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Navigating Supply Chain Multiverses: The colliding worlds of ESG and Product Compliance Reporting, implications for reporting across global supply chains

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Abstract:
Companies that place products onto the marketplace, whether they are internally manufactured or sourced from a supply chain face ever increasing requirements to provision data, wherever the products are sourced and transported from, manufactured, and distributed at applicable local, regional, and global levels.

The Product Compliance world considers product safety and regulatory compliance activities. The Environmental, Social, and corporate Governance (ESG) world considers a much broader range of sustainability and social development related activities, performed at a corporate level. ESG reporting was originally developed within the financial sector by investors to aggregate a given organisation reporting against ESG related topics.

The European Union (EU) has been implementing additional EU ESG reporting requirements, in the form of several directives and regulations flowing down from the EU Green Deal (EC, 2019), which aligns all it's actions against the EU 2030 Climate Target Plan (EC, 2021a), this includes EU Capital Markets Action Plan (EC, 2020a), which includes direct intervention in the financial sector, requiring EU financial sector to adhere to the new EU ESG reporting requirements when providing financial services to industry. As a result, companies within the EU will need to adhere to these new EU ESG reporting requirements, which include reporting at economic activity and product level, to obtain investment from the EU financial sector, hence a significant additional burden of reporting will be placed against global supply chains in a significantly different manner to traditional ESG reporting, resulting in the collection of data and reporting linked to economic activities and at the product level, fusing the worlds of Product Compliance and ESG reporting. Existing systems and standards will need to be updated to reflect the granularity and accuracy of data to be reported.

This paper contributes to existing literature by identifying a research gap in understanding the emerging ESG reporting requirements globally, and their resulting implications in terms of supply chain data collection and ESG reporting requirements. The outcomes of this paper support the development of organisational action plans to implement systems and solutions to enable adherence to the new requirements.

Keywords: Product Compliance, Environmental Social and corporate Governance, ESG, Product Health and Safety, Environmental Health and Safety, Regulatory Compliance, Sustainability, Product Design, Product Stewardship, Circular Economy, Carbon Footprint Analysis, Substances of Very High Concern, Corporate Strategy, Supply Chain Reporting, Corporate Cohesion, Forced Labour; Corporate Identity; Ethical Identity, Environmental Management.

1.0 Introduction

Classic economic theory presents the view that economies emerged from simple bartering, exchanging one article for another article, evolving to articles being exchanged for precious metals such as gold and silver, evolving over millennia, to exchanging goods in return for a financial reward, across different actors within a supply chain (Gale, 1960; Porter, 1980; Porter, 1996; Porter, 1998; Smith and Cannan, 2003; Keynes & Keynes, 2017). Industry exists to generate profits and return some form of economic return for shareholders.

Supply chains can be described as a collection of actors, trading goods and services with one another. The flow of goods can entail multiple actors utilizing raw materials (chemicals, mixtures, materials), to produce goods, which may potentially be consumed by other manufacturers to produce different goods or sold as is (Skinner, 1978; Porter, 1980; Johnson and Scholes, 1988; Min and Zhou, 2002).

Chemical substance development gathered pace following the end of the second world war, resulting in vast amounts of new technologies, new products and ever increasing consumption of new chemicals being introduced with limited or simplified product testing being undertaken, it was a period in which little regard was paid to registration of new chemical substances, where regulators were in a reactionary mode, in terms of hazards being publicly identified resulted in detailed investigation and control measures being applied. As a direct result of the Thalidomide and Asbestos scandals, chemical regulations first began to appear from the 1960's (EC, 1967; EPA, 1976). Today, numerous chemical regulations have evolved globally most notably from California Prop 65 (OEHHA, 1986); EU Registration, Evaluation, Authorisation and restriction of CHemicals (EU REACH) (EC, 2006), EU Classification Labelling and Packaging (EU CLP) (EC, 2008; EU, 2018), EU Restriction of Hazardous Substances in electronic and electrical devices (EU RoHS) (EC, 2011), EU Biocidal Properties Regulation (EU BPR) (EC, 2012), which have been necessitated by the sheer volume of new chemical substances being generated on a daily basis, as of Q2, 2022, the number chemical substances registered on the main CAS database of substances stood at 192 Million (CAS, 2022).

Figure [1] shows a high-level correlation between increasingly new technological advancements bought on from an ever-increasing number of chemical substances, leading to increasing identification of industrial emissions, resulting direct and indirect control measures being applied to offset emissions. Some examples direct measures include national, international, global treaties and regulations, for example: UN Globally Harmonized System of Classification and Labelling of Chemicals (UN GHS) (UN, 2002); UN Sustainable Development Goals (SDGs) (UN, 2015b), EU REACH (EC, 2006), EU CLP (EC, 2008; EU, 2018), EU RoHS (EC, 2011), EU BPR (EC, 2012). Some examples of indirect measures include California Prop 65 (OEHHA, 1986), UN Global Compact (UNGC) (UN, 2000), EU Ecolabel (EC, 2022d), EC Horizon 2020 and Horizon Europe sustainable investment projects (EC, 2022e; EC, 2022f).

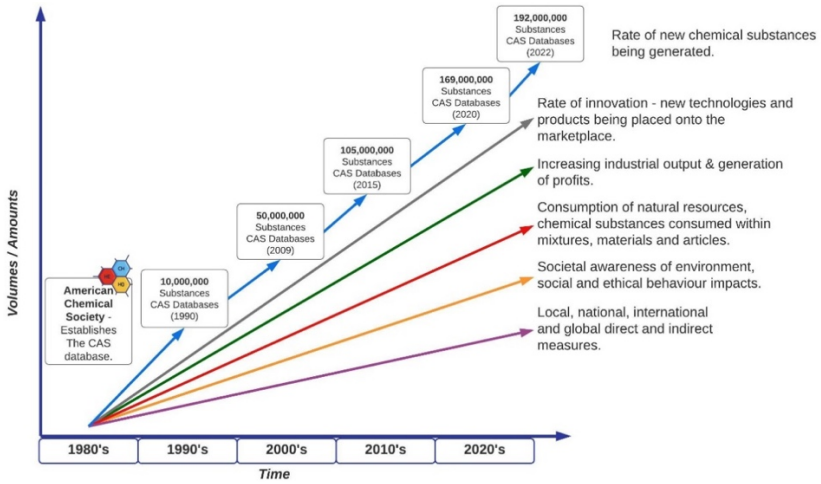


Figure 1: Overview of new chemical substances being generated, innovation, emissions

The focus of traditional supply chain management has been to effectively: (1) outsource manufacturing to the lowest cost centres; (2) develop closer ties across the supply chain to integrate suppliers into product manufacturing, research, design, and development; (3) become reactive to emerging compliance reporting needs, such that as new reporting obligations arise, contractual agreements are placed upon applicable supply chain tiers, to provision the required information.

Modern industry depends upon diverse global supply chains, where multiple actors provision products and services, utilising resources (raw materials, energy, people), which may be distributed across national and international boundaries. As products and services are placed onto the marketplace, organizations are then faced with an ever-increasing demand to report against complex reporting requirements, from a diverse set of national and international reporting requirements, as shown in Figure [2].

