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Abstract

While there has been significant progress in the measurement of an organization's environmental and social performance, metrics to evaluate the impact of products once they come to market lag far behind. In this paper we provide a framework for systematic measurement of product impact in monetary terms and delve into the rationale for the framework's seven elements. We then apply the whole framework to two competitor companies and elements of the framework across companies in different sectors of the economy to show the feasibility of measuring product impact and the actionability of the framework. Not only does this application demonstrate feasibility, it also indicates the value of impact-weighted financial statement analysis. We see our results as a first step, rather than a definitive answer, towards more systematic measurement of product impact in monetary terms that can then be reflected in financial statements with the purpose of creating impact-weighted financial accounts.

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1. Introduction

Given that all companies have impacts on employees, customers and the natural environment, efforts to measure environmental and social impact are crucial. Effective resource management depends upon an accurate understanding of the current baseline and the anticipated path forward. These allow for benchmarking, quantification of under- or out-performance, and the possibility for course correction. Metrics also allow for allocation of resources in markets and the development of price signals. Furthermore, they allow for the design of contracts, such as compensation or lending contracts, which incentivize certain actions. For example, recent efforts include the incorporation of environmental and social metrics in both executive compensation plans and in bank loan contracts. Similarly, they can be included in the design of regulatory incentives, such as tax or subsidy incentives.

The importance of measuring the impacts of companies is highlighted by the significant growth in efforts to understand, measure and improve environmental and social impact. More companies are disclosing environmental, social and governance (ESG) data as customers, employees, investors and regulators are seeking to incorporate ESG considerations in their decisions. As of 2017, 75% of the largest 100 companies in each of 49 countries (75% of 4,900 companies) were issuing sustainability reports with ESG data, a marked increase from the 12% in 1993.[1] With over $22 trillion in assets under management labeled as ESG and more than $80 trillion publicly committed to integrate ESG data in investment decisions, asset owners and managers have demonstrated a commitment to integrate ESG information in their investment process.[2]

However, our own analysis and other research has indicated that currently most environmental and social metrics disclosed by companies and prescribed by reporting standards pertain to a company's operations, defined as activities that happen within the company's own organizational control or in some cases, in their upstream supply chains.[3] Examples of operational impacts include water consumption, waste generation, carbon emissions, employee health and safety records or diversity and inclusion efforts. While great progress has been made in measuring

[1] Jose' Luis Blasco, Adrian King, et al., "The road ahead: The KPMG Survey of Corporate Responsibility Reporting 2017," KPMG International, page 9. Accessed July 9, 2019.
[2] Global Sustainable Investment Alliance, "2016 Global Sustainable Investment Review" (PDF File), downloaded from GSI-Alliance Website on July 9, 2019.
[3] NYU Stern Center for Business and Human Rights. "Putting the 'S' in ESG: Measuring Human Rights Performance for Investors." March 2017. Accessed July 9, 2019.

such operational impacts and more disclosure now exists around them, the progress on measuring the far-ranging impacts that products have on consumers and society has been less impressive.

Product impact refers to impact that occurs once a company has transferred control of goods or services, which is consistent with traditional accounting recognition of a sale. Measurement efforts for product impact are still coarse, relegated to broad categorizations such as businesses with large negative externalities, traditionally tobacco and more recently coal, versus all else. However, in reality, different products can have fundamentally different impacts due to their effectiveness, affordability and reach, among other factors.

Moreover, while significant progress has been made in the development of environmental and social metrics, these are not embedded in a financial statements' framework enabling managers and investors to understand trade-offs and relative performance evaluation that considers impact along with risk and return. Monetization based on available data translates impact into a language that is familiar to decision-makers. For this to happen impacts need to be measured and monetized based on available data. Creating impact-weighted financial accounts is a scalable solution for the incorporation of impact in business decision-making.

For companies that do measure their product impact, impact evaluation is highly specific, limiting comparability and scalability. Moreover, the number of companies that have managed to measure product impact in monetary terms is even more limited. Of the 56 companies that have experimented with monetary impact valuation, only twenty percent estimate product impact.[4] NS Rail applies a monetary value to the mobility trains provide, whereas Safaricom measures the value of secure financial connectivity created by M-Pesa. As demonstrated, the dimensions on which these companies measure product impact are highly specific to individual products. Therein lies the difficulty with measuring product impact: such impacts, in contrast to employment or environmental impacts from operations, tend to be highly idiosyncratic limiting the ability to generalize and scale such measurements.

A framework in which product impacts can be measured and monetized is needed. First, creating a framework to measure the impacts of products introduces a systematic and repeatable methodology that can capture product impacts across industries. This allows for transparency, comparability, and scalability of product impacts. Second, a framework enables more nuanced

[4] George Serafeim, T. Robert Zochowski, Jen Downing. "Impact-Weighted Financial Accounts: The Missing Piece for an Impact Economy", Harvard Business School. Accessed December 16, 2019.

measurement of product impact. Rather than categorizing certain products, such as cigarettes or coal, as unequivocally negative, a framework allows measurement of the level of positive or negative impact that all types of products can create, including many that have large negative externalities but are not traditionally classified as 'sin' businesses (e.g. high trans-fat or sodium food). Measuring positive impacts allows for differentiation across products and companies and derivation of a more balanced assessment of a company's impact. Finally, the introduction of a product framework encourages a holistic approach of measuring and reflecting impact in financial statements by broadening the scope of impacts beyond operations. Instead of relying on customer willingness to pay or demand to measure product impact, a framework expands measurement to impacts that may not be felt by customers until years later or may not be borne by customers directly, as in the case of environmental damage. An exhaustive system for measuring impact is critical to promote and manage the development of products with better total stakeholder value. Ultimately, the aspiration is to provide investors and managers with the ability to make more informed decisions that account for the impact of a company's product.

In this paper we provide a framework for systematic measurement of product impact and the rationale for each of its elements. Moreover, we apply the framework in the context of two competitor companies to show the feasibility of measuring product impact and actionability of the framework. Then we generalize the framework showing examples of how it could be applied on companies in other industries, such as pharmaceuticals, consumer packaged goods companies, and water utilities. We see our results as a first step, rather than a definitive answer, towards more systematic measurement of product impact in monetary terms that can then be reflected in financial statements with the purpose of creating impact-weighed financial accounts.

2. Current efforts to measure product impact

There has been a significant level of experimentation in the market attempting to measure product impact. These efforts have moved the field forward and allowed for a more sophisticated treatment of product impact. In examining the different methodologies used to measure product impact by organizations such as companies, investors, reporting standards, and data providers, a few patterns arise. The metrics often are input or process oriented and are highly specific to single products, investments, or industries. Where monetary impacts are estimated, there is a lack of transparency around the specific assumptions used to monetize outcomes. In addition, the current state of product impact measurement has comparability and accountability limitations. Below, the current measurement efforts of different companies, investors, reporting standards, and data providers is examined.

2.1.Companies

Companies have made significant progress in identifying a consistent methodology with which to measure product impact. For example, the Handbook for Product Social Impact has created a consensus-based methodology to inform companies on how they can assess the impacts of products.[5] Given the highly idiosyncratic nature of product impacts, a consistent methodology can still produce a wide range of reported impacts that vary between companies. Even within a single company with a range of different products, there is no consistent set of metrics used to estimate product impacts. Yet, companies can compare their products to alternatives in the market when identifying the impact their product generates. These product impact comparisons indicate a feasibility for using similar metrics to compare the product impact of two different products and suggests there is some set of relevant metrics across products that should be identified and standardized.

