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Article

An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model)

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Abstract: A toolbox for assessing the environmental impacts of processes, products and services has been gradually developed over the last 30 years. The tools and methods place attention on a growing holistic concern to also consider stakeholders' views connected to impacts of the entire life cycle of products. Another change is the gradual increase in consideration of the economic and social dimensions of sustainability since the 1990s. This paper presents this development using two interlinked models that illustrate the changes from the scopes of time and system complexity. The two initial models are further merged into one, the Capacity-building in Sustainability and Environmental Management model (the CapSEM-model), which presents organizations a systemic way to transition to sustainability, seen from the scopes of system complexity and performance complexity. The CapSEM-model attempts to integrate the different dimensions of systems and of methodologies and their contribution to increased environmental and sustainability performance. The Sustainable Development Goals (SDGs) are further mapped onto the model as an example of how they can be useful in the transition to sustainability. The model is, therefore, a conceptualization and needs further development to specify accurate level boundaries. However, it has proven to be helpful for organizations that struggle to find a systematic approach toward implementing sustainability. This is described through a brief example from the manufacturing industry.

Keywords: environmental performance; management; sustainability; the SDGs; systems thinking; systems engineering; life cycle; capacity building in sustainability

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1. Introduction

The focus on methodologies to assess environmental aspects and connected impacts has increased tremendously over the last 30 years [1–7]. *Our Common Future*, also known as the Brundtland Report, was launched in 1987 by the World Commission on Environment and Development (WCED), and importantly linked the needs of the environment and development for future agendas [8]. Presented at the 1992 Rio Conference, the report in many ways initiated the quest for sustainable development (SD) on an international scale. It was a catalyst for nations, as well as for large international corporations and smaller organizations, to take responsibility in addressing their sustainability challenges through management of their environmental impacts. Twenty years later, at Rio+20, the foundational ideas of the report continued to influence global SD initiatives, and the development of the United Nations (UN) Sustainable Development Goals (SDGs). Adopted in 2015, the SDGs [9] are the present global call to action for nations and companies alike. Progress, however, is not on track to reach all prescribed targets, and has been further curbed by the coronavirus disease 2019 (COVID-19) pandemic [10,11].

In addition to the competitive advantage that comes from increased environmental management and sustainability consciousness [12–15], companies of all sizes have a duty to improve the sustainability of their organizations. They are an essential piece to solve the complex puzzle of global SD [10,11,16]. Nearly 35 years after the release of the Brundtland Report, this paper focuses especially on the environmental dimensions of SD. Furthermore, it presents the advances of life cycle based sustainability management tools over the period. It discusses how the tools relate to corporate practice, and how they have developed to expand thinking beyond firm level impacts to wider system level SD. It finally raises some critical questions to the extent the tools have advanced companies toward solving the challenges outlined in the SDGs.

To understand and manage the impacts of systems, the concepts of systems thinking and life cycle thinking are essential [17]. *Systems thinking* involves recognizing systems and subsystems, and the interactions within and between them, from a holistic perspective [18,19]. A *life cycle approach* to problem solving considers the material and resource inputs and resulting environmental, social and economic impacts across all phases of a product or service's life cycle [20]. It puts new demands on corporations as analytical requirements become increasingly complex, refined and demanding. In time, this will increase demand for specialized staff for monitoring and reporting. There is, in other words, a gap between the numerous and diverse analytical models for sustainability aspects, and organization capacity and practice. Furthermore, an overview of these methods and the knowledge needed to implement them is often lacking, especially in smaller companies with more limited resources [21]. As both internal and external requirements become more stringent to meet growing sustainability challenges, companies and organizations need a holistic toolbox to help them navigate the interacting systems of SD, from triple-bottom-line aspects, to geographic scope and long-term timelines.

2. Meeting Sustainability Challenges with Life Cycle-Based Environmental and Sustainability Management Tools

To clarify the toolbox of life cycle-based environmental management tools, sustainability challenges can be classified according to the systems in which they occur. For example, from pollution and environmental degradation caused by production processes, to resource depletion and impacts across different stages of products' life cycles, to a lack of awareness from the management side of companies and policy makers.

These challenges can be met by organizations with a combination of technological advancement and a change in procedures and strategies across different environmental performance levels that vary in temporal and environmental scope [22,23], for example:

1. Environmental engineering;
2. Pollution prevention;
3. Environmentally conscious design and manufacturing;
4. Industrial ecology; and
5. Sustainable development.