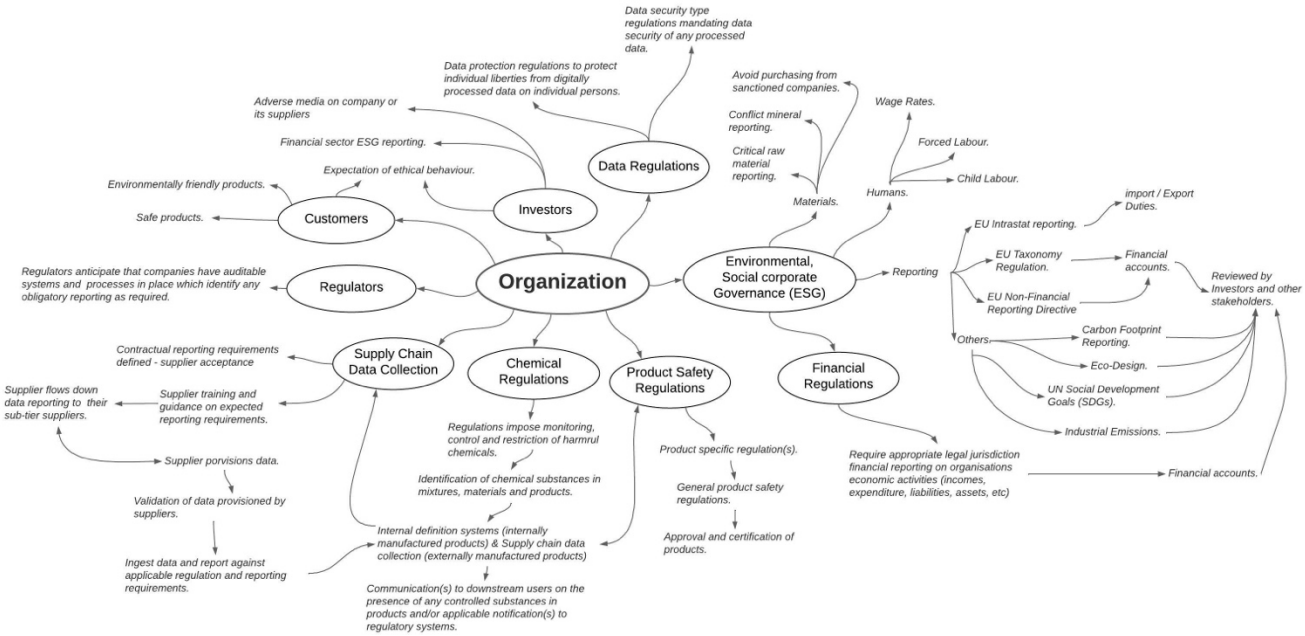


Figure 2: Organizational reporting burdens

Emerging global reporting requirements, particularly in the Environmental, Social, corporate Governance (ESG) space, facilitate the need for increased reporting of supply chain information, at a product level, as

opposed to the traditional corporate level reporting undertaken for data on critical raw materials, emissions, force labour, human rights, conflict minerals and sustainability indexes. Performing any form of supply chain reporting is often seen as being a 'non-value added' activity which is often viewed as a necessary evil to enable products and services to be placed onto the marketplace, rather than something which should be incorporated into the overall corporate strategic direction for an organization. Organizations which understand, adapt and align existing data collection and reporting systems in line with the new and emerging ESG reporting requirements, will indeed face great challenges, which, when overcome and reporting is aligned to the data on the actual products being manufactured, as opposed to summarised organisational level reports, then, those same organisations will emerge in a much stronger position in being able to grasp the additional opportunities, as a result of lowering the use of any hazardous chemicals within products, enabling greater circularity by supporting both clean recycling and lowering emissions, as well as enriching the social conditions of both direct employees and in-directly across a given supply chain by enshrining the same mandates for all supply chain actors.

A fusion in organisational decision-making processes needs to occur which supports the extended ESG reporting requirements, enhancing, or encompassing product compliance initiatives, which focus on product safety and reporting of hazardous chemicals at the product level, within the ESG reporting realm. Both product compliance reporting and ESG reporting needs, must be enshrined into the forefront of all organisational corporate strategic decision-making processes to effectively identify any areas of potential risks identified by both from product compliance reporting ESG reporting activities.

2.0 Purpose

The goal of this research paper is to examine the emerging global regulatory horizon which shows an emerging fusion between the worlds of ESG and PC. This technical paper is organized to address the following research questions:

1. What is Product Compliance (PC)?
2. What is Sustainability?
3. What is Product Stewardship (PS)?
4. What is Corporate Social Responsibility?
5. What is Environmental, Social, and corporate Governance (ESG)?
6. What Are the Emerging Trends in ESG Reporting**?**

This paper is structured as follows: research methodology section defines the research approaches undertaken; findings section shows the outcomes from the literature review; discussion section outlines proposed approaches to deal with the anticipated global supply chain reporting burden as a result of increasing fusion between the worlds of PC and ESG; conclusions show the main outcomes of this technical paper and areas for potential further research.

3.0 Research Methodology

The research methodology adopted for this research paper consisted of: (1) identification of literature in scope (Tranfield, et al, 2003; Kable, et al., 2012), resulting in the identification of keywords, performing a literature search using Google Scholar and Scopus search engines; (2) the subsequent literature search was conducted using the following specific search terms 'product compliance', 'environmental social governance', 'ESG', 'environmental' 'circular economy', 'sustainability' and 'corporate social responsibility'; (3) with the search engine results being down selected, filtered down, analysed and results presented in the findings section. The adopted research methodology is shown in Figure [3].

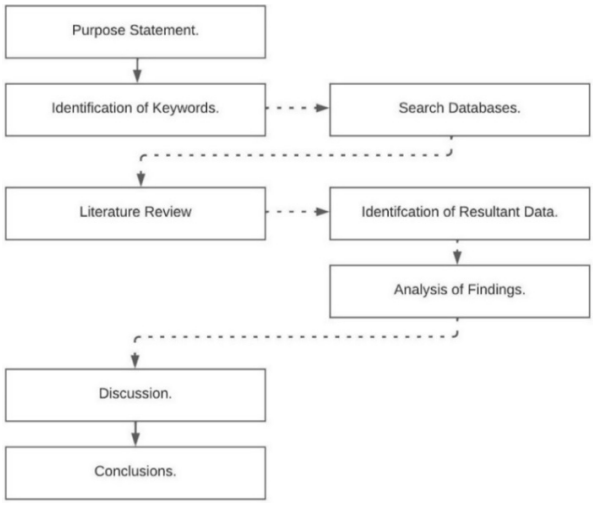


Figure 3: Adopted research methodology

4.0 Findings

4.1 What is Product Compliance (PC)?

Product compliance reporting considers the due diligence activities undertaken by product manufacturers in relation to meeting mandated legal requirements to enable products to be placed onto a marketplace. The traditional pillars of product compliance are shown in Figure [4].

