017): 2023–38, https://doi.org/10.1007/s10668-016-9842-3.; Stephen Wheeler, "Sustainable Urban Development: A Literature Review and Analysis," *University of California at Barkeley* (University of California, 1996), https://escholarship.org/uc/item/6mx0n01x.; Stephen M. Wheeler, "Planning for Metropolitan Sustainability," *Journal of Planning Education and Research* 20, no. 2 (2000): 133–45, https://doi.org/10.1177/0739456X0002000201.

6 Bergaglio, "The Contemporary Illusion: Population Growth and Sustainability," 2017, 2025.; Wheeler, "Sustainable Urban Development: A Literature Review and Analysis," 1996, v.

7 Lisa M.Butler Harrington, "Sustainability Theory and Conceptual Considerations: A Review of Key Ideas for Sustainability, and the Rural Context," *Papers in Applied Geography* 2, no. 4 (October 1, 2016): 365–82, https://doi.org/10.1080/23754931.2016.1239222.; Ulrich Grober, "The Discovery of Sustainability - The Geneology Of A Term," in *Theories of Sustainable Development*, ed. C. Judith Enders and Moritz. Remig (London & New York: Routledge, Taylor & Francis Group, 2015), 6–15.

8 Egon Becker, Thomas Jahn, and Immanuel Stiess, "Exploring Uncommon Ground Sustainability and the Social Sciences," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume 1 (London and New York: Routledge Taylor & Francis Group, 2005), 379–93.

9 Stephen A. Roosa, *Sustainable Development Handbook*, 2nd Ed. (Lilburn, Georgia; Boca Raton, Florida; London, England: The Farmont Press, Inc.; Taylor & Francis Ltd., 2010), 36-39.

within the next 100 years, followed by abrupt and unpredictable population and industrial capacity loss.[10]

The systems theory may prove dynamic in its ability to objectively and scientifically explain the earth's ecological health deterioration, as documented in the Club of Rome's *The Limits to Growth* report. However, research on the concept of sustainability and its evolution revealed that problems of sustainability transcended beyond ecological crisis phenomena and were inextricably linked to the problems inherent in the social structure.[11]

In other words, concerns about sustainability were not limited to coping with environmental degradation.[12] The social and economic systems, as well as the institutions and activities that comprised them, confronted sustainability challenges as they grew and evolved in increasingly unsustainable ways.The whole concept had revolved around a meeting point between the scientific evaluation of the ecosphere's crisis phenomenon and societies' continuous influence in their relations with nature.[13] Figure 1 depicts the evolution from the discourse that primarily focused on ecological issues towards the concept of SD, gathered from the literature.

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10 Donella H. Meadows et al., *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind,* (Washington, DC: Potomac Associates, 1972), 66, 126, 159-160. The report was updated in 2004 entitled *Limits to Growth – the 30-Year Update.* See:Donella Meadows, Jorgen Randers, and Dennis Meadows, *A Synopsis Limits to Growth The 30-Year Update* (United States and Canada; United Kingdom and Commonwealth; Japan; Hungary: Chealsea Green; Earthscan; Diamond, Inc; Kossoth Publishing Company, 2004) 3-24.See also the discussion in Sandy Halliday, *Sustainable Construction*, Second Ed. (New York, NY: Routledge, 2019), 9;Robert McGinnis, "Review," *Demography* 10, no. 2 (1973): 295-99, http://www.jstor.org/stable/2060820.

11 Becker, Jahn, and Stiess, "Exploring Uncommon Ground Sustainability and the Social Sciences," 2005, 382, 384-86.

12 It should be emphasised, however, that this viewpoint may conflict with the position taken by the English Nature in English Nature, *Strategic Planning and Sustainable Development*, (Drummond & Marsden, 1992), 17.

13. Becker, Jahn, and Stiess, "Exploring Uncommon Ground Sustainability and the Social Sciences,"2005, 382-86.

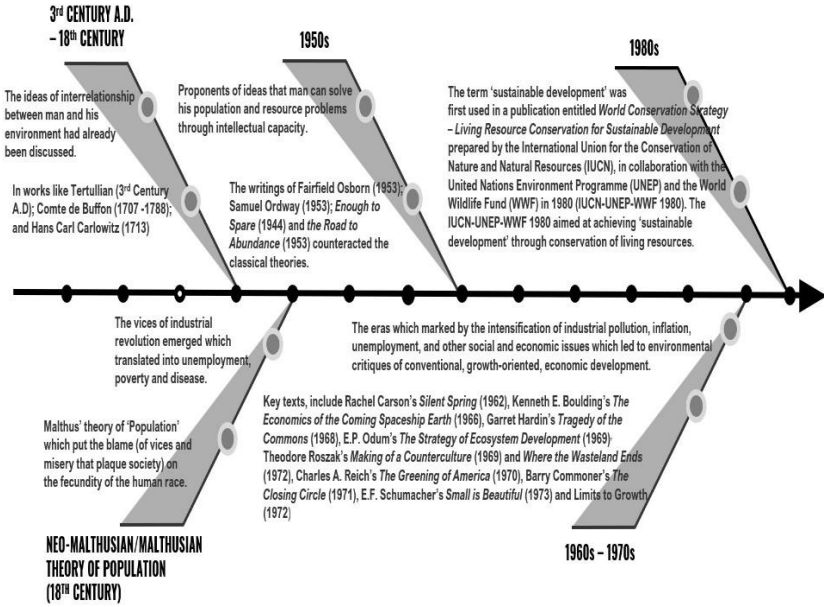


Figure 1.Notable historical and evolutionary perspectives of the concept of sustainability towards the concept of SD from literature.[14]

[14] Meadows et al., *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*,1972, 17-197; Helmut K. Buechner, "Imbalance Between Man And Environment," *Ecology* Vol. 37, no. No. 2 (n.d.): 397–98, https://www.jstor.org/stable/1933163.; Desta Mebratu, "Sustainability and Sustainable Development: Historical and Conceptual Review," *Environmental Impact Assessment Review* 18, no. 6 (1998): 493–520, https://doi.org/10.1016/S0195-9255(98)00019-5.; Sharachandra Lele, "Sustainable Development A Critical Review," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift (London and New York: Routledge Taylor and Francis Group, 2005), 165–90.; W.M. Adams, "The Origins of Sustainable Development," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume II (London and New York: Routledge Taylor and Francis Group, 2005), 69–100.; Thomas Malthus, "The Theory of Population," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume 1 S (London and New York: Routledge Taylor and Francis Group, 2005), 23–27.; Kenneth E. Boulding, "What Do We Want To Sustain? Environmentalism and Human Evaluations," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume II (Routledge Taylor and Francis

## WCED'S SD – BRIDGING 'DEVELOPMENT' AND 'SUSTAINABILITY'

The term SD (as illustrated in Figure 1 was previously used in a 1980 publication entitled *World Conservation Strategy - Living Resource Conservation for Sustainable Development*, prepared by the International Union for Conservation of Nature and Natural Resources (IUCN), in collaboration with the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) (IUCN-