These environmental performance levels, or systems, are numbered and presented in Figure 1a and further explained in the following text. Several models for a systematic presentation of the development that has taken place since the early 1990s can be found in literature [24]. The models presented in Figure 1 are one way of illustrating the development of the field over time. They are also a way to demonstrate how the toolbox for environmental assessment and improvement can be used to assess the challenges of transitioning to sustainability and contributing to meeting the objectives set by the SDGs. Figure 1a, together with 1b, are the starting point of the Capacity-building in Sustainability and Environmental Management model (CapSEM-model), presented in Section 3. Each of the models has advanced the goal to guide companies and other organizations to systematically implement sustainability practices in their products and internal strategies while also building partnerships with the larger societal system.

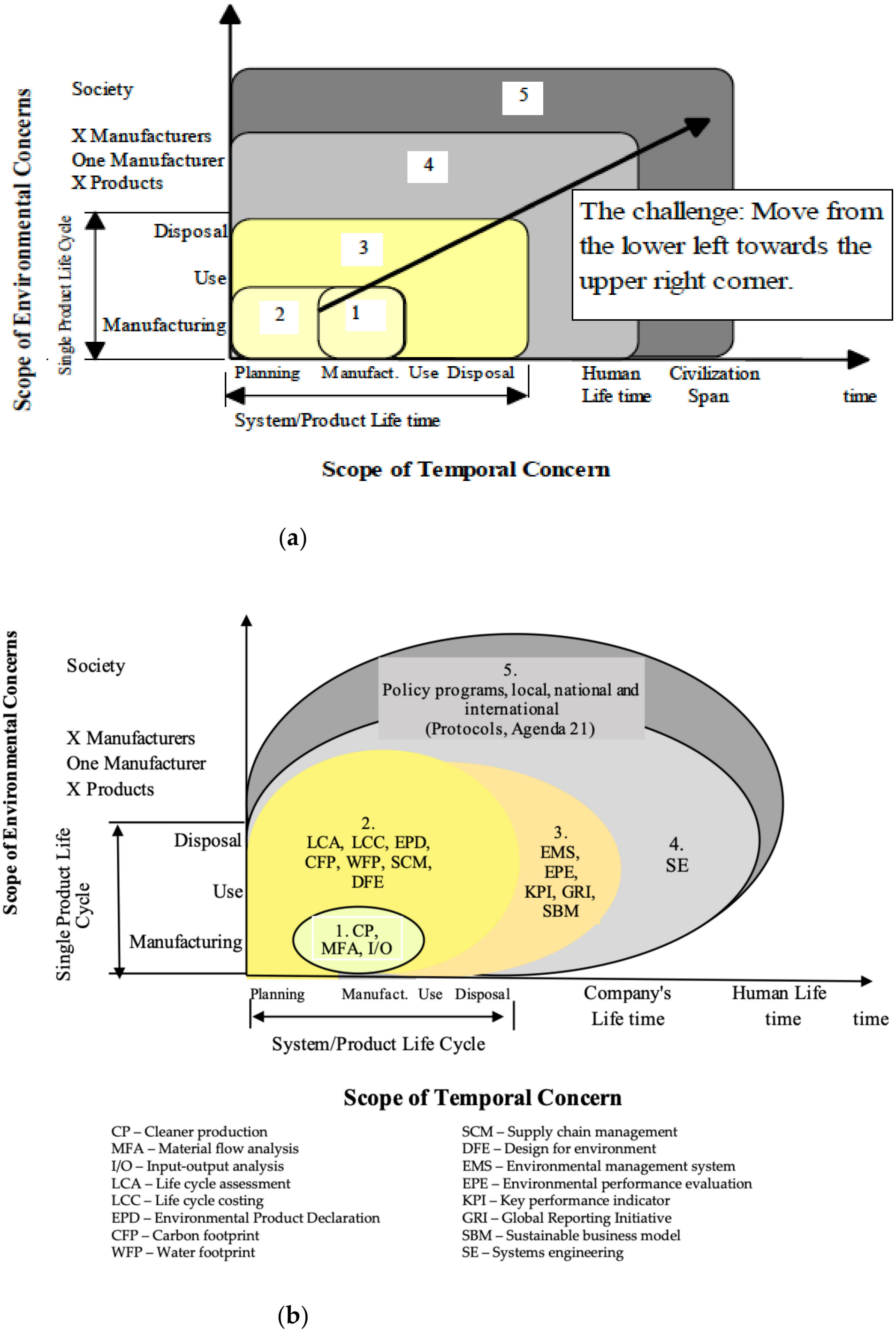

Figure 1. (**a**) Classification of environmental performance levels, [23] modified after [22]; (**b**) a classification of methods and tools for environmental performance improvements, modified after [23,25].