TABLE 1

Sample of Companies Measuring Product Impact

Company	Example products	Measurement	Example metrics or impacts
ABN·AMRO	Fee and interest-based payment and account services, mortgages, corporate loans and advice[6]	Monetary ranges	Client value of money storage and management, value of time, data and privacy breaches, decrease in cash related crime, financial distress due to repayment difficulties of loans[7]
AkzoNobel	Decorative paints, automotive and specialty coatings, industrial coatings,	Descriptive and numeric and descriptive	Revenue from products with sustainability benefits that outperform the market, standard of reducing hazardous substances and volatile organic compounds in products, percent of timely deliveries[8]
BASF We create chemistry	Petrochemicals, nutrition and care chemicals, coatings, crop care[9]	Monetary	Reduction of fat in the liver from product consumption, percent improvement in crop

[5] Goedkoop, M.J. Indrane, D.; de Beer, I.M.; Product Social Impact Assessment Handbook - 2018, Amersfoort, September 1st, 2018.
[6] ABN AMRO Group N.V., "Impact Report 2018", page 18. Accessed September 11, 2019.
[7] ABN AMRO Group N.V., "Impact Report 2018", page 23. Accessed September 11, 2019.
[8] AkzoNobel, "AkzoNobel Report 2018", pages 155 – 157. Accessed September 16, 2019.
[9] BASF, "BASF 2018 Report", pages 68 – 106. Accessed September 10, 2019.

			yield, customer emissions from the use of end products
	Pharmaceutical drugs, oncology drugs	Numeric	Number of patients reached, health gains per patient year in Quality-adjusted life years [10]
	Rail transportation	Monetary and numeric	Percent customer satisfaction, percent punctuality, seat availability, monetary values for mobility created and journey time[11]
	Mobile services and mobile payments	Monetary	Increase in personal savings due to theft reduction, increase in personal savings due to convenience and reduced transaction costs[12]
	Mobile services, Internet of Things connectivity, cloud services, carrier services[13]	Monetary	End of life waste production, avoided emissions through reduced commuting and office utilities, improved modem efficiency[14]
	Vehicles, excavators, trucks, haulers, wheel loaders	Numeric	Emission levels, external sound levels, recyclability[15]
	Water utility services	Monetary	Water quality compliance, water supply interruptions, customer service satisfaction, customer bills[16]

2.2.Investors

As more investment managers incorporate ESG issues into their decision-making, a few them have made either their methodology or examples of metrics used publicly available. Similar to companies that report their product impact, investors rely on metrics that are specific to each investment. Interestingly, all four investment firms that have made some progress towards measuring product impact are investing in private markets, having relatively concentrated portfolios in a small number of investee organizations. This reflects the difficulty in producing product impact measurements for thousands of organizations that would be required for investors holding broadly diversified portfolios in public markets. Ultimately, given the nature of investment decisions, these methodologies tend to produce a prospective estimation of potential financial, social, and environmental gains, rather than an estimate of the impacts that have occurred.

[10] A.H. Seddik, J. Branner, R. Helmy, D.A. Ostwald, S. Haut, *The Social Impact of Novartis Products: Two Case Studies from South Africa and Kenya.* Basel/Berlin/Darmstadt, August 2018.
[11] NS, "NS Annual Report 2018", pages 7 and 127. Accessed September 13, 2019.
[12] KPMG International Cooperative, "KPMG True Value Case Study Safaricom Limited". Accessed September 17, 2019.
[13] Vodafone Group Plc, "Annual Report 2019", page 6. Accessed September 17, 2019.
[14] Vodafone Netherlands, "Environmental Profit and Loss Methodology and Results 2014/15". Accessed September 17, 2019.
[15] Volvo Construction Equipment, "Environmental Declaration Volvo Articulated Haulers". Accessed September 12, 2019.
[16] Yorkshire Water, "Our Annual Performance Report 2018/2019." Published July 2019. Accessed September 16, 2019.

TABLE 2

Sample of Investors Measuring Product Impact

Company	Public information	Measurement	Sample case or methodology	Sample product metrics
BainCapital	Case study examples	Numeric	Skills-focused education company	Number of programs completed, number of sponsored students, percent of learners reporting pay increase, percent of learners reporting career improvement, net promoter score[17]
The Carlyle Group	Case study examples	Numeric	Manufacturer of powertrain components	Number of electric vehicle patents filed, percent reduction in efficiency losses, miles traveled on a single charge[18]
KKR	Case study examples	Numeric	Medical transportation company	Communities served, vehicles in fleet, frequency of critical interventions, patients transported, natural disasters responses[19]
RISE	Methodology	Monetary	Impact multiple of money on online alcohol abuse course	Students (scale), reduction in alcohol incidents following course completion (desired social outcome), value of fatality reduction (economic value of social outcome), probability of impact (risk adjustment), probability of ongoing value creation (terminal value calculation)[20]

2.3. Reporting standards

Given the interest in ESG data, many global reporting frameworks have begun to help companies with measurement and reporting of sustainability information. Two of the global leading standard setters, the Sustainable Accounting Standards Board (SASB) and the Global Reporting Initiative (GRI), have identified hundreds of sustainability metrics. One key difference between SASB and GRI is that the SASB standards are industry-specific. SASB's identification of industry-specific metrics translates to the larger number of identified product related outcomes and impacts. This reflects the idiosyncratic nature of product impact. Given that product impacts differ significantly across industries, one would need an industry lens to capture product outcome metrics.

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[17] Bain Capital Double Impact, "Year in Review." Published May 2019. Accessed September 18, 2019.
[18] The Carlyle Group, "Corporate Sustainability Report 2019." Accessed September 18, 2019.
[19] KKR, "2018 ESG, Impact, and Citizenship Report." Accessed September 18, 2019.
[20] Chris Addy, Maya Chorengel, Mariah Collins, and Michael Etzel, "Calculating the Value of Impact Investing". *Harvard Business Review* January-February 2019 Issue pp. 102 – 109.

TABLE 3

Sample of Reporting Standards and Product Metrics

Standard	Industry Metrics	Number of Industries	Measurement	Input or Outputs	Outcomes or Impacts
GRI	N	-	Descriptive and numeric	4	2
SASB	Y	47	Descriptive, monetary, and numeric	70	117

2.4. Data providers

With standard-setting efforts for ESG disclosure underway, complementary efforts to provide ESG data are also ongoing. For two of the main data providers sharing ESG data, neither provides impact or monetary metrics. For example, one product metric Bloomberg examines in the telecom space is the number of phones recycled rather than the monetary value of the emissions saved from recycling. Similarly, Thomson Reuters has a metric on product recalls rather than the monetary value from injuries or illnesses associated with the recall. Although product recall count provides color to the health and safety of a company's products, monetary figures associated with the recall provide a metric that can be seamlessly integrated into financial statements and decision-making.

TABLE 4

Sample of Data Providers and Product Metrics

Standard	Industry Metrics	Number of Industries	Measurement	Input or Outputs	Outcomes or Impacts
Bloomberg	Y	3	Numeric	33	4
THOMSON REUTERS	N	-	Numeric and rating	25	18

While highly idiosyncratic, the metrics of these reporting standards and data providers seem to have recurring themes. For example, although the underlying metrics themselves may vary, most of these organizations make some effort to capture the accessibility or recyclability of a product. In summarizing these recurrent themes of measurement, it appears some common ones include access, environment, health and safety, information, quality, and satisfaction. The metrics from reporting standards and data providers are distributed across the product impact categories with a focus on environmental, health and safety, and access related impacts.

TABLE 5

Number of Product Metrics by Theme

Product impact theme	**Number of metrics**
Access	49
Environment	108
Health and safety	87
Information	17
Quality	3
Satisfaction	9

3. Product impact framework design methodology

A framework for measuring product impacts should build on existing measurement efforts and leverage public data. The framework should also be applicable to any industry or product to allow for comparability and scalability. Finally, the framework should aim to adhere to certain guiding principles.