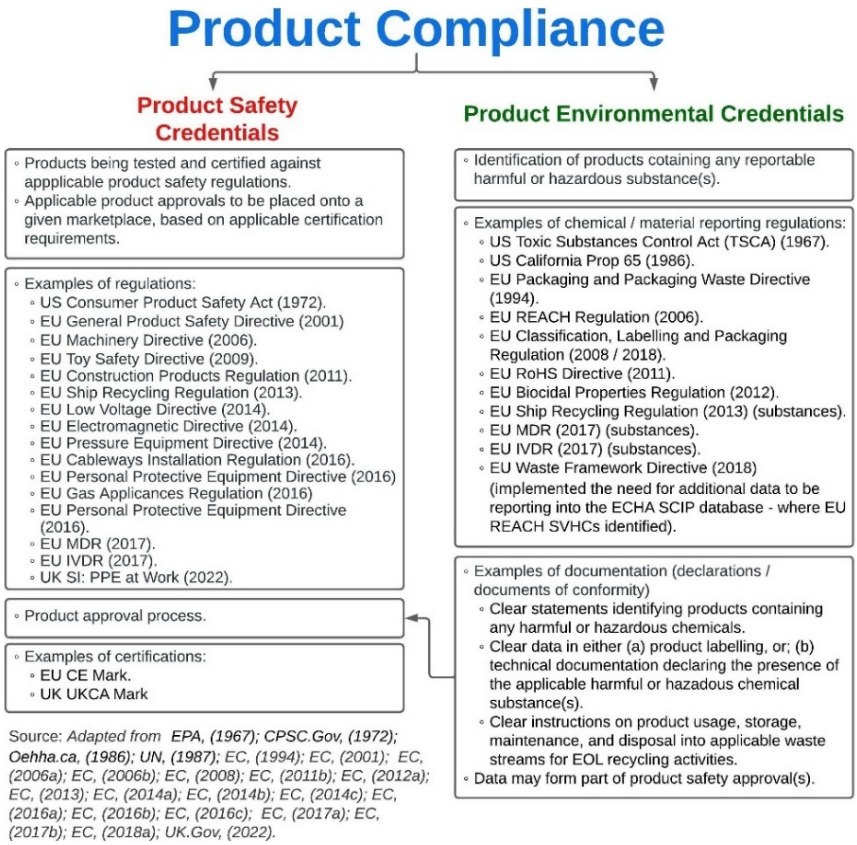


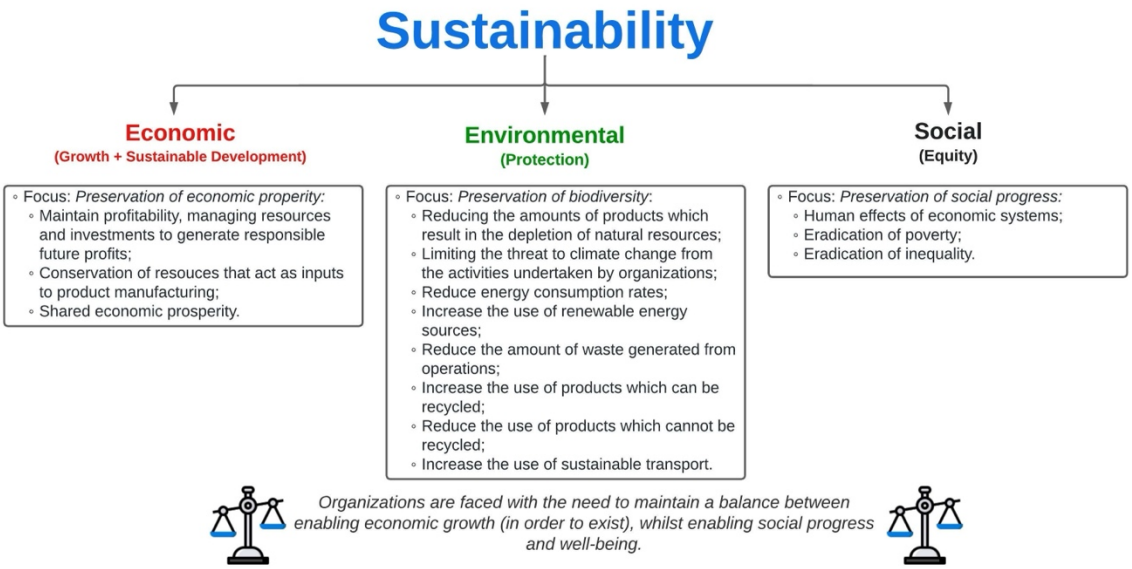
Figure 4: The Traditional Pillars of Product Compliance

Organisations that fail to comply with product regulations, placing non-compliant products onto a marketplace, may find themselves liable for regulator actions which may include potential: (1) loss of

market access for products, leading to a loss in market share and revenues; (2) legal action(s) from regulators; (3) financial penalties imposed by regulators.

4.2 What is Sustainability?

Prior to the publication of the Brundtland report (WCED, 1987), the focus of modern day supply chain management activities was seen as being related to the: (1) mass production of products at the lowest possible costs; (2) the key to being successful was seen as pricing products cheaper than competitors in the marketplace; (3) little regard was paid to storing and recycling waste production materials; (4) products were designed with defined lifespans; (5) limited end of life product recycling was being undertaken, and; (6) product functionality and safety formed the basis of internal products reviews. The Brundtland report (WCED, 1987) highlighted issues with the traditional linear economic model based on mass production resulting in increased pollution and a rapid depletion of natural resources, outlining the key areas as shown in Figure [5].



Source: *Adapted from WCED, (1987).*

Figure 5: The traditional pillars of sustainability

The simplest definition for sustainability comes from the Brundtland report (WCED, 1987) *'meeting the needs of the present without compromising the ability of future generations to meet their needs'*. Sustainability results in the examination of all organizational activities both in the short-term and long-terms, to ensure strategic decision-making processes align with determination to make sustainable choices, considering the wider societal and environmental implications, in order to maintain planet's existing ecosystems, which if left unchecked, will result in loss of natural resources, increased pollution resulting in climate change issues in the future.

4.3 What is Product Stewardship (PS)?

Product Stewardship (PS) is evolved during the 1990s as industry started as examining the health, safety, environmental and social impacts of a product across its life span (Bennett, et al, 2018). PS provides a methodology for organisations to assess the risks and impacts related to all activities related to product manufacturing (internal and external), ensuring adequate measures are in place to manage the environmental impacts of different products and materials and at different product lifecycle stages in terms of initial design, prototyping, release into production, consumer use and End-Of-Life disposal. These activities may be mandated or voluntary reporting via regulations, standards, or initiatives. PS by its very

nature, needs to be engrained into mandated gated reviews for products from conception through to EOL and potential recycling activities, PS needs to be embedded within core strategic decision-making processes as it calls for the need to examine all activities in relation to manufacturing products.

4.4 What is Corporate Social Responsibility?

Corporate Social Responsibility (CSR) a concept that first arose during the the 1950's and 1960's (Bowen, 1953; Friedman, 1970), where there was conceptual belief that industry should act more in responsible ways towards society and the environment, not purely existing to generate economic gain for its stakeholders, became a catalyst to motivate industry to adopt broader sustainability strategies. Conceptual CSR methodologies first started to appear around the same time as PS first emerged, encompassing a wider set of reporting topics, as industry started to fuse the concepts of being both environmentally and socially friendly could potentially result in both an increase of brand awareness, maintaining and growing market shares, resulting in the potential for premium pricing then being applied to products.

4.5 What is Environmental, Social, and corporate Governance (ESG)?

Environmental, Social, and corporate Governance (ESG) reporting arose within the financial sector from 2005, as a means of analysing organizational performance towards ESG related targets. Figure [6] presents a high-level overview of ESG reporting criteria.

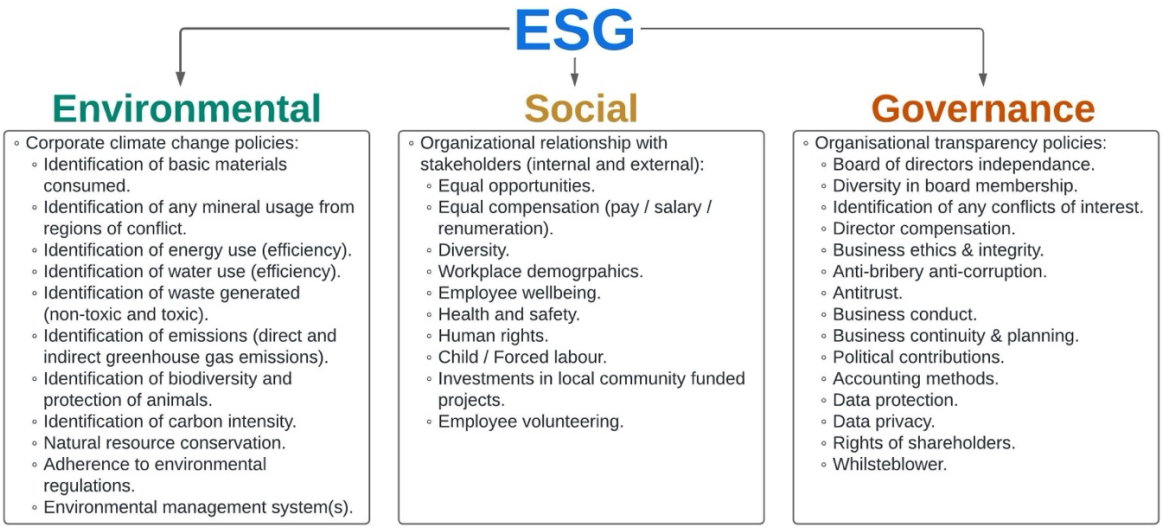


Figure 6: Examples of ESG reporting criteria

ESG was originally envisaged as a means of the financial sector encouraging organizations to make progress towards *'the common good'* objectives outlined within a given set of ESG reporting criteria, which typically contain some elements from the UN SDGs. The initial state, ESG reporting logic was based on a perception that by encouraging industry to embrace ESG reporting, the ESG scores for a given organization would result in more investment flows to those organizations which achieved higher ESG ranking scores.