Area 1 in Figure 1a represents the perspectives related to environmental engineering strategies to reduce negative environmental impacts within production and manufacturing processes. This space takes a limited systemic scope in both time and environmental concern (only during the manufacturing process and life cycle stage).

Area 2 increases the temporal scope and involves pre-planning for the manufacturing phase to prevent pollution and negative impacts during the process. Pollution prevention strategies arose in 1992 through the initiatives launched by the Environmental Protection Agency (EPA) [26], with the objective to reduce the environmental impacts of products by identifying them in the design phase. This way, the impacts throughout the life cycle could be reduced through better planning of product design. For example, better planning might consider techniques for assembly and material selection to help avoid negative impacts in the use and dismantling phases later in the product's life cycle. So, even though this space has a limited system scope on planning and manufacturing only, it helps build an understanding of potential problems that may arise later in the life cycle. It can be seen as a prelude to the later consideration on the entire life cycle of a product.

Area 3 expands the scope from processes related to manufacturing to the product as a whole and considers design to reduce negative impacts across its complete life cycle. The increase in consciousness of environmental concerns is illustrated through the additional consideration of the use and disposal phases. The wider consciousness is also reflected in the expanding temporal scope related to the gradual knowledge development of how to address the entire life cycle of products [27].

Area 4 further broadens the system boundaries and understanding of impacts throughout the entire industrial system. This includes perspectives related to tracking material and energy flows according to principles of industrial ecology (IE), e.g., industrial symbioses and circular material flow models [28].

Finally, Area 5 represents the holistic consideration of environmental aspects over an extended timescale and beyond the firm and its network. This means considering aspects relevant for present and future generations and that address all stakeholders, and likely societal and political challenges over time.

Advancing Figure 1a, a model for a systematic approach to environmental performance improvements was developed [23,24]. This model is presented in Figure 1b and shows adaptations from the first model, most notably the addition of specific tools and methods for life cycle-based environmental assessment management mapped along environmental performance improvement levels.

Figure 1b suggests a series of environmental performance and management tools to be implemented for the purpose of moving to a higher level as indicated by Areas 1–5 presented in Figure 1a. The tools are further classified into a model for capacity building in sustainability and environmental management—the CapSEM-model. The application of the tools for the achievement of a transition towards sustainability is described in Figure 2. Readers should note that the models presented in Figure 1a and b focus mainly on environmental aspects of sustainability, and do not fully consider the needs of stakeholders and other social aspects. Systems engineering (SE) is, therefore, introduced as an overall process to better consider stakeholder opinions and involvement in a holistic transition process. SE can be viewed both as a discipline and as a process [23]. As a discipline, SE is about taking the holistic life cycle perspective and bringing in aspects from other disciplines when needed in a multidisciplinary context. SE as a process, is about bringing a system into being with an understanding of challenges to the system during its life cycle. A six-step SE-methodology is introduced by Fet [23], and suggests the following steps in the context of sustainability:

1. Identify stakeholders and their needs related to sustainability performance (of a system, hereunder also an organization or the society as a system);
2. Define the requirements for the achievements of stated needs;
3. Specify the current performances related to environmental, social and economic aspects;
4. Analyze and optimize the performances according to needs and requirements;
5. Suggest solutions according to stated needs and requirements;
6. Verify the suggested solutions against *1.* and *2.*

