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# Research Opportunities in Supply Chain Transparency

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***Abstract:*** More firms than ever before are disclosing provenance of their products, results of product testing, and suppliers' labor-practice compliance with western norms in annual reports, sustainability reports, and press releases, besides making it available on third-party websites. The problem remains however that companies find collecting and disclosing such information not only to be costly and complicated, but also do not understand the benefits. To motivate further research on supply chain transparency, we first report recent examples of companies providing supply chain transparency. We also present potential benefits of supply chain visibility and supply chain transparency separately for the company. While terminology has not yet been standardized, this paper distinguishes visibility – managers' efforts to learn more about operations upstream in their supply chains – from supply chain transparency, by which we mean a company disclosing information to consumers, investors, and other stakeholders about compliance to consumer-expected norms in its supply chain operations and products. Finally, we propose some topics for research on supply chain transparency arranged by stakeholder.

**Keywords**: Supply chain transparency, supply chain visibility, stakeholder resource-based view, research topics, stakeholders

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# 1. Introduction

Although more companies than ever before are disclosing information about their products and their supply chains to consumers (Marshall et al. 2016), there is much confusion and uncertainty about what to disclose and whether doing so has any benefit apart from meeting necessary regulatory requirements. Companies are disclosing provenance of their products, results of product testing, and suppliers' compliance of labor practices with (western) consumer-expected norms in annual reports, sustainability reports, and press releases, and via third-party websites. Yet, companies find that choosing, collecting, and disclosing such information is costly, complicated and time-consuming. In fact, the major audit companies offer 'assurance' practices and third parties offer transparency services to companies to assist in such efforts. Moreover, companies do not understand very well the value of such disclosure. This paper seeks to offer a research agenda for operations management (OM) scholars to motivate further research on *supply chain transparency*.

Although terminology is not yet standardized, we find it worthwhile to separate visibility from transparency of the supply chain. By *supply chain visibility*, we refer to managers' efforts to gather information about operations upstream and downstream in their supply chains and by *supply chain transparency*, we mean a company disclosing information to the public, including consumers and investors, about upstream operations and about the products it sells to consumers. *Traceability* is that capability of a company in ascertaining provenance, and hence an aspect of visibility; whether or not the company discloses any of this information to the public is a matter of transparency.

As a necessary step for supply chain transparency, companies need to first invest in supply chain visibility by mapping out their supply chain operations, conducting audits and interviews, and developing or commissioning reports. This investment in supply chain visibility has economic value by way of improved operational decisions (Handfield 2017). Next, these companies selectively disclose some of their supply chain information along with information about their products to the public (new 2010) to

show that it is not damaging the environment or harming communities where the company or its suppliers have operations and is not making products that would harm consumers by way of improving supply chain transparency.

While visibility caters to the needs of stakeholders *internal* to the company (or its supply chain) like managers or immediate suppliers or customers, transparency targets a broader set of *external* stakeholders, including consumers and consumer rights' advocacy groups, NGOs as well as investors and monitoring agencies. We focus primarily on concerning consumers rather than business customers because it is to consumers that companies misrepresent, or can misrepresent, the value or safety of their products and services, thus "phishing for phools" (Akerlof and Schiller, 2015: 1-11).

Furthermore, by supply chain transparency, we refer voluntary disclosure as distinct from that required by the government or regulators. Even though we use the word 'transparency' as an abbreviation for 'supply chain transparency', we recognize there are other aspects of transparency for a publicly listed company: disclosure of gender pay gap or the top *n* customers or not participating in corruption.

We focus mostly, but not solely, on the *supply-side* or upstream operations for transparency because a firm disclosing its list of customers could just be advertising, which is why many companies forbid their suppliers from 'disclosing' their names as customers. However, downstream transparency is becoming increasingly important regarding disclosing post-consumer waste from a company's products or their packaging. Supply chain visibility, in contrast, is needed not only for upstream operations but also downstream because a company's sales can be affected by disruptions at a customer or at a customer's customer.

In the next section, we report on the transparency phenomenon with examples of companies providing information to consumers, investors, and monitoring agencies. Next, we discuss the potential benefits of supply chain visibility in Section 3 and those of supply chain transparency in Section 4. In Section 5, we propose some research topics before concluding in Section 6.