4.5.1 Understanding current state ESG ecosystems

Current state ESG ecosystems are shown in Figure [7] depict: (1) change initiators highlighting new impacts and risks; (2) ESG reporting requirements definers then reviewing and / or adopting relevant data presented by (1), which may then be applied to existing and future ESG reporting requirements; (3) financial intermediation chain ingesting data from industry; (4) industry provisioning data used by (3) to generate ESG ranking scores against applicable ESG index frameworks.

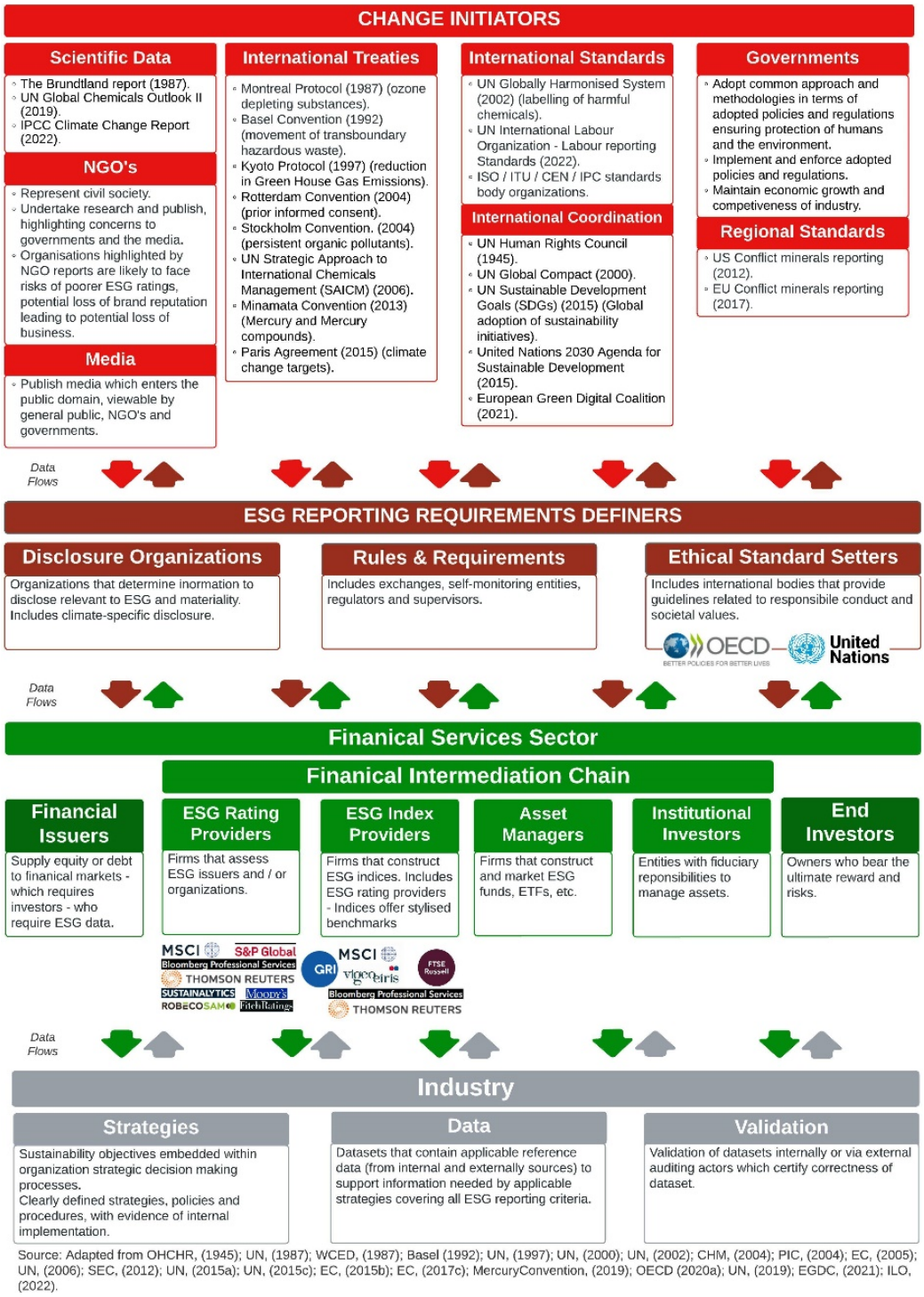


Figure 7: Current state ESG ecosystem(s)

4.5.2 Issues with ESG reporting

(1) As industry exists to generate an economic return for its investors, ESG presents industry with a paradigm of (i) maintaining the need to keep costs down; (ii) whilst attempting to appear as a good social actor, maintaining existing ESG ratings and assumed value to potential investors. This is in direct contrast, to organization strategic decision-making processes which invoke the need to maximize short-term gains, this in turn often results in a shift in mindset focus on short-term completion of minimal reporting which focuses on completion of PC criteria in terms of regulatory

reporting needs, which support placing products onto a marketplace as soon as possible, without any assessment of long-term impacts.

(2) Numerous ESG providers and ESG framework indexes: Existing providers and frameworks result in a patchwork quilt of reporting data derived from multiple sources, usually collected as a series of conformity assessments, external review, and assessment. With the sheer multitude of different ESG framework models, each requiring differing datasets, criteria, inherent flaws, and output rankings, which may not truly reflect how effective an organization has truly been in transitioning towards sustainability, ESG and circular economic targets against the backdrop of nations attempting to achieve their net-zero targets (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013).

(3) Greenwashing: A specific term used to denote an organizations sales and marketing literature which promotes the organization as being a good actor, acting responsibly in terms of its ESG obligations, in order to attract consumers to purchase products and services, which appear environmentally friendly, however in reality the organizations operations been acting in a far from responsible manner. Examples of greenwashing include activities such as: (i) tree-planting; (ii) using 'carbon neutral' gas, whilst still consuming vast amounts of natural resources as part of day-to-day operations; (iii) offsetting projects such as (i) and (ii) generate credits which are then counterbalanced against emissions such as carbon dioxide.

(4) Public availability of data, has enabled mass scrutiny of organizational behaviour with regular NGO and media articles highlighting the organizations actions, some examples of this include: (i) Deutsche Bank AG (Bloomberg, 2022); (ii) BNY Mellon (InvestmentWeek, 2022); (iii) KLM (Sky News, 2022); (iv) HSBC (eMarketer, 2022); (v) Coca-Cola (TechCrunch, 2022), and; (vi) Adidas (Daily Mail, 2022).

(5) '*Tick in the box*' mentality: Organizations adopting ESG reporting standards as 'tick in the box' type activities, where superficial efforts were made in terms of adoption of ESG criteria with limited factual data to support actual improvements happening, for example published policies, to obtain higher ESG ranking scores, with lack of depth in monitoring, enforcing and review of the underlying data.

(6) Lack of regulation of ESG rating providers and indexes has resulted in governments and states to review financial sectors and implement stricter rules on governance and data processing (Insiderengage, 2022).

(7) Corporate level summary reporting: Several ESG reporting frameworks consider ESG topics at a 'corporate' wide perspective, at an organizational level, for example in terms of policies and reporting of summary data. Whilst within the Environmental theme, data needed to be analysed at a per product level to understand the true environmental impacts of manufacturing products. Emerging ESG reporting trends are seeing a focus on reporting data at a per product basis.

(8) Specialist expertise: ESG reporting requires the ability to work with nuanced data, which requires a degree of investment in technology and dedicated expertise that may not exist within an organization.

4.6 What Are the Emerging Trends in ESG Reporting**?**

Following the Paris Agreement (UN, 2015a), increasing revalidation of activities needed to be undertaken to meet the agreed net-zero emissions targets, has resulted in a revalidation of ESG reporting, with specific direct interventions appearing within emerging ESG reporting requirements.

4.6.1 Europe

Emerging ESG trends within the EU are shown in Figure [8], where the top level strategic direction, is set by the EU Circular Economy Action Plan (EU CEAP) (EC, 2020a), which then established the (1) EU Green Deal (EC, 2019a) as the main core strategic plan, which; (2) defined the EU Climate Target Action Plan (EC, 2021a) as the key climate change targets which are then embedded as committed goals in all sub-level EU directives, regulations, standards, and initiatives, covering all ESG related topics and

establishing a new framework to coordinate reporting of hazardous chemicals in products, with enhanced reporting requirements placed on industry when attempting to import or manufacture products within the EEA.