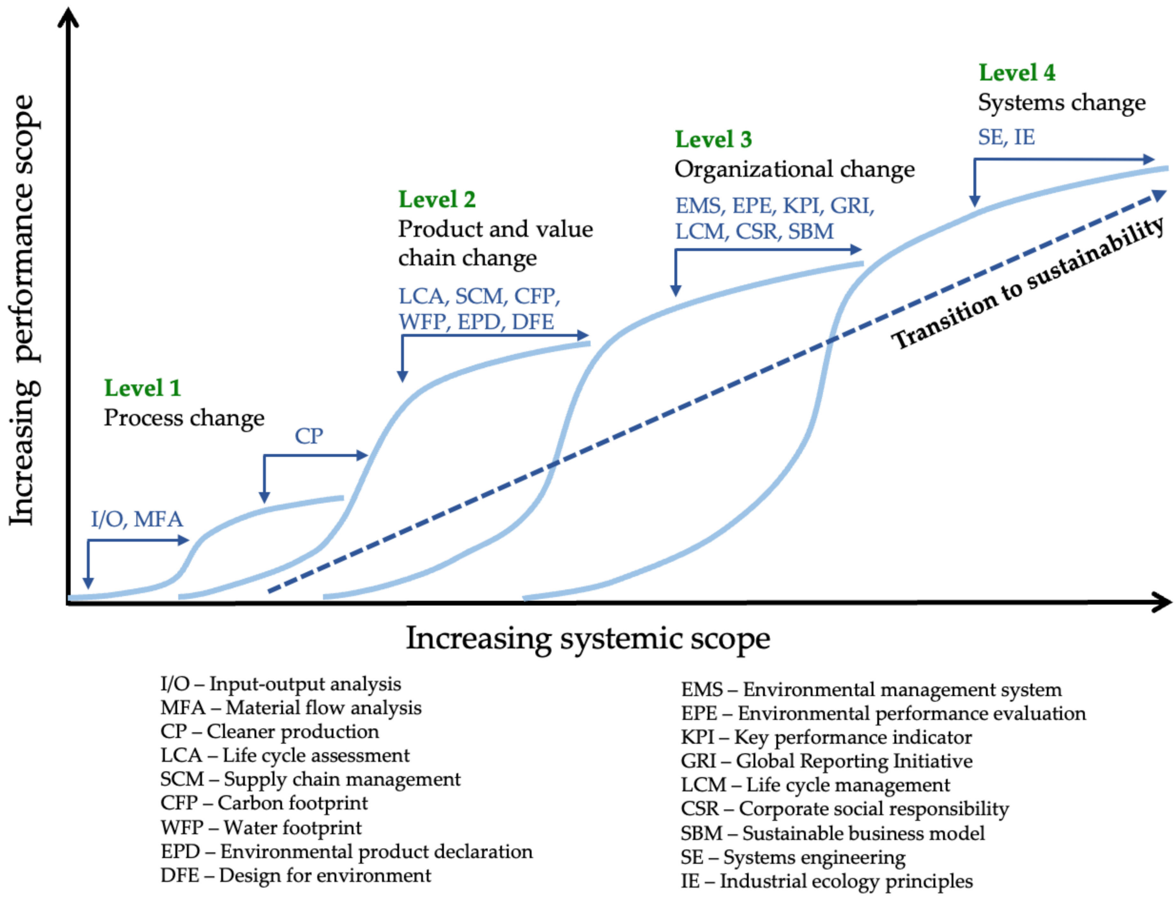

Figure 2. The Capacity-building in Sustainability and Environmental Management model (CapSEM-model)—a systemic approach towards sustainability, modified from [29].

This process can be used for each area in Figure 1. The complexity of stakeholder involvement, and thereby the sustainability aspects to be addressed along the road from the lowest to the higher levels, will increase. The steps in the SE-process can be performed in several cycles until the best solutions are achieved.

3. The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model)

Based on the improvement of the models presented in Figure 1, the CapSEM-model was developed to illustrate the spectrum of environmental performance areas, here termed ‘levels’, ultimately reaching a holistic level of systemic sustainability. This requires that companies expand their environmental and sustainability management perspectives, extending the scope and number of impacts that are considered as they move toward more integrated sustainability. Figure 2 presents the CapSEM-model.

The waves in the CapSEM-model illustrate different levels of performance of the systems under study. A systematic use of the toolbox helps companies investigate the potential for appropriate actions to improve the environmental and sustainability performance related to production processes (Level 1), products and value chains (Level 2) and strategic organizational actions (Level 3). The highest level (Level 4) represents the larger societal system and a company’s recognition of its place and responsibility within it. The term ‘improvement’ is used to mean the reduction of negative impacts and increase of, or replacement with, positive impacts—ultimately leading to strong, proactive and holistic sustainability as companies move toward the upper right of the model. As an organization traverses the levels, knowledge and tools from the previous levels are used as input to more extensive methods.

Each axis describes a change in scope. The horizontal axis shows the scope of systems and begins at the simple production process at Level 1. Furthermore, it extends to the set of processes within the value chain of a product at Level 2. Then, to the organizational level (Level 3), embracing concerns for production processes and products in addition to the integration of strategic management systems to implement sustainability consciousness in a more holistic manner. Within Level 3, aspects connected to economic and human factors should also be considered. The scope of the systems on Level 4 can be defined as the sector that the organization is a part of, or as wide as a societal system since all organizations are part of a larger system.

The vertical axis illustrates the scope of performance. Level 1 focuses on the environmental impacts of material flows, while in Level 2 the focus has broadened to the performance of the entire value chain where e.g., management of the supply-chain could contribute to an improvement of the value chain. Level 3 adds aspects to be considered from a strategic level, such as management systems that help organizations move to a higher level of performance over time. A broader range of sustainability aspects should also be considered at this level. Since Level 4 system scope depends on the context of the operation of the organization, a higher level of performance can be achieved under the holistic recognition of opportunities that come from improving system performance. From a systemic perspective, the different levels could be described as subsystems and system elements of a larger societal system.

