National Safety Council

LITERATURE REVIEW

The New Value of Safety and Health in a Changing World

Foundation

verdantix

Contents

Background and Context

Introduction

This literature review has been conducted to explore the value of safety in light of the growing importance and corporate recognition of environment, social and governance (ESG) and sustainability; human and organizational performance; mental and physical wellbeing; and psychological safety. The increasingly multi-dimensional concept of safety, due to these growing trends and changing dynamics, has created demand for an intersectional analysis of the value of safety.

This review expands upon previous work done by the National Safety Council (NSC) in partnership with Avetta and Lloyds Register Foundation (LRF), as well as Delft University of Technology in partnership with LRF. It has been supplemented with literature searches, addressing research gaps previously identified, as well as seeking to tease out actionable insights.

In particular, this literature review seeks to answer the following questions:

- What is understood by the meaning and value of safety?
- How has ESG impacted the value and valuation of safety?
- How are prominent trends, including psychological safety, human and organizational performance (HOP), and mental health and wellbeing impacting the definition of safety?

The contents of this review build, most significantly, upon the progress made by Delft University of Technology's Value of Safety report (VoS Report) (Yang, M. et al. 2022). The VoS Report identifies several gaps in existing safety valuation methods. These gaps are:

- Limited existing approaches for measuring sustainability value, ethics value, resilience value, political value and reputation value
- The health value of safety predominantly covers physical health – there are no widely used or accepted assessment approaches for mental health analysis before incidents available (see 'Health Value')
- There is limited economic data for economic value calculation
- The environmental value of safety is focused on the impact of pollution resulting from incidents, and studies frequently lack a full description of the impact on ecosystems, residents and their livelihoods

For more detail on the granular methodology, source selection and search criteria, please see Appendix 1.

Valuing Safety

The Value of Safety Report developed by Delft University of Technology (VoS Report) on behalf of Lloyd's Register Foundation identified that safety can mean different things to different people, depending on their perspective as well as their role, industry and geography. This viewpoint was also reflected in the additional literature Verdantix reviewed, which defined safety as dependent on individual fears and preferences as workers/stakeholder groups perceive particular risks and threats differently (Perry-Duxbury, 2019).

Defining the value of safety has been approached from the perspective of answering 'what are the benefits of safety excellence and robust safety programs and policies?' Understanding the value of safety is often not possible until an unsafe event or incident occurs. Valuing safety is facilitated by considering counterfactual scenarios (what would have resulted if interventions had not occurred?).

Considering the multi-faceted and changeable ways to understand safety, the VoS Report developed an overall hierarchy of different safety values. These values refer to the benefits that a proposed safety intervention would provide, which can be used to support decision-making processes around safety initiatives and investments (see Figure 1).

Value of Safety Report, The Delft University of Technology

Figure 1. Hierarchy of Environment, Health and Safety Value (adapted from Yang, M (2022))

The additional literature reviewed by Verdantix validated the applicability of this framework as the values identified through this research aligned with this existing categorization. As a result, the Hierarchy of Environment, Health and Safety Value has been used to structure and present the research results, which are defined as follows (see Figure 2).

Term	Definition
Health value	Physical and mental health and wellbeing of all employees or applicable individuals affected by the activities of an employer.
Economic value	Cost savings incurred from safety interventions, and the expected benefits of safety interventions.
Environmental value	Protection of the environment due to safety interventions. This includes prevention of pollutants, toxic releases, damage to land and natural resources etc.
Sustainability value	Enhanced ESG and sustainability performance due to safety interventions, and the expected benefits of safety interventions.
Resilience value	Ability to adapt to changing conditions and withstand, respond to and recover from disruptions. This includes productivity benefits and reduced downtime.
Ethical value	Improved trust in safety-related activities, increasing the perception of justice and fairness, and engagement with safety activities.
Political value	Advancements in safety-related standards, regulation and cultural value of safety.
Reputational value	Enhanced brand perception and reputational value due to safety interventions, and the expected benefits of safety interventions.

Figure 2. Defining Safety Value

Given the focus of this literature review in better understanding the impact of emerging trends on safety value, Verdantix consolidated and defined some of the major themes relevant to this study (see Figure 3).

Term	Definition	Sources
ESG	Together ESG (Environment, Social and Governance) encompasses issues related to the natural world, issues related to people and issues related to standards for running an organization.	Verdantix
Mental Health	Emotional, psychological and social wellbeing; affecting thoughts, feelings, how someone handles stress, how they relate to others and the choices they make.	CDC, Verdantix
Total Worker Health	An approach bringing together safety, health and wellbeing, including wages, work hours, workload, work social issues, workers' families and their communities.	NIOSH, Verdantix
Human and Organizational Performance (HOP)	Risk-based operating philosophy recognizing human error as unavoidable, and that organizational processes and systems influence worker actions.	NSC, Verdantix
Psychological Safety	An organizational state where workers fom diverse backgrounds are included and allowed and encouraged to learn, contribute and challenge co-workers without fear of ridicule.	McKinsey, Verdantix
Diversity, Equity and Inclusion	Presence of different genders, races, orientations within organizations with the ability to embrace and leverage their skills and offer fair access to opportunities, resources and power to excel.	Verdantix, UNPRI

Figure 3. Defining Emerging Themes

Executive Summary

Verdantix conducted a literature review to assess how safety is valued and understood in light of prominent trends such as ESG, psychological safety, and mental health and wellbeing. Initiatives prioritizing physical and mental worker health can increase productivity, reduce incidents and cut costs as a result. Building a psychologically safe and diverse workforce and leadership team can also reduce one-track thinking, ensure businesses can better manage risks, and also drive ESG and sustainability performance.