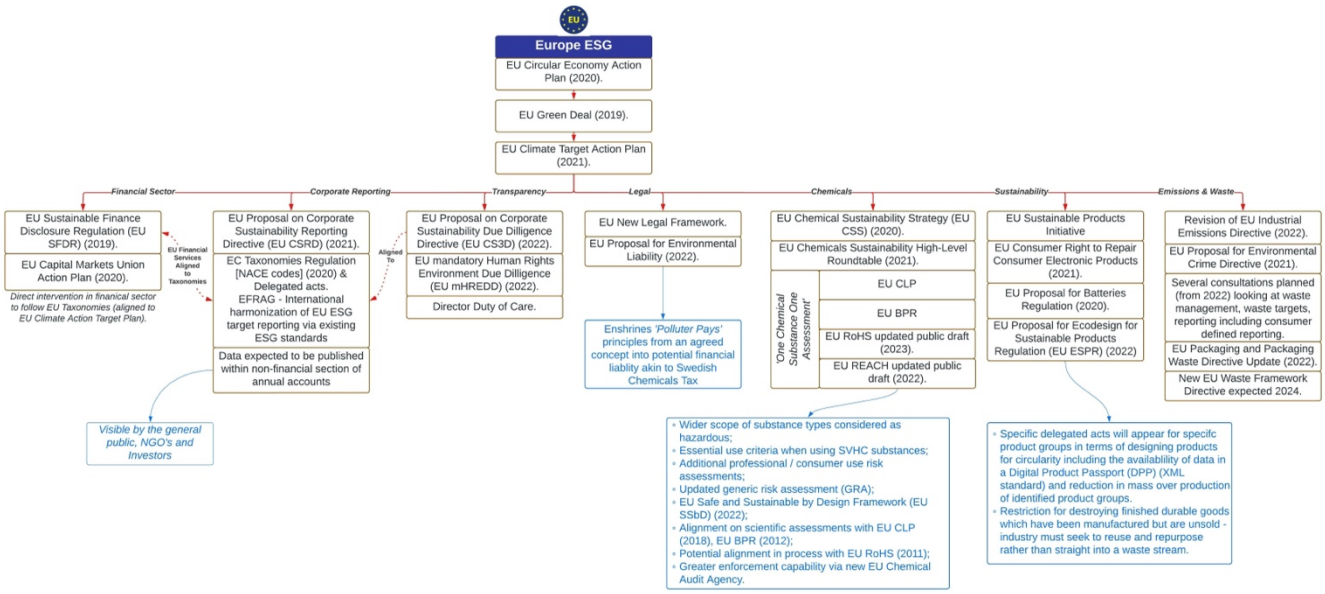


Figure 8: EU Emerging ESG trends

4.6.2 USA

Since the very start of the Biden administration (20th January 2021), several executive orders have been implemented with a strong focus by the US government to align itself with the Paris Agreement (UN, 2015a) agreed climate change targets. Figure [9] depicts examples of emerging ESG requirements appearing from the USA.

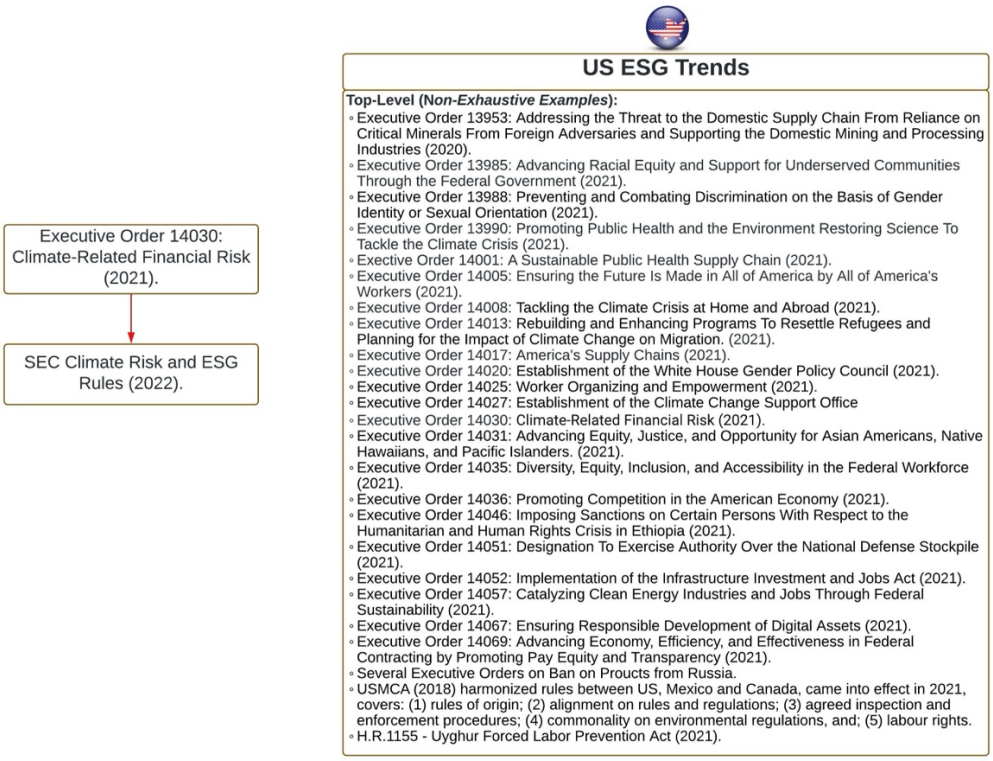


Figure 9: USA Emerging ESG trends

4.6.3 UK and China

From a solid pre-Brexit position of have implemented strong policies on social, anti-bribery and corruption reporting, the UK stalled somewhat during the transition phase prior to its formal withdrawal from the EU on January 31st, 2020. The UK government is in the process of establishing its own UK centered chemicals policy during Q4, 2022, which will bear some resemblances to certain key aspects of the EU CEAP (EC, 2020a), and EU Green Deal (EC, 2019a). China has started to require mandatory reporting measures. Figure [10] presents a summary view of UK and China ESG trends.

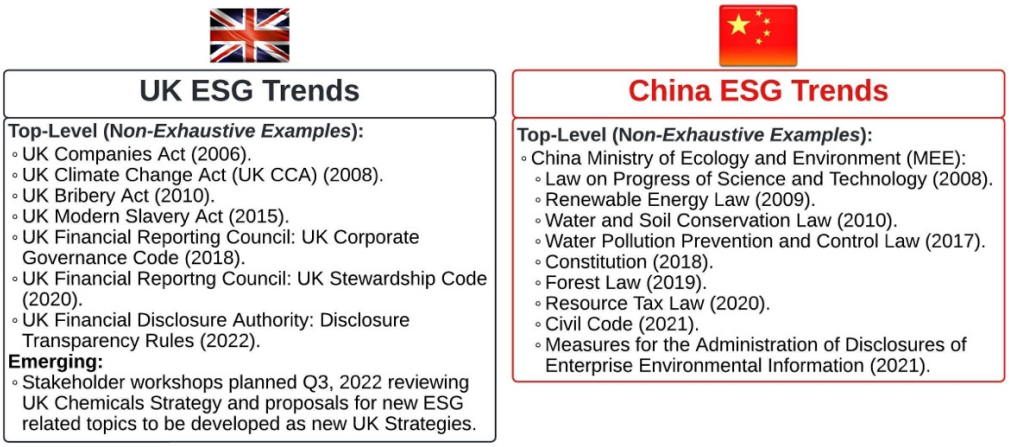


Figure 10: UK and China Emerging ESG trends

4.7 Summary

The evolution of strategies from sustainability, product stewardship, corporate social responsibility, through to ESG reporting is shown in Figure [11]:

Figure 11: Evolution from PS, CSR through to ESG. Source: Adapted from Takhar & Liyanage (2021).