Group, 2005), 154–64.; Garrett Hardin, "The Tragedy of the Commons," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume 1 (London and New York: Routledge Taylor and Francis Group, 2005), 75–88.; E.P. Odum, "The Strategy of Ecosystem Development: An Understanding of Ecological Succession Provides a Basis for Resolving Man's Conflict with Nature," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume 1 (London and New York: Routledge Taylor and Francis Group, 2005), 58–74.; E.F. Schumacher, "The Role of Economics," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume 1 (London and New York: Routledge Taylor and Francis Group, 2005), 112–20.; Michael R. Redclift, "General Introduction," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael R. Redclift, Volume 1 (London and New York: Routledge Taylor and Francis Group, 2005), 1–22.; Dan Cristian Duran et al., "The Components of Sustainable Development - A Possible Approach," *Procedia Economics and Finance* 26 (2015): 806–11, https://doi.org/10.1016/s2212-5671(15)00849-7.; Susan Baker, *Sustainable Development*, (London and New York: Routledge Taylor & Francis Group, 2006), 7-8, 18; STWR, "The Brandt Report: A Summary | Share The World's Resources (STWR)," Share: The World's Resources - Reforming the global economy, 2006, http://www.sharing.org/information-centre/reports/brandt-report-summary.; Bethany Hubbard, "The Ecologist January 1972: A Blueprint for Survival," 2012, https://theecologist.org/2012/jan/27/ecologist-january-1972-blueprint-survival.; Antonis A. Zorpas, Irene Voukkali, and Pantelitsa Loizia, "Definitions of Sustainability," in *Sustainability behind Sustainability*, ed. Antonis A. Zorpas (New York: Nova Publisher, 2014), 1–6.; International Union for the Conservation of Nature (IUCN), "Living Resource Conservation," in *Sustainability Critical Concepts in the Social Sciences*, ed. Michael Redclift, Volume 1 (London and New York: Routledge Taylor and Francis Group, 2005), 184–89.; International Union for Conservation of Nature and Natural Resources, ed. "World Conservation Strategy: Living Resource Conservation for Sustainable Development," IUCN–UNEP–WWF, 1980.

UNEP-WWF 1980).[15] The SD within the IUCN-UNEP-WWF 1980s framework was mainly to be achieved via the conservation of living resources. However, the strategy has a disadvantage in that it is primarily concerned with ecological sustainability. The connection between ecological sustainability and broader social and economic challenges was not established.[16]

The WCED's SD diverged from the IUCN-UNEP-WWF 1980s approach. The WCED recognises the interrelation between development and ecological sustainability and constructs a new development model, which links the three components, i.e., environment, economy, and social.[17] It was developed upon the understanding of interrelatedness or linkage between ecological issues with economic growth and the ecological and economic issues with social and political considerations.[18]

Apart from managing resources, the WCED's SD was predominantly concerned with addressing human needs, particularly of the impoverished. It further incorporated other values or normative principles into the formulation to overcome challenges,particularly in reconciling the conflicting demands between developed and developing countries.[19] Normative principles are loosely referred to as

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15 International Union for the Conservation of Nature (IUCN), "Living Resource Conservation," 2005, 184-89; International Union for Conservation of Nature and Natural Resources, ed. "World Conservation Strategy: Living Resource Conservation for Sustainable Development," IUCN–UNEP–WWF, 1980, IV-VII.

16 Susan Baker, *Sustainable Development*, 2nd Ed. (London and New York: Routledge Taylor & Francis Group, 2016), 22-23.

17 Baker, *Sustainable Development*,2016, 23-25.; Duran et al., "The Components of Sustainable Development - A Possible Approach," 2015, 809-10.

18 WCED, "Report of the World Commission on Environment and Development: Our Common Future," 1987, para 39-54 of Chapter 1, 36-40.

19 WCED, "Report of the World Commission on Environment and Development: Our Common Future," 1987, 5-9, 16-17, 41-59.; Brian R. Keeble, "The Brundtland Report: 'Our Common Future," *Medicine and War* 4, no. 1 (1988): 17–25, https://doi.org/10.1080/07488008808408783. See also the discussion in Geoffrey Sayre-McCord, "Normative Explanations," *Philosophical Perspectives* 6 (1992): 55, https://doi.org/10.2307/2214238.; Luca Tacconi, "Developing

moral standards that, amongst others, define and determine how individuals should interact.[20] The principles include inter-and intra-generational equity, common but differentiated responsibilities, justice, participation, and gender equality.[21]

These normative principles of SD were formalised into a global programme of action at the Conference on Environment and Development of the United Nations (UNCED), held in Rio de Janeiro, Brazil, from 3 to 14 June 1992 (1992 Rio Earth Summit),[22] with the introduction of several principles of good governance, such as the principle of subsidiarity and the precautionary principle.[23]At the 1992 Rio Earth Summit, a number of critical agreements were adopted, including the Rio Declaration, which proclaimed 27 principles of SD,[24]

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Environmental Governance Research: The Example of Forest Cover Change Studies," *Environmental Conservation* 38, no. 2 (June 2011): 234–46, https://doi.org/10.1017/S0376892911000233.; and K.N. Llewellyn, "The Normative, the Legal, and the Law-Jobs: The Problem of Juristic Method," *The Yale Law Journal* 49, no. 8 (1940): 1355–1400, https://www.jstor.org/stable/792545.

20 Baker, *Sustainable Development*, 2016, 44-45. See also: Sayre-MacCord, "Normative Explanations," 1992, 56-68.

21 Baker, *Sustainable Development*, 2016, 44-54.

22 The Summit drew the biggest number of heads of state and government ever assembled. Adopted by 178 of the UN's Member States. (United Nations, "United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, 3-14 June 1992," 1992, https://www.un.org/en/conferences/environment/rio1992.; Gregory Borne, "Agenda 21," in *Green Politics An A-Z Guide*, ed. Dustin Mulvaney and Paul Robbins (Los Angeles, London, New Delhi, Singapore, Washington DC: SAGE Publications Inc., 2011), 8–10, https://doi.org/10.4135/9781412971867.n128.; Baker, *Sustainable Development*, 2016, 141-43).

23 Baker, *Sustainable Development*, 2016, 141-142.; Baker, *Sustainable Development*, 2006, 55-56. See also: Erling Holden, Kristin Linnerud, and David Banister, "Sustainable Development: Our Common Future Revisited," *Global Environmental Change* 26, no. 1 (2014): 130–39, https://doi.org/10.1016/j.gloenvcha.2014.04.006.

24 The 27 Principles of SD in the Rio Declaration encompass concepts that include (i) humans are at the core of SD problems, and environmental protection must be treated as an integral component of the development process, not as a separate entity. (Principle 1 and Principle 4); the sovereignty of a State is recognised; however, when it comes to

Agenda 21,[25] and three other framework conventions.[26] These SD normative principles play essential roles in articulating specified states' obligations as well as rights and serve as guidance in devising relevant rules and regulations concerning the environment internationally and at the national level.The principles have widened the scope of environmental responsibilities, transcending boundaries and generations.[27] In other words, the WCED's SD and its underlying

developmental impacts, the porous nature of national boundaries must be recognised, and appropriate demographic policies should be in place (Principles 2, 8, 14, 18 and 19); the Principle of Intra and Inter-Generational Equity must be fulfilled when it comes to developmental and environmental needs (Principle 3); poverty eradication is recognised as an indispensable requirement for SD (Principle 5); special priority is to be given to special situation and needs of developing countries (Principle 6); promotion of co-operation and transfer of technologies (Principle 9); acknowledging the importance of participation of all concerned citizens and the importance of specific groups (Principles 10, 20, 21 and 22); promotion of peace, justice and avoidance of conflict (Principles 23, 24, 25 and 26); the Principle of Common but Differentiated Responsibilities is recognised acknowledging the disparate contributions by each State to global environmental degradation (Principle 7); the introduction of the Precautionary Approach Principle to prevent environmental degradation (Principle 15); and the introduction of Polluter Pays Principle as an economic preventive measure (Principle 16). The Rio Declaration further outlines the requirements for effective legal measures concerning environmental (Principles 11, 13 and 17). (Biosafety Unit, "Rio Declaration on Environment and Development," (Secretariat of the Convention on Biological Diversity, 2006), https://www.cbd.int/doc/ref/rio-declaration.shtml.)