A strong safety and ESG record, particularly on mental health and diversity, equity and inclusion (DEI), can improve a firm's reputation and attract talent. Increased transparency on these factors, especially down the supply chain, helps to build resiliency and stakeholder trust. However, long-term environmental consequences, particularly for local ecosystems and communities, need to be further addressed when safety initiatives are formulated. In addition to safety programs having a wider environmental impact, broader political and ethical trends, such as the ethics of digitalization and labor market dynamics, influence and are impacted by safety initiatives.

When reviewing the values of safety identified in the VoS report, Verdantix found the different values are closely interconnected. Furthermore, the analysis found that 'political value,' both in name and definition, did not adequately capture the value generated from safety initiatives. This value area is more appropriately named 'society value,' which describes the benefits to employees, communities and society resulting from business or government action to drive higher safety standards and legislation.

The literature review revealed there remains a key focus on serious injury, illness and fatality prevention (SIIF), as well as ESG and sustainability across all the safety value areas identified. A growing focus on mental health and DEI also exists in modern business practices. While firms are incorporating elements of total worker health, psychological safety, and human and organizational performance into their safety management systems and programs, these initiatives are often not being labeled with the aforementioned terminology due to their nascency. Despite this progress, more work is required to support the effective valuation of safety value, as ESG metrics and existing quantification methods do not sufficiently capture the multiple benefits of modern safety excellence.

Health Value of Safety

Understanding the Health Value of Safety

Traditionally, health value has referred to the physical health of employees and the public (Yang, M. et al. 2022). However, the concept of health and safety has been shifting to encompass mental health, wellness and psychological safety as well as physical safety. This holistic understanding of safety is emerging under the name of 'human capital' or 'total worker health' (The SustainAbility Institute by ERM, 2021; CDC Workplace Health Resource Center, 2018). The expanded understanding of safety and health, and health value has partly risen due to the COVID-19 pandemic, where the interconnectivity between how business is conducted and the quality of life for employees and communities has come to the forefront (Atkins, J. et al. 2022).

Impact of Emerging Trends

The pandemic helped demonstrate that psychological safety and mental health and wellbeing are closely connected to work life, productivity and overall worker health (McKinsey, 2020; Atkins J. et al. 2022). The Capitals Coalition, drawing on the Organisation for Economic Co-operation and Development, defines current wellbeing as being determined by material conditions, such as income, wealth, housing and quality of life factors, such as work and life balance, social connections, education and skills. Additionally, the conditions required to sustain wellbeing over time require resources, such as natural and human capital. The Capitals Coalition defines human capital as the knowledge, skills, competencies and attributes individuals have which facilitate the creation of personal, social and economic wellbeing, whereas natural capital refers to the world's natural resources that often provide ecosystem services. Natural and human capital must be managed and preserved to sustain wellbeing, as, for example, time in green spaces can benefit mental health.

Without measures in place to ensure worker wellbeing, high-stress workplaces can cause the activation of psychological states, triggered by stress, that can cause disorientation and cognitive and/or perceptual impairment (McKinsey, 2020). For many people, the pandemic created an unambiguous physically unsafe environment. This shared fear allowed people to have a more open and intimate dialogue with colleagues, in turn contributing to a more open environment for sharing ideas and concerns at work.

By fostering an absence of interpersonal fear, the work environment can be psychologically safe for its workers, where team members can speak openly about personal health issues or health risks, which can then be taken into consideration to avoid exacerbating workplace health conditions (McKinsey, 2020; Psychological Safety, 2020). However, it should be noted these shifts towards psychologically safe workplaces and an appreciation for worker wellbeing brought to light during the pandemic did not apply across all industries. For example, essential workers, who may have felt physically unsafe while still being required to show up at work, may not have felt able to speak up about their concerns or mental health (McKinsey, 2020).

Therefore, partly due to the pandemic, psychological safety and mental health and wellbeing are being incorporated into how safety is understood in the workplace, as it's becoming increasingly clear that conducting good business necessitates a holistic approach to worker health.

Impact of ESG

To some extent, mental health and wellbeing are being subsumed under the 'S' pillar of ESG. Equally, prioritizing worker wellbeing can ensure your business operations are more sustainable, by improving the lives of workers inside and outside of work, and enable them to be more productive (Deloitte, 2022). However, while the meaning of safety has been evolving to a more holistic view, ESG metrics and measurement methods have not kept up with this development. This expanded view of safety, Atkins and co-authors argue, demands a radical change in ESG metrics to clearly demonstrate how companies are contributing to human life and safety in terms of wellbeing and psychological safety, thus going well beyond only measuring physical injury counts and rates.

Gaps and Limitations

The health value of safety predominantly covers physical health. There are no standardized mental health assessment approaches available for analyzing pre-incident conditions.

Verdantix research did not find widely used or accepted ways in which to quantify mental health in the workplace before incidents, aside from generally encouraging an open and safe work environment to have ongoing discussions and check-ins about mental health and wellbeing (CDC Workplace Health Resource Center, 2018; McKinsey, 2020).

Furthermore, the different components of managing human capital and health value are currently siloed between HR, EHS and learning and development functions, which inhibits a holistic and integrated approach to health management (ERM, 2021).

Economic Value of Safety

Understanding the Economic Value of Safety

The VoS Report defines economic value as concerning the cost of incidents and the costs and expected benefits of safety interventions. Economic value is closely connected to the business case for undertaking safety initiatives and managing social and human capital.