As seen initially in Figure 1b, Area 1 contains the suggested tools of cleaner production (CP), material flow analysis (MFA) and input-output analyses (I/O) to monitor the environmental impacts during production and manufacturing processes. In the CapSEM-model, Level 1 encompasses process-related changes for environmental accounting and (more sustainable) performance (e.g., principles of eco-efficiency [30]). When setting objectives related to emissions, resource use and waste generation, companies must assess the current use and flows of materials in order to reduce consumption and waste in their production processes. The methods of I/O and MFA, therefore, fit in Level 1 as they measure baseline levels for defining improvement and resource efficiency [31]. CP is also located on this level, where source reduction is the objective rather than end-of-pipe solutions [32]—therefore moving its placement further along the scales of system scope and performance. The focus on resource efficiency is often driven by economic and/or policy incentives, as these methods provide for diagnostic comparison and benchmarking of companies. Focus only on environmental aspects means that the Level 1 system does not explicitly consider the wider impacts on society. Its system boundaries are drawn at the firm level around specific processes.

In Area 2 in Figure 1b, the tools for the purpose of environmentally conscious product development are life cycle assessment (LCA) [33], life cycle costing (LCC), supply chain management (SCM) [34], carbon footprint of products (CFP) and water footprint of products (WFP) [35], environmental product declaration (EPD) [36], and design for environment (DFE). By expanding from the boundaries of a single process, Level 2 in Figure 2 focuses on product- and value chain-related changes. This means a focus on a product or service and all activities and processes along its value chain. The methods in Level 2 include LCA, which quantifies material flows (from Level 1) across the full life cycle of a product. Results from an LCA are quantified and weighted in terms of environmental impact. The weighted criteria can then be used to implement changes for more sustainable SCM upstream in the value chain. In addition, the quantified impacts can be used to perform carbon- or water-foot printing of a product, or to reach certifications for acceptable levels of environmental impact, e.g., EPDs. The principles of DFE, e.g., design for recycling or dismantling, can transform the value chain, accounting and planning for reduced environmental impact through the full life cycle of the product and its materials. Social-life cycle assessment (S-LCA) could also be placed on Level 2, as a way to track social impacts through the life cycle of a product [37]. Such methods are younger in their methodological development and can be difficult to quantify. However, further developing both quantitative and qualitative indicators to measure social sustainability impact is essential to reach holistic sustainability as mandated in the SDGs.

Area 3 in Figure 1b presents tools to be used by companies to improve their strategic approach for being more environmentally conscious, e.g., by implementing environmental management systems (EMS) [38], environmental performance evaluation (EPE), key performance indicators (KPI), the Global Reporting Initiative (GRI) [39], and sustainable business model (SBM) frameworks [40]. To further increase the comprehensiveness and scope of aspects considered, Level 3 moves toward the implementation of methods for stronger sustainability within an organization's management systems and strategy. The transition from Levels 1 and 2 into Level 3 represents an important advancement of management and monitoring for sustainability, allowing the incorporation of more social aspects. The organization must now widen its view beyond the firm itself, or its associated value chains, and track and report on its impacts in relation to the past, to its competitors, and for its long-term survival.

To make and monitor strategic changes across a company's operations, tools and methods for organization-level changes help address more complex sustainability challenges. Meeting these challenges might include establishing management systems to monitor goals for reducing negative environmental impacts and engaging further with stakeholders and customers. It also means looking beyond the value chain for effects of the organization on its employees and global and local environments in the long-term. Level 3 tools, therefore, include EPE, life cycle management (LCM) and EMS for benchmarking, meeting goals and continuous improvement (e.g., through ISO14001). Corporate social responsibility (CSR) embraces the triple bottom line of sustainability and is one approach to stakeholder engagement [41,42]. Establishing KPIs is an essential step in setting these goals, and companies can use a range of indicator frameworks from national systems to large, standardized reporting and communication systems such as the GRI. Methods from Levels 1 and 2 can be used to collect the data required for measuring the KPIs—demonstrating the knowledge development path represented by the CapSEM-model. SBMs are also placed on this level as they can help firms conceptualize their current value flows (environmental, economic and social) and identify areas to innovate for sustainability [43].