## 2. Examples of Supply Chain Transparency

Many companies have sharpened their corporate social responsibility focus to environmental and social sustainability (Tang, 2018), including making their supply chain operations more transparent to the public to signal their commitment to sustainability to consumers and investors. Below are examples of companies disclosing different levels of supply chain information to the public. Nearly all these examples are from the apparel industry, along with only a couple of exceptions from computers and electronics. The food sector should have been another sector especially when it comes to provenance (Wognum et al. 2011), but there are not many examples.[1] In fact, there are many more examples of deliberate *opaqueness* from the food and the pharmaceutical sectors (see Section 5.5).

***Disclosing supply chain information at all tiers.*** Some companies collect and disclose process information for the entire supply chain. Heidi.com S.A. is a Swiss company that produces and sells apparel for men and women, offering "openness" as its core value to differentiate itself from other apparel companies. Each Heidi garment has a tag that comes with a code that can enable consumers to review the entire supply chain process from the source of the cotton to the distribution center by entering this code on the Respect Code website.[2]

***DisclosingTier-1 supplier information.*** Many apparel companies disclose Tier-1 suppliers including the supplier's name, location, and activity as of this writing. After facing years of criticism over child labor by its suppliers, Nike began to disclose its contract supplier base in 2005.[3] It provides the names and locations of its Tier-1 active contract factories (Doorey 2011)[4] -- all 567 of them in November 2017 -- on its 'manufacturing map' website.[5] Apple too discloses its top 200 Tier-1 suppliers, which in 2014 represented 97% of its costs of procurement of components, manufacturing, and assembly. Marks and Spencer, a leading UK-based retailer, discloses the name, the location, and the percentage of female workers of each of its 1,539 factories in 57 countries on an interactive map online.[6] California-based

apparel company, Patagonia, has also launched its 'footprint chronicles'[7] by disclosing information about both its suppliers (raw materials such as wool, cotton, and down) and contract manufacturers.

***Disclosing environmental footprint in the supply chain (all tiers).*** Environmental disclosure information includes the extent to which the factories of a company's suppliers comply with the environmental regulations or accepted norms in energy usage, water consumption, water recycling, waste treatment, and air pollution. Many companies, including Walmart, Target, and Costco, now share their environment reports with the public, but very few companies provide information about suppliers beyond the first tier. As a notable exception, the Kering Group, parent to luxury brands such as Alexander McQueen, Bottega Veneta, and Puma, discloses greenhouse gas emissions, air and water pollution, land use and water consumption incurred by its suppliers all the way from Tier-1 contract suppliers performing assembly operations to Tier-4 suppliers producing raw materials in its online "Environmental Profit and Loss Statement."[8]

***Disclosing supply chain cost.*** Supply chain costs include materials cost, labor cost, transportation cost, and customs duties. Typically, in the retail industry, companies do not want consumers, competitors or suppliers to gain such information (Sinha 2000). However, San Francisco-based apparel retailer Everlane is pushing for "radical transparency" by revealing its supply chain (input) costs as well as the average price markup by others in selling similar items.[9] Everlane's online customers can therefore determine the retailer's price relative to what it pays its suppliers to inform their purchasing decision.

***Disclosing supplier workplace safety compliance.*** Workplace safety compliance information is about the extent to which a supplier's factory meets Environment, Health, and Safety (EHS) standards. After the collapse of Bangladesh's Rana Plaza in 2013 with a death toll of 1134, over 166 apparel corporations from 20 countries along with NGOs and Bangladeshi worker unions formed the Accord on Fire and Building Safety in Bangladesh with a five-year (2013-18) agreement to ensure a safe working environment. Some US retailers including Walmart formed a separate Alliance for Bangladesh Work

Safety without involving worker unions.[10] The goal of these consortia, Accord and Alliance, is to improve workplace safety for over 2 million workers at 1,800 factories over a limited period (Kapner and Banjo, 2013). The organizations created by these consortia respectively conduct audits of suppliers, posting the audit reports online (Caro et al. 2018).[11] PVH Corporation, owning such brands as Calvin Klein and Tommy Hilfiger, has audited 84% of its Tier-1 suppliers at least once per year since 2012 to assure western consumers about their suppliers' compliance with EHS regulations.