The Capitals Coalition identified five business value drivers which are the mechanisms through which adopting holistic safety initiatives drives business performance improvement and economic value creation. Verdantix analysis finds these business values that drive the economic value of safety cover three key areas:

- Ensuring compliance by obtaining or maintaining a license to operate
- Engaging with stakeholders by mitigating the risk of negative publicity and strengthening relationships with employees, local communities, distributors and retail partners
- Gaining a competitive advantage by building resilient value chains, being prepared for potential regulations, optimizing people management, and ensuring product and service growth and innovation

Beyond economic value, the above mechanisms are intertwined with the generation of reputation value, resilience value, and ethics and politics values. Equally, if firms do not appropriately address and manage safety performance this can result in sudden tail events, such as large-scale incidents, with costly and significant business and reputational consequences (PwC, 2021).

Impact of Emerging Trends

Economic value has long been seen as closely related to health value. One example of the financial benefits of putting in place programs, policies and practices to prevent injuries and illnesses at work is that employees can be more productive and are less likely to become injured or ill. Workers with access to paid sick leave, for example, were 28% less likely to be injured on the job than workers without this benefit (CDC Workplace Health Resource Center, 2018). However, as firms move to recognize total worker health, beyond physical health, additional methods to ensure employees are productive and able to perform at work are being explored. For example, making accommodations for employees to ensure health conditions, such as depression or obesity, are not aggravated (CDC Workplace Health Resource Center, 2018).

Impact of ESG

Having strong safety initiatives is an important part of an ESG agenda and it continues to be proven that good ESG performance correlates with higher financial performance and returns in the medium to long term (Verdantix, 2022). For example, firms with strong ESG performance often gain greater resiliency to stock market shocks and experience reduced stock price volatility. In an S&P Global study, during the first year of the COVID-19 pandemic, 73% of the ESG exchange-traded funds analyzed outperformed the S&P 500 (Verdantix, 2022).

In addition to utilizing investment returns to measure the economic value of safety initiatives, incorporating ESG metrics into executive compensation can closely tie measuring safety performance with economic value. One report by PwC recommended incorporating well-calibrated one-year targets for health and safety initiatives into executive pay structures (2021). These targets can be set up as pass-or-fail objectives since the health and safety metric landscape is fairly developed compared to emerging environmental metrics. It is important to note that compensation metrics programs can be exploited. Where instead of driving safety performance, business divisions are motivated to underreport to hit targets. These targets must be established, communicated and monitored in such a way that they drive positive behavior as opposed to undermining a strong safety culture.

Gaps and limitations

There is limited economic data for economic value calculation.

The VoS Report identified the most frequently used approaches to measure safety as: quantitative risk assessment, Bayesian network, fuzzy theory and cost-benefit analysis. While on the one hand, cost-benefit analyses quantifying cost avoidances related to medical fees, fines, workers' compensation, insurance fees and property damage can help drive the business case for investing in safety initiatives. Verdantix research identified flaws in using this approach when the loss or potential loss of human life is involved. Ale and co-authors argue that cost-benefit analysis does not take into account the true cost of incidents, including the cost of human life, environmental damage, cost of rebuilding and using public services to evacuate or to answer inquiries in the long term. Additionally, ascribing human life to a dollar amount in a cost-benefit analysis is morally insufficient, and the exact cost varies widely depending on the incident, meaning budgets can easily be valued above risking lives, despite the moral imperative (Ale, B.J.M et al., 2021).

While the research highlighted conflicts with existing quantification methods of the economic value of safety, no robust alternatives were identified, and this remains an existing gap in current literature and approaches. As a result, NSC will be conducting extensive value chain research to further explore how to concretely establish an updated model to capture the economic value of safety.

Environmental Value of Safety

Understanding the Environmental Value of Safety

The environmental value of safety is commonly referred to in terms of pollutant prevention, focusing on high-exposure incidents and the associated risk assessments (Yang, M. et al. 2022). Incidents such as oil spills are highly visible and can have reputational impacts on firms partly due to their easily measurable environmental impact. Focusing only on these pollution events, which provide clear short-term financial losses highlights the lack of consideration of wider and longer-term environmental value. The concept of wider environmental value was mentioned in the literature Verdantix reviewed and continues to be highlighted as an area that needs to be addressed in corporate strategies and action plans as detailed below (Hintz, W. and Relyea, R., 2019, Verdantix, 2022).

Impact of Emerging Trends and ESG

One way in which emerging safety themes and ESG have impacted the environmental value of safety is the integration of circular economy initiatives into product safety and product stewardship programs. The circular economy is centered around three pillars: eliminating waste and pollution, circulating products and materials, and regenerating nature. By reducing extractive processes and designing for waste-free outcomes, this opens up opportunities to reduce carbon footprints and non-renewable resources and restore natural spaces that have become polluted from plastic waste or toxic emissions (Verdantix, 2022). This is closely connected to conducting product life cycle analyses, which evaluate the energy, emissions and waste footprint of goods, that can then be used in an environmental product declaration.

Work to quantify the environmental footprint of goods is becoming increasingly important as consumers, particularly in consumer-facing industries like retail, are questioning firms on the green credentials in their supply chains. Additionally, the environmental impact of corporate value chains will be an important consideration for firms seeking to meet net-zero targets and for national governments which are setting biodiversity targets (Verdantix, 2022). The growing importance of understanding and reducing the environmental footprint of products due to ESG and sustainability trends, alongside any chemical compliance work traditionally within the environment, health and safety wheelhouse, will create environmental value by reducing carbon footprints, mitigating reliance on non-renewable resources and regenerating natural spaces.

