A Strategic Framework for Achieving Sustainability and Resilience in Global Supply Chains

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Abstract

In order to achieve sustainability and resilience at the same time in global supply chains, a strategic framework and ecosystem collaboration is required to orchestrate the activities of the different supply chain participants to achieve a common goal. While the necessity of ecosystems is understood and accepted, the successful implementation of those remains a challenge. This paper looks from the perspective of practitioners at this challenge, identifying the critical success factors to make a collaboration ecosystem work. Based on the analysis of existing strategy concepts, ESG frameworks and of several ecosystems, a strategy framework is developed that can serve as a blueprint to successfully create global value networks that balance sustainability and resilience concerns using data and analytics.

Keywords: Supply Chains, Sustainability, Resilience, Sustainability Framework, Collaboration Ecosystem

1. Introduction

Sustainability and resilience in global supply chains are often considered to be opposing requirements, especially if defined in a more traditional way. Sustainability is frequently interpreted as protecting the environment at the expense of profits, while resilience is seen as limiting risks to profits, without considering the impact on the environment. Therefore, the UN Sustainable Development Goals (SDGs) and concepts like the Triple Bottom Line (Miller, 2020) specifically stress the inter-related dimensions of people, planet and profit. This broader perspective offers the opportunity to find new forms of business value for organizations. Also in this more holistic value world, different values may still have a negative impact on each other, so the key success factor is to find the right balance between competing requirements. Looking at strategic management concepts, like the Balanced Scorecard (Kaplan & Norton, 1996), can provide guidance in finding this balance, including sustainability and resilience requirements.

If we define sustainability as being broader than environmental protection, following the guidance of the UN SDGs and the Triple Bottom Line Concept, we argue that resilience is part of sustainability. It is a requirement or business value in the profit dimension of the Triple Bottom Line and part of UN SDG #9 (Industry, Innovation and Infrastructure). In fact, UN SDG #9 is defined as follows: "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". A supply chain can be considered as a piece of infrastructure in our global economy.

To improve the holistic sustainability of global supply chains, new business models and digital solutions are key components. Digital solutions are all about data and data enables new business models. In a supply chain, seamless data exchange between the different participants is critical, but also challenging. Data spaces (IDS-RAM, 2022) are an enabler for collaboration, by helping organizations to share data, which, together with algorithms, can optimize the supply chain on different sustainability dimensions. Unfortunately, many Data Space concepts, like Gaia-X (Gaia-X, 2022), are focusing on the technology, not addressing the broader context (e.g., around people, processes, business models and business value).

This paper proposes a strategic framework that integrates existing and new approaches into an innovative and holistic concept to ensure sustainability and resilience are improved through data spaces in global supply chains.

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2. The Supply Chain Sustainability Framework

Achieving sustainability in global supply chains is a highly complex undertaking. One way to describe and address complex challenges and systems are frameworks and reference models. They exist for business and technology, are industry-agnostic or industry-specific and many industry associations and standards organization have created them, for example the Reference Architecture Manufacturing Model 4.0 (RAMI 4.0, 2018) of Platform Industrie 4.0.

2.1 Overview

Our framework uses the RAMI 4.0 concept and structure as input to develop a Supply Chain Sustainability Strategy Framework (short SCSF), as a practical guidance for organizations to strategically improve on sustainability in their supply chain. The framework should guide an organisation in implementing holistic, multi-layer solutions for sustainability challenges and opportunities. The SCSF goes beyond organizational boundaries and extends into the supply chain, as a multi-stakeholder approach in form of a value network is needed to address the complex issues of sustainability.

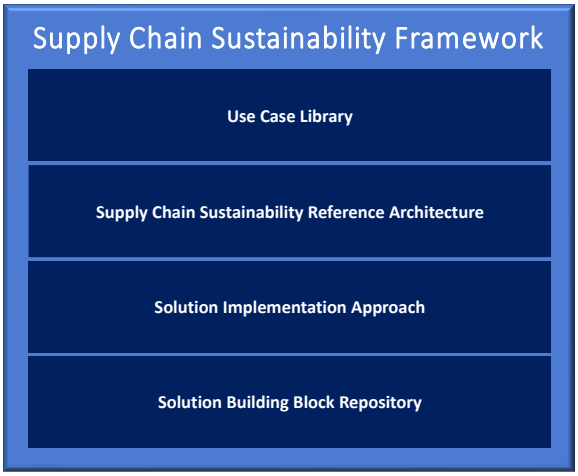

Figure 1. The Supply Chain Sustainability Framework.