***Assuring provenance.*** Provenance includes names or suppliers, and the materials used and produced by suppliers, including the source location and how these were extracted or produced. Supply chain traceability is about companies being able to trace the path of materials upstream to the extent possible. Some companies disclose only how they ensure provenance is compliant to assure consumers (or business customers) that suppliers meet western standards but without revealing the names of suppliers or any other details. Patagonia, a California-based apparel company, developed a "traceable down" initiative after the German animal-rights organization Four Paws accused it using live-plucked down from force-fed geese harvested for foie gras and meat. The company can now trace the sourced down upstream all the way to the farm so it is in a position to assure consumers that the down it uses for its products is not associated with such practices.[12] Similarly, Intel seeks information about its systems and processes to be able to assure its customers that the minerals used in, or for, its products are conflict-free.[13]

Of course, if a company does not provide transparency voluntarily, there is a risk that third parties may obtain and publish such information. Consider the following examples.

***Involuntary third party-disclosure of a company's information***: When companies source from Chinese contract manufacturers who source their materials from yet other Chinese suppliers, the supply chain is often opaque and lower tier suppliers' environmental regulations compliance records are not easily accessible. The Institute of Public and Environmental (IPE) (www.ipe.org.cn), an NGO based in Beijing, compiles information about water and air polluting factories in China and discloses the identity

of their overseas customers of polluting factories on its website. In 2011, IPE published a report detailing the alleged malpractice in Apple's supply chain in China, which resulted in factory workers getting poisoned and even disabled, and entire communities faced with pollution (Schroeder 2011). In response, Apple developed its "supplier responsibility" program by conducting more audits and providing more education and training to improve its supplier's environment, health & safety performance than before.[14] Apple does not disclose supply chain cost information in contrast to Everlane; however, the Economist provided cost transparency for Apple's iPhone in 2011 – $178 worth of parts against US list price of $560, which grows substantially in other countries, raising questions about the company's markup.

As these examples show (**Table 1**), companies disclose information to varying degrees: in detail for all supplier levels, for Tier-1 suppliers only, or only assurance to customers that their suppliers meet western norms. Or, companies may provide no information at all. This variation is partly because companies perceive the value of transparency differently. We need further research for better understanding of transparency, but, before we list research topics, we outline potential benefits of *supply chain transparency*, over and above those of *supply chain visibility* alone. We do so for two reasons: First, getting information by gaining visibility into the supply chain is a necessary step towards being able to disclose some of this information. Second, visibility efforts aim at stakeholders internal to the company and its immediate customers or suppliers while transparency efforts target external stakeholders by way of consumers, investors, and regulators amongst others.

| **Types of information** | **Entity disclosing information** | **Extent of disclosure** | **Examples** |
|---|---|---|---|
| Supply chain (suppliers at all tiers) | Company | Transparency | • Heidi's respect code initiative. |
| Supplier base (Tier 1 suppliers only) | Company | Transparency | • Nike's manufacturing map initiative<br>• Marks & Spencer's supplier map the initiative<br>• Patagonia's Footprint Chronicle initiative<br>• Apple disclosing top 200 suppliers |

| | | | |
|---|---|---|---|
| Supply chain environmental footprint | Company | Transparency | • Kering Group's Environmental Profit and Loss Report |
| Supply chain cost information | Company | Transparency | • Everlane's disclosure of its supply chain cost as well as markups on competing products in the market |
| Supplier workplace safety compliance | Consortia | Transparency | • Accord on Fire and Building Safety in Bangladesh<br>• Alliance for Bangladesh Work Safety |
| Supplier workplace safety compliance | Company | Assurance | • Patagonia's traceable goose-down initiative<br>• Intel's Conflict-Free Supply Chain initiative<br>• PVH Corporate Responsibility Initiatives |
| Supplier Environmental regulations compliance | Company / NGOs | Involuntary | • Institute of Public & Environmental Affairs (IPE) disclosing information on treatment of workers at Apple's suppliers |
| Supply cost | Company | Involuntary | • The Economist disclosing supply chain cost for iPhone compared to Apple's list price. |

**Table 1. Disclosing product and supply chain information to consumers.**

In the next two sections, we discuss the potential benefits to a company from gaining supply chain visibility in Section 3 and the potential benefits to this company for providing transparency to its external stakeholders in Section 4.