Gaps and limitations

The environmental value of safety is focused on the impact of pollution resulting from incidents; studies frequently lack a full description of the impact on ecosystems, residents and their livelihoods.

Despite the importance of environmental quality to both current and future human wellbeing as mentioned above, there is at present a limited appreciation of the environmental values gained from strong safety initiatives, with the safety of local ecosystems sometimes being traded off for short-term human safety. Indeed, one study identified how salting the roads during extreme winter conditions had a negative impact on local freshwater ecosystems due to the runoff, which will in turn limit the provision of ecosystem services (Hintz, W. and Relyea, R., 2019). The safety of local ecosystems needs to be reconciled with human safety measures to take into account medium to long-term environmental value.

A major challenge facing the business community is that the goalposts on environmental issues are continually shifting. Practices readily accepted twenty years ago may threaten a firm's license to operate today. While trends relating to ESG, including the circular economy, are encouraging businesses to look further up and down their supply chains, the lack of mandatory drivers sees the focus remain on direct operations and pollution events.

Sustainability Value of Safety

Understanding the Sustainability Value of Safety

The VoS Report identifies safety as a precondition of sustainable development. Unsafe business practices undermine resilience, threaten business continuity and reduce organizational sustainability. However, the Verdantix analysis found there is not yet a consensus on how safety, sustainability and ESG intertwine. While some research suggests sustainable operations are also safe, as health and safety is an integral part of both ESG and sustainability strategies, other research found safety and sustainability planning remain distinctly siloed (European Environment Agency, 2021).

A survey performed by Avetta on behalf of NSC found that 26% of participants considered health and safety partners or stakeholders to play a key role in corporate ESG programs. The survey also found that the health and safety function is involved in ESG initiative implementation. However, only 19% of participants considered it to be a key enabler (Avetta, 2022). In contrast, Verdantix research found that across different business units, the EHS function has the largest role in defining and influencing a firm's ESG and sustainability strategy, indicated by 42% of the 400 respondents (Verdantix, 2022).

These varying results demonstrate a clear overlap between health and safety and ESG and sustainability initiatives, with health and safety executives and stakeholders playing a role in decision-making processes. However, the varied results show this is a developing relationship. Furthermore, due to an increasing corporate focus on decarbonization and plastics reductions, it is easy for safety to be left as a secondary priority when evaluating sustainability value (Verdantix, 2022).

Despite the inconsistencies and barriers, ESG and sustainability, commonly used interchangeably, have helped bring to light the multiple dimensions and impacts of safety initiatives. There is robust evidence that safety falls across all three ESG pillars, but it remains to be seen the extent to which safety will play a role in corporate sustainability planning going forward.

Impact of Emerging Trends and ESG

Health and safety programs have typically been incorporated in corporate sustainability strategies within the 'S' pillar of ESG (ERM, 2021). The growing recognition of mental health and wellbeing and DEI is providing more incentives for safety programs of this kind to be understood within the context of corporate sustainability strategies and the wider sustainability value they produce. Furthermore, potential employees in the recruitment pool are utilizing corporate ESG performance on mental and physical health, DEI and work balance factors to select jobs, impacting both resilience and reputation value for firms (Verdantix, 2022). This increasing connection between safety and sustainability is demonstrated in the software market where EHS software vendors are expanding their capabilities to support sustainability strategies and are looking to integrate their offerings with social and governance systems (Verdantix, 2022).

The literature review found various differing approaches on how to understand the relationship between ESG and safety. Some research considered safety to be an 'old' ESG measurement, related to fulfilling regulatory requirements and risk management which contrasts with 'new' ESG priorities and measures, such as decarbonization, plastic reduction and diversity (PwC, 2021). While a survey performed by Avetta on behalf of NSC found the value of safety spans across the three pillars of ESG (environment, social and governance) depending on the industry. For example, in manufacturing, EHS initiatives including waste, water and energy management are priority issues to be reported against. Whereas finance and insurance firms focus on cyber security and data privacy. Furthermore, the European Environment Agency highlighted how sustainable product design also improves safety by protecting citizens against harmful chemicals and ensuring a low environmental impact. This is considered a sustainability requirement, with climate impact and ecosystem impact considered on the same beat as safety.

Resilience Value of Safety

Understanding the Resilience Value of Safety

By creating a safe working environment, firms can build resilience and become better equipped to both anticipate and prepare for changing conditions and respond to and recover from disruptions. The value of prioritizing resilience measures to prepare for a recovery operation after an incident is disputed by Ale and co-authors due to the ethical implications of putting human lives at risk if companies fail to take precautionary measures to prevent incidents (2021). This highlights the importance of considering resilience value as incorporating both preparation and adaptation measures into business-as-usual and everyday decision-making.

Although resilience value is a benefit of adopting well-rounded safety initiatives, it is less explicit than the more tangible values reflected in the base of the Hierarchy of Environment, Health and Safety Value developed in the VoS report (see Figure 1). Furthermore, Verdantix analysis finds this value is often generated as a result of other value creation activities, such as safety initiatives that generate health value or sustainability value and decrease risk which in turn improves resilience.

Impact of Emerging Trends and ESG

Improved business resilience has been linked with several emerging trends across safety and ESG. Firms can ensure business resilience by prioritizing psychological safety in the workplace so team members can feel they can speak openly. This creates an interconnected team that can withstand adversity better than a fragmented team (Psychological Safety, 2020). One element of ESG which has impacted the resilience value of safety initiatives is diversity, equity and inclusion. When businesses do not have a DEI agenda, discrimination at the workplace can lead to mental illnesses, reduced trust and productivity, and higher employee turnover (Deloitte, 2022). A diverse and inclusive leadership team can reduce siloed and one-track thinking, positioning the team more effectively to tackle problems and manage risks. A diverse team can also ensure sustainability goals are kept within scope, and improve trust between stakeholders (Oracle, 2022).