3.1. Framework design principles

In designing a standard product impact measurement framework, the five preliminary design principles for creating a methodology for impact-weighted accounts were applied.[21] The scope of source of impact and scope of stakeholders focuses the design to simple but important metrics from a small set of directly impacted stakeholders to test implementation. Specificity as a design principle ensures clear direction when choosing metrics for measurement. Monetization of impact metrics enables that all metrics are expressed in currency terms. Finally, a broad scope of value ensures all material impacts of a firm are captured.

[21] George Serafeim, T. Robert Zochowski, Jen Downing. "Impact-Weighted Financial Accounts: The Missing Piece for an Impact Economy", Harvard Business School. Accessed December 16, 2019.

From these preliminary principles, an additional five product-specific guiding principles were identified when testing the framework against various industries. *Consistency* ensures the framework has constant units, scale, and approach. *Incentive alignment* encourages consideration of the behavior that is incentivized by the framework to ensure it is aligned with positive social and environmental impact. *Best-in-class* benchmarking protects the impact of a product or industry from moving towards an unwanted average. *Conservatism* bases the framework in feasible assumptions and comparisons. Finally, limiting impacts to *first-order* effects allows for clear delineation and attribution.

3.2. Building the framework

To identify the relevant dimensions of product impact, a thought experiment was conducted in which the product impact of two products with identical features and qualities are compared. All else equal, the product with greater reach would have greater impact. Therefore, *reach* must be a dimension of product impact, composed of a product's quantity and duration. In reality, products do not have identical features and therefore, greater reach does not mean greater impact. Holding reach constant in simplified examples allows identification of the other dimensions of product impact.

To identify these other dimensions of product impact, additional thought experiments can be conducted to explore the elements of a customer's interaction with a product. Consider the impact of designer handbags and water where both products have the same reach. Water would be viewed as more impactful because of the inherent goodness of the product. While water is a basic need that provides sanitation and prevents dehydration, a designer handbag is a luxury item with lower inherent utility. This example illustrates that *quality* is a dimension of a product's impact. To specify, quality as a dimension of impact therefore captures the extent to which a product provides a basic need of inherent goodness and the effectiveness of a product which can be measured by customer satisfaction, rather than the level of craftsmanship or leather that might be used in a designer bag.

Next, consider the impact of a generic and prescription drug where both products have the same reach and quality but the generic has a lower price. The lower priced generic would be viewed as more impactful since its pricing makes it more accessible to consumers. Therefore, another dimension of a product's customer usage impact is access.

Holding price, reach, and quality constant, consider the example of cigarettes. Cigarettes have accessible pricing (especially in the absence of taxes), broad reach, and high customer satisfaction but are generally accepted as a product that is unequivocally bad. Regardless of the negative impacts of cigarettes, the product maintains broad reach due its addictive nature. Therefore, a dimension that product impact should capture is consumer *optionality* (i.e. if the consumer has the freedom to make choices). In cases of addictive products or monopolies this optionality is limited. Together, access, quality, and optionality compose of the customer usage dimensions.

Finally, consider various products that produce energy, such as coal and solar. If the two products had the same price, reach, quality, and optionality, solar energy would have greater positive impact than coal because solar energy produces fewer emissions than coal when used. A product's environmental impact through usage *efficiency* and end of life *recyclability* is a dimension of capturing a product's overall impacts.

Looking at existing disclosure data, reach (quantity and duration), the customer usage dimensions (quality, access, and optionality), environmental usage, and end of life impacts of products are comprehensive of the categories that appear in existing measurement efforts. Pricing and underserved impacts are components to access. Health and safety, data privacy, and innovation are some of the attributes of a product's quality. Information is one of the components within optionality. Finally, emissions, energy and recyclability contribute to a product's environmental impact.

4. Diving deeper into the product impact framework

The dimensions of product impacts can be aggregated into a cohesive framework for use across products and industries.

FIGURE 1

Product Impact Framework Dimensions

Reach		Dimensions of Customer Usage			Env Use	End of Life
Quantity	Duration	Access	Quality	Optionality	Emissions & efficiency	Recyclability
The magnitude of individuals reached	Length of time the product can be used, particularly for durables	Accessibility of product through pricing and efforts to provide for the underserved	Quality of product through health, safety, effectiveness, and inherent need or goodness	Ability to choose an alternative product with full information and free will	Emissions in the environment and efficiency enabled through customer usage	Projected product volume recycled at end of product life

Reach

Reach examines how many individuals are reached by the product and the length of time for which the product can be used. Some sample metrics that can be used to estimate a product's reach are sales volume or number of customers. Duration can be estimated with metrics such as average or expected product life. For example, the quantity component of reach for a pharmaceutical company where a discrete number of customers might be unavailable can be estimated through sales data by pharmaceutical drug divided by dose pricing and doses in a treatment to identify the number of individuals treated. For the duration component of reach, most pharmaceutical drugs will have a duration of 0 with implants having a duration equivalent to average product life.

Access

Access is how available a product is to consumers. This can be measured through product pricing and efforts to make the product available for underserved populations. Sample metrics that can be used to estimate affordability include the difference between a product's price and average pricing in the market. For example, a consumer-packaged goods company could compare the price per calorie of their own products to the average price per calorie of all alternatives in the relevant product categories as identified by a standard research or reporting firm such as Nielsen. The accessibility of a product to the general population can be estimated through affordability.

For particularly vulnerable populations, access to various products often allows for the realization of large, critical impacts at a scale far beyond that of the general population. Given the significance and importance of these impacts, product impacts to the underserved are estimated separately in addition to general access. For a product to qualify as accessible to the underserved, the product must address a UN Sustainable Development Goal in a market that would usually not have access to the product. For example, cigarettes do not address a sustainable development goal but are sold in developing markets. They would not be viewed as products that address an underserved population even though they are serving a developing market because they make no contributions to development. On the other hand, a pharmaceutical company could estimate the averted medical and mortality costs and productivity gains of providing qualified drugs to underserved markets.

Quality

Quality of a product can be measured by the health and safety, effectiveness, and inherent goodness of the product. The health and safety of a product examines whether the product performs to expected health, safety and privacy standards. For a packaged food product, its health and safety would not be captured by how healthy the food product is, but by the costs associated with food-borne illnesses from product recalls. Other metrics that can capture the health and safety of a product include controversies or data leaks associated with the product.

The effectiveness of a product is whether the product works as it should. For packaged food products, effectiveness would be where the nutritional value of the product is captured. For example, the whole grains, fiber, added sugar, sodium, and trans-fat content of a product can be translated to costs associated with changes in risk of coronary heart disease or diabetes. Where effectiveness cannot be readily observed, customer satisfaction can be used as a proxy measure.

Lastly, the necessity dimension of the product examines whether the product provides some basic need to the population. Elasticity can be used to identify products that are basic needs. Some other relevant metrics for estimating how the product addresses a basic need include global economic losses avoided through the product. For example, the basic need component of a utilities company providing water would be captured through the averted economic losses from sanitation. Similarly, the basic need component of certain food products would be the averted economic losses of starvation.

Optionality

Optionality of a product is the extent to which consumers have free will and full information in their purchasing choices. The optionality in product choice is composed by information availability, monopolistic nature of the industry, and decision altering characteristics. Under information availability, sample metrics would include labeling and marketing controversies. For example, a water utilities company could use warning letters and fines around improper marketing to estimate the costs of inaccurate information to consumers.

To identify products in an industry with monopolistic behavior, the Herfindahl-Hirschman Index (HHI) or four-firm concentration ration (CR4) can be used. Monopolistic industries such as the pharmaceutical industry can estimate extractive rents to consumers by using the excess of costs associated with marketing to research and development.

For decision altering products, sample metrics include how addictive a product is. A tobacco company could estimate the productivity and treatment costs associated with addiction itself.