## 3. Potential Benefits of Gaining Visibility for Internal Stakeholders

Gaining visibility creates value for a company, not only to enable it to provide transparency, but also to reduce its exposure to risk and, at the same time, improve efficiency.

### 3.1 Managing Supply Chain Risk

Companies need to coordinate their global supply chains across many tiers of suppliers in different geographical locations. These supply chains are vulnerable to different types disruptions *external* to the supply chain (earthquakes, floods, terrorist attacks, etc.) or *internal* to the supply chain (product recalls, supply shortages, supplier bankruptcies, etc.) (cf. Sodhi and Tang, 2012). Moreover, as western firms source from the so-called 'low-cost countries', they put the suppliers under tremendous pressure to do

things faster, better and cheaper. Under such pressure, suppliers may engage in risky behavior (Lee et al. 2012) such as excessive overtime or child labor (**Table 2**), potentially damaging the company's brand (Tang 2006).

| **Risks for the buying firm** | **Suppliers' risky behavior** |
|---|---|
| Materials risks | Use of materials (e.g., conflict minerals) that violate agreements/regulations or use ingredients not allowed in the buying firms' markets |
| Product risks | Use of unsafe materials in products (e.g., lead and cadmium in toys, melamine in food products, etc.) or of shoddy manufacturing practices |
| Reputation risk | Have unsafe workplace due to unsafe buildings; use of child labor |
| Environmental risks | Violation of environmental regulations not only in the buying firms' markets but also in the suppliers' own country |
| Product development risks | Accepting to deliver a product or component without the necessary capability or manufacturing process to develop it in time for market launch (as in Sony's release of PlayStation 4) |
| Product delivery risks | Failing to deliver on time |

**Table 2. Supply chain risks.**

The research literature on supply chain disruptions is vast (cf. Sodhi and Tang, 2012:pp.311-331). These disruptions include Ericsson losing 400 million euros in one quarter alone after their supplier's semiconductor plant in New Mexico caught fire in 2000 and Land Rover laying off 1,400 workers after one of their key suppliers became insolvent in 2001. Baxter recalled Heparin in 2008 after its Chinese supplier provided a counterfeit ingredient and Mattel recalled toys in 2007 after its supplier produced lead-tainted toys. Boeing had to live with multiple delays in its 787 development in 2009 after its suppliers failed to deliver different modules. Other supply chain disruptions can cause negative publicity: major international brands faced media attention after the collapse of several Bangladeshi contract factories in the Rana Plaza tragedy. With supply chain visibility into upstream operations, companies can develop proactive strategies to reduce the chance of these disruptions and to mitigate their negative consequences if they do occur (Tang 2006).

Downstream visibility is useful to a company as well. For instance, when the Thai floods of 2012 disrupted hard disk manufacturers such as Western Digital, computer manufacturers who bought their output were affected, thus affecting their purchase of chipsets and other components (Bunya and Tang,

2014). Thus, Intel suffered loss in sales despite having no disrupted suppliers itself in the affected region in Thailand. Likewise, customers' inability to pay, most notably during the 2008 financial crisis in western countries, can lead to the company's bankruptcy.

### 3.2 Reducing Reputational Damages

With improved supply chain visibility, firms can develop different auditing/inspection mechanisms to prevent or reduce reputation damages caused by the public exposure of unacceptable supplier practices or undesirable supply provenance. To ensure the factory buildings of suppliers in low-cost countries comply with safety standards, over 200 apparel brands, retailers and importers worked with trade unions and NGOs in Bangladesh to establish the ACCORD on fire and building safety in 2013. The ACCORD calls for independent audits of different factory buildings and the requirements for factories to take corrective measures to ensure building safety (Caro et al. 2018). Intel has conducted surveys, visited different smelters, conducted on the ground interviews, and supported independent audits since 2013 to ensure the company is using "conflict-free" minerals for its microprocessor manufacturing. Finally, since 2011, Apple has increased independent audits of its Chinese suppliers for labor-rights and environmental violations.[15]