Ethics Value of Safety

Understanding the Ethics Value of Safety

The VoS Report elaborated on ethics values as including justice and trust in risk management. These topics must continue to be assessed as cyber and human safety become more intertwined. The Verdantix analysis found safety can be defined as the protection of a device's environment (e.g., human and natural) and security can be seen as protecting a (often technological) device from its environment (Vedder, A., 2019). As IoT devices, artificial intelligence (AI) and increasing amounts of digital technology are a growing part of work and home environments and safety initiatives, ethics value will play an increasingly important role in how we assess and understand safety.

Impact of Emerging Trends and ESG

A growing discussion and contention around the ethics of safety are focused on the conflict around exactly whose safety is prioritized, between the group and the individual (Vedder, A. 2019). Over the last few decades, in the U.S. and UK in particular, there has been a political focus on protecting inhabitants, as well as public and private assets, from terrorist attacks. In light of this, the balance of retaining individual liberties and ensuring public safety, without sacrificing too much of either, is being navigated. This too is true in work environments where the uptake of wearable devices and camera analytics to improve worker safety is generating discussion on potential infringements on employee and data privacy (Verdantix, 2019). Hence, while safety initiatives can ensure distributive justice and help facilitate trust amongst workers or the general public, topics such as cyber security and collective safety continue to raise ethical discussions and dilemmas that must be navigated.

Strong safety initiatives can help improve trust by boosting the perception of justice and fairness (Yang, M. et al. 2022). One type of safety initiative that is becoming increasingly important due to ESG and sustainability trends is building and maintaining a sustainable supply chain (Verdantix, 2022). This includes managing supplier physical safety and following due diligence on human rights, working conditions and environmental protection. This is closely connected to the ethics value of safety initiatives, as not only is, for example, human rights an ethical issue, but successful supply chain sustainability relies on a firm's ability to generate trust and resilience. To ensure safety and sustainability programs down the supply chain align with corporate ESG targets and values, and to demonstrate overall alignment with concepts of justice and fairness, increased transparency will be essential.

Political Value of Safety

Understanding the Political Value of Safety

As discussed in the Ethics Value section and the VoS Report, incidents can impact safety policies and politics. Additionally, the VoS Report found risk reduction interventions may not be prioritized by governments due to corruption or lack of capacity due to other budget priorities. It has been found that political dynamics and the overarching structure of the labor market can impact safety initiatives. Greer argues that different approaches to safety in firms arise depending on the country of work's labor market conditions and the extent of unionization (2018). For example, in coordinated labor markets, since workers have powerful institutional resources with which to speak out against dangerous workplaces, firms have increased incentives to invest in the health and safety of their employees. On the other hand, when the core of the labor market is the contract between the individual and the firm, the individual has less bargaining power and faces a greater risk for speaking out against unsafe work practices.

Additionally, the VoS Report references, under their political value definition, that risk perception and safety are influenced by psychological, social, physical, political and cultural factors. This is explored in a recent paper by Edwards and Maxwell, who look at how the feeling of safety is produced in and through our interactions and is bound up in social hierarchies and structures of belonging (2022). For example, the political discourse around disability frames safety as a paternalistic protection from risk, whereas for the disabled urban residents interviewed in the study, safety was connected to feelings of autonomy, comfort, trust and a clear spatial routine. Government policies and spatial planning designs, therefore, had a major impact on the generation of safety value for these residents.

Impact of Emerging Trends and ESG

The global pandemic has further amplified the spotlight on employee wellbeing, with workers facing burnout, reduced human contact and less separation between work and home life (McKinsey, 2020). Consequently, firms are increasingly implementing initiatives, technologies and training to mitigate mental health risks. HR functions, EHS teams and senior executives have been tasked with implementing wellbeing strategies without the guidance of a globally recognized standard or government regulations. These corporate mental health programs highlighted the increasing need for guidance (Verdantix, 2021). These trends in occupational safety have seen the International Organization for Standardization release the ISO 45003 standard in June 2021 to support firms in managing the mental health of their workers and set a benchmark for mental health management practices going forward.

Reputation Value of Safety

Understanding the Reputation Value of Safety

The VoS Report found that a poor safety record can negatively impact a company's reputation. Taking an example in the food and beverage industry, food safety public scandals, such as the horse meat scandal in Europe in 2013, can damage the food producer's reputation causing their profits to rapidly decrease (Han, G. et al. 2021). Major safety events such as the BP Deepwater Horizon disaster, and migrant worker deaths in Qatar leading up to the FIFA 2022 World Cup, further demonstrate the significant link between safety and reputation value.

Additionally, the reputational impact of incidents, such as plane crashes, can impact the personal subjective perception of safety. For example, though plane crashes may statistically cause fewer deaths or injuries than car crashes, the reputational impact and high visibility of these events cause greater personal fear for travelers (Perry-Duxbury, M. et al., 2019).

Impact of Emerging Trends

As mentioned in the 'sustainability value' section, potential employees in the recruitment pool are utilizing firm reputation on mental and physical health, DEI and work balance factors to select jobs. While strong worker wellbeing initiatives can boost a firm's reputation, negligence around health and safety and worker wellbeing can be significantly detrimental to a firm's reputation. For example, it emerged in March 2021 that Goldman Sachs analysts were facing 100-hour work weeks spurred on by unrealistic deadlines and suffered severe deterioration of physical and mental health as a result. This created a public scandal negatively impacting Goldman Sachs' brand reputation and attractiveness to both clients and employees.