The **Use Case Library** (UCL) is a collection of sustainability challenges and opportunities individual organizations and the supply chain have.

The **Supply Chain Sustainability Reference Architecture** (SCSRA) contains blueprints for solutions addressing the sustainability use cases.

The **Solution Implementation Approach** (SIA) describes how to develop sustainability solutions, leveraging the content in the SCSRA.

The **Solution Building Block Repository** (SBBR) is a collection of components that can be reused to build sustainability solutions.

The following chapters describe the different parts of the Supply Chain Sustainability Framework in more detail. The authors want to state here that this paper does focus on the structure of the framework and not its content. How the content is developed will be explained tough. In this paper we focus on the Supply Chain Sustainability Reference Architecture. The other parts of the framework are added at a later point in time by the "Sustainable Supply Chain" Task Group of the MIT Club of Germany.

2.2 Supply Chain Sustainability Reference Architecture

The Supply Chain Sustainability Reference Architecture (SCSRA) is intended to make the design and implementation of a solution for a specific use case easier, by providing blueprints for different components of a solution. Those blueprints can be adopted and combined to meet the needs of a specific organization and supply chain.

The SCSRA has a 3-dimensional structure, forming a cube with 3 dimensions: Solution Layers, Solution Life Cycle and Solution Reach.

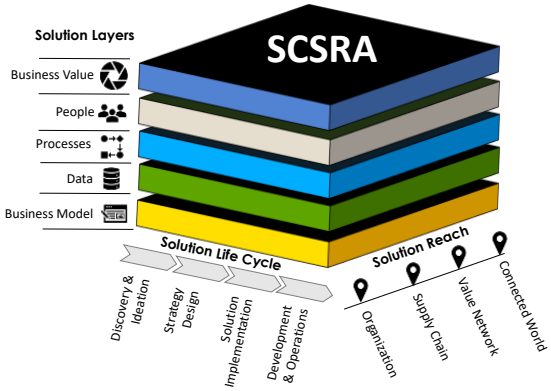

Figure 2. The SCSRA.

Solution Layers

The different layers of the reference architecture are described in more detail in the following sections of this paper. Therefore, here only a short introduction is given.

- **Business Value** defines the objectives and targets, the stakeholders in a supply chain value network

want to achieve. Our paper aims to take one step towards a more consistent approach in measuring value derived from a sustainability perspective.

- **People** looks at motivation, mindset, skills and measurements companies need to build for their people in order to achieve sustainability and resilience in a supply chain. As this is new territory, leadership skills and behavior are critical to drive and sustain change.
- **Processes** define the flow of materials and products through the supply chain. Ideally a supply chain minimizes the impact on profile, planet and people.
- **Data** is not the new oil that creates new revenue streams, but it is needed by all different ecosystem partners to provide real-time insights and support better decisions making.
- **Business Model** innovation needs to reflect the new set of business values, by creating new value propositions. While every organisation in the supply chain will have their own business model, an alignment in the partner ecosystem is required to make sure all stakeholders work towards a set of shared business values.

Digital solutions that improve sustainability in global supply chains are complex to design, implement and operate due to the fact the multiple parties need to act in sync. This requires identifying the dynamics between the different stakeholders that make up the complex supply chain system. The concepts of systems thinking, sand systems dynamics (MIT Sloan, 2022) can be applied to analyse the supply chain and even the wider value network. The "Solution Layers" dimension of the SCSRA is something where a systems dynamics model can be applied. The dynamics within an organization can be modelled and the insights this provides, can be used for the required change management activities to ensure the successful implementation of a sustainable supply chain solution.