### 3.3 Improving Supply Chain Efficiency

As firms gain more visibility into their supply chain operations across different tiers, they can evaluate other supply chain configurations. For example, after realizing the benefits of developing and manufacturing specific products closer to their customers, GE re-shored its water heater production back to the US. Similarly, Ford and Boeing re-shored some of their operations to the U.S.[16] After Amazon experienced UPS late deliveries of its products to customers in 2013, Amazon developed its in-house logistics services to improve its delivery performance in 2017.[17]

Companies seek real-time information across the supply chain to make real-time decisions to prevent or respond to supply-demand mismatches. However, there is a need for new tools to take advantage of real-time information (Handfield 2017).

Besides these potential benefits (Sections 3.1-3.3 above), supply chain visibility enables firms to disclose some of this information to the public and thus be more transparent to external stakeholders. This brings "extra" benefits, which we discuss next.

# 4. Potential Benefits and Risks of Offering Transparency to External Stakeholders

Traditionally, companies safeguarded supply chain information to protect their competitive advantage in product development, production cost, product quality, and delivery speed. Therefore, companies fear losing their competitive edge, including through intellectual property leaks. However, with the free flow of information on the internet, it is getting harder to protect this information. It may be advantageous for companies to disclose supply chain information voluntarily for two key reasons: (1) a company can contain its reputational damages if it discloses negative news voluntarily and proactively (instead of being exposed by other parties (e.g., NGOs, government agencies); and (2) a company can increase sales if its disclosure helps build public trust and generates word-of-mouth marketing. Let us consider the potential benefits to a company of disclosing information about its supply chain and products (Sections 4.1-4.3), followed by potential drawbacks (Section 4.4).

## 4.1 Gaining Consumers' and Investors' Trust

Many websites or social media platforms provide consumer with comparative price and quality information on products, possibly on whether they are linked to any environmental or social violations of norms anywhere in the supply chain. Few online consumers rely on advertisements alone to make

purchasing decisions and instead turn either to comparison platforms or online reviews. KBB.com is one such platform for comparing price and quality of cars just as Shopzilla.com allows price comparisons of consumer goods. Websites providing reviews include Yelp for local businesses, Goodguide.com for consumer goods, and Tripadvisor for hotel and airline reviews. According to eMarketer (2016), 80.7% of 1132 surveyed internet users say that online reviews influence their online purchasing decisions. Phelon (2017) reports that 74% of young consumers turn to social networks such as Facebook for guidance on purchase decisions.

Consumers may also look for, or come across, information on social media on a company's products and whether or not these products meets environmental and social norms wherever the production operations might be. Consumers' use of such information to inform their purchasing puts companies under pressure to make more information about their products and supply chain operations available online than they would have otherwise. Investors also seek such information to understand consumers' acceptance of the company's products and the potential for sales growth, besides the company's economic sustainability.

Thus, companies need to provide more transparency to consumers, investors and the public in general (Nunes 2014) to gain consumer trust, create consumer awareness, solicit feedback from consumers, and communicate their efforts for environmental and social sustainability. Younger consumers, the so-called Millennials, have less trust in big corporations than the preceding generation (Hertz, 2016) and companies have come under greater pressure to disclose provenance in the wake of product recalls such as the Europe's horsemeat scandal in 2013. Institutional and other investors also follow development-or-production-related delays in product delivery or launch, e.g., Tesla's production problems leading to delays in deliveries for its Model 3 in 2017-18. Such events can cause consumers and investors to lose trust in the company.

Some companies have responded quickly to the challenge. As mentioned earlier, after Patagonia discovered that its suppliers were using live-plucked goose down, the firm apologized publicly, developed

its Traceable Down initiative, and communicated its process to assure consumers that the geese are not subject to force-feeding and live-plucking.