[25] Agenda 21 is divided into 40 chapters that contain action plans in a variety of areas. Through Local Agenda 21, it emphasises the need of bottom-up participation, particularly community-based approaches. National strategies for SD are encouraged to be developed taking into account the country's different sectoral economic, social, and environmental policies and programmes. (Baker, *Sustainable Development*, 2016, 142-43.)

[26] They are the UN Framework Convention on Climate Change (UN FCCC), the UN Convention on Biological Diversity (CBD) and the Forest Principles. (Baker, *Sustainable Development*, 2016, 142-43; Jan-Gustav Strandenaes, "Sustainable Development Governance towards Rio+20: Framing the Debate," *Stakeholder Forum* (London, 2011), 1-12).

[27] Baker, *Sustainable Development*, 2016, 135-165; Baker, *Sustainable Development*, 2006, 19-25, 51-79.

principles paved the way for a more inclusive global SD governance system.[28]

In this regard, the United Nations (UN) may be said to have played a critical role in shaping a global governance framework to promote SD. Over 30 specialised UN organisations and programmes are now involved in the global promotion of SD. This SD global system of governance has resulted in various international environmental regimes which deal with a wide range of environmental issues, including biodiversity loss, hazardous waste, climate change, and ozone depletion, such as the UNFCCC(the United Nations Framework Convention on Climate Change) to address climate change and CBD (the Convention on Biological Diversity) to address biodiversity loss.[29]

These international environmental regimes are crucial from a legal standpoint since they are the sources of international environmental law. International law can be grouped into two categories: 'hard law' and 'soft law'. Any legal rule or principle contained in the former is binding on a state's relation with other states.[30] Treaties (which may include conventions or accords sometimes known as multilateral environmental agreements (MEAs),[31] customs, generally acknowledged concepts, and judicial decisions are examples of 'hard laws'. On the other hand, 'soft laws'refer to pronouncements, principles, guidelines, and norms that are non-binding and discretionary.[32] The use of terminologies, which include

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28 Baker, *Sustainable Development*, 2006, 71-72; Chiheb Khemis et al., "Governance for Sustainable Development in the Arctic," 2016, 9-10.,https://www.researchgate.net/publication/322037265.

29 Baker, *Sustainable Development*, 2016, 136-38.

30 Felixia Maxim, "Hard Law versus Soft Law in International Law," *Conferinta International de Drept, Studii Europene Si Relatii Internationale*, 2020, 113–26, 115.

31 See definition of 'treaty' in Article 2 of the Vienna Convention on the Law of Treaties 1969 (United Nations, "Vienna Convention on the Law of Treaties (with Annex)," 1969, https://treaties.un.org/doc/publication/unts/volume 1155/volume-1155-i-18232-english.pdf.).

32 I. Ghulam Khan, W. Wan Dahalan, and Z. Nopiah, "An Analysis of International Conventions Related with Solid Waste Management and the Position in Malaysia," *MLJ* 5 (2017): i.; Maxim, "Hard Law versus Soft Law in International Law."113-22; Kenneth W. Abbott and Duncan Snidal, "Hard and Soft Law in International Governance," *International*

'ratification', 'approval', 'accession', and 'acceptance',typically reflects the consent of a state to be bound by a treaty.[33]

The development of these international environmental regimes, their institutional frameworks, MEAs, principles and standards, and their conventions and protocols, amongst others, has led to the formation of what is referred to as 'global environmental governance'.[34] Despite this, a state's sovereignty remains with the state. The objective was to foster a close partnership with other states to address collective environmental challenges inside and outside state boundaries.[35]

Since the first international environmental conference in Stockholm in early June 1972, also known as the Stockholm Declaration, these international environmental regimes have passed numerous milestones. The global community is currently implementing'the 2030 Agenda' for SD, adopted in the 2015 UN Special Meeting.[36]Figure 2 depicts the key milestones and agendas of the global environmental governance system since the WCED's SD.

*Organization* 54, no. 3 (2000): 421–56, https://www.jstor.org/stable/2601340.

33 Article 2 of the Vienna Convention on the Law of Treaties 1969 (United Nations, "Vienna Convention on the Law of Treaties (with Annex)," 1969).

34 Baker, *Sustainable Development*, 2016, 135-39; Baker, *Sustainable Development*, 2006, 52-54.

35 Baker, *Sustainable Development*, 2016, 137; Baker, *Sustainable Development*, 53-54.

36 United Nations, "About the Sustainable Development Goals - United Nations Sustainable Development," Sustainable Development Goals, 2015, https://www.un.org/sustainabledevelopment/sustainable-development-goals/.; United Nations, "Transforming Our World: The 2030 Agenda for Sustainable Development," 2015, https://doi.org/10.1891/9780826190123.ap02.

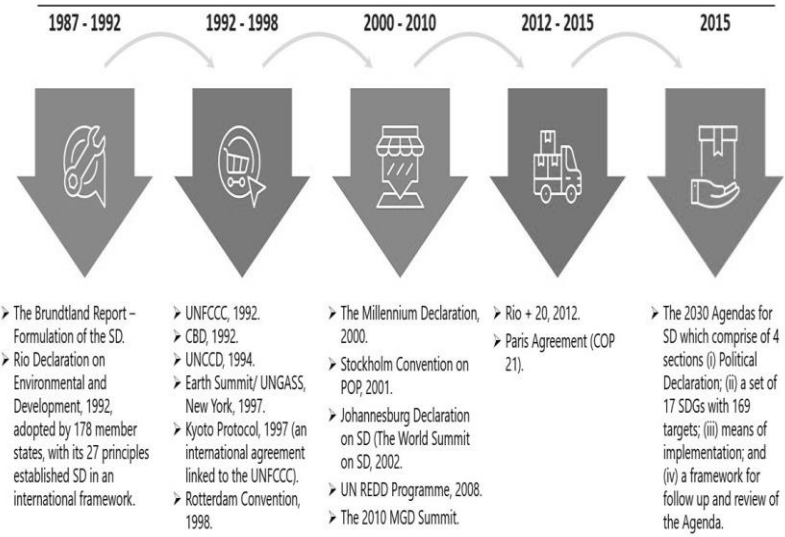


Figure 2.A snapshot of key milestones and agendas of the Global Environmental Governance System since the WCED's SDwas gathered from the official websites of the United Nations'respective summits, conventions, and protocols.[37]