Environmental use emissions

Environmental impacts from product usage include emissions to the environment and efficiencies enabled through product use. Some sample metrics that capture the efficiency of a product are carbon or particulate emissions from use or energy required from use. A consumer-packaged goods company could identify the carbon cost of emissions that would be used for cooking and storage of the product.

End of life recyclability

End of life environmental impacts are based on the end of life treatment of the product. Sample metrics could include volume or percentage recyclability and recoverability. A pharmaceutical company could identify the associated carbon costs with the end of life treatment of products sold.

5. Application of the product impact framework

Thus far, the product impact framework has been applied to company pairs within a number of different industries across different sectors. These applications ensure the framework is feasible, scalable, and comparable across different sectors. These applications also uncover nuances within the dimensions of the framework and demonstrate how actual monetary values can be estimated within each dimension.

We will first review a deep-dive of two competitor companies within a single industry, automobile manufacturing, to provide a cohesive example that examines the impacts of automobiles across all the product impact dimensions. We focus our impact estimates on those of passenger fleet vehicles. The companies will be referred to as Company A and B given the purpose of this exercise is to examine feasibility and is not to assess the performance of individual companies. However, we note that all the data are actual data from two of the largest automobile manufacturers in the world. We will then examine each dimension of the product framework with an example from one of the following industries: consumer packaged goods, pharmaceuticals, or water utilities, to demonstrate applicability of the dimensions across different industries and different sectors when the underlying data and assumptions change.

5.1 Data collection process

The examples below are based on publicly disclosed data and industry-wide assumptions. Company datapoints reflect information found in the most recent annual financial statements such as the company's Form 10-K, annual sustainability reports which often disclose SASB and GRI metrics, and industry-wide assumptions from government agencies such as the US Department of Transportation or the Food and Drug Administration.

6. Automobile manufacturing application of the product impact framework

6.1 Overall impacts estimated

TABLE 6

Product Impacts of Company A and B

			Reach		Dimensions of Customer Usage			Env Use	End of Life
Company	Revenue	Total Product Impact	Quantity	Duration	Access	Quality	Optionality	Emissions	Recyclability
A	$160bn	-$3,718m	5,982,000 vehicles sold	14.72 years	-$1,102m	$4,805m	-	-$8,760m	$1,340m
B	$147bn	-$3,378m	8,384,000 vehicles sold	14.26 years	-$2,258m	$7,728m	-	-$9,894m	$1,046m

**variances from totals below due to rounding*

Reach

TABLE 7

Product Sales and Duration of Company A and B

Data

SASB Disclosure		**A**	**B**
TR-AU-000.A	Number of vehicles manufactured	6,000,000	8,459,236
TR-AU-000.B	Number of vehicles sold	5,982,000	8,384,000
Secondary Data		**A**	**B**
Forbes	Maximum[22] mileage	198,409	192,169

Estimation

		A	**B**
Forbes	Maximum mileage	198,409	192,169
		÷	
FHWA	Average annual mileage[23]	13,476	
		=	
	Average product life	**14.72**	**14.26**

[22] Henry, Jim. "Toyota Leads Top 10 Longest Lasting Brands". Forbes Media LLC. Accessed October 23, 2019.
[23] Office of Highway Policy Information. "Average Annual Miles per Driver per Age Group". US Department of Transportation Federal Highway Administration. Accessed October 23, 2019.

To estimate the relevant quantity and duration for reach, a combination of publicly disclosed data and secondary assumptions were used. The maximum mileage of the manufacturer's vehicle and average annual mileage in the United States are used to estimate average product life. Although annual mileage is specific to the United States, this does not indicate that the framework itself is only applicable in the United States. Instead, this is indicative of how an estimate can be influenced by data availability. If a company were to apply this framework, internal data on product life could be applied instead of calculating duration from a localized assumption.

The importance of accounting for average product life is highlighted with durable products. The impact of a vehicle on the consumer is not limited to point of sale, but throughout its useful life. For example, a vehicle has affordability and efficiency impacts throughout use and maintenance and environmental impact at end of life. Therefore, average product life is needed to determine how long and when to recognize usage and end of life impacts.

Access – affordability

TABLE 8

Affordability of Vehicles Sold by Company A and B

Data

SASB Disclosure		**A**	**B**
TR-AU-410a.1	Sales-weighted avg passenger fleet fuel economy (mpg)	28.90	23.00

Secondary Data		**A**	**B**
Kelley Blue Book	Average cost of company vehicle	$42,125	$40,130
Repair Pal	Average annual maintenance cost for company vehicle	$775	$649

Estimation

		A	**B**
Blue Book	(Avg cost of company vehicle	$42,125	$40,130
		÷	
	Avg product life of company vehicle)	14.72	14.26
		-	
Blue Book	(Avg vehicle cost[24]	$36,843	
		÷	
BTS	Avg car product life[25])	11.60	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Vehicle price impact	**$1,884m**	**$2,928m**

[24] Kelley Blue Book. "Average New-Car Prices Up 2 Percent Year-Over-Year for April 2019". *PR Newswire*. Published May 2019. Accessed October 23, 2019.
[25] Bureau of Transportation Statistics. "Average Age of Automobiles and Trucks in Operation in the United States". US Department of Transportation. Accessed October 23, 2019.

		A	B
Repair Pal	(Avg maintenance for company vehicle	$775	$649
		-	
	Avg general vehicle maintenance[26])	$1,186	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Maintenance impact	**$2,458m**	**$4,502m**

		A	B
FWHA	(Average miles driven	13,476	
		÷	
SASB	Vehicle mileage)	28.9	23
		-	
FWHA	(Average miles driven	13,476	
		÷	
EPA	Most efficient mileage[27])	136	
		x	
EPA	Price of gallon of fuel[28]	$2.64	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Fuel price impact	**-$5,799m**	**-$10,775m**

The affordability of a vehicle should consider the complete price for ownership. Therefore, the estimated affordability compares the annualized sale price, fuel costs, and maintenance costs of the manufacturer's vehicle against a reasonable best-in-class alternative. The reasonable best-in-class alternative is the best option that a consumer is able to choose. While the default comparison should be to an average in the market, in situations where the product creates clear damage, the alternative should be to the minimize damage to ensure incentive alignment.

[26] AAA. "AAA Reveals True Cost of Vehicle Ownership". Published August 2017. Accessed October 23, 2019.
[27] Office of Energy Efficiency & Renewable Energy. "Most Efficient Cars by EPA Size Class". US Department of Energy.
[28] US Energy Information Administration. "Gasoline and Fuel Update". Accessed October 23, 2019.

Vehicle price impact

In comparing the vehicle price to determine affordability, the sales price is divided by the average product life to estimate an annualized sales price difference that should be recognized until end of product life. The average product life is a key factor in determining affordability because even though a certain car might have a very low sales price, it could also have an extremely short product life and require more frequent car purchases. Furthermore, this recognition timing matches the common mode of payment for vehicles through long-term leases.

Maintenance impact

Another component for affordability is the cost of maintaining the vehicle given different vehicles can vary in their durability and maintenance needs. This estimate is dependent on initial industry assumptions around the average annual maintenance cost for vehicles. These estimates can be challenged and refined with industry input to improve accuracy.

Fuel price impact

In this example, the average fuel economy across all car types is compared to the best in class car for fuel efficiency, a Hyundai Iconic EV. The comparison is reasonable given the Iconic EV has a lower sales price than the average vehicle price for both companies. The comparison is also limited to vehicles rather than other modes of transportation given the first-order principle to ensure there is not an intractable comparison.

In practice, a manufacturer with more detailed fuel economy data could make the comparison by car type rather than across car type. For example, the companies could compare their EVs to the Hyundai Iconic EV and use the non-EV best-in-class fuel economy for their other vehicles.