Companies also use supply chain transparency as a marketing tool (Werbach, 2009) to gain consumers' trust and increased revenues. Kline (2017) reports that 73 percent of the respondents in the 2016 Label Insight Transparency Study reported themselves as being willing to pay more for a product with supply chain transparency. Everlane was the first online apparel retailer to disclose its supplier-related costs possibly in this hope. Indeed, revenues from Unilever's Lipton Tea brand increased dramatically in western Europe after Rainforest Alliance certified Unilever's sustainability efforts in tea-growing regions (Seifert and Ionescu-Somers, 2011).

## 4.2 Meeting Regulatory Compliance or Preventing Bad Publicity

Another source of pressure on companies to disclose information is regulation. Many governments have passed new laws requiring companies to provide more transparency into their supply chain operations. Examples include the California Transparency in Supply Chains Act, the United Kingdom's Consumer Protection Act, and Europe's General Product Safety Directive (Marshall et al. 2016).

Companies also need to 'manage' different NGOs advocating human rights (Fair Labor Association), animal rights (Four Paws and PETA), or environmental sustainability (IPE and Green Peace). Managing NGOs is not as much as regulatory compliance per se but failing to do so could result in adverse publicity and loss of revenues. Apple had initially ignored IPE's information on the company's suppliers in China violating air and water pollution. IPE then issued a report, "The other side of Apple" in 2011, publicly sharing its findings on Apple's suppliers in China. Negative publicity forced Apple to become more transparent, and in 2012, Apple released its first "supplier responsibility progress report" including a list of its top 200 suppliers (Gies, 2012).

## 4.3 Monitoring Suppliers through "Crowdsourcing"

It is costly for companies to monitor and audit their suppliers in their entire global supply chain at all tiers and at all times. By disclosing information about their suppliers (name, location, operations, and employee demographics) to the public, these companies can enlist consumers, NGOs, and even the suppliers' employees to monitor these suppliers' activities through "crowdsourcing". Any of these entities could expose suppliers' violations of standards such as those on child labor, EHS, or water-and-air pollution. Supply chain transparency can help the focal company reduce the cost of audits and enforcement. For example, after facing with many unsafe food and consumer products in China, GlobeScan (globescan.com) reported over 200 million Chinese consumers using social media networks (Weibo, WeChat, etc.) to investigate and report on how responsibly companies are behaving on social and environmental issues. With increased scrutiny and rapid dissemination via social media networks, suppliers may be deterred from undesirable practices (Tang and Babich, 2014) thus reducing the monitoring efforts of the buying firms.

## 4.4 Perceived Drawbacks of Providing Supply Chain Transparency

With these potential benefits, many companies are warming up to disclosing product and supply chain information, at least in the apparel industry. However, there are perceived drawbacks:

**Difficulty and cost of gathering information**: To disclose information about its supply chain operations, a company must first gather relevant information. Many companies report that they have limited visibility beyond Tier-1 suppliers; i.e., they do not even know who Tier-2 suppliers are (Nimbalker et al. 2013).[18] At the same time, it can be difficult and costly for a company to get the necessary supply chain information for reasons such as: (1) the sheer numbers of suppliers at different tiers; (2) the suppliers being spread all over the world; (3) suppliers beyond tier-1 may be reluctant to share information. There is also the question of the quality of the information gathered. Although technology will render these

costs low and improve the quality of information – for instance, using direct SMS-based surveys of employees at supplier plants or tracking products using the Internet of Things – but setup costs or effort for such technology may be high.

**Potential risks for disclosing supply chain information**: A company would not like to disclose Tier-1 suppliers to avoid revealing any sources of the company's competitive edge or its supply chain vulnerabilities. There is also the risk of *guilt by association*: the company being tarred with questionable, labor practices at even if the volume of business with this supplier is tiny and is two or more tiers upstream. There is the risk of *guilt by omission*: if disclosure is seen as not being full, consumers or advocacy groups may assume the company has something to hide and actively seek the 'missing' information on social media. Finally, there is loss of *deniability*: if the company has disclosed the identity of a supplier say two tiers upstream, it will not be able to deny knowing anything about the supplier or its operations in case there are negative news about this supplier.

**Negative consumer response**: Disclosing provenance to consumers can cause potentially negative response especially in the food sector. The horsemeat crisis in Europe, but not only, showed that there are incentives to deceive and misrepresent origins. Also, established western companies may prefer to be seen as buying ingredients locally even though they are sourcing them from Asia or Africa: disclosing provenance or even suppliers could puncture the 'wholesome' all-European or all-American image that these companies may wish to project.

