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Proposing a Framework to address the Sustainable Development Goals

Prince Garcia Schult[1] Ann-Kathrin Losse[2] Christian Czarnecki[3] Eldar Sultanow[4]

Abstract: Reducing poverty, protecting the planet, and improving life on earth for everyone are the essential goals of the "2030 Agenda for Sustainable Development"committed by the United Nations (UN). Achieving those goals will require technological innovation as well as their implementation in almost all areas of our business and day-to-day life. This paper proposes a high-level framework that collects and structures different uses cases addressing the goals defined by the UN. Hence, it contributes to the discussion by proposing technical innovations that can be used to achieve those goals. As an example, the goal "Climate Actionïs discussed in detail by describing use cases related to tackling biodiversity loss in order to conservate ecosystems.

Keywords: Sustainable Development Goals; Green IT; framework

1 Introduction

In 2015, the United Nations (UN) confirmed the "2030 Agenda for Sustainable Development"to reduce poverty, protect the planet, and improve improve life on earth for everyone by 2030 [Un15]. The Agenda defines 17 Sustainable Development Goals (SDGs) which address economic, social and environmental aspects.
The progressively narrowing timeline for effective interventions and the inertia towards the targets call for decisive actions. 2030 is approaching with less than seven years from now on. Thus, innovative solutions are being called for to address the underlining causes and consequences for humanity.
Apart from national governments, companies, corporations, and organizations assume a pivotal role in this process. These have relevant know-how and resources, as well as a wide range of stakeholders and organizations within their reach. Therefore, corporations have the potential to significantly contribute to the development of innovative solutions to accomplish the targets set out by the SDGs.
This paper proposes a high-level framework to structure use cases addressing the SDGs. The framework is based on technology use cases and project insights that have been methodically gathered and scrutinized by the consulting firm, Capgemini. The results have been discussed with Capgemini internal experts. The goal of this framework is to provide an initial proposal

[1] Capgemini, Lübecker Straße 128, 22087 Hamburg, Deutschland, prince.a.garcia-schult@capgemini.com
[2] Capgemini, Potsdamer Platz 5, 10785 Berlin, Deutschland, ann-kathrin.losse@capgemini.com
[3] FH Aachen, Eupener Str. 70, 52066 Aachen, Deutschland, czarnecki@fh-aachen.de
[4] Capgemini, Bahnhofstraße 30, 90402 Nürnberg, Deutschland, eldar.sultanow@capgemini.com

of feasible use cases and technologies to address the SDGs. It allows practitioners to gain inspiration to foster actionable measures towards sustainable development.
Chapter 2 establishes the context of the paper by introducing the 17 SDGs. In chapter 3, the fundamental principles, the design process, and the core artifact, namely the framework itself, are presented. Chapter 4 explores three specific use cases centered around SDG 13, "Climate Action."The paper concludes by providing an outlook in chapter 5.

2 The 17 Sustainable Development Goals

The 2030 Agenda for Sustainable Development aims to reduce poverty, protect the planet, and improve life on Earth for everyone by 2030. As shown in figure 1, the agenda consists of 17 SDGs, addressing current societal challenges reaching from ending poverty and hunger, protecting the planet from degradation, fostering peaceful societies and strengthening global solidarity. [Un15].

Fig. 1: The 17 Sustainable Development Goals [Th15]

The SDGs can be organized into three dimensions being social, ecologic or economic [Vi20, Sc21]. These dimensions are widely recognized as the "Three Pillars of Sustainability"that are crucial for "building epistemic communities of shared understanding of and common commitment to linking environmental and economic development concerns" [Sc07] – or in short: pursuing sustainable development [Sc07]. According to [Vi20], the SDGs 1, 2, 3, 4, 5, 6, 7, 11 and 16 relate to the social pillar, the SDGs 8, 9, 10, 12, 17 relate to the economic pillar and the SDGs 13, 14 and 15 relate to the ecologic pillar. Schoormann et al. argue that a strict distinction of SDGs into the three pillars is not possible because of interrelations between the SDGs and the pillars themselves, thus suggesting a classification of SDGs into multiple pillars [Sc21]. This suggestion and the concept of the

Three Pillars of Sustainability are built into the proposed framework, as presented in figure 2.

3 Designing a Framework to address the SDGs

The 17 Sustainable Development Goals form the basis of the framework proposed in Figure 2. The artifact is structured along a horizontal and a vertical axis. Horizontally, so-called "green streams"provide clusters for the SDGs. Each green stream may consist of one or more SDGs. The colouring of the SDGs follows the official colour scheme as proposed by the UN (Figure 1). On the vertical axis, an additional structure is provided by grouping the benefits according to the Three Pillars of Sustainability. Within this matrix of benefits and green streams, the green technology use cases are positioned according to their benefit to the Three Pillars of Sustainability.
Additionally, their contribution in reaching one or more SDGs and their associated green stream is also represented. The use cases have been obtained by analyzing practice and literature. The analysis aims to create a holistic presentation of the current actions to achieve the SDGs with innovative technologies. For this, Capgemini-internal databases have been scanned for projects and articles referencing actions for tackling societal challenges. Additionally, web scraping was used to add more practical use cases from other businesses and organizations like AI for Good (AI4Good) [IT23]. AI4Good is a scientifically grounded initiative connecting problem owners and innovators, aiming to address the SDGs by using the power of AI [IT23]. The platform offers a range of use cases that align with the framework in figure 2. On top, LinkedIn was used systematically to obtain use cases from ambitioned practitioners wanting to share newest technologies for creating positive societal impact. Every new post regarding the SDGs, climate change, sustainability, social good or similar key words in combination with technologies like AI, drones or smart sensors triggered notifications. The posts have then been analyzed for possible use cases regarding to their relevance to the framework. Similar to the LinkedIn key word search, a literature review was conducted to extract use cases from science, revealing emerging technology trends. Technology and AI related keywords like IoT, Technology, Quantum Computing, Artificial Intelligence, Neural Network, Machine Learning, Deep Learning and Natural Language Processing have been combined with SDG related keywords like Sustainability, Ecological, Climate, Societal, poverty, Well-being, Health, Education, Water and Energy. The keyword search was carried out in AISel, IEEE and ScienceDirect and has provided a wide range of results to be analyzed and filtered out.
Every identified use case was clustered into one or more SDGs and assigned to one of the green streams and a sustainability dimension. In total, more than 60 use cases have been collected in this process. This number is expected to increase constantly, rendering the framework a dynamic and evolving artifact.