Even with manufacturer data, these estimates are reliant on industry-wide assumptions around fuel price and average miles driven in a year. Industry input is therefore crucial in refining these assumptions to improve accuracy and ensure alignment over time.

Access – underserved

TABLE 9

Underserved Access to Vehicles Sold by Company A and B

Data

Secondary Data		**A**	**B**
Statista	% sales to developing countries	26%	57%

Estimation

		A	**B**
UN	Addresses SDG	1	
		x	
ANTP	(Avg travel time with car	.42 hours	
		-	
ANTP	Avg travel time w.out car)	.63 hours	
		x	
World Bank	Average global net national income (per capita)[29]	$8,826	
		÷	
	Annual working hours	2,080	
		x	
Statista	Percent of sales to developing countries	26%	57%
		x	
SASB	Vehicles sold	5,982,000	8,384,000
		=	
	Underserved impact	**$353.3m**	**$1,085.7m**

Sales of vehicles in underserved markets qualify as providing a positive impact to the underserved since vehicles address the ninth sustainable development goal on industry, innovation, and infrastructure. In this example, sales to underserved markets is approximated by the percentage of sales to a developing country. A manufacturer with more detailed data could apply a more nuanced approach to identifying sales that qualify as underserved.

The impact of these sales can be estimated using industry assumptions on time savings when relying on private vehicles for transportation compared to other modes of transportation. These time savings can be estimated for a local population or with a global constant. For illustrative

[29] The World Bank Data. "Adjusted net national income per capita (current US$). Accessed November 11, 2019.

purposes, this example relies on a global time savings constant. Again, this constant could be refined through industry debate and recommendations.

To identify the monetary value of these time savings, the average global hourly wage is applied. A global wage is preferred to a local wage to ensure perverse incentives are not created for manufacturers to avoid countries with the lowest wages, and likely the most underserved. Although the monetary value of time saved could have also been estimated using willingness to pay for time, global wage is preferred given the willingness to pay for time varies by congestion (free flow, slowed down, stop and start) and timeliness (early arrival, minimized lateness, reduced mean travel time)[30]. As with the affordability impact, the underserved impact can be recognized until end of product life.

Quality – health and safety

TABLE 10

Safety Impact of Vehicles Sold by Company A and B

Data

SASB Disclosure		A	B
TR-AU-250a.1	Percentage of vehicle models rated by NCAP programs with an overall 5-star safety rating, by region - US	59%	73%
TR-AU-250a.3	Number of vehicles recalled	5,940,000	4,230,000

Estimation

		A	B
AAA	Crash / 100 million miles	519	
		÷	
FWHA	Average miles driven	13,476	
		x	
Statista	% of 5-star safety cars	59%	73%
		x	
NCBI	% of reduction in crashes[31]	14%	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
		x	
Tavss	Average cost of crash[32]	$69,100	
	Safety impact	**$2,387m**	**$4,141m**
		A	**B**

[30]Zheng Li, David A. Hensher, John M. Rose. "Willingness to pay for travel time reliability in passenger transport: A review and some new empirical evidence". *Transportation Research* Volume 46, Issue 3, May 2010. Accessed October 23, 2019.
[31] Metzger KB, Gruschow S, Durbin DR, Curry AE. "Association between NCAP Ratings and Real-World Rear Seat Occupant Risk of Injury". *Traffic Injury Prevention 2015*. Accessed October 23, 2019.
[32] Tavvs Fletcher. "The Price Paid for Automobile Accidents and Injuries". Accessed October 23, 2019.

SASB	Recalled vehicles	5,940,000	4,230,000
		÷	
BTS	Number of vehicles in US[33]	272.4m	
		x	
NHTSA	# vehicle caused crashes[34]	44,000	
		x	
Tavss	Average cost of crash	$69,100	
	Recall impact	**-$66.2m**	**-$47.2m**

Safety impact

The safety of a vehicle is estimated using the US-based NCAP rating program. This safety rating is associated with a reduction rate in injury for frontal crashes. The monetary value of the reduced injuries attributable to the manufacturer can be estimated with average costs associated with a crash. For illustrative purposes, this example applies a US safety rating to all vehicles sold. A manufacturer would be able to apply this methodology on data that is disaggregated to use safety ratings from different geographies. Furthermore, this estimate is reliant on industry ratings and assumptions that can be continually adjusted as new safety and injury information becomes available. For example, the injury reduction assumption applied is limited to frontal crashes. Yet, there is a known association between safety ratings and reduced injury for two additional crash types. Industry debate can identify an estimate that can be generalized to all crashes.

Recall impact

The recall impact is based on manufacturer disclosed data on recall car volume and public reports of vehicle caused crash rates. The attribution of these recalled cars to the pool of crashes can be approximated by applying the percentage of cars on the road that are recalled by the manufacturer. This estimate implicitly assumes that only recalled cars are capable of a vehicle caused crash and that all recalled cars can produce a crash given the time frame required to fix a recalled car. For a manufacturer with data on the rate at which their recalled cars are fixed, the attribution percentage can be lowered by using the number of unfixed recalled cars remaining on

[33] Bureau of Transportation Statistics. “Number of US Aircraft, Vehicles, Vessels, and Other Conveyances. Accessed October 23, 2019.

[34] National Highway Traffic Safety Administration. “Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey”. *Traffic Safety Facts.* Accessed October 23, 2019.

the road rather than the total number of recalled cars. Given ongoing changes and advances in the industry, it is possible to imagine a future in which extended warranties can also factor into the health and safety impacts.

Quality – effectiveness

TABLE 11

Customer Satisfaction Impact of Company A and B

Data

Secondary Data		**A**	**B**
ASCI	Customer satisfaction rate	80%	80%

Estimation

		A	**B**
ASCI	Satisfaction rate	80%	80%
		-	
ASCI	Average satisfaction rate[35]	79%	
		x	
Carfax	% loss in car value (initial year)[36]	20%	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Satisfaction impact	**$251m**	**$506m**

Since the effectiveness of a vehicle is not directly measurable, it is approximated through customer satisfaction rate. The value associated with customer satisfaction is estimated by applying the loss in car value after ownership in the initial year. This implicitly assumes that a customer is able to realize their dissatisfaction in the initial year of ownership and has the optionality to change to another vehicle. Given the assumption is tied to the initial year of ownership, the satisfaction impact should be recognized only in year of sale. The customer satisfaction and car value loss assumptions are again, based on industry estimates that can be refined with additional information. Furthermore, as new technology is introduced, it is possible that effectiveness can be more directly measured in this industry. For example, one could imagine a future in which vehicles influence congestion, reduce commute time or avert accidents differently by make and model through recorded innovations such as driver assisted technology.

[35] American Customer Satisfaction Index. "ACSI Automobile Report 2018 – 2019". Accessed October 23, 2019.
[36] Carfax. "Car Depreciation: How Much Value Will a New Car Lose?". Accessed October 23, 2019.

These innovations would then reflect differences in the ability for different vehicles to effectively transport the user.