[37] United Nations, "Declaration of the United Nations Conference on the Human Environment," *United Nations Environment Programme*, no. June (1972): 1–4.; WCED, "Report of the World Commission on Environment and Development: Our Common Future," 1987, 1-300.; United Nations Sustainable Development, "United Nations Conference on Environment & Development – Agenda 21," 1992, 1-351.; United Nations, "UNGASS -19: Sustainable Development Knowledge Platform," 1997, https://sustainabledevelopment.un.org/milestones/gass19.; United Nations, "What Is the Kyoto Protocol? | UNFCCC," 1997, https://unfccc.int/kyoto_protocol.; Biosafety Unit, "Rio Declaration on Environment and Development," 2006; United Nations, "United Nations Treaty Collection," Treaty Reference Guide, 2014, https://treaties.un.org/.; United Nations, "Plan of Implementation of the World Summit on Sustainable Development," *Johannesburg Plan of Implementation (JPOI)*, 2002.; United Nations, "The Future We Want: Outcome Document of the United Nations Conference on Sustainable Development," *United Nations*, 2012, 41, https://sustainabledevelopment.un.org/content/documents/733FutureWe

## A HEURISTIC APPROACH TO THE PHILOSOPHICAL FOUNDATION: ANTHROPOCENTRIC *vs* ECOCENTRIC

The new paradigm (of SD) sought to be achieved by Brundtland's formulation was not spared from criticisms. Among the common criticisms levied at Brundtland's formulation of SD is the ambiguity or vagueness of the concept which leads to various interpretations and debates, and the other concern is its proclivity for 'anthropocentrism'. While critics of its vagueness are deemed regressive in character,[38]

Want.pdf.; United Nations, "United Nations Conference on Sustainable Development, Rio+20: Sustainable Development Knowledge Platform," 2012, https://sustainabledevelopment.un.org/rio20.; United Nations, "Addis Ababa Action Agenda of the Third International Conference on Financing for Development" (Addis Ababa, 2015), https://www.un.org/esa/ffd/wp-content/uploads/2015/08/AAAA_Outcome.pdf.; United Nations, "Conference of the Parties Twenty-First Session (COP 21)," 2015.; United Nations, "OHCHR | United Nations Millennium Declaration," accessed October 23, 2019, https://www.ohchr.org/EN/ProfessionalInterest/Pages/Millennium.aspx.; United Nations, "Sustainable Development Goals Report 2019," accessed October 23, 2019, https://unstats.un.org/sdgs/report/2019/the-sustainable-development-goals-report-2019.pdf.; UNFCCC, "Climate Action | UNFCCC," 2019, https://unfccc.int/climate-action.; United Nations, "UNFCCC Sites and Platforms," accessed October 23, 2019, https://unfccc.int/.

[38] The objections against the paradigm's ambiguity were mostly based on the fact that the two aspects, "sustainable" and "development", cannot be merged to achieve a unified goal. These varying conceptions about what SD should signify are a reflection of divergent ideas and understanding about nature held in various nations, civilizations, and historical circumstances, as well as personal views. The realisation of inevitable complexities due to these widely differing values, backgrounds, and concerns with diverse obligations on a national and international level, as well as the artificial divides between East and West and between industrialised and developing countries, is prevalent throughout the (Brundtland) report. (See for example: Boulding, "What Do We Want To Sustain? Environmentalism and Human Evaluations," 2005, 154-64; Camaren Peter and Mark Swilling, "Linking Complexity and Sustainability Theories: Implications for Modeling Sustainability Transitions," *Sustainability (Switzerland)* 6, no. 3 (2014): 1594–1622, https://doi.org/10.3390/su6031594.; Anke Brons and Peter Oosterveer, "Making Sense of Sustainability: A Practice Theories Approach to

critics of its anthropocentrism tendency are worth investigating to comprehend the potential repercussions.

Anthropocentrism has been observed to refer to the belief that importance is placed on humans and that all other beings exist to serve human interests.[39] In contrast to anthropocentrism, ecocentrism believes that nature has 'intrinsic value' and seeks to establish a mutually beneficial relationship between humans and the environment.[40] These two opposing viewpoints have been seen to have significant repercussions, particularly in policy formulation and development.[41] In this regard, it is apt to explore the concept and formulation set out to evaluate the varying approaches and their impacts towards nature within the context of these philosophical foundations of anthropocentric and ecocentric.[42]

The variety of policy options connected with SD is best represented by a ladder (as shown in Table 1) which was first constructed by Baker et al. in 1997.[43] The ladder appraises policy decisions in the continuum of four models of SD, between 'ideal model', 'strong sustainable development', 'weak sustainable development', and 'pollution control'. It offers a valuable heuristic instrument to recognise which rung of the continuum a policy decision stands. The nine parameters investigated,i.e., (i) the approach on the normative principles; (ii) the type of development; (iii) the approach towards nature; (iv) the economic consideration; (v) the extent of

Buying Food," *Sustainability (Switzerland)* 9, no. 3 (March 21, 2017), https://doi.org/10.3390/su9030467.; Duran et al., "The Components of Sustainable Development – A Possible Approach," 2015, 806-11). The other critics mainly commented on lexical semantics. (See for example: Lele, "Sustainable Development A Critical Review," 2005, 165-90).

39 This has been said to be the genesis of the term in environmental ethics. (Helen Kopnina et al., "Anthropocentrism: More than Just a Misunderstood Problem," *Journal of Agricultural and Environmental Ethics* 31, no. 1 (February 1, 2018): 109–27, https://doi.org/10.1007/s10806-018-9711-1.).

40 Kopnina et al., "Anthropocentrism: More than Just a Misunderstood Problem," 2018, 1.

41 Baker, *Sustainable Development*, 2016, 37-38; Baker, *Sustainable Development*,2006,28.

42 Baker, *Sustainable Development*, 2016, 37-44; Baker, *Sustainable Development*,2006, 28-29.

43 Baker, *Sustainable Development*, 2016, 37.

implementation of good governance; (vi) the use of technology; (vii) how policy and environment are integrated; (viii) how SD is integrated into policy tools; and (ix) the extent of the relationship between civil society and the state in the promotion of SD, would frame a policy decision into a specific category as either promoting a strong SD, a weak SD which is acceptable to the promotion of SD or a mere pollution control that ought to be rejected.[44] The ladder, as formulated by Baker, is reproduced (with adaptation) in Table 1.[45] The matrix of traits and approaches in each model alongside the continuum of ecocentric to anthropocentric is synthesised in Table 2.[46]

[44] Baker, *Sustainable Development*,2006, 28-29.

[45] Baker, *Sustainable Development*, 2006, 30-31; Baker, *Sustainable Development*, 2016, 38-39.

[46] Baker, *Sustainable Development*, 2006, 32-35.