Figure [12] depicts the colliding worlds of PC and ESG, where: (1) PC reporting is undertaken on a per product basis, with; (2) ESG reporting traditionally presents a summarized view of topics in a generalized corporate level report, where certain data points may reference product families.

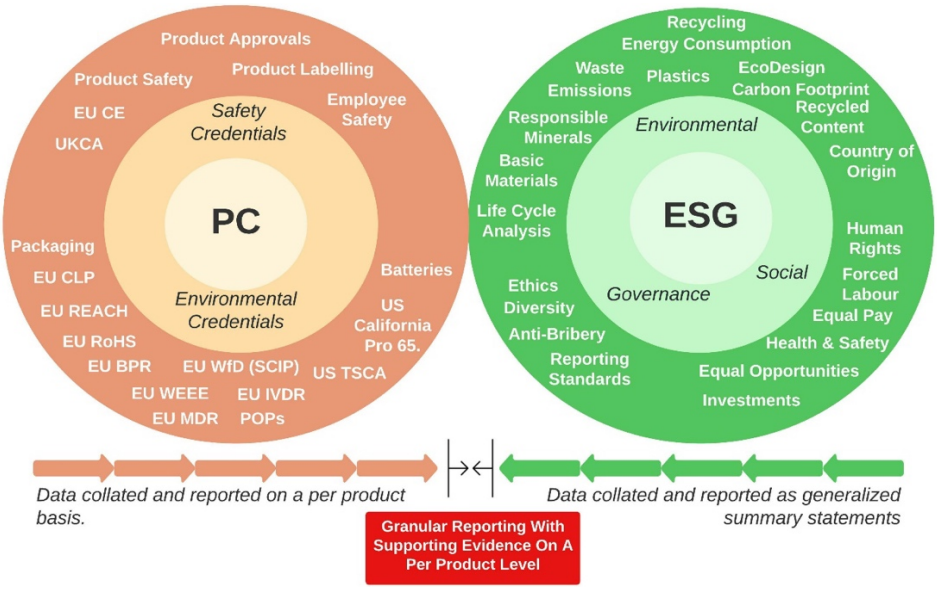


Figure 12: The colliding worlds of PC and ESG

As the evolution from PS through to ESG type reporting has arisen, this is has resulted in increased reporting burdens being placed upon industry to collect the required levels of data from internal sub-systems and external data collected from the supply chain.

5.0 Discussion

5.1 Understand your article transformation cycle(s)

Figure [13] presents the article transformation cycle, which describes the transformation of articles (products) from chemical substances, mixtures, and materials into articles which are distributed and then consumed and enter waste streams as part of End-Of-Life activities.

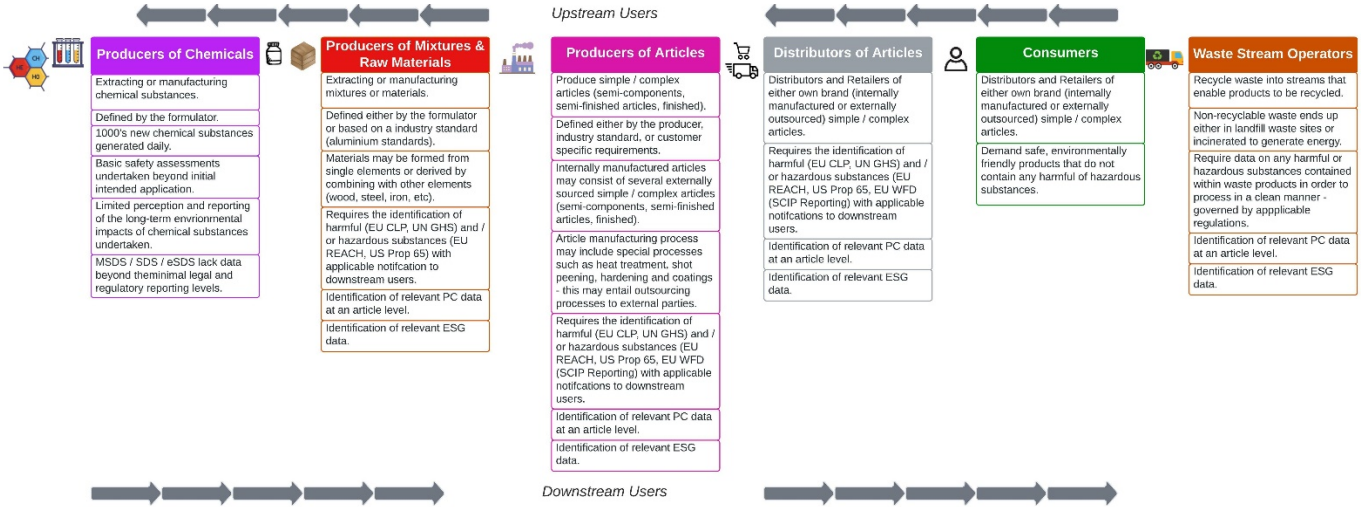


Figure 13: The 'Article Transformation' Cycle. Source: Adapted from Takhar and Liyanage (2018).

Understanding how articles (products) are transformed from raw materials is a key step in identification of actors and roles, this feeds into the development of any subsequent value chain mapping activities.

5.2 Mapping value chains

Value systems were first conceptualised by Porter (Porter, 1980; Porter, 1996; Porter, 1998), as a means to identify activities that result in value being generated in a given supply chain from an initial order by a customer, through all the actors needed to generate value upon the customer receipting the product or service. Primary activities were defined as: (1) inbound logistics; (2) operations resulting in products and / or services; (3) marketing and sales; (4) service and maintenance of products and services. Secondary activities were defined as: (1) infrastructure; (2) human resource management; (3) technology, and (4) procurement. This type of analysis worked well for organisations where the bulk of the manufacturing activities occurred either (1) within the same organisation, or (2) where chemical substances, mixtures, materials, and articles were being sourced from a known concise set of suppliers. Value system analysis provides a useful aid to understanding how value could be attributed to activities undertaken by the organization in terms of handling inputs, manufacturing products, then distribution to end consumers. However, with the advent of the internet and globalization of product manufacture to global lower cost centres, augmented the usefulness of the value system model. Porter's value system analysis established the basis for future value stream mapping initiatives. Value chain stream mapping can be quite complex, Figure [14] depicts a simple supply chain made from a few sub-tiers providing products, chemical substances, mixtures and materials. Figure [15] provides an example of a much more globally diverse complex supply chain where suppliers provision products, services, chemical substances, mixtures and materials.