Quality – necessity

TABLE 12

Basic Needs Met by Company A and B

Data		
Secondary Data		
Harvard	Long-run price elasticity of vehicle	1.2
Harvard	Price elasticity of vehicle (rural)[37]	0.2

Estimation			
		A	**B**
	Necessity (elasticity < 1)	1	
		÷	
Illustrative	Percent of rural sales	50%	50%
		X	
	Average daily commute[38]	.45 hours	
		X	
	Commute days	260	
		X	
Ho, Chinh	WTP for mobility as a service[39]	$6.40	
SASB	Vehicles sold	5,982,000	8,384,000
	Necessity impact	**$2,231m**	**$3,127m**

The final component to quality examines whether a vehicle meets a basic need. The elasticity of a vehicle demonstrates that vehicles are a basic need in rural areas. This makes logical sense as urban areas have alternative modes of transportation and vehicles could contribute to congestion. For illustrative purposes since detailed sales data is not available by geography, this example simply assumes that 50% of sales are rural. To estimate the impact created by rural vehicle provision, the time spent commuting annually is valued with willingness to pay for mobility. Given the impact is realized in all years of ownership, the necessity impact can be recognized throughout

[37] Patrick L. Anderson, Richard D. McLellan, Joseph P. Overton, Dr. Gary L. Wolfram. "Price Elasticity of Demand". Accessed October 23, 2019.
[38] Sinclair, Liz. "Commute Times in Every State, Ranked." Accessed October 23, 2019.
[39] Chinh Ho, David Hensher, Corinne Mulley, Yale Wong. "Potential uptake and willingness-to-pay for Mobility as a Service (MaaS): A stated choice study". *Transportation Research*, volume 117, pages 302-318. Accessed October 23, 2019.

the expected product life. In practice, the manufacturer could apply the actual percentage of non-urban sales and industry input could identify precise estimates on the value of mobility.

Optionality

TABLE 13

Optionality Impact for Company A and B

Data		Estimation	
Secondary Data		Monopoly (HHI > 1500)	0
HHI for vehicle manufacturers[40]	650	**Optionality impact**	**-**

For the monopolistic component of optionality, the vehicle manufacturing industry is not a monopoly. Therefore, no impact related to monopolistic behavior exists to be estimated. Similarly, vehicles do not have decision-altering capabilities. Finally, neither company has reported marketing or information penalties for the year of 2018.

Environmental Use Emissions

TABLE 14

Costs of Emissions Produced by Vehicles Sold by Company A and B

Data

SASB Disclosure		**A**	**B**
TR-AU-410a.1	Sales-weighted average passenger fleet fuel economy, by region - tail pipe emissions per vehicle (grams / mile)	312	251.41

Monetization

		A	**B**
SASB	Emissions (grams / mile)	312	251.41
		x	
FWHA	Average miles driven	13,476	
		÷	
	Grams per ton	907,184	
		x	
EPS	Social cost of carbon[41]	$316	

[40] Korus, Sam. "The Automotive Industry is on the Threshold of Massive Consolidation". *Ark Invest*. Accessed October 23, 2019.
[41] Steen, Bengt. "Monetary Valuation of Environmental Impacts". Environmental System Analysis Chalmers University of Technology. Accessed January 17, 2020.

		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Emissions impact	**-$8,760m**	**-$9,894m**

To estimate the costs associated with disclosed tail-pipe emissions per mile, assumptions need to be made around customer usage of the vehicle which can be captured through average annual mileage and the carbon cost associated with the emissions. The carbon cost applied assumes no discounting of costs over time and is expected to be continually refined to reflect the latest data. Similarly, the average annual mileage should also be refined as new information is available. This example captures the emissions impact associated with a single year of vehicle use and should be recognized for the entirety of expected product life.

End of Life Recyclability

TABLE 15

Recyclability and Recoverability Vehicles Sold by Company A and B

Data

SASB Disclosure		**A**	**B**
TR-AU-440b.3	Average recyclability of vehicles sold	85%	85%
	Average recoverability of vehicles sold	95%	95%

Monetization

		A	**B**
ANL	Cars recycled in operating markets	79.15%	57.5%
		x	
SASB	Recyclability	85%	85%
		x	
	Curb weight (pounds)	4,506	4,071
		x	

	Value per pound[42]	$0.08	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Recycling impact	**$1,450m**	**$1,334m**

		A	**B**
ANL	Cars recycled in operating markets	79.15%	57.5%
		x	
SASB	Recoverability delta	10%	10%
		x	
	Curb weight (pounds)	4,506	4,071
		x	
	Value per pound[43]	$0.01	
		x	
SASB	Vehicles sold	5,982,000	8,384,000
	Recovered impact	**$23m**	**$21m**

		A	**B**
ANL	(Cars recycled in operating markets	79.15%	57.5%
		x	
SASB	Waste from recycling	5%	5%
		x	
	Curb weight)	4,506	4,071
		+	
	Cars not recycled	20.85%	42.5%
		x	
SASB	Vehicles sold	5,982,000	8,384,000
		x	
	Cost per pound of waste[44]	$0.02	
	Waste impact	**-$133m**	**-$309m**

[42] B.J. Jody and E.J. Daniels. "End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue." Energy Systems Division, Argonne National Library. Accessed October 23, 2019.

[43] B.J. Jody and E.J. Daniels. "End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue." Energy Systems Division, Argonne National Library. Accessed October 23, 2019.

[44] B.J. Jody and E.J. Daniels. "End-of-Life Vehicle Recycling: The State of the Art of Resource Recovery from Shredder Residue." Energy Systems Division, Argonne National Library. Accessed October 23, 2019.

As is standard in the automobile manufacturing industry, both companies disclose the recyclability and recoverability of vehicles sold. For illustrative purposes, average curb weight is estimated from industry aggregate assumptions. In practice, a manufacturer could use actual curb weight of sales. The assumptions around recycling rates and associated value of recycled, recovered or wasted volume can be refined with additional information. Given the recycling and recovering occurs at the end of product life, the associated impacts should be recognized at the expected end of product life.

7. Select example applications of the product impact framework by dimension

Having documented the applicability of the framework in the context of two competitor companies within an industry, in this section we focus on expanding the breadth of the applications of the framework. Below we discuss the application of the framework using real data for companies in the pharmaceutical, consumer packaged goods, and water utility industries.

Access - affordability

TABLE 16

Affordability of Products Sold by Example Consumer Packaged Goods Company

Data

Company Disclosure		
Form 10-K	Total US sales	$9,062m
Secondary Data		
Nielsen	Approximated % sales from cereal	18.44%
Nielsen	Approximated % sales from yogurt	11.34%
Nielsen	Approximated company cereal price per ounce	$0.25
Nielsen	Approximated company yogurt price per ounce	$0.19
Nielsen	Approximated industry cereal price per ounce	$0.21
Nielsen	Approximated industry yogurt price per ounce	$0.21

Estimation

Form 10-K	Total US Sales	$9,062m
		x
Nielsen	% cereal sales	18.44%
		÷
Nielsen	Company cereal price per oz.	$0.25
		x
Nielsen	(Industry cereal price per oz.	$0.21
		-
Nielsen	Company cereal price per oz.)	$0.25
	Cereal price impact	**-$280.8m**
Form 10-K	Total US Sales	$9,062m
		x
Nielsen	% yogurt sales	11.34%

		÷
Nielsen	Company yogurt price per oz.	$0.19
		x
Nielsen	(Industry yogurt price per oz.	$0.21
		-
Nielsen	Company yogurt price per oz.)	$0.19
	Yogurt price impact	**$88.9m**

For consumer-packaged goods ("CPG") companies, affordability can be estimated by comparing a product's price to that of others in the same product category. Given the range of products sold by a CPG manufacturer, it is reasonable to aggregate and compare pricing within a commonly accepted product categorization. For illustrative purposes, the Nielsen product group has been applied to estimate manufacturer and general price per ounce for comparison for the manufacturer's two largest product categories. In practice, a manufacturer could estimate differences at the actual price per calorie level which more closely captures the intent of measuring accessibility.