**Table 1: The Ladder of SD**

| MODEL OF SUSTAINABLE DEVELOPMENT | NORMATIVE PRINCIPLES | TYPE OF DEVELOPMENT | NATURE | SPATIAL FOCUS | GOVERNANCE | TECHNOLOGY | POLICY INTEGRATION | POLICY TOOLS | CIVIL SOCIETY/STATE RELATIONSHIP | PHILOSOPHY |
|---|---|---|---|---|---|---|---|---|---|---|
| IDEAL MODEL | Principles take precedence over pragmatic considerations (participation; equity, gender equality, justice: common but differentiated responsibilities) | Right livelihood; meeting needs not wants; biophysical/planetary limits guide development | Nature has intrinsic value; no substitution allowed; strict limits on resource use, aided by population reductions | Bioregionalism; extensive local self sufficiency | Decentralisation of political, legal, social and economic institutions | Labour-intensive appropriate, Green Technology; new approach to valuing work and well-being | Environmental policy integration; principled priority of environment | Internationalisation of sustainable development norms through ongoing socialisation, reducing need for tools | Bottom-up community structures and control; equitable participation; deliberative democracy | Ecocentric |
| STRONG SUSTAINABLE DEVELOPMENT | Principles enter into international law and governance | Changes in patterns and levels of consumption; shift from growth to non-material aspects of development; necessary development in Third World | Maintenance of critical natural capital and biodiversity | Heightened local economic self sufficiency, promoted in the context of global markets; green and fair trade | Partnership and shared responsibility across multi-levels of governance (international, national, regional and local); use of good governance principles | Ecological modernization of production; mixed labour and capital intensive technology | Integration of environmental considerations at sector level; green planning and design | Sustainable development indicators; wide range of policy tools; green accounting | Democratic participation; open dialogue to envisage alternative futures | |
| WEAK SUSTAINABLE DEVELOPMENT | Declaratory commitment to SD principles stronger than practice | Decoupling; reuse, recycling and repair of goods; product life-cycle management | Substitution of natural capital with human capital; harvesting of biodiversity resources | Initial moves to local economy; minor initiatives to alleviate power of global markets | Some institutional reform and innovation; move to global regulation | End-of-pipe technical solutions; mixed labour and capital intensive technology | Addressing pollution at source; some policy co-ordination across sectors | Environmental and SD indicators; market-led policy tools; economic valuing/pricing | Top-down initiatives; limited state/civil society dialogue; elite participation | |
| POLLUTION CONTROL | Pragmatic, not principled approach | Exponential, market-led growth | Resource exploitation; marketisation and further closure of the commons; nature as use-value | Globalization; shift of production to less regulated locations | 'Command-and-control' state-led regulation of pollution | Capital intensive technology; progressive automation | 'End-of-pipe' approach to pollution management | Conventional accounting | Dialogue between state and economic interests | Anthropocentric |

*Source*: Adapted from Baker (2016).[47]

47 Baker, *Sustainable Development*, 2016, 38-39.

**Table 2:Synthesis of the Relevant Matrix of Traits and Approaches**

| APPROACHES | POLICY IMPERATIVES |
|---|---|
| **Ideal Model** | • This model focuses on structurally reshaping society, the economy, and political systems.<br>• Some of the proponents of this model reject Brundtland's formulation of SD. The SD formulation is altered to reflect a more radical, socialist perspective.<br>• For others, Brundtland's formulation is accepted with severe restraints on both development and resource consumption.<br>• The model concentrates on the non-interference and coexistence of human life and nature. |
| **Strong SD** | • Emphasis is placed on environmental protection as a precondition for economic development.<br>• Total preservation of 'critical' natural capital and does not consider any technological substitution in this respect. An approach different from the 'weak' form of SD.<br>• In tandem with the normative traits of 'precautionary principle'.<br>• Promoting this type of SD necessitates a combination of solid-state intervention and governance.<br>• Consumption patterns must also be altered through the collective involvement of consumers, economic interests, and local communities.<br>• Focus only on necessary development, and growth is only permitted under certain limited conditions. |
| **Weak SD** | • The environment is regarded as a quantifiable resource.<br>• The purpose of policies is to promote economic growth.<br>• Utilising the accounting principle, the drawdown of natural resources will be permitted if the gains (in using the natural resources) outweigh the losses.<br>• Weak sustainability presupposes near-total technological substitutability. |

| | |
|---|---|
| **Pollution Control** | ▪ This model emphasises the human intellectual capacity to innovate and solve any arising problems relating to the environment.<br>▪ Believes that environmental protection should neither limit development nor should it becomes a main priority. The pollution control policies are perceived to be sufficient to address potential environmental problems.<br>▪ However, the model is manipulable and cannot control, for example, pollution displacement activity. |

*Source*: Adapted from Baker (2016)[48]

The varying ideas and debates on SD agendas are illuminated by looking into the ladder of SD and the relevant matrix of traits and approaches. Depending on the policy imperatives, international and national SD agendas should occupy the middle ground of the spectrum as either a 'weak' or a 'strong' SD model. However, any policy measure that favours a 'weak' SD model must be accompanied by the recognition that it cannot be sustained permanently, as it allows for the depletion of natural resources to maintain its output. As a matter of course, a strong SD model ought to be targeted and achieved. Any SD project must be rejected at both extremes of either the 'ideal' or 'pollution control' models.[49]

## SUSTAINABILITY AND SD IN BUILT ENVIRONMENT

The discourse over the WCED's SD possible proclivity for anthropocentrism and the synthesis of the traits and approaches in each SD model and policy imperatives of the opposing continuum (between anthropocentrism and ecocentrism) are highly pertinent in the built environment in particular when the matter is approached in the context of the new geological epoch of the Anthropocene[50] which points to

48 Baker, *Sustainable Development*, 2016, 40-44.

49 Baker, *Sustainable Development*, 2006, 35.

50 Will Steffen et al., "Planetary Boundaries : Guiding Changing Planet," *Science* 347, no. 6223 (2015): 1–10, https://doi.org/10.1126/science.1259855.; Fernando Jaramillo and Georgia Destouni, "Comment on 'Planetary Boundaries: Guiding Human Development on a Changing Planet,'" *Science* 348, no. 6240 (June 12, 2015): 1217–c, https://doi.org/10.1126/science.aaa9629.; Dieter Gerten et

human activities as the primary cause of global environmental change.[51]

As the name implies, the built environment is indeed anthropocentric in form and structure, devised by humans for human needs.[52] This anthropogenic interference, notably building and construction operations, either has a positive or negative impact on the overall quality of the environment, both built and natural, as well as human-environment relations. However, the negative impacts, are considerably prevalent.

Apart from the resource and environmental concerns that surround the building industry, ensuring that the built environment is safe and enjoyable for humans is viewed as a critical productivity issue. It had been reported that if the current trends continue, the built environment will damage or harm natural habitats and animals on more than 70% of the earth's land surface by 2032, owing primarily to population growth, economic activity, and urbanisation.[53] In other words, these are the underlying causes of the built environment's unsustainable state. These had affected negatively, not just towards the environment or natural world, but also transcend to encompass social issues,as depicted in Table 3.[54]

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al., "Towards a Revised Planetary Boundary for Consumptive Freshwater Use: Role of Environmental Flow Requirements," *Current Opinion in Environmental Sustainability*, December 2013, https://doi.org/10.1016/j.cosust.2013.11.001.; Linn M. Persson et al., "Confronting Unknown Planetary Boundary Threats from Chemical Pollution," *Environmental Science and Technology* 47, no. 22 (November 19, 2013): 12619–22, https://doi.org/10.1021/es402501c.; Georgina M. Mace et al., "Approaches to Defining a Planetary Boundary for Biodiversity," *Global Environmental Change* 28, no. 1 (2014): 289–97, https://doi.org/10.1016/j.gloenvcha.2014.07.009.

51 Johan Rockström et al., "A Safe Operating Space for Humanity," *Nature* 461 (2009): 472–75, https://doi.org/10.1038/461472a.