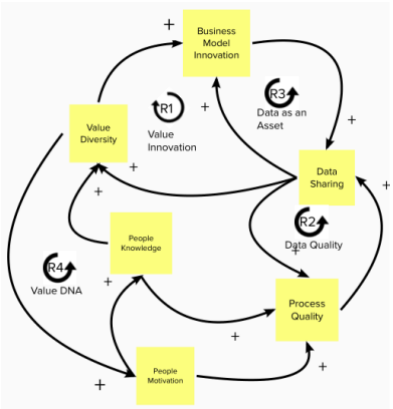

Figure 3. System Dynamics Model for the Solution Layer.

The system dynamics model focused on positive impacts and as a result only reenforcing loops appear.

Solution Life Cycle

A solution goes through multiple phases from idea to design, to build, to operations. A solution life cycle starts with discovery of a sustainability challenge or opportunity and ideation of solution ideas. Important is to be sure the challenge or opportunity is properly understood, before switching into solution ideation mode. Design Thinking (IDEO, 2022) as a methodology can be used in this Solution Life Cycle phase. Although this phase could be done by a single organization, it is recommended to co-innovate through collaboration in an ecosystem. Industry associations and communities of interest play a key part in orchestrating an ecosystem. The non/pre-commercial setting allows the open exchange of ideas and knowledge and can even produce the creation of a consortium that solves a specific problem. An example here is Catena-X (Catena-X, 2022) where the global automotive supply chain exchanges data. Catena-X is currently looking to extend its scope also to CO_2 footprint data.

During the solution life cycle, it is always good to remind all ecosystem partners why they are doing this and how it generates business value for everyone. While collaboration can have a negative impact on the timeline of implementing a solution, the quality of the solution will be better and there will be synergies for individual organizations created that would not be possible with a "isolated" approach.

Solution Reach

Solutions for sustainability in supply chains can extend beyond the boundaries of a single organization. Their impact can even go beyond the actual supply chain. The four ecosystem circles defined in the SCSRA allow to define the reach of a solution and motivate the ecosystem partners to systematically think about the impact beyond the business value they define for themselves.

The "Supply Chain" consists of all organizations involved in the life cycle of a physical or digital product that is produced for permanent use or consumption. The supply chain partners have commercial agreements in place, which are usually between two organizations. The value exchange in the supply chain drives the business value for the individual organization. Business model innovation requires the alignment of the different supply chain partners, as well as the exchange of data.

All supply chain partners have impact on organizations and individuals that are not directly

involved in the supply chain activities. Here some examples: 1. Working conditions can have impact on public health and hence concern the government and health care organizations. 2. Pollution of waterways can have a negative impact on the environment and hence concern NGOs working to protect the planet. 3. Reducing energy consumption of factories through new technologies can have a positive impact on the economy of the country, where the technology provider sits. Those "outside" stakeholders extend the supply chain into a value network, as organization and individuals outside the direct supply chain receive value. This is not a value exchange, but more of a value transfer.

In the area of sustainability, the value created can even go beyond the Value Network and benefit our planet as a whole. Think about reduced CO_2 emissions, less plastics in oceans or a decrease in resource extraction and material consumption. If we look at the UN Sustainability Goals, we can identify value created for the Connected World, by improving our global supply chains.

SCSRA Content

So far, we have described the structure of the Supply Chain Sustainability Reference Architecture. While many reference architectures and models on the market come with content as well, this paper does suggest a different approach to create the content of the reference architecture. Content for many existing reference models is created by a small group of experts with more or less practical experience. Looking at the complexity of sustainability in supply chains and the number of potential use cases, a small group of experts would not only need quite some time to create the content, but the potential lack of diversity in this group may not produce the number of use cases and quality of reference content that a crowd-sourced approach will bring. Therefore, we suggest setting up a process in a specific supply chain or industry association to ask participants to contribute the content, once a solution is implemented. This has also the advantage that there is a reference implementation for the content in the reference architecture.

3. Business Value

Measuring value in global supply chains beyond traditional, profit-oriented metrics is an emerging topic. As sustainability is an increasingly used lens to assess impact-oriented performance in supply chains, measuring impact, and thus value, has become highly pertinent (Search & Ahi, 2020; Saeed & Kersten, 2017; Malesios et al., 2020), both for regulators, as well as for investors and customers.