Fig. 2: Framework - Mapping technology use cases to the SDGs

The majority of the identified use cases lies within the domains of social and ecological benefits and address all SGDs except SDG 5, 10, 16 and 17. Another interesting preliminary observation of the architecture indicates that especially *SDG 13: Climate Action* is prevailing in multiple green streams according to the interrelations between SDGs [Sc21]. For example, SDG 12 shares a multitude of use cases with SDG 13 in the context of resource scarcity, showing that the measures to address responsible consumption and production also create benefits addressing climate action. A comprehensive asessment shows that the majority of use cases have been identified to have the potential to, albeit indirectly, to contribute to the advancement towards SDG 13. This observation is in alignment with the scholarly discourse as SDG 13 is regularly referred to as an overarching goal [Sc23].
Analyzing the underlying technologies leveraged within the use cases, it is evident that artificial intelligence (AI) can be expected to play a major role in reaching the sustainable development goals. This includes generative AI, for example using ChatGPT to analyze information about biodiversity as well as in fostering water conservation. In addition, the utilization of AI-driven tracking techniques offers substantial potential for examining green area decrease, monitoring the proliferation of bark beetle populations, investigating the progression of oceanic conditions or tracking the movements of sperm whales. Nonetheless, the scope of AI-driven tracking techniques to the Sustainable Development Goals (SDGs) extends beyond the ecological benefits. Within the social benefit dimension further green technology use cases have been identified in promoting efficient labor practices, pertaining to SDG 8 and 9. Furthermore, AI can support in facilitating the management of smart cities through traffic control systems and intelligent waste bin management, thereby addressing issues related to overpopulation and waste disposal within the realms of environmental sustainability.
In addition to AI, several other IT mega trends, including Open Data, Digital Twins, and the Internet of Things (IoT), have been recognized for their capacity to contribute significantly towards the attainment of the Sustainable Development Goals (SDGs). Moreover, beyond the technology-enabled use cases, crucial concepts such as the Circular Economy have been incorporated into the framework. Overall, the artifact is designed to highlight the powerful array of opportunities technology offers in the battle against climate change. Its primary aim is to inspire corporations and governmental organizations to intensify their commitment to climate action, harnessing the potential of technology-driven use cases.

4 Use Cases – Addressing Biodiversity Degradation for Climate Action

With SDG 13 being the predominant SDG addressed by current technology solutions, it is logical to undertake a more in-depth examination of the promising use cases concerning climate action. For this, the green stream biodiversity degradation (figure 2) will be detailed because it is a major concern among the global population and thus an important green stream addressing SDG 13. Biodiversity loss has negative effects on the proper functioning of water and land ecosystems and needs to be carefully managed with appropriate approaches for biodiversity management [Ba06]. Capgemini, a leading global IT-Consulting firm, actively

promotes biodiversity by taking part in combating the risks of biodiversity loss. The firm formulated four use cases for biodiversity conservation: (1) Sperm Whale Tracking with AI, (2) Turtle Migration Tracking with Satellites, (3) Ocean Tracking with AI and most recent, (4) Protection of Insect Ecosystems with AI. The AI-driven use cases mentioned, were developed during Capgemini's annual Global Data Science Challenge (GDSC) which aims to create a sustainable future with the power of AI. In the context of the use case regarding the Protection of Insect Ecosystems, Capgemini employees from all over the world participated in the challenge.

5 Conclusion

In conclusion, this paper presents a framework for green technology use cases contributing to achieving the Sustainable Development Goals (SDGs). With the 2030 Agenda for Sustainable Development in mind, companies, organizations and governmental bodies are called upon to contribute innovative solutions to address global challenges. The architecture categorizes green technology use cases according to green streams and the three pillars of sustainability. It highlights the relevance of different technology use cases, particularly impacting the overarching SDG 13. Particularly, the significance of artificial intelligence (AI) in achieving the SDGs becomes evident, as further explored in chapter 4. Overall, the "green potential“ of IT mega trends beyond AI, including Digital Twins or IoT is emphasized through the framework.
The proposed artifact provides inspiration for sustainable actions, emphasizing the role as well as the potential of information technology. The framework should help companies and organizations to gain ideas for contributing to social and environmental well-being systematically by providing a holistic overview over practical and theoretical use cases related to the SDGs. The artifact could be beneficial, particularly to companies seeking to embrace Corporate Social Responsibility (CSR) through innovative technologies, providing valuable insights into the possibilities already available. The presented framework also serves as an orientation and foundation for further dialogue. However, it is crucial to recognize it as a call for to intensify the collaboration and research to promote wider adoption of green technology applications in order to maximize its potential. The authors are constantly expanding the framework and welcome any type of contact requests for further collaboration on adding new use cases addressing the SDGs.

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