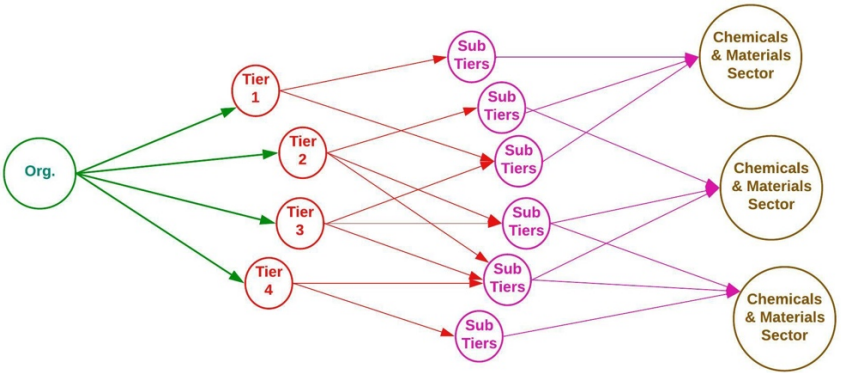


Figure 14: An example of a simple value chain map

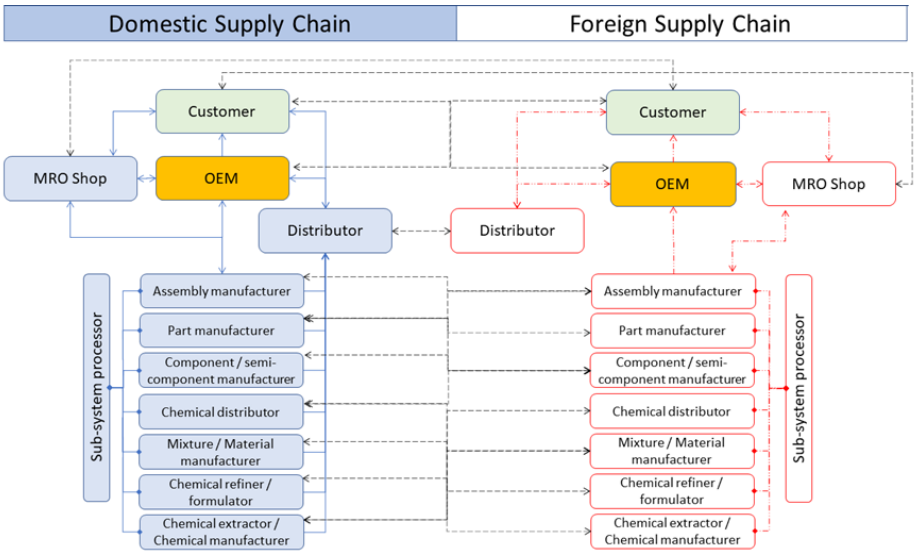
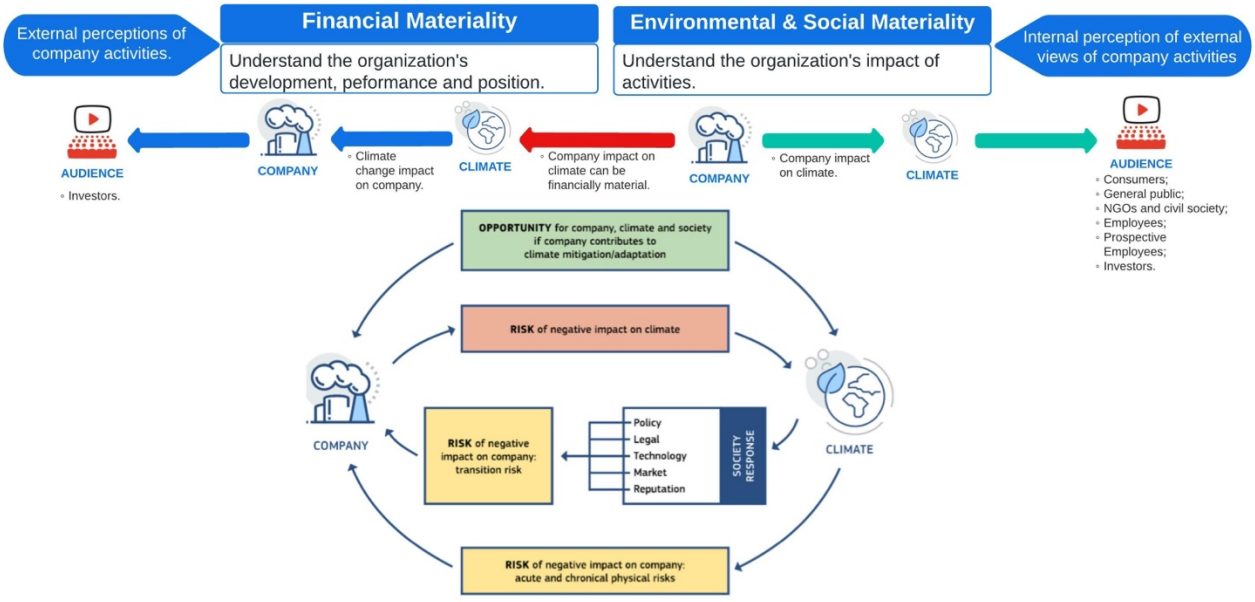


Figure 15: Example of a complex international supply chain

5.4 Consider the 'double materiality' concept

Figure [16] depicts the double materiality concept (EC, 2019c), which is based on the logic that the materiality of given issue can potentially shift based on known or unknown circumstances.



Source: *Adapted from* EC, (2019c)

Figure 16: 'Double Materiality' concept

The concept was further expanded (WEF, 2020) to state investors play a vital role 'investors have begun initial explorations is anticipating how issues might become financially material either across an entire industry or for a specific company. What is financially immaterial to a company or industry today can become material tomorrow, a process called 'dynamic materiality.'". Organizations need to factor in both investor perceptions as well just looking at how the company appears to external world

5.3 Develop a clear vision statement

Having defined a value chain is just the start of the process, a clear vision statement should be established in terms of the high-level direction an organisation is attempting to embark upon, this contextually would encompass several of the elements as shown in Figure [11]. Flowing on from the vision statement additional lower-level strategies, policies and procedures may then be implemented to capture the required internal and external data collection activities as applicable to a given reporting need. Figure [17] presents a high-level list of activities which may need to be undertaken in order to develop systems to support the emerging ESG reporting needs.

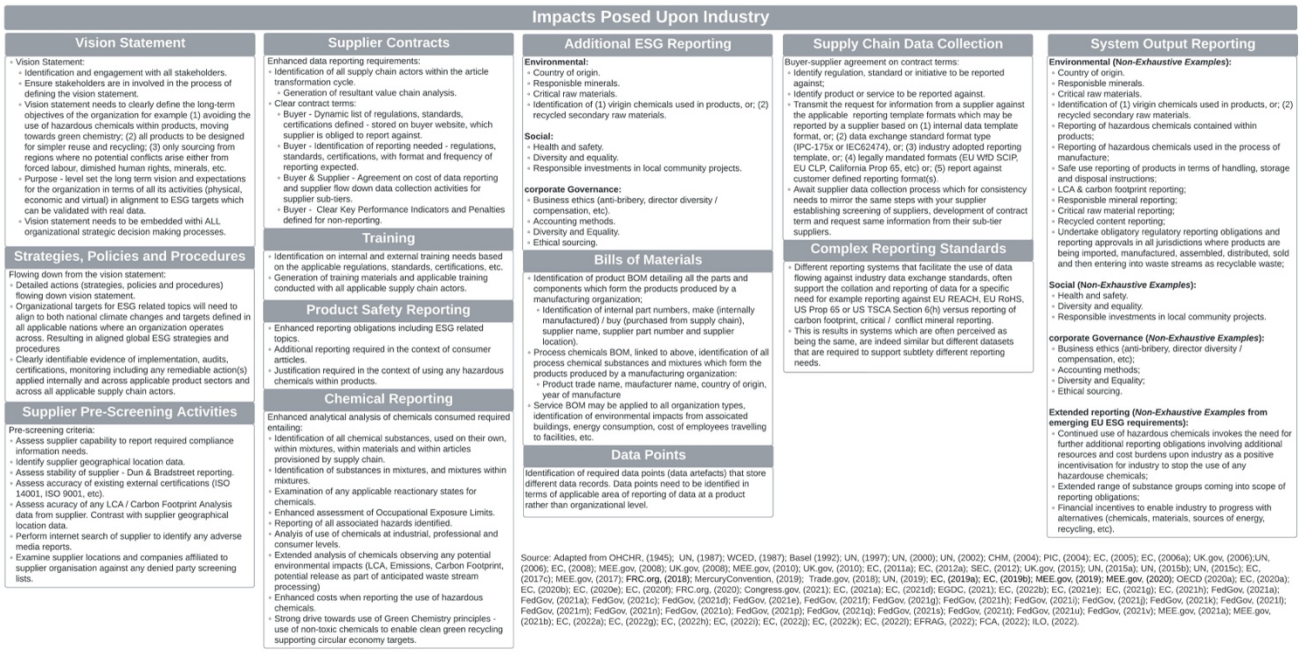


Figure 17: Impacts posed upon industry (*non-Exhaustive*)

5.4 Embed reporting requirements

Figure [18] outlines a three-stage phased implementation approach aligned to common product design and actual lifecycle states: (1) embedding reporting requirements internally and across a supply chain; (2) embedding processing of data internally including collection of applicable data from a supply chain, through to; (3) typical product / software / service lifecycle states.