Given the emerging nature of this trend, there are few standards or best practices on suitable metrics or their target value. This is primarily because measuring the complex concept of sustainability is challenging for several reasons, such as: 1) lack of transparency across the value chain, 2) limited data available that is relevant and reliable (silenced data, green and rainbow washing, collection/measuring difficulties), 3) complex relationships across its three dimensions that are not yet fully understood.

In addition, not adequately accounting for the value associated with sustainability performance (i.e., over-reliance on profit-oriented metrics) can also severely undermine resilience in global supply chains. Breaches in both social and environmental performance (e.g., severe violations in human rights on factory floors, or toxic spills related to waste management) amplify risks, undermine credibility, and ultimately reflect on business performance. For this reason, sustainability and resilience along global supply chains are deeply intertwined.

Consequently, systematically integrating sustainability in global supply chains calls for a long-term, iterative, and collaborative approach to, over time, develop solid metrics that adequately value sustainability. In turn, this calls for an effort to re-define /re-design value when accounting for supply chain 'performance'.

Redesigning value from a sustainability (rather than profit)-oriented perspective commands a dis-aggregation of the concept into its three dimensions: people, planet, profit, the so-called 3Ps, often treated separately. Real life cases reveal, however, that the three elements do not always align in an automatic manner, and significant trade-offs often exist. Therefore, in light of new regulations and consumer pressures, also businesses realize the urgency for more strategic efforts to 1) understand the interrelations, 2) identify the conditions that allow progress (optimize) along all three dimensions, 3) weigh the importance of various objectives when there are trade-offs, and 4) integrate across the three dimensions in business models accordingly.

The development of shared value requires therefore an experimental methodology, and the Lean Startup approach (Ries, 2011) seems to be a good fit for this purpose. Based on this approach, Value Design can be broken down into 3 phases in a closed loop system: 1)

Define objectives (Build); 2) Gather data (Measure); 3) Identify value (Learn).

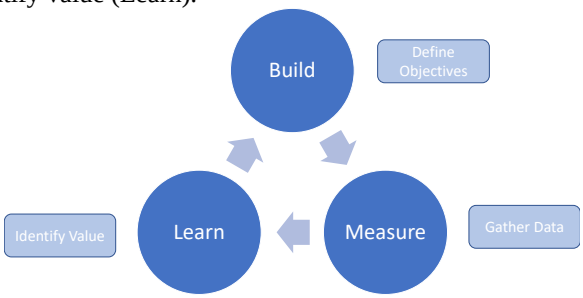

Figure 4. Value Design Loop.

Objectives are defined using the SMART Objectives method (Doran, 1981), which means each objective must be: Specific, Measurable, Achievable, Relevant, Time-bound. And each objective must be documented by its: name, description, metric, target value, and Timeline. This approach aligns well with the Balanced Score Card (Kaplan & Norton, 1996).

Gathering data ensures that all relevant data is collected from the different supply chain ecosystem partners and managed on a supply chain data space. The challenge emerges from the collaborative effort required to collect and share relevant data across sustainability and resilience dimensions of supply chains (i.e., across the ecosystem). Some of the solutions to these challenges are more technological, while others are more strategic/organizational. It is therefore important to learn from initiatives that have already made progress towards collaborative sustainability data collection, validation and action, such as Fair Labor Association, CDP, Responsible Business Alliance, Better Buying Initiative, or WikiRate.

A case that illustrates such efforts to measure value is the collaboration between Supply Impact and Ulula to assess performance of businesses not merely in financial terms, but also with respect to environment and social impact. The objective of this collaboration has been to:

1) identify a set of metrics for social and environmental impact along the supply chain that are specific, measurable, achievable, relevant and time-bound (SMART),

2) promote inter-comparability of the metrics over time and across entities at global and EU level, particularly within same sectors and size categories;

3) facilitate data collection and enhance its reliability; and

4) enable analysis of complex interconnections across financial, social and environmental performance, thus shedding light on synergies, overlaps, as well as potential trade-offs that exist across them.

We have been working towards achieving these objectives by developing a digital ESG assessment and reporting tool that combines self-assessment questionnaires (SAQ), worker voice platforms, and stakeholder engagement.