52 Tom J. Bartuska, "The Built Environment: Definition and Scope," in *The Built Environment A Collaborative Inquiry into Design and Planning*, ed. Wendy R. McClure and Tom J. Bartuska, 2nd Edn (New Jersey: John Wiley & Sons, Inc., 2007), 404, 3-14.

53 UNEP, "Sustainable Building and Construction," *UNEP Industry and Environment*, No. 2-3 (2003), 5-8.

54 UNEP, "Sustainable Building and Construction," 2003, 5-8.

**Table 3:Building Industry Main Environmental and Social Impacts**

| Raw materials consumption; exhaustion of related resources |
|---|
| • Changes in land usage, including the destruction of existing vegetation |
| • Noise pollution |
| • Energy consumption and greenhouse gas emissions |
| • Indoor and outdoor pollutants |
| • Visual deterioration |
| • Water consumption and wastewater generation |
| • Transportation requirements |
| • Local and worldwide consequences of building material transport |
| • Production of waste |
| • Corruption |
| • Disruption of communities, for example, through erroneous or inappropriate design and material selection |
| • Health hazard on construction sites and among building occupants |

*Source*: Adapted from UNEP (2003).[55]

The discussion on sustainability within the confines of the built environment in the current geological epoch of the Anthropocene further reveals a catch-22 situation concerning anthropogenic interference. This anthropogenic interference can be broadly categorised into primary and secondary interferences. The primary interference refers to situations, such as the destruction of forests for agricultural development, urbanisation on previously agricultural land,

55 UNEP, "Sustainable Building and Construction," 2003, 6.

or competition for urban space.[56] The secondary interference refers to mitigation efforts, such as building large-scale renewable energy plants or resettlement. Although the aim of building large-scale renewable energy plants, for example, is to mitigate the adverse effects of climate change,[57] this measure requires massive land clearance. Thus, it further, directly or indirectly, increases pressure on land as a resource instead of conserving it.[58]

Human activities are indeed the primary cause of global environmental change. The effect of the primary anthropogenic interferences was sought to be alleviated by implementing secondary interference. Unfortunately, this secondary interference triggered another dispute, virtually replicating the effect of the initial anthropogenic interference. Again, due to the scarcity of land as a resource, higher density construction is favoured over lower density construction. However, density would indirectly harm the quality of life. Human living conditions may deteriorate unless density is compensated for by organic and sustainable design.[59] Therefore, there is a thin line between these primary and secondary anthropogenic interfering factors that the relevant stakeholders and policymakers should carefully and cautiously tread.

## SDGS AND GREEN BUILDING

The construction industry seems to have taken heed of precipitate alterations in the natural world and ecosystemas well as impacts on humanity, both directly and indirectly. The advent of sustainable construction and green building principles is the industry's ethical response towards global environmental problems, a subset of the global agenda for SD and a natural out growth of global environmental governance.

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56 Rebecca Froese and Janpeter Schilling, "The Nexus of Climate Change, Land Use, and Conflicts," *Current Climate Change Reports* 5, no. 1 (2019): 24–35, https://doi.org/10.1007/s40641-019-00122-1., 24.

57 Froese and Schilling, "The Nexus of Climate Change, Land Use, and Conflicts," 2019, 24.

58 Froese and Schilling, "The Nexus of Climate Change, Land Use, and Conflicts," 2019, 24.

59 UNEP, "Sustainable Building and Construction," 2003, 6.

Sustainable construction tackles the ecological, social, and economic implications of a building in relation to its community.[60] Green buildings have been defined as "healthy structures designed and constructed with resource efficiency and ecological principles in mind".[61] Green building, thus, refers to the quality and attributes of the actual structure constructed utilising sustainable construction concepts and practices.[62] For example, the life-cycle approach incorporated into the Principles of Sustainable Construction (introduced by Task Group 16 of the Conseil International du Bâtiment (CIB), could contribute towards establishing and maintaining a healthful built environment with efficient management of natural resources and environmentally friendly design.[63] The principles include measures to minimise resource consumption, reuse resources, emphasis on recyclable resources, nature protection, toxics elimination, life-cycle costing, and prioritising quality.[64]

The CIB Task 16 Group further proposed a framework for sustainable constructionto elucidate the potential contribution of the built environment towards SD achievement.[65] The framework illustrates the application of the Principles of Sustainable Construction in every phase of the building life-cycle, from the planning stage to the deconstruction (demolition) stage.The four primary and targeted resources identified in the framework are (i) land, (ii) materials, (iii) water, and (iv) energy. The principles are to be applied further when assessing other components and resources required to construct and

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60 Charles J. Kibert, *Sustainable Construction Green Building Design and Delivery*, 4th Edn (New Jersey: John Wiley & Sons, Inc., 2016), 10.

61 Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 11. See also: Darren A. Prum, "Green Buildings, High Performance Buildings, and Sustainable Construction: Does It Really Matter What We Call Them?," *Villanova Environmental Law Journal* XXI, no. Number 1 (2010): 1-33.

62 Kibert,*Sustainable Construction Green Building Design and Delivery*, 2016, 11.

63 Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 10.

64 Kibert,*Sustainable Construction Green Building Design and Delivery*, 2016, 10.

65 Ibid.

manage the built environment across its complete life-cycle, as shown in Figure 3.[66]

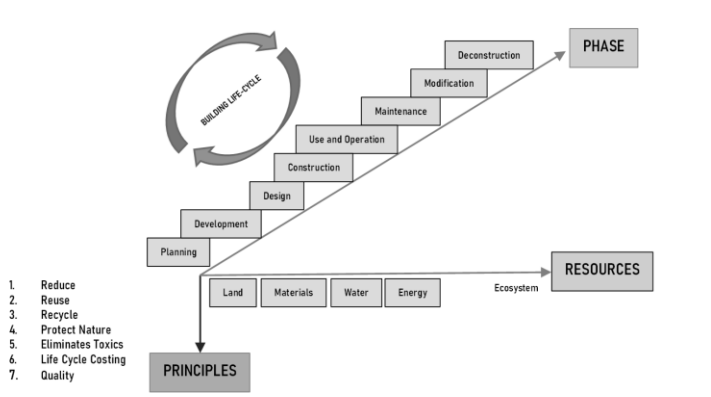


Figure 3:Framework for Sustainable Construction as proposed by the CIB Task 16 Group[67]

Meanwhile,the 17 goals of the 2030 Agenda are broad in scope, whereby several of them can and have been considerably aided by green buildings. The following discussions, which were based on literature, emphasise this point. The World Green Building Council's (WGBC) infographic in Figure 4 illustrates the potential contribution of green buildings in achieving several of these SDGs.


Figure 4: Potential contribution of green buildings in achieving several SDGs.[68]

66 Ibid.

67 Ibid.

68 World Green Building Council, "Green Building & The Sustainable Development Goals," Green Building, 2017,

Green building features like indoor environmental quality,which include measures to ensure optimum indoor air quality, thermal comfort, mould prevention, indoor carbon dioxide monitoring, lighting, visual and acoustic comfort, have shown positive impacts on the health and well-being of building occupants.[69] Therefore, potentially contributing to Goal 3 of the 2030 Agenda. Meanwhile, energy savings are frequently mentioned as one of the most talked-about benefits of green buildings that can help achieve Goal 7.[70]

Statistics showed that these high-performance green buildings use significantly less energy.[71] For example, in 2000, a significant reduction in energy consumption was seen in high-performance green buildings in the United States from the average energy consumption reading in conventional office buildings. The energy consumption reading depleted to approach 100 kWh/m2/yr (33,000 BTU/ft2/yr.)from the average of more than 300 kilowatt-hours per square metre per year (kWh/m2/yr) or 100,000 BTU/square foot per

https://www.worldgbc.org/green-building-sustainable-development-goals.