Access – underserved

TABLE 17

Underserved Access to Products Sold by Example Pharmaceuticals Company

Data

Company Disclosure		
SASB 240a.2	Product on WHO's list of prequalified medicines	13
Secondary Data		
CHAI	Estimated implant units sold	2.1m
UNFPA	Healthcare cost savings per person[45]	$34.26

Estimation

CHAI	Estimated implant units sold	2.1m
		x
UNFPA	Healthcare cost savings per person	$34.26
	Underserved access impact	**$74.2m**

For a pharmaceutical company, access to the underserved can be estimated by identifying procurement sales of products on WHO's list of prequalified medicines. These two requirements ensure the sales are reaching the underserved at an accessible price and are also addressing the

[45] "UNFPA Annual Report | 2016". *United Nations Population Fund*. https://www.unfpa.org/annual-report-2016. Accessed December 13, 2019.

Sustainable Development Goal of good health and well-being. For illustrative purposes, this example examines the impact from one of the company's 13 qualified products. The impact of this product is based on estimated procurement sales volume and an industry standard on the healthcare cost savings from enabling family planning. In practice, a company could apply this methodology to their entire suite of pre-qualified medicines and use actual procurement sales volume.

Quality – health and safety

TABLE 18

Health and Safety of Products Sold by Example Consumer Packaged Goods Company

Data

Company Disclosure		
CN0103-09	Number of recalls	5
Form 10-K	Total US sales	$9,062m
Secondary Data		
Company	Approximate number of product lines	1500
	Recall volume for 1 product line	1.8m
Target	Ounces in 1 unit of recalled product	17
Nielsen	Price per ounce for product line	$0.25
	Total product line sales	$496m
	Average price per unit of recalled product	$2
ERS	Cost of E. coli[46]	$4,298
ERS	Cost of salmonella[47]	$3,568

Estimation

Form 10-K	Total US sales	$9,062m
		x
Est.	% sales from product line with a recall (number of recalls / total product lines)	0.33%
		x
Est.	(Recalled sales for single product (recall volume * ounces in unit * price per ounce)	$7.76m
		÷
Est.	Total product line sales)	$496m
		÷
Est.	Average price per unit of recalled product	$0.25
		x
	Average cost of food-borne illness (between E. coli and salmonella)	$3,933
	Recall impact	**-$926.6m**

The health and safety of packaged food products can be estimated by identifying the associated costs of food-borne illnesses caused by products that are eventually recalled. In this

[46] Economic Research Service. "Cost Estimates of Foodborne Illnesses". *United States Department of Agriculture*. Accessed November 25, 2019.
[47] Economic Research Service. "Cost Estimates of Foodborne Illnesses". *United States Department of Agriculture*. Accessed November 25, 2019.

example, the recall volume is extrapolated from the number of recalled product lines, sales volume, and standard recall volumes for a single product line. For illustrative purposes, it is assumed that half of the recall volume causes E. coli and the other half causes salmonella. In practice, a company would not need to estimate their recall volume but could report the actual recall volume and use the relevant food-borne illness to identify associated costs.

Quality – effectiveness

TABLE 19

Effectiveness of Products Sold by Example Consumer Packaged Goods Company

Data

Company Disclosure		
Form 10-K	Total US sales	$9,062m
Secondary Data		
Food Business News	Product sales with 8+ grams of whole grains	$1,670m
Nielsen	Price per serving with whole grains	$0.25
Food Business News	Ounces of whole grain in one serving	0.5
ODPHP	Annual whole grain consumption (from DV) ounces[48]	1095
Food Science and Nutrition	Whole grain consumption on CHD reduction[49]	17%
	Products with no trans fat	90%
Nielsen	Average price per ounce	$0.27
HSPH	Annual trans fat consumption at 2% of caloric intake (g)[50]	1662

Estimation

Food Bus	Product sales with 8+ grams of whole grains	$1,670m
		÷
Nielsen	Price per serving	$0.25
		x
Food Bus	Ounces of whole grain in one serving	0.5
		÷
ODPHP	Annual whole grain consumption (from DV) ounces	1095
		x
AHA	Prevalence of CHD in US	5.2%
		x
Food Sci and Nutr	Whole grain consumption on CHD reduction	17%
		x
	(Medical cost of CHD	$12,361
		+
	Productivity cost of CHD	$13,750)

48 Office of Disease Prevention and Health Promotion. "Dietary Guidelines for Americans 2015 - 2020". *U.S. Department of Health and Human Services, U.S. Department of Agriculture.* 8th Edition. Accessed November 25, 2019.

49 Angela Bechthold, Heiner Boeing, Carolina Schwedhelm, Georg Hoffmann, Sven Knüppel, Khalid Iqbal, Stefaan De Henauw, Nathalie Michels, Brecht Devleesschauwer, Sabrina Schlesinger & Lukas Schwingshackl. "Food groups and risk of coronary heart disease, stroke and heart failure: A systematic review and dose-response meta-analysis of prospective studies". *Critical Reviews in Food Science and Nutrition, 59:7, 1071-1090*.

50 R. Micha, D. Mozaffarian. "Trans Fatty Acids: Effects on Cardiometabolic Health and Implications for Policy". *US National Library of Medicine.* 2009 September 1. Accessed November 25, 2019.

HSPH	Associated increase in CHD risk from 2% trans fat intake[51]	23%
	Medical cost of CHD[52]	$12,361
	Productivity cost of CHD[53]	$13,750

	Whole grains impact	**$698.6m**
	Products with trans fat (100-90%)	10%
		x
Form 10-K	Total US sales	$9,062m
		÷
Nielsen	Average price per ounce	$0.27
		x
Est.	Trans fat (g) per ounce	1
		÷
HSPH	Annual trans fat consumption at 2% of caloric intake (g)	1662
		x
AHA	Prevalence of CHD in US	5.2%
		x
HSPH	Associated increase in CHD risk from 2% trans fat intake	23%
		x
	(Medical cost of CHD	$12,361
		+
	Productivity cost of CHD	$13,750)
	Trans fat impact	**-$639.7m**

The effectiveness of a packaged food product is the product's nutritional profile. Current research indicates that there is a relationship between trans fat, added sugar, sodium, whole grains and fiber on health outcomes such as coronary heart disease. This example demonstrates how the impact of trans fat and whole grains can be estimated from product sales, medically defined risk reductions and disease cost estimates. The change in risk from consuming fiber or trans fat on heart disease is based on medical research and expected to be refined as new information is made available. As such, it is also possible that relationships can be defined for additional nutrients. In practice, a company would be able to apply the actual volume of whole grain or trans fat sold in

[51] R. Micha, D. Mozaffarian. "Trans Fatty Acids: Effects on Cardiometabolic Health and Implications for Policy". *US National Library of Medicine.* 2009 September 1. Accessed November 25, 2019.
[52] Center for Health Metrics and Evaluation. "Cardiovascular Disease: A Costly Burden for America". American Heart Association. Accessed January 17, 2020.
[53] Center for Health Metrics and Evaluation. "Cardiovascular Disease: A Costly Burden for America". American Heart Association. Accessed January 17, 2020.

the calculation rather than estimating whole grain volume from sales and other publicly available datapoints. Furthermore, a company would also be able to identify how their effectiveness impact has changed over time as they have reformulated foods in line with new medical findings. For example, it is companies that have reduced the amount of trans fat in their products would see a larger positive effectiveness impact year over year.

Quality – necessity

TABLE 20

Basic Needs Met by Water Utilities Company

Data			Estimation		
Company Disclosure					**A**
GRI 102-6	Services provided to	14m		Necessity (elasticity < 1)	1
					x
			WHO	(Global economic loss	$260bn
Secondary Data					÷
	Elasticity of water	0.28		Affected population)	783m
WHO	Global economic loss from lack of water access[54]	$260bn			x
WHO	Affected population	783m	GRI 102-6	Services provided to	14m
				Necessity impact	**$4,648m**

For a water utilities company, the elasticity of the product indicates that water is a basic need. The impact of providing this basic need to society is estimated by identifying the individuals reached by the company and the per person economic loss from lack of sanitation and dehydration associated with lack of water access.