Impact of ESG

A bad safety record often correlates with poor ESG performance, in turn affecting a firm's reputation. In general, negative ESG performance is often driven by external factors, such as safety issues or environmental degradation, often affecting emissions-intensive or high EHS risk industries the most, making it extremely costly or challenging for firms to get a handle on these issues (Crace, L. and Gehman, J. 2022). Alternatively, positive ESG indicator performance is driven by strategic considerations. Therefore, strong safety initiatives, such as those addressing psychological safety, effective human capital management or sustainable supply chain practices can also improve the reputation of a firm, help with workforce attraction and engagement, and overall correlate with increased ESG performance.

Limitations and Gaps: Sustainability, Ethics, Resilience, Political and Reputation Value of Safety

Limited approaches exist for measuring sustainability value, ethics value, resilience value, political value and reputation value.

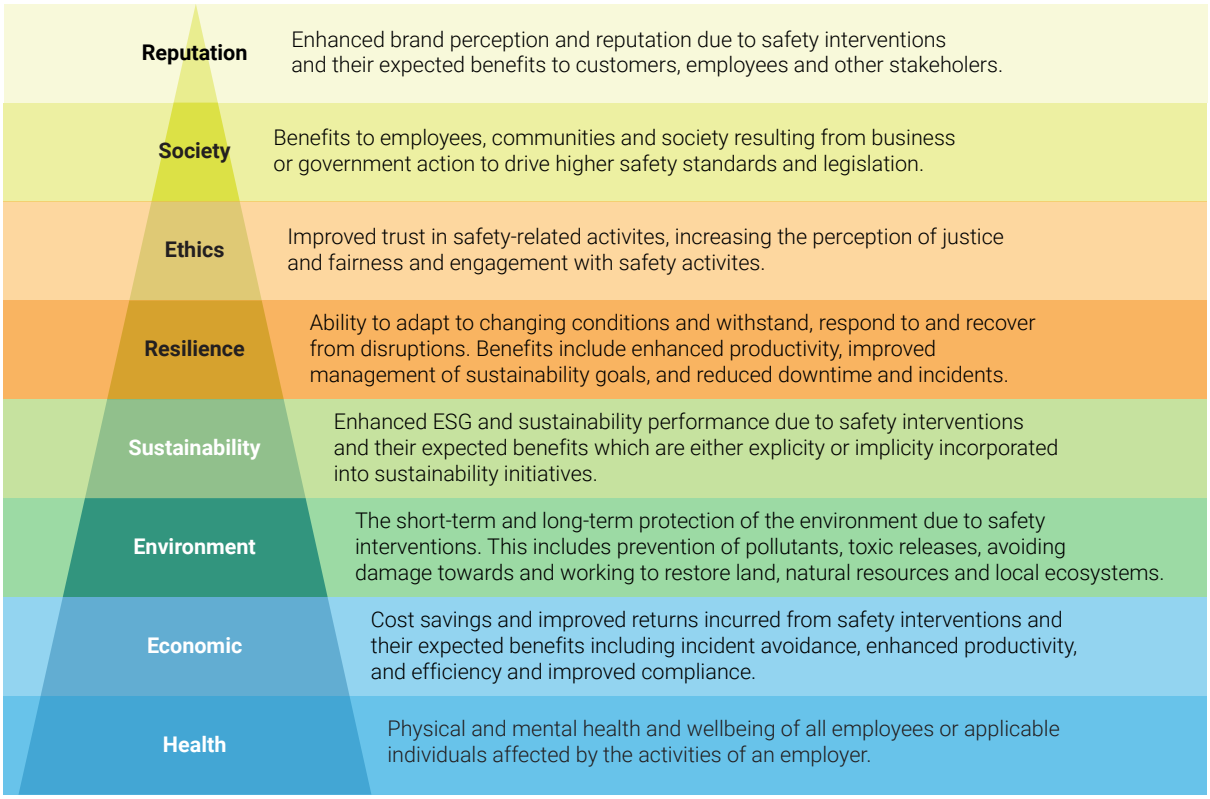
Approaches to quantifying sustainability value, ethics value, political value and reputation value found by Verdantix mostly consist of ESG metric collection and reporting, which can then be correlated with stakeholder responses and economic performance. However, the research also identified numerous studies criticizing the current use of ESG metrics to measure safety. One study assessed a sample of 50 Fortune 500 publicly listed companies' sustainability reports and collected the metrics they utilized to measure safety performance (Kotsantonis, S and Serafeim, G. 2019). The wide range of metrics collected often used different units of measurement making any benchmarking work, and efforts to determine which firms were top health and safety performers, challenging.

Additionally, as companies that disclose more information often receive lower ESG scores, it's clear work needs to be done to understand the purpose and quality of different metrics and how they can best be used to assess corporate performance. This should be done to repurpose health and safety indicators not only for investors and employees but for all actors in the supply chain to maximize visibility into health and safety practices as a whole (Atkins, J. et al. 2022).

Discussion and Conclusion

In light of the research detailed above exploring each safety value concerning our key research questions, several discussion points and expansions to the initial research have been identified.

While the Hierarchy of Environment, Health and Safety Value established in the VoS Report created a strong foundation off of which to base this research, Verdantix found that 'political value,' both in name and definition did not adequately capture the value generated from safety initiatives. This value area is more appropriately named 'society value,' which describes the benefits to employees, communities and society resulting from business or government action to drive higher safety standards and legislation. Furthermore, the additional insight gained through this literature review enabled Verdantix to expand on the initial definitions for each safety value (see Figure 4).