69 Sam Kubba, "Indoor Environmental Quality," in *Handbook of Green Building Design and Construction LEED, BREEAM, and Green Globes*, 2nd Ed. (Oxford, United Kingdom; Cambridge, MA: Elsevier; Butterworth-Heinemann, 2017), 353–412.; World Green Building Council, "Better Places for People | World Green Building Council," World Green Building Council 2016-2019, 2019, https://www.worldgbc.org/better-places-people.; Dominika Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," Eco Business, 2017, https://www.eco-business.com/opinion/how-green-buildings-can-help-achieve-the-sustainable-development-goals/.; Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 460-463.

70 Sam Kubba, "Impact of Energy and Atmosphere," in *Handbook of Green Building Design and Construction LEED, BREEAM, and Green Globes*, 2nd Ed. (Oxford, United Kingdom; Cambridge, MA: Elsevier; Butterworth-Heinemann, 2017), 443–571.; Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," 2017.; Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 269-323.

71 Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 6-7.

year (BTU/ft2/yr).[72] The high-performance buildings in Germany demonstrate even more impressive energy profiles, averaging 50 kWh/m2/yr (17,000 BTU/ft2/yr.).[73] The emerging concept of net-zero energy (NZE), which emphasises passive design strategies, allows buildings to generate more energy from renewable resources, and thus reduces the consumption rate from non-renewable resources.This reduced energy consumption is aligned with the 2030 Agenda's Goal 7, which aims for affordable and clean energy. It also aids in the reduction of the carbon foot print towards achieving Goal 13.[74]

The domino effect of green building demand could also be a catalyst in achieving the 2030 Agenda's Goal 8. The growing demand for green buildings would consequently be translated into demands in the workforce needed to build them.[75] Green building's life-cycle with its specific features and requirements at every phase would create a wide range of job descriptions, as well as the emergence of niche areas of expertise and supply chain.[76] It further leads to innovation, which supports Goal 9 of the 2030 Agenda, to ensure maximum reduction in

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72 Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 6-7.

73 Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 6-7.

74 Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," 2017; Dominika Czerwinska, "Green Building: Improving the Lives of Billions by Helping to Achieve the UN Sustainable Development Goals," World Green Building Council, 2017, https://www.worldgbc.org/news-media/green-building-improving-lives-billions-helping-achieve-un-sustainable-development-goals.

75 Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," 2017; Czerwinska, "Green Building: Improving the Lives of Billions by Helping to Achieve the UN Sustainable Development Goals," 2017.

76 Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," 2017; Czerwinska, "Green Building: Improving the Lives of Billions by Helping to Achieve the UN Sustainable Development Goals," 2017.

natural resources consumption and proper management of the impact of resource consumption on ecological systems.[77]

The synergy between building location and commuting energy consumption has been established.[78] Therefore, to significantly reduce total energy consumption, transportation energy must be reduced alongside building energy consumption. Strategic building location helps reduce energy consumption and can also save daily commuting costs.[79] This aspect has been one of the requirements in designing and constructing green buildings under the rubric of site planning and management, thus, in tandem with Goal 11 of the 2030 Agenda.

The 2030 Agenda's Goal 12 addresses responsible consumption and production. This aspect is related to the CIB's Principles of Sustainable Construction, as previously discussed. The term *"closed-loop"* refers to a concept in sustainable construction that describes a method of reusing and recycling materials rather than discarding them at the end of a product's or building's life cycle as waste.[80] Selection of materials, their recyclability, and their ability to be reused are critical aspects in the framework of sustainable construction. Further, it is an integral part of the green building delivery system to evaluate the life-cycle impacts of manufactured products.[81]These life-cycle impacts, which include evaluations on energy consumption as well as carbon emissions associated with resource extraction, product manufacturing, transportation, products installation during construction, during

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77 Global Commission on the Economy and Climate, "Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action In Urgent Times," 2018, NCE 2018 (newclimateeconomy.report).

78 Kibert, *Sustainable Construction Green Building Design and Delivery*, 2016, 7, 270-71.

79 Kibert, *Sustainable Construction Green Building Design and Delivery*,7, 414-19.

80 Kibert, *Sustainable Construction Green Building Design and Delivery*,12, 371, 374.;Sam Kubba, "Green Building Materials and Products," in *Handbook of Green Building Design and Construction LEED, BREEAM, and Green Globes*, 2nd Ed. (Oxford, United Kingdom; Cambridge, MA: Elsevier; Butterworth-Heinemann, 2017), 257–351., 313-316.

81 Kibert, *Sustainable Construction Green Building Design and Delivery*,5-9, 371, 374-78.; Kubba, "Green Materials and Products," 346.

building operation, and demolition or disposal impacts,[82] are known as *'circular principles'*, as depicted by the WGBC in the infographic (Figure 4).

The 2030 Agenda's Goal 13 aims to address the impacts of climate change. Accordingly, it is a crucial goal in green building and sustainable construction to significantly reduce built-environment energy consumption and its associated carbon footprint. Amongst the in-built strategies in green building and sustainable construction that support the reductionof the carbon footprint of the built environment are: (1) significantly lower energy consumption; (2) converting to renewable sources of energy; (3) focusing on compact types of development; (4) transitioning to mass transit; (5) constructing structures for long-term use and adaptation; (6) natural system restoration; (7) devising low-energy hydrologic systems for the built environment; (8) designing buildings with viability to repurpose the materials upon deconstruction; (9) deciding on materials based on their recycling capabilities; and (10) building assessment systems criteria must include building carbon footprint.[83]

Another goal that the industry can positively contribute is Goal 15 through the adoption of the concept of 'sustainable land use'. Strategies include minimising development on previously undeveloped, natural or agricultural land or greenfield and repurposing damaged land or brownfield lands and blighted urban areas or grayfield lands.The long-term benefits of these measures would include land protection and stewardship and economic and social revitalisation in impoverished communities.[84]

Besides materials, energy, and land, another resource critical in the creation and operation of a building is water. Protecting the existing groundwater and surface water supplies is becoming increasingly important. Green building is advantageous in this regard as one of its

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82 Kibert, *Sustainable Construction Green Building Design and Delivery*,5-9, 371, 378-80.

83 Kibert, *Sustainable Construction Green Building Design and Delivery*,7-8, 418-19; The Guardian, "What Are CO2e and Global Warming Potential (GWP)? | Environment | The Guardian," 2016, https://www.theguardian.com/environment/2011/apr/27/co2e-global-warming-potential.