The SAQ was designed to collect data that (a) conforms with major existing and emerging sustainability reporting initiatives, like the Global Reporting Initiative and the European Sustainability Reporting Standards, to promote standardization, and (b) meet conditions set for semi-SMART metrics, with the realization that getting to SMART measures will most likely be the result of an incremental process whereby entities get better at data collection and management.

Worker Voice platforms play are important for increasing compliance. Some data, particularly in the social realm, is intrinsically difficult to quantify and requires more innovative measures (such as surveys, audit support, mobile apps, feedback reporting). An example is harassment that is difficult to quantify intrinsically. Designing even a simple worker survey that collects information regarding their experiences at the workplace, can serve to achieve a measure that is relevant (SMART); e.g., the share of women workers who experienced sexual harassment. The worker voice element can also be built into the tool to increase the reliability of environmental data.

Finally, the stakeholder engagement aspect of the Supply Impact/Ulula tool was designed not only to select those social and environmental dimensions that are prioritized for the value of the company, but also to facilitate the selection of targets and timelines to achieve changes.

Such a tool would allow businesses to analyze and better understand complementarities, overlaps and trade-offs that exist across the 3Ps at various stages of the supply chains, thus facilitating the promotion of sustainable (and resilient) supply chains.

4. People

The success of any collaboration ecosystem heavily depends on the people who will use it to facilitate the adoption of sustainable and resilient practices. In establishing the platform, we will consider human and organizational behavior factors and, more specifically, peoples' 1) knowledge, 2) skills, and 3) attitudes needed to build sustainable and resilient supply chains.

First, we see the need to develop a shared understanding of the concepts of sustainability and resilience. Having a common understanding is essential for a successful collaboration in building sustainable and resilient supply chains (Scholten & Schilder, 2015). However, while organizations increasingly appreciate the necessity to share knowledge about sustainability and resilience practices and strategies, confusion about the theoretical concepts of sustainability and resilience and how they relate to each other exists (Negri et al., 2021). To jointly develop best practices that can simultaneously improve sustainability and resilience in supply chains, a shared definition for both concepts needs to be established. Similarly, clarifications should be made about the practices that will improve both sustainability and resilience at the same time.

Building on the proven concept of MOOCs, a shared e-learning platform may be used to facilitate knowledge acquisition and knowledge sharing about theoretical concepts and relevant practices.

Secondly, we see the need to develop peoples capabilities to build sustainable and resilient supply chains. One of the barriers to develop strategies and practices for sustainable and resilient supply chains is a lack of training and development (Negri et al., 2021). This is, to a large part, due to the fact that little is known about which skills and abilities are required. Hence, within the proposed ecosystem, the skills should be jointly defined that people in different roles need. Extrapolating from other literatures such as innovation, organizational learning, and resilience, we argue that creativity and innovation, critical thinking and reflection, decision-making, and risk management are probably amongst the key skills needed in the context of sustainability and resilience.

People might also be trained to facilitate team adaptation and team learning processes such as retrospectives and project reviews, which help learn from disruptions and routine breakdowns and to come up with innovative ideas on how to improve sustainability and resilience in the supply chain (Knipfer & Kump, 2022; Scholten et al., 2019).

The proposed e-learning platform can be used to train the skills required to build sustainable and resilient supply chains and to establish a larger learning community to jointly advance best practices.

Third, we argue that while knowledge and skills are important success factors, people's attitudes leverage their commitment to action and decisions in favor of sustainability and resilience. For instance, sustainability is often considered as a threat or constraint rather than as an opportunity (Negri et al., 2021), and organizations often fail to learn from disruptions – both of which hinders the development of resilience (Knipfer & Kump, 2022). People's external motivation can be influenced by goals, objectives, and performance measurement. Intrinsic motivation, however, depends heavily on the mindset of people and is difficult to change. People need to be convinced that a sustainability and resilience mindset is key, not only for their daily work, but also for the health of people and our planet.