**Negative governance and investor response**: Managers may also worry about negative reaction from their boards or large investors as they share the company's suppliers' performance on environmental and social sustainability. Providing only positive information while withholding negative news could make the company legally liable to investors. There may also be fears that that transparency would get in the way of the company working for and reporting good financial results to investors.

In light of these costs and risks, the net benefit perceived by companies remains unclear, which motivates many research opportunities.

## 5. Research Opportunities in Supply Chain Transparency

We identify OM research topics in this section, arranged by stakeholder – the investors (and the managers working for them), the consumer, competitors, and suppliers. This is in keeping with the *stakeholder resource-based view* (SRBV) of the firm, which is a framework to inform decision-making of managers of a company towards maximizing their utility not only by developing their own organization's capabilities and resources but also improving the utility of those whose utility depends on these decisions, i.e., the stakeholders (Sodhi, 2015). The framework helps identify descriptive (what is?), instrumental (how does?) and normative (how should?) research questions (**Table 3**). Researchers can examine these topics with field experiments, behavioral experiments, empirical analysis, and mathematical analysis, or using multiple methods to create *research streams* (Sodhi and Tang, 2014).

| Stakeholder | Research Questions |
|---|---|
| **5.1. Investors** | *1. What prevents companies from seeking more supply chain visibility?*<br>*2. What information should a company disclose about compliance in its supply chain and products to the public?*<br>*3. What are the potential risks associated with disclosing supply chain information to the public? In addition, how should a company mitigate risks from such disclosure?*<br>*4. How do investors react to good news and bad news as companies disclose compliance-related information about their suppliers ?*<br>*5. How are companies evaluating costs and benefits from transparency and implementing disclosure? How should they do so to maximize shareholder value?* |
| **5.2. Consumers and consumer advocacy groups** | *1. How does transparency offered by a company impact consumers' (a) willingness to pay, and (b) actual purchasing of the company's products and services?*<br>*2. Do consumers react differently to supply chain information when it is: (a) disclosed by the company versus a third party such as an NGO or a consortium, or (b) provided by the company voluntarily versus that provided under regulatory or other mandatory requirements?* |

| | |
|---|---|
| **5.3. Competitors** | *1. When a company implements supply chain transparency, should its competitors follow?*<br>*2. What are the barriers to entry for a firm to offer supply chain transparency when its competitor already offers it?* |
| **5.4. Suppliers** | *1. How do and how should companies collaborate with its suppliers to improve transparency?*<br>*2. How should a company (or a consortium) use Blockchain in collaboration with suppliers to enable greater supply chain visibility as well as transparency?* |
| **5.5. NGOs and monitoring agencies** | *1. How should NGOs and companies publish information about the companies' compliance with environmental and social norms?*<br>*2. How should a firm collaborate with NGOs to improve transparency and be rewarded for it?*<br>*3. How should monitoring agencies require transparency for the benefit of consumers (or workers and their communities) in the face of political lobbying by companies?* |
| **5.6. Communities and the environment, post-consumption** | *1. How can companies measure (a) the quantity of post-consumer waste from their products and packaging and (b) its impact on communities and the environment? How should they report it?* |

**Table 3. Research topics in supply chain transparency, arranged by stakeholders**

## 5.1 Investors

A potential benefit of visibility is that it helps a company avoid, mitigate, and respond to supply chain disruptions (cf. Tang, 2006; Werbach, 2009) that threaten shareholder value (Hendricks and Singhal, 2005). Moreover, transparency is not possible without visibility as we use the terms. However, many firms still do not have sufficient visibility to manage supply chain risk. According to a survey of 335 global manufacturing executive respondents of the KPMG's 2013 Global Manufacturing Outlook (a report from the Economist Intelligence Unit), 49 percent of the respondents admitted that their companies currently do not have visibility of their supply chain beyond Tier-1 suppliers. Only 7 percent of the US respondents claimed that they have complete visibility of their supply chains. This result is consistent with a 2013 survey of Australian fashion companies in which 93% of the respondents admitted they did not know the identity of their raw material suppliers (Nimbalker et al. 2013).