84 Kibert, *Sustainable Construction Green Building Design and Delivery*,2016, 12, 241-43.

key elements is its water-saving strategy. It is part of green building requirements to incorporate efficient water and plumbing strategies, water metering and leak detection system, rainwater harvesting and utilisation system, and greywater recycling. Apart from that, and acknowledging that wetlands and other features are key elements of existing ecosystems,protecting them (from the impacts of construction) and maintaining as much as possible the natural hydroperiod of the site is another key feature integrated into green building construction.[85]

Finally, Goal 17 of the 2030 Agenda is'partnership for the goals'. Previously, the industry had been observed to be relatively poor in pursuing and establishing collaborative efforts in addressing climate change challenges.[86] However, in 2015, the WGBC, UNEP, and numerous other organisations collaborated to hold the inaugural *"Buildings Day"* as part of the official COP21 Agenda[87] and launched the Global Alliance for Buildings and Construction.[88]

## ANALYSIS AND CONCLUSION

As evident from literature, sustainability is an evolving concept that, by its very nature, is incapable of being crystallised into one consistent and binding definition. However, it will continue to be an important

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85 Sam Kubba, "Water Efficiency and Sanitary Waste," in *Handbook of Green Building Design and Construction LEED, BREEAM, and Green Globes*, 2nd Ed. (Oxford, United Kingdom; Cambridge, MA: Elsevier; Butterworth-Heinemann, 2017), 413–41.; Kibert, *Sustainable Construction Green Building Design and Delivery,2016*, 13, 238-39.

86 Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," 2017; Czerwinska, "Green Building: Improving the Lives of Billions by Helping to Achieve the UN Sustainable Development Goals," 2017.

87 COP 21 is an acronym to the twenty-first session of the Conference of the Parties (COP) held in Paris on 30 November to 11 December 2015 (United Nations, "Conference of the Parties Twenty-First Session (COP 21)," 2015).

88 Global Alliance for Buildings and Construction, "History | GlobalABC," 2022, https://globalabc.org/about/history-timeline.; Czerwinska, "How Green Buildings Can Help Achieve the Sustainable Development Goals | Opinion | Eco-Business | Asia Pacific," 2017; Czerwinska, "Green Building: Improving the Lives of Billions by Helping to Achieve the UN Sustainable Development Goals," 2017.

topic and a critical issue, with intricate interactions and a plethora of interpretations and approaches, particularly in the current geological epoch of the Anthropocene.

Rising population, rapid urbanisation, industrialisation, and the resulting pressure on the natural world demand a complete overhaul of the development paradigm. The WCED's SD, despite criticisms, levied against the concept, catalysed this new paradigm by establishing and recognising the interrelationship between development and ecological sustainability. The new development paradigm must now recognise the linkage between ecological issues with economic growth and the ecological and economic issues with social and political considerations, i.e., the three pillars of SD, social, environment, and economy.

Discussion on philosophies underpinning the concept of SD with the application of the heuristic approach provides insights into the foundations and ideas behind various policy imperatives and measures and their possible long-term outcomes. The discussion highlights complexities of issues that arise when development and environment are juxtaposed. However, the complexity has proven to be politically advantageous when it permits nation-states with different and usually competing interests to find common causes, thereby shaping current international environmental policies, international environmental laws, and international relations. As stated in a 2010 report to the United Nations General Assembly:

> The concept of sustainable development is like a bridge. It seeks to bring together not only the three domains — economic, social, and environmental — but also developed and developing countries, governments, businesses, and civil society, scientific knowledge and public policy, the city and the countryside, and present and future generations. It has also created the awareness that the environment and development are not two separate agendas but two faces of the same agenda. Development is the midwife of sustainability, just as sustainability is the life support system for development.[89]

[89] United Nations, "Preparatory Committee for the United Nations Conference on Sustainable Development First Session 17-19 May 2010," *United Nations General Assembly*, vol. A/CONF.216, 2010., 1.

More importantly, the development of these international regimes provides a solid foundation for the advancement of green building and sustainable construction practices. The emergence of green building and sustainable construction movements were attributed to similar concerns amidst financial crises, climate change, and an increasing number of conflicts, all of which have contributed to an air of insecurity that has engulfed governments and institutions worldwide, as pointed out in the following passage:

> [A]ll of these problems are linked, and that population and consumption remain the twin horns of the dilemma that confronts humanity. Population pressures, increased consumption by wealthier countries, the understandable desire for a good quality of life among the 5 billion impoverished people on the planet, and the depletion of the finite, non-renewable resources are all factors creating the wide range of environmental, social and financial crises that are characteristic of contemporary life in the early twenty-first century. These changing conditions are, inevitably, changing the built environment in significant ways.[90]

The built environment is a domain in which humans dwell and interact. Sustainability in this domain dictates the degree of comfort and live ability both in the context of current and future generations. It is important to remember that the very definition of SD is for development that meets the present needs without jeopardising future generations' ability to meet their own needs.[91]

However, it must be noted that, albeit the new development paradigm introduced by the WCED's SD, discussions on sustainability in the built environment reveal the vicious circle of anthropogenic interference. As previously stated, there is a fine line between these primary and secondary interferences, and the success in managing this potential vicious circle towards achieving SD would rest on the relevant stakeholders and policymakers. In other words, it all depends on policy decisions, and imperatives made today.

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90 Kibert, *Sustainable Construction Green Building Design and Delivery*,2016, 6.

91 WCED, "Report of the World Commission on Environment and Development: Our Common Future," 1987, 41.; Baker, *Sustainable Development*, 2006, 19-25.

Without a doubt, the construction industry is in the process of transforming itself and adapting to new policies and agendas aimed at 'greening' the industry in accordance with SD principles.The discussions on the SDGs in green building demonstrate a strong synergy between green building and sustainable construction, with all three pillars of SD enshrined in the 2030 Agenda. The synergistic links between economic, social, and environmental components of sustainability in green building correspond to SD principles, incorporating the applicable SD's normative principles into its framework for sustainable construction. Therefore, the seven principles of sustainable construction are reduce, reuse, recycle, protect the environment, eliminate harmful materials, and consider life-cycle costs and quality.

To that end, one cannot ignore the fact that managing all aspects of SD in the Anthropocene may prove more difficult, particularly in the construction industry, whereby harvesting of biodiversity resources, amongst other things, is somewhat inevitable. The difficulties may create an infinite number of innovative possibilities. One of the most prominent examples is the rise of automation and disruptive technologies.However, the use of technology, if it is simply end-of-pipe technological solutions rather than process modifications, will not produce the desired results for the promotion of a 'strong' SD model.

Despite all attempts, the construction sector has yet to attain the wholesome strong form of SD. A glance at the *ladder* of SD (Table 1) would bring the construction industry into the 'weak sustainable development' rung of the continuum. The analysis reveals that the framework for sustainable construction fits into the type of development within the 'weak' SD model that focuses on reuse, recycling and repair of goods, and product life-cycle management. As mentioned earlier, harvesting biodiversity resources is inevitable in the industry, and the industry is yet to achieve maximum ecological modernisation of production with an emphasis on maintaining critical natural capital and biodiversity. These aspects further cement the industry in the 'weak' spectrum of the SD model.

As previously stated, any policy measure favouring the 'weak' SD model must be implemented with the understanding that it cannot be sustained continuously. A 'strong' SD model is required for long-term development, and any policy decisions and innovations in the construction industry must be undertaken with this in mind.The focus

of technology development must be shifted to include a greater emphasis on environmental considerations.Thus, to move from ‘weak’ to ‘strong’ SD would require more robust and united efforts from all the stakeholders in the construction industry and those incumbent with policymaking.

In conclusion, despite changes in time and ways of doing things, such as the emergence of automation and disruptive technologies, the foundational theories underlying the development of SD should not be viewed in isolation. These underlying philosophies should serve as the backbone or basis for all policy decisions and innovations in the construction industry to realise the aspirations for a more sustainable future.