In our view, leaders play a significant role in shaping individual sustainability and resilience mindsets: They may communicate a shared vision that centers around sustainability and resilience aspects and empower their teams to bring this vision to life. At the same time, they can create the conditions for joint reflection about how to achieve sustainability and resilience and setbacks in implementing sustainability and resilience practices (Knipfer et al., 2018). They can develop trustful relationships for learning and innovation in the entire supply chain where routine breakdowns, disruptions, and failures can be discussed openly with each other to learn from them (Knipfer et al., 2018). Finally, they will act as role models in facilitating the adoption of sustainability and resilience practices; if they explicate their own sustainability and resilience-related values and what is important for them personally, this might motivate their followers to follow them suit (Pircher Verdorfer & Peus, 2020).

The proposed e-learning platform should therefore put emphasis on training and development of leaders as they are important catalysts in establishing a sustainability and resilience mindset in people who are involved in either building or adopting sustainable and resilient supply chains.

5. Data

Data is not the new oil anymore. Data is more like sunshine, abundant and unlimited in its potential. But it needs to be "harvested" and shared. While enterprise-wide data sharing is already complex, data sharing across an ecosystem is a significant challenge.

The most crucial part is to associate value with data and design corresponding business models around it. Data sharing in a business context should not be an act of kindness or altruism, but based on economic reasoning. While physical products usually have a defined and agreed price, we are still in the early days regarding price tags for data. Established revenue streams from data sharing are needed to cover the often-

underestimated data engineering efforts of the data owner.

The most important data points to fight climate change are the Greenhouse Gas emissions measured in tons CO2e. They can be seen as an additional currency in addition to financial dimensions like revenue and profit. Mechanisms like (internal) carbon pricing are an established method to integrate the emission reduction target with common financial practices. It is important that the emissions are not just reported but that they are acted upon. While this seems to be a standard wisdom of business intelligence, many companies are still struggling to distill insights from their sustainability reports and act upon them. The widely adopted Science Based Target Initiative (Science Based Target Initiative, 2022) is providing support to define meaningful targets to achieve the net zero goals.

Equally important to the data itself is their contextualization. Metadata management therefore is a mandatory capability for people and technology. An example is the consolidation task of carbon emissions across the supply chain. The applied evaluation method, the survey date and certification status are examples of required input parameters to receive a valid and certifiable result. As these results are part of important decisions further downstream this data has to be trustworthy.

Trust needs transparency. But the transparency has to be well balanced as the partners of the ecosystem usually act in co-opetition. Initiatives like Catena-X (Catena-X, 2022) for the automotive industry and Estanium (Estainium, 2022) for a wider industry are in the process of defining this balance of trust, transparency and privacy. All of these initiatives are based on the fundamental achievements of the International Data Spaces Association. One of the most important aspects are the roles defined in the International Data Spaces Reference Architecture Model (IDS-RAM, 2022). A clear understanding is key to be able to design a system of systems and allow evolving business cases without breaking changes.

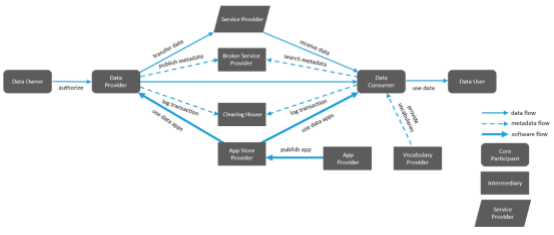

Figure 5. Roles and interactions (IDS-RAM, 2022).

As mentioned in the previous chapters, the value design loop involves continuous learning and thus needs leadership. Leaders must support new forms of collaboration and instill confidence that mistakes are part of the learning process. In some situations, corrections have to be shared. They must be accompanied with explanations for the modifications. This is already an established practice in corporate sustainability reports, e.g. scope 3 increases for previous reporting years due to increased system scopes. In other situations, un-sharing of data is mandatory. The underlying technology must provide capabilities to revoke data access in order to remove this data from the ecosystem data space. The digital nature of data makes this much more complicated than re-collecting physical products.

For the technical implementation of data sharing several technologies can be considered. One fundamental design aspect is the intended openness and decentralization. When striving for a high degree of decentralization blockchain technologies might be appropriate. But rebound effects must be taken into account: Technologies like Ethereum have a significant carbon footprint itself (Statista, 2022) and therefore can conflict with the intended carbon savings.