Note: Although called a "hierarchy," these concepts are not meant to be thought of as strictly or ordinally hierarchical in nature.

Figure 4: Updated Hierarchy of Environment, Health and Safety Value (adapted from Yang, M (2022))

The literature review also clearly demonstrated these different value areas are interconnected. A targeted activity focused on a primary value area generates secondary and tertiary benefits across numerous other value areas in the hierarchy (see Figure 5). Safety interventions will typically be implemented specifically targeting value creation from areas at the bottom of the hierarchy (Health, Economic, Environment and Sustainability), yielding secondary and tertiary value creation from areas at the top (Resilience, Ethics, Society and Reputation).

Example Activity	Primary Value Creation	Secondary Value Creation	Tertiary Value Creation
SIIF prevention and mental health programs	Health	Economic	Sustainability, Resilience Ethics, Society, Reputation
Fatigue management to enhance productivity	Economic	Health, Ethics	Resilience, Society, Reputation
Emissions reduction and management	Environmental	Economic, Sustainability	Health, Resilience Ethics, Society, Reputation
Diversity, equity and inclusion programs	Sustainability	Resilience	Health, Economic Ethics, Society, Reputation
Business continuity managment	Resilience	Economic	Health, Environmental, Sustainability, Ethics
Ethical supply chain initiatives	Ethics	Health, Economic, Environmental	Sustainability, Resilience Society, Reputation
Impact assessments and interventions for ecosystems and communities	Society	Health, Environmental	Economic, Sustainability Resilience, Ethics, Reputation
Brand enhancement campaigns promoting safe working practices	Reptutation	Economic	Health, Environmental, Sustainability, Resilience Ethics, Society

Figure 5. Interconnected Value Creation

Verdantix also mapped the prevalence of the key themes against each of the safety values (see Figure 6). The literature revealed there remains a key focus on serious injury, illness and fatality prevention, and ESG across all the safety values. Mental health and DEI are increasing in focus and priority across the different safety values, evidence of their growing acceptance and adoption in modern business practices. Very nascent themes such as total worker health, psychological safety, and human and organizational performance had a minimal presence across the research reviewed. While firms are incorporating elements of these themes into their safety programs, these initiatives are not being labeled using total worker health or HOP terminology across the literature reviewed.

Value \ Theme	Serious Injury and Fatality Prevention	Mental Health	Total Worker Health	Psychological Safety	Human and Organizational Performance	Diversity, Equity and Inclusion	ESG and Sustainability
Health							
Economic							
Environmental							
Sustainability							
Resilience							
Ethics							
Society							
Reputation							

Key: High Focus Medium Focus Low Focus

Figure 6. Safety Values Focus on Key Themes

Based on the literature reviewed and an analysis of the findings it is clear these themes, like the safety values themselves, are interconnected and have areas of overlap. For example, total worker health can be used as an umbrella term that includes SIIF prevention, mental health and psychological safety. Furthermore, HOP speaks more to an operating philosophy than a safety program, the principles of which can be designed into specific safety initiatives (see Figure 7).

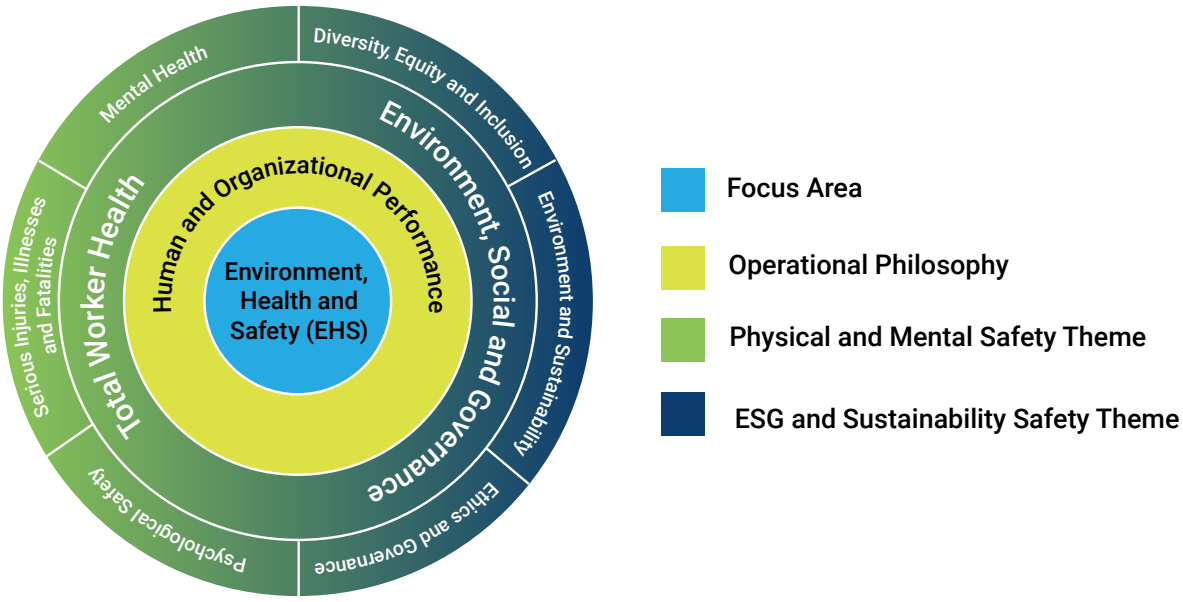


Figure 7. Framework of Environment, Health and Safety Themes

It is clear the meaning of safety is expanding to include emerging physical and mental health, and ESG and sustainability themes. Initiatives targeting these themes are increasingly evident in modern safety programs and recent literature reinforces the value generation potential across the safety values hierarchy that can result. Despite this progress, more work is required to support the effective valuation of safety value, as ESG metrics and existing quantification methods do not sufficiently capture the multiple benefits of modern safety excellence.