To achieve sustainable development in the long-term perspective, Areas 4 and 5 in Figure 1b present the policy programs and international regulations that help to set goals for a larger societal system. The highest level in the CapSEM-model, Level 4 also focuses on systems-related changes. This includes the most comprehensive assessment of sustainability aspects, both environmental and social, and for the company to see itself as one actor in a complex network of actors. While Levels 1-3 focus mainly on environmental aspects, Level 4 (and the higher degrees of the Level 3) command the inclusion of stakeholders and their long-term needs. Here, systems engineering (SE) is suggested as a helpful methodology to address these challenges and to include the principles of industrial ecology, e.g., principles of industrial symbioses and circularity [44].

Just as discussed in relation to Figure 1, the six-step SE methodology, can be performed at each level of the CapSEM-model until the most sustainable performance has been achieved. For simplicity, SE is placed at Level 4 to illustrate that it yields to the lower levels, but also because the increased scope required for Level 4 represents the most advanced form of SE.

To summarize, the CapSEM-model shows a spectrum of tools and methodologies for transitioning towards sustainability. It does not mandate that a company place itself within one level. Rather, it shows the way the tools and perspectives are linked and build upon each other. Additionally, it provides an example toolbox of methods that can be applied for improved sustainability in an organization depending on its level of ambition or maturity.

4. Adding the Sustainable Development Goals (SDGs) to the CapSEM-Model

The SDGs were established to guide the global sustainable development agenda until 2030. They are an extension of the previous global development framework, the

Millennium Development Goals (MDGs), which laid out an agenda for global poverty reduction. Recognizing the limitations of the MDGs, the SDGs were developed in a participatory process involving stakeholders across the global south and global north and introduced a set of specific targets and indicators for national governments to measure and communicate progress [45]. The SDGs have two aims—the reduction of global poverty and the halting of climate change, and chiefly recognize the link between the two. Criticisms of the triple-bottom-line approach, for example [46,47], suggest replacing environmental, social and economic silos with a more integrated view that sees the dimensions in a nested system for SD and the SDGs, respectively. These factors combine to make the SDGs a systemic framework that dictates the recognition of the interconnections between the goals and their targets. The set of 17 goals must be seen as a whole to achieve SD on the system level.

Although the official SDG target and indicator framework is for national governments, the agenda depends on industry participation and commitment. Many companies today use the SDGs to guide and communicate their sustainability strategies. A number of organizations provide guidelines and frameworks for use in companies to set goals and indicators within their strategies and operations. The SDG Compass [48], a joint initiative between the World Business Council for Sustainable Development (WBCSD), UN Global Compact and the GRI, is one such guideline, and provides databases of business tools and indicators openly accessible to companies. Nonetheless, it can be challenging to navigate the 17 goals and their respective indicators.

Just as the CapSEM-model helps make sense of the plethora of methods to measure sustainability performance by grouping them in levels, it can also help companies understand how their activities contribute to each of the SDGs. This logic is explained through the exemplification of a company in the manufacturing sector. Figure 3 places the SDGs along the CapSEM-model and discusses them in relation to each of the levels. Although the goals are each placed on a single level of the model, this is only used to illustrate an entry point to their application. In parallel to Rockström and Sukhdev's 'Wedding cake model of the SDGs' [47], SDGs 6, 13, 14 and 15 are grouped in the environmental layer, SDGs 1, 2, 3, 4, 5, 7, 11, 16 and 17 within the social layer, and SDGs 8, 9, 10 and 12 on the economic layer. Even though the SDGs can be systematized this way, we stress that the systemic nature of the SDG frameworks also requires that they are considered on all levels. However, to incorporate the SDGs into company strategies, specific goals and targets must be prioritized as a starting point [49].