6. Processes

Sustainability only becomes real when it comes down to processes. So-called Green Business Process Management (vom Brocke, 2014) acts as an enabler of the sustainability strategy and helps create action. Green Business Process Management (GreenBPM) anchors sustainability in the organization and its supply chain by integrating it into business process management. In the following, we will elaborate on the central role of processes in all the SCSRA solution layers and underline the relevance of processes in the areas of supply chain sustainability. To illustrate the role of processes in global supply chain sustainability and resilience, we will take examples from high-impact supply chains as listed by the World Economic Forum and look at them from different points of views.

Processes, also known as operations, build the heart of every business and are key to everything a business does. Business value and the business model rely on the execution and implementation of effective and efficient processes. In the business model canvas (Osterwalder, 2012), processes are depicted as key activities. In the Balance Scorecard (Kaplan and Norton, 1996), one of the key perspectives is internal business process. As Kaplan mentioned in this article on the Balance Scorecard in the ESG Era (Kaplan and

McMillan, 2021): “The one perspective that needs no redefinition is process, critical to deliver value and allow the triple bottom line objectives to be achieved.”

A Green Business Process Management in the supply chain helps to build a cross-organizational, efficient, and transparent supply chain and consists of 4 areas of action.

Figure 6. GreenBPM action areas for sustainable supply chains

- Environmental Management considers the impact of the overall product lifecycle has on the planet, e.g. scope 1 to 3 emissions, water consumption and waste creation.
- Social Management show the overall supply chain interacts with society and how it contributes to the society related UN Sustainable Development Goals.
- Risk & Compliance Management: As an increasing number of sustainability risks appear and regulations are directly impacting the supply chain, organization must assess their operations on ESG criteria.
- Stakeholders Management: As sustainability is key to a brand’s reputation and value, all stakeholders, including consumers, employees, and NGOs need to be taken into account.

Supply Chains, shaped by processes, are responsible for a big chunk of global emissions, as show for example in an analysis of the Boston Consulting Group.

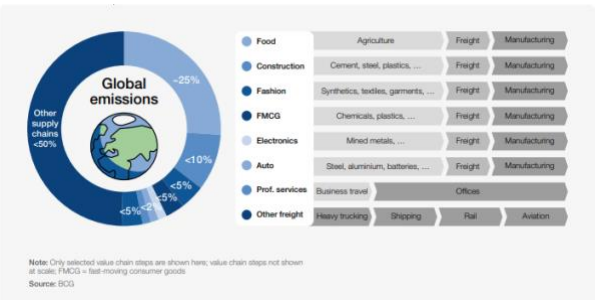

Figure 7. Eight supply chains are responsible for more than 50% of global emissions

As a case study in Green Business Process Management, a major Brazilian producer of eucalyptus pulp used for manufacturing paper and cardboard was lacking process clarity in its supply chain while urged to act on a sustainable forestry process cycle. Reworking its supply chain to establish a transparent and centralized repository helped the company to create an integrated process view for its overall supply chain including both customers and suppliers. It simplified complex supply chain processes from farm to customers and even set guidelines for working with ethical suppliers and simplified compliance with ESG regulations. Based on a central process repository the company monitors KPIs towards its sustainability goals and an efficient and resilient supply chain.

7. Business Model Innovation

Building and innovating business models for and upon sustainability in supply chains is a challenging endeavor, mostly because sustainability creates value in terms that are not typically optimized for by classical business models. We need to go beyond direct commercial impact that defines value as “revenue minus cost” (Profit) and take the overall 3P (incl. Planet and People) into account. The capturing and measurement of value creation needs to happen in a different way, looking at different KPIs while using the right quality and quantity of data and then tying it back to profit terms, which will still be required for each business model to be viable, taxable and investable.

Ecological/social sustainability value can generally be created following two drivers: Consumer demand, meaning consumers only buy from sustainably acting companies, and legal compliance, meaning companies will be punished – e.g. with CO2 taxes or fines – if they don’t act sustainably. As mentioned in previous sections, the data to measure if a player in the supply chain acts sustainably is of utmost importance.