Optionality

TABLE 21

Optionality Impact for a Water Utilities Company

Data			Estimation	
Secondary Data			Monopoly (HHI > 1500)	1
	HHI for Utilities	7000		

[54] Hutton, Guy. "Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage". *World Health Organization.* Published 2012. Accessed November 20, 2019.

	Optionality impact	-

Although a water utilities company is a clear monopoly, there is no associated negative optionality impact. This is because the water utilities company is highly regulated with little opportunity to set price (in the absence of cronyism). Because the price setting prevents the company from extracting high rents from their customers, the optionality impact from monopoly is not relevant in this case.

Environmental Use Emissions

TABLE 22

Costs of Emissions Produced by Products from Pharmaceutical Company

Data

SASB Disclosure		
GRI 305-3	GHG emissions from use of sold products (metric tons)	148,100

Monetization

GRI 305-3	GHG emissions from use of sold products (metric tons)	148,100
		x
EPS	Social cost of carbon[55]	$316
	Emissions impact	**-$46.8m**

Given the pharmaceutical company discloses the GHG emissions produced during use of their sold products, the emissions impact is based on the emissions produced and the current estimate of the social cost of carbon. The carbon cost applied assumes no discounting of costs over time and is expected to be continually refined to reflect the latest data.

End of Life Recyclability

TABLE 23

Recyclability and Recoverability of Products from Pharmaceutical Company

Data	Monetization

[55] Steen, Bengt. "Monetary Valuation of Environmental Impacts". Environmental System Analysis Chalmers University of Technology. Accessed January 17, 2020.

SASB Disclosure		
GRI 305-3	GHG emissions from end-of-life treatment of sold products (metric tons)	44,900

GRI 305-3	GHG emissions from use of sold products (metric tons)	44,900
		x
EPS	Social cost of carbon[56]	$316
	Waste impact	**-$14.2m**

Similarly to emissions from use, the pharmaceutical company discloses GHG emissions produced from end-of-life treatment of their sold products and the emissions impact is based on the emissions produced and the current estimate of the social cost of carbon.

8. Accounting treatment of product impacts

As these identified product impacts are to be used in decision-making, the accounting treatment of these impacts needs to be considered. These considerations include where to recognize these impacts in financial statements and the timing of recognition.

In determining where to recognize product impacts, it is useful to identify where other product-related line items are recognized. For example, product sales are recognized in the income statement as revenue. Following the treatment of product sales, product impacts could likely be recognized as an adjustment to revenue. A company with overall negative product impacts would find their impact-weighted revenue lower than their financial revenue while a company with overall positive product impact would have a higher impact-weighted revenue than their financial revenue number.

Although product impact is recognized in the income statement there needs to be consideration of potential balance sheet effects. While product impact in this case is not to be recognized as an asset or a liability, the positive or negative effect would flow to other comprehensive income. These impacts are non-cash flow items that can contribute to equity which is recorded in the balance sheet. Furthermore, it is imperative to note that although product impacts are not recorded in the balance sheet, that is not to say that all other social and environmental impacts should be recorded directly in the income statement. For example, employment-related impacts such as the impact from employee training could be recognized as human capital investments in the balance sheet that

[56] Steen, Bengt. “Monetary Valuation of Environmental Impacts”. Environmental System Analysis Chalmers University of Technology. Accessed January 17, 2020.

are depreciated over time. We explore employment impact and its accounting treatment in a future paper.

As the timing of impact recognition has been discussed above in the example automobile manufacturer application, product impact could be recognized when the actions influencing impact take place. This is preferable to recognizing impact at point of sale since the recognition should not be forward looking. For an automobile manufacturer, the timing of recognition for the dimensions of product impact can vary by when the action occurs. This is highlighted when one examines emissions and recyclability. With emissions, the impact would be recognized for the duration of expected product life since the vehicle is being used throughout product life and the emission particulates are being emitted during that usage. This is preferable to recognizing emissions impact at point of sale since the particulate emissions have not yet been created. On the other hand, their recyclability impact would be recognized at end of product life since that is when the vehicle is being recycled.

9. Value of impact-weighted financial statement analysis

This application of the product framework to the competing automobile manufacturers not only indicates feasibility of estimating monetary product impacts, but also demonstrates the potential value of impact-weighted financial statement analysis. As indicated in the application, one potential analysis enabled is a comparability of the product impacts of different companies. Within a single industry, one can identify differences in how the two companies approach different product attributes such as vehicle emissions or vehicle safety. For example, our analysis suggests that while one company has relatively better performance on the access dimension the other company outperforms on quality. Analyzing each dimension allows for a deeper understanding of the business strategies employed by each company. The company that outperforms on recyclability is better positioned to compete in the circular economy while the company that provides more access to products through lower maintenance costs and lower fuel expenses is better positioned to compete in underserved markets.

Beyond identifying differences in approach, impact-weighted financial statement analysis can also help investors identify companies that are well-positioned to create additional impact in dimensions of interest. For example, although both Company A and Company B create vehicles with the same recyclability and recoverability rates, the prevalence of recycling in the markets in which both companies differ. Company A operates in markets where more cars are recycled. Therefore, even if both companies were to make the same improvement to their vehicle's recyclability and recoverability, Company A is better positioned to create positive end of life recyclability impacts in the future.

Moreover, as more data is available around monetary product impacts, one can analyze a company's performance within certain dimensions to identify valuable industry and company specific insights. For example, our hypothesis is that disruptive companies would have particularly positive impact on their access and quality dimensions even if they have not yet gained significant reach. Incumbents that see their access and quality impacts becoming more negative over time, even though their reach could stay similar, might be prime candidates for future disruption.

Furthermore, as more data becomes available across companies, we could start understanding the complementarities and trade-offs between the impact dimensions. Are access and quality negatively correlated? What is the relationship between environmental use and quality? How do these relations differ across industries? Answering those questions would enable managers to make better decisions as they seek to optimize across impact dimensions to improve their impact-weighted accounting numbers.

As financial statement analysis today enables business insights beyond the reported values, one can expect that impact-weighted financial statement analysis should also drive insights beyond the numeric impact estimated.

10. Conclusion

Although interest in ESG measurement has grown significantly, the focus has largely been around the impacts related to a company's operations rather than those created through product use. Product impact has been difficult to systematically measure given the idiosyncratic nature of the impacts and the tendency to view products in broad categorizations of simply good and bad. This idiosyncrasy is highlighted in the efforts of the few companies, investors, and disclosure frameworks that identify product impact.

The creation of a product impact framework that captures a product's reach, accessibility, quality, optionality, environmental use emissions and end of life recyclability allows for a systematic methodology that can be applied to different companies across a wide range of industries. This enables transparency, comparability, and scalability within product impact reporting. The identified standard dimensions on which product impact can be measured are rooted in existing measurement efforts, allowing data that is publicly available to be leveraged.

To ensure applicability, determine feasibility, and identify nuances within each dimension of product impact, the framework will be tested on company pairs within each GICS sector. A sample application for a single vehicle manufacturer indicates that monetary estimates can be derived for impacts within each dimension using publicly disclosed data and industry-wide assumptions. The example highlights the need for ongoing discussion and refinement of industry-accepted assumptions given new information and changes to industries and technology over time. Input from industry is crucial for the framework to be widely applicable. The example also demonstrates how general estimates of impacts can become more precise when applying internal company data with more granularity within this framework.

The next set of working papers will examine applications of the framework across each GICS sector with the first in the series focused on automobile manufacturers for consumer discretionary, food products for consumer staples, water utilities for utilities, oil and gas for energy and pharmaceuticals for healthcare.

Ultimately, the aspiration is to develop and provide a framework that enables more informed decisions which account for the many impacts created by products.