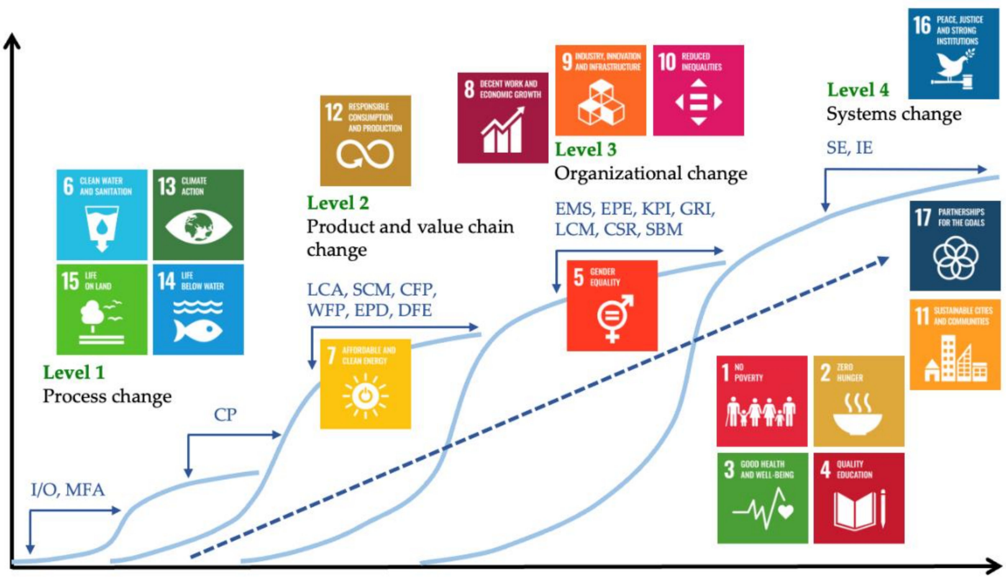

Figure 3. The CapSEM-model and the Sustainable Development Goals (SDGs), modified from [29].

Manufacturing involves several resource-consuming production processes (Level 1) where different materials, energy and chemicals are used, and resulting wastes generated. These wastes are typically disposed into air, land and water systems, and have contributed to the disruption of the Earth system. When considering improving sustainability in this sector, needs and requirements, therefore, include minimizing resource use, and avoiding pollution and the unnecessary expense and disposal of resources, especially into natural systems. I/O analyses can be used to quantify material flows within a production process or company system. Then, the quantified information can help inform decisions about the best solutions for designing new or adapting processes to reduce negative environmental impact. SDGs 6 (clean water), 13 (halting climate change), 14 (life under water) and 15 (life on land) have therefore been grouped on Level 1 in Figure 3 as their targets direct, for example, the increase in efficiency of water use (target 6.4) and the protection and restoration of water-related ecosystems (target 6.6). The selected goals and targets for improving sustainability in the manufacturing sector can be used to guide manufacturing companies in selecting indicators and making strategic decisions on how to reach them using the tools and methods at this level. The same process can be applied across the remaining levels and SDGs.

The move from Level 1 to Level 2 means that in addition to production processes, all other impacts related to the product and its value chain, e.g., the transportation of materials and components in the upstream life cycle of the product. In addition, downstream issues of distribution, maintenance and repair during the use phase and end of life treatment should be monitored for the entire life cycle of the product. Today, we see increased requirements for documentation of e.g., the carbon footprint of products. This means that the manufacturing company should take responsibility to achieve quantified information from the suppliers of materials, components and services across the life cycle. Based on the quantified information, optimized solutions for reduced GHG-emissions such as renewable energy sources should be achieved. SDGs 7 (clean energy) and 12 (responsible consumption and production) are therefore grouped on Level 2 to capture both upstream and downstream value chain sustainability improvements. SDG 12 places a focus on the entire value chain, and SDG 7 requires that products are designed and manufactured for cleaner energy systems. Because Level 1 can be seen as an input, or subsystem, to Level 2, the goals and targets at Level 1 must necessarily also be accounted for.

Pressure from public procurement and customer demands for products that support more sustainable living or help clean-up past damage, encourage manufacturing companies to report and communicate their progress toward improved sustainability. They must, therefore, develop their organizational strategies and practices (Level 3) in accordance with known guidelines and frameworks e.g., the SDGs. This requires trustful information from the companies across the other levels. For example, that all Level 1 processes are controlled and managed in a sustainable way, that systems for quantification of the carbon-footprints are in place at Level 2, and that the companies can present a management or certification system (e.g., ISO 14001) that supports the company in their annual assessment of improvements. The tools presented for Level 3, as well as Levels 1 and 2, should help the company to communicate the performance through a set of KPIs that give the stakeholders the information they need for an eventual approval of the sustainability performance or ranking of the company. SDGs 5 (gender equality) and 10 (reduced inequality) are placed on Level 3 and relate to the social aspects of e.g., equal employment and stakeholder inclusion to be mandated within the company's sustainability management systems and strategic organizational goals. SDGs 8 (decent work and economic growth) and 9 (industry, innovation and infrastructure) have also been grouped on the organizational level. This is because they pertain to the economic viability of a company and may further support its knowledge and innovation development relating to products that support a sustainable society.