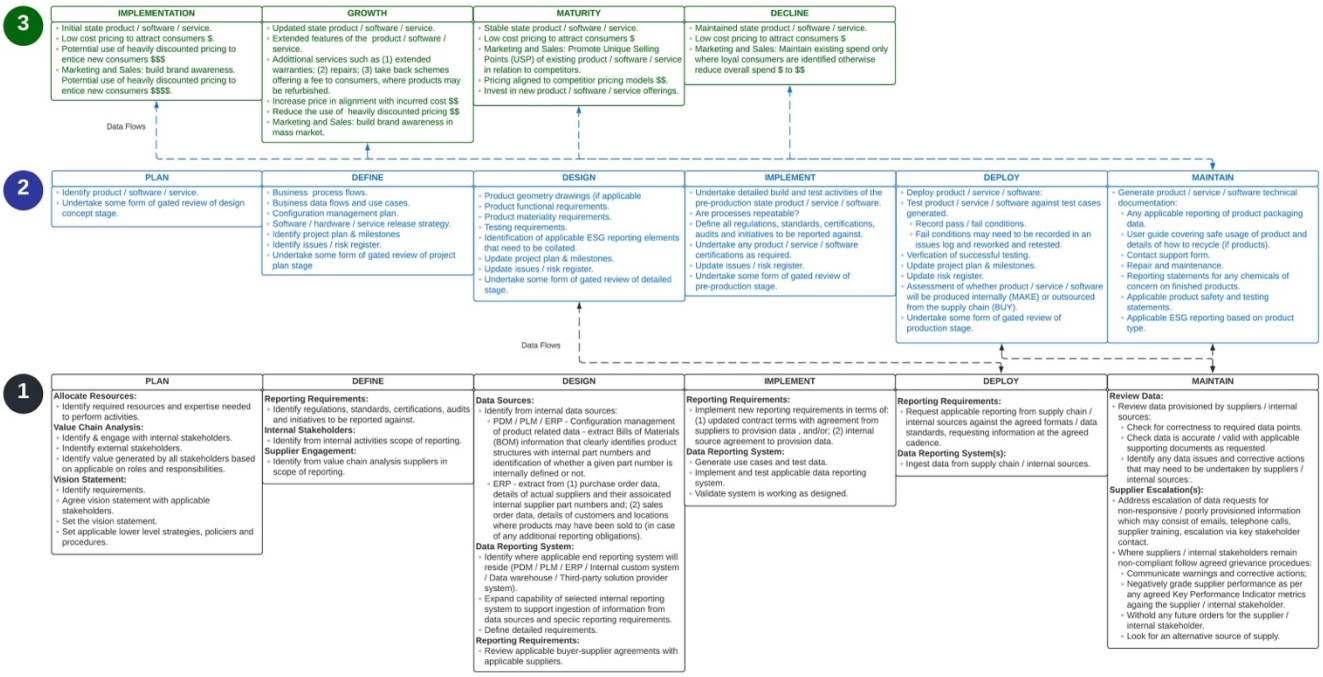


Figure 18: Embedding reporting requirements

6.0 Conclusion

The goal of this research paper was to investigate the emerging fusion between the worlds of PC and ESG reporting. Emerging ESG reporting requirements follow a consistent approach in trying to impose a desire on industry to make the required adjustments needed against the agreed climate change targets defined within the Paris Agreement (UN, 2015a).

The common theme in all the emerging global ESG reporting requirements is the need to capture and report all data at a much more granular level towards the assessing all impacts (PC and ESG) at the product level, which is then expected to be made publicly available in a digital format, which can then be checked and validated by enforcement agencies and the public to examine and apply appropriate levels of scrutiny against the data, where negative reporting impacts will of course lead to loss of brand reputation and a reduction in potential investment targets.

These emerging requirements will cause a seismic shift in the way ESG data collection, reporting, rating and index data is processed at the product, its constituent component, materials, mixtures and chemicals layers in stark contrast to the traditional corporate level summary reporting level that is currently being undertaken for data on force labour, human rights, conflict minerals, sustainability indexes. This further identifies the need for organisations to identify information beyond the traditional cradle-to-grave, towards the examination products in the context of cradle-to-cradle approaches, which examine wider planetary impacts of operations, in alignment with attaining the desired UN SDGs objectives as shown in Figure [19].

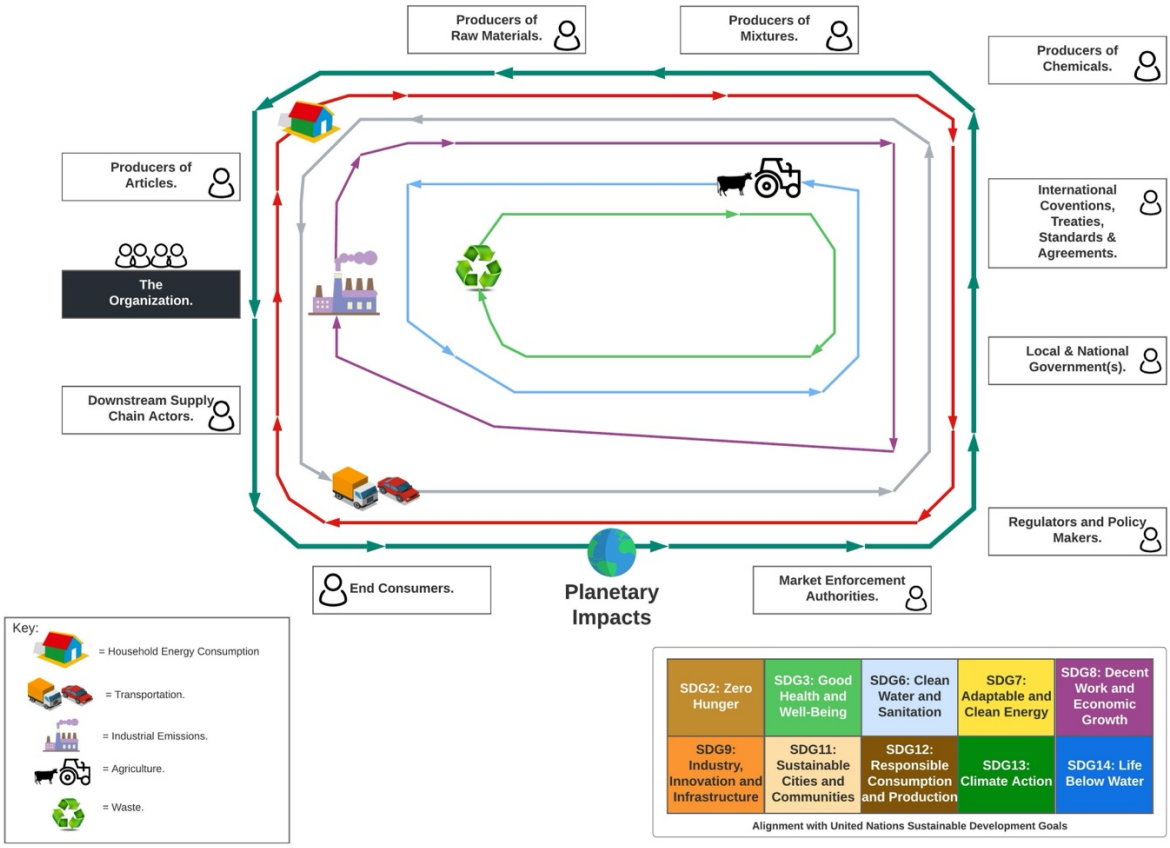


Figure 19: Planetary impacts of operations

There is a great tsunami of reporting requirements that are emerging which is fusing the worlds of PC and ESG together based on the level accurate data reporting needed, which will drive industry to develop reporting solutions that can analyze data at a product level with respect to resultant PC and ESG reporting.

PC and ESG data collection and reporting needs be at the heart of all corporate strategic decision-making activities. Organizations developing internal strategies, systems, processes to support reporting of the PC and ESG data require a vast amount of data from multiple internal and external sources, which needs to be integrated with the corporate strategic decision-making process to ensure any organizational investment decisions align with the organizational ESG targets.

Organizations that seize the challenges posed by this tsunami of data reporting are likely to yield the greatest rewards as opposed to those organizations which maintain the existing status quo in terms of data collection and reporting.

Further research needs to be conducted to identify exact data points where PC and ESG overlap, with a more robust and detailed roadmap of activities which need to be undertaken and potential impacts on industry.

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