As a working assumption for the regulatory and environmental boundaries within which a business model operates, we can suggest a far-reaching yet simple approach to making sustainability count: Assuming the government takes all corporate profits along a value chain away (e.g. with a 100% tax rate) and distributes them back to the players in that value chain according to their contribution to sustainability, thus translating 0% or 100% of sustainability achievement into 0% or 100% of profit capture. The economic value of the overall industry pie may not get bigger if sustainability is achieved, it may be distributed differently across players though.

While sustainability is typically an external factor a business model optimizes for, because it is important for an external party (customer or regulator), resilience is an innate need of each player in the supply chain and, thus more readily optimized for in a business model.

Two questions should be discussed in this section:

1) How does and how should a business model be defined and configured, that takes sustainability into account?
2) How can these business models be further innovated to continue to stay relevant in a world where sustainability definition and requirements are constantly evolving?

Business models are traditionally defined by describing their main aspects in a Business Model Canvas (BMC). Originally designed by (Osterwalder, 2010), the BMC captures the main external (such as customer needs) and internal (such as processes) components of a business model in a very concise, abbreviated, and focused way, ideally on one page (the canvas). It is primarily a tool for communication and focus. It is a self-evident question whether the traditional (Osterwalder-)way of thinking about and defining business models is still relevant or even viable in the light of sustainability requirements in supply chains. While we may need to add a few additional sections, e.g. "Contributions to Sustainability", the skeleton of a business model will have to remain intact, as the main constituents (customers and their needs, partners, processes) and stakeholders providing financial viability (investors, tax authorities) will, albeit adding sustainability to their needs, still follow basic economic rules.

In defining a starting point for a sustainability-driven business model, and combining all aspects addressed in the previous chapters in this paper, we are trying to provide a first "build" for the build-measure-learn cycle. Key to sustainability -based business models' own resilience is their ongoing evolution. As of today, an initial business model can be built as a starting point, but we already know that we don't know what requirements will need to be fulfilled in 5-10 years' time. So, building a muscle for ongoing innovation is even more important than trying to get the business model right once now.

As outlined in the beginning of this section, optimizing for sustainability may contradict classical profit-oriented optimization objectives of business models and, thus, may not be very welcomed by existing organizations. An important organizational enabler for innovating these models is the separation from the core business in a way that allows them to emerge and grow. We call this approach excubation (Anding, 2016).

Given that innovation works best when it is somewhat separated from the core business, it is a challenge to drive business model innovation of the supply chain, which is deeply engrained within the core business. Nonetheless, the level of innovation required here is transformative, not incremental. The magnitude of changes needed to not only renew the way value is created and measured, but also taking a whole new externally focused perspective and involving a whole ecosystem, mandates an innovation approach akin to the way startups innovate. The organizational setup to deliver startup-like innovation is characterized by a small team, tight timeline, short iterative development cycles to deliver a bookable MVP and generate measurable value (typically: revenues, potentially: CO_2 reduction) after a few weeks, not months or years. Actual resilience of a business model is achieved by creating a high level of adaptability and fast build-measure-learn cycles, not by creating a deterministic, strong impenetrable structure for eternity.

A case study shows how this can work in practice: When the Swiss industry conglomerate ABB decided to extend their footprint within the electric vehicle value chain into B2B fleet management software for EV fleets, they decided to do so with a dedicated separate legal entity. B2B software is quite transformative for a hardware-based industry player and requires a very different approach to the business model, product development, go-to-market, even team build-up. In a very customer-centric and iterative way, the venture developed a value-creating product portfolio and effective way to sell it to previously unknown customers. It turned into a companion for managers of electric fleets and was named Panion (Panion, 2022). While being closely connected to ABB as the holding company, Panion hired its own team, built its own processes, made mistakes, and corrected them. One

important step ABB took, when setting up the venture, was hiring a very capable and startup-experienced CEO and CTO tandem to lead the venture in a very entrepreneurial way from day one. Also, a specialty consulting company was brought on board as a venture builder with a ready-to-go team to kick-start venture build-up for the first 12 months.

Setting this up in an ecosystem context with a high number of partners involved (e.g. Catena-X of the automotive industry) is challenging and may fail the traditional (alignment and error-avoidance) needs of a large corporation. Thus, delivering business model innovation in this context requires first and foremost top management understanding and support for a novel innovation approach. If this can be achieved, revamping the supply chain for sustainability is a real possibility.

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