Level 4 relates to the methods and tools that help drive systemic societal change and mandate the company view itself as one actor within a network of actors. SDGs 1 (no poverty), 2 (zero hunger), 3 (good health and well-being) and 4 (quality education) are placed at this level as they represent the basic criteria for thriving livelihoods. Without meeting these livelihood goals, sustainability will not be reached or maintained over time. They also require that companies consider all stakeholders in their actions. SDGs 11 (sustainable cities and communities), 16 (peace, justice and strong institutions) and 17 (partnerships for goals) are also placed on this level as they help companies recognize their place in the larger system, from communities and cities, to regional, national and global impacts. In a smart and sustainable city system, for example, there are increasing requirements to document the carbon footprint of subsystems, from furniture used in public spaces and private homes, to infrastructure that is designed for easier repair and that supports smart renewable energy systems. The need for take-back systems and sharing economy systems will also appear more frequently, and IE is one of the tools for developing symbioses within a circular economy. Similarly, SE is an important tool for seeing systems and their interactions from a holistic perspective. Level 4 embraces the underlying features of Levels 1, 2 and 3.

It is common to see the cherry-picking of select SDGs that neatly meet ongoing operations, ignore interactions between them or fail to reflect upon the system as a whole [34]. Clear company strategy is, therefore, needed for prioritization of areas for sustainability improvement and related SDGs and targets. The authors do not claim that the ordering of SDGs in Figure 3 is the absolute placement, but rather that it is one way to help a company identify the ways their operations initially relate to each goal. If companies better understand and engage with the goals, their ability to prioritize and make strong measurable contributions to their targets increases [49,50].

5. Discussion

The CapSEM-model demonstrates how the different dimensions of systems and of methodologies can be integrated to contribute to increased environmental and sustainability performance. Transitions can be achieved within organizations through the use of the tools presented first in Figure 1b and advanced since the early 1990s. The SDGs are further mapped onto the model as an example of how they can be useful in the transition to sustainability as entry-points to and objectives for action. The models in Figure 1a,b have their roots in the initiatives that were introduced in the 1990s. Work towards improved environmental consciousness in organizations has advanced since clean-up and pollution prevention were the main strategies. Over this period, a set of methodologies were developed and matured. For example, early versions of CP have contributed to the further development of standards for EPE and EMS. Similarly, the first versions of LCA were the foundation of other tools such as WFP, CFP, EPD and DFE, and the inclusion of the social dimension in S-LCA. Other tools have come later, or new versions of early pilots have been further developed under new names. The GRI framework is one such example. While indicators and reporting schemes were initially developed by different bodies, the GRI is now used as a common concept for reporting-systems and the use of performance indicators across different sectors. As methods and tools continue to be advanced, and new approaches or frameworks are initiated, the CapSEM-model will need to be updated to reflect changes in the toolbox and outlooks of organizations. The list of methods presented in the model is not exhaustive since new supportive tools are under continuous development.

Numerous scholars have suggested categorizations of environmental performance and sustainability methods (e.g., [51–53]). The CapSEM-model, however, classifies analytical methods and tools in a practical way that can serve as an entry- or positioning point for companies. Its development has paralleled the historical growth in concern for the environment and is a result of engagement with companies of various maturity levels and outlooks over the period.

As an organization moves between levels, tensions or limitations may be identified in relation to requirements or assumptions in methods at other levels. This may be due to the limited scope of certain methods that are unable to capture aspects across all SD dimensions. In many cases, tough decisions must be made between sustainability trade-offs and require that the organization has a clear strategy to guide their priorities.

In further research the CapSEM-model should be tested across different sectors and the different dimensions of sustainability. The systems studied at each level in the CapSEM-model should also be further described as they appear as different categories of systems, either as physical systems (e.g., production processes), theoretical systems (e.g., management systems), or geographical systems (e.g., for a societal study). Further development of the model is, therefore, encouraged, under a systematic approach to stakeholder involvement and actions for checking the achievements of initially formulated needs and requirements.

6. Conclusions

The purpose of this paper has been twofold. First, to illustrate how different initiatives of environmental consciousness and related monitoring and management tools have been developed over time and can be further systematized for the purpose of environmental and sustainability performance improvements at different system levels. Second, the paper demonstrates how these tools can be used in a systematic way for organizations in their transition to sustainability.

No matter what is the driver of sustainability improvement within an organization, SD is a wicked and complex problem (e.g., [54–56]), that requires transdisciplinary, collaborative and holistic thinking across triple-bottom-line principles, long-term systemic reasoning and wide stakeholder involvement. The CapSEM-model is a conceptualization of methods and approaches to help companies address this problem, and to identify opportunities within it. Although the CapSEM-model needs further development to specify accurate level boundaries, it has proven to be helpful for organizations that struggle to find a systematic approach toward implementing sustainability.

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