Appendix 1: Scope of Literature Reviewed

In order to build upon existing work, search efforts have been weighted on identifying and reviewing sources answering our three research questions and cover the gaps identified above. Literature has been sourced using two methods:

1. Publicly available grey literature, such as white papers, obtained through search engines
2. Verdantix research and survey data available on the Verdantix research portal
3. Open-source academic journal articles obtained through searching the following databases: Science Open, Science Direct, CORE, JSTOR, Springer Link, SSRN, Sage Journals, Google scholar and Arxiv

These databases, search engines and aggregators were used to access a breadth of open-source journals from across disciplines, seeking to find sources from the sciences, humanities and social sciences to gain a breadth of perspectives. The searches were conducted between September and November 2022. As the VoS Report utilized the Web of Science to access articles, we have chosen to utilize different sources so as not to reproduce work already executed.

Methodology

The 'Value of Safety' study used a bibliometric analysis to find out the value of safety from 3,685 papers published from 1900 – 2021. Due to the scale of literature previously analyzed, this review uses a manual search of publicly available documents. Professional judgment was applied to select sources for review based on the following factors:

- The perceived quality and reputation of the source
  - Was it published in an academic journal?
  - When looking at white papers, what is the size of the firm producing the white paper, how familiar is the name as a thought leader? (do they have well-known expertise from consulting work, fund management, data collection and ratings, and extensive customer insights)
  - How many citations has this white paper received? (this information was available when using Google scholar)
  - How many participants are there in the cited surveys?
- The applicability of the literature title or content
  - Was the word 'safety' mentioned more than twice in the report and notably included within the analysis?
  - If it contributed towards answering the key research questions and the identified research gaps
- The type of literature or source
  - Does this piece fit into the categories of 'A', 'B', 'C', or 'D'? (see below)
  - If this piece fits into the categories of 'C' or 'D' does it provide exemplary insights which cannot be found in a more high-quality document from 'A' or 'B'?

Criteria For Selection

This literature review considers literature from the past five years (2017 – 2022) to understand recent developments in the expansion of safety value.

A quality segmentation has been applied to identify the reliability of the sources used and to chart the range of grey literature represented. Sources selected range from academic research to press releases and blogs (see **Table 1**). Quotas have been skewed towards quality levels 'A' and 'B', with 'C' and 'D' pieces only included if they contain exemplary insights that could not be found in a piece of higher quality material. To ensure these categorizations are reliable, we conducted a double-blind review. We brought in an anonymous senior analyst to go through the sources we reviewed and classify them by quality level. We then cross-referenced their assessments with those conducted by the analysts working on this project. Variations in the quality level assigned by the reviewers were addressed collaboratively by the project manager and project director who reviewed the source relative to other sources included in the literature review to assign the most applicable quality designation.

Quality Level	Definition	Grey Literature in Scope	Count of Documents Reviewed
A	Traditional literature reviews, case reports, quantitative case studies, theoretical papers and other similar material. Academic research.	Conference papers, clinical trials, dissertations and theses, government documents and reports, patents, research reports, statistical reports	15
B	Research outputs produced by organizations. Not traditional academic research.	Datasets, surveys, market reports, white papers	7
C	Factual pieces based on business news or verbal accounts.	Press releases, interviews, newsletters	1
D	Marketing material based on no underlying research. Written outputs that were not initially intended for formal publication.	Blogs, discussion forums, email discussions, tweets	3

Table 1

We only included sources from categories 'C' and 'D' if they had exemplary insights which could not be found in a source that fits within the categories of 'A' and 'B'.

Findings Framework

All literature review data has been captured in a framework that segments findings into four sections, which have been identified and split out in line with our research questions (see **Table 2**):

The meaning and value of safety	Valuation, metrics and measurement	Expanded view of safety	Limitations and gaps
How safety is defined and valued by various stakeholders	Quantitative methods used to value and measure safety performance or safety interventions	The impact of emerging trends on safety	Limitations and gaps in existing safety valuation methods and frameworks

Table 2

Key Search Terms Used

We deployed both keyword and semantic searches between September and November 2022, and the terms used have been documented and grouped by research theme:

ESG and Sustainability

- 'safety' AND 'sustainability'
- 'ESG' AND 'safety'
- "impact of ESG on health and safety"

Meaning and Value of Safety

- "business value of safety"
- "economic value of safety"

Expanded View of Safety

- "quantifying value of psychological safety"
- 'workplace' AND 'mental health'
- "impact of total worker health on safety"
- "economic value of safety"
- "business value of safety"

Limitations and Gaps

- 'community' AND 'ecosystem' AND 'safety'
- 'safety' AND 'political'
- "safety resilience value"
- 'community' AND 'ecosystem' AND 'safety'
- 'reputation' AND 'value' AND 'safety'

After identifying sources, another strategy we deployed to find key literature was through following the citation trail found in identified sources, and, when we had identified a new document through this method we returned back to our three qualifying categories: quality, applicability and type. We then determined the source's applicability for the study.

Appendix 2: Literature Reviewed Categorized by Quality Level

Quality Level A:

Ale, B.J.M et al. (2021) 'Prevention, precaution and resilience: Are they worth the cost?' Safety Science, 140, pp.1-7.

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