It is possible that many firms view the cost of supply chain visibility to be too high. However, consulting firms (e.g., Kinaxis) and software development firms (e.g., GT Nexus) lower the cost for companies to gain visibility into supply to end-customer delivery, including information about production, in-transit operations, on-hand inventory, and cost visibility along the supply chain. In addition, IT service providers such as Zetes.com and Freqentz.com have developed mobile solutions for pharmaceutical and for food products to enable manufacturers to obtain visibility into their supply chains. As such, a pertinent research topic is

1. *What prevents companies from seeking more supply chain visibility?*

Then there is the matter of deciding what to disclose. Many more firms are accumulating different types of supply chain information than ever before but may not understand the impact of disclosing supply chain information -- the location of supplier factories, demographic information of supplier workers, supplier factory's labor practices, etc. -- on consumers' valuation of the company's products or of the company itself. Specifically, companies need to consider what to share with consumers, investors and other external stakeholders (**Table 1**). It is necessary to examine the impact of different types of supply chain information on consumer valuation of the product as well as their purchasing decisions (New and Brown 2011) to avoid information overload for consumers and to create economic value for the firm. Therefore, there is a great research opportunity to explore what to disclose, given the needs of investors and other external stakeholders for the maximum economic benefit for the company:

2. *What information should a company disclose about compliance in its supply chain and products to investors and other external stakeholders?*

When deciding whether to disclose different types of supply chain information to the public, the company needs to identify and assess different types of risks associated with information disclosure that could threaten shareholder value. For instance, companies such as Coca-Cola and KFC may disclose some but

not all of the ingredients of their products to retain their unique offerings. However, there are various types of negative outcomes that can arise from supply chain transparency for the focal company:

- *Information overload*. Too much information can be counter-productive if it creates information overload, discouraging consumers from buying from the company
- *Product and service differentiation*. When a company discloses its supply base and other cost information to the public, its competitors can use the same suppliers to produce similar products at similar cost and the company's products may no longer be distinctive
- *Guilt by association*. When a company discloses its suppliers to the public, suppliers with poor performance on the environment, workers' health and safety, etc. will be linked to the firm, jeopardizing the firm's reputation.

When a company decides to disclose suppliers' identity as well as their environmental, health, and safety performance to the public, should it invest further in the suppliers' capabilities to improve compliance with norms or let "crowdsourcing" ensure such compliance? Accord and Alliance take different approaches to this, with Accord companies having more of a development approach towards the suppliers. Therefore, we need to investigate:

> 3. *What are the potential risks associated with disclosing supply chain and product-related information to the public? In addition, how should a company mitigate risks from such disclosure?*

In addition, companies may consider "no news is good news" or follow a policy to disclose good news only. Indeed, many companies tend to disclose only good news. However, hiding negative news about the supply chain from the public, including investors, can cause a backlash. Consider two examples. First, by not disclosing the internal production problem that the actual production quantity of Tesla's Model 3 is 80% below target, the stock market responded more negatively after the Wall Street Journal published this on October 9, 2017. Second, by using the environmental incident data disclosed by IPE

(the NGO mentioned in Section 3) from 2006 to 2013, Lo et al. (2018) found empirical evidence that an environmental violation can cause the stock price of the polluting Chinese manufacturer as well as that of its western customers to drop. This observation leads to another question.

> *4. How do investors react to good news and bad news as companies disclose compliance-related information about their suppliers?*

Before committing to disclose all sorts of supply chain information, a firm needs to examine the costs (including expected costs from realized risks) and benefits of revealing supply chain information to the public. For example, since 2011, Switcher SA, a Swiss clothing company, used the Respect-Code platform (like Heidi.com). While this information is novel, it appears this particular form of supply chain transparency did not increase consumers' valuation of the product, and hence, consumers were unwilling to pay a higher retail price. By 2016, Switcher was bankrupt, unable to pay its employees and suppliers. Apparel company Icebreaker similarly offered a "BaaCode" for the wool in its products in 2008; customers could type this code from the product they bought to get a video tour of the specific sheep station in New Zealand where the merino wool came from. Although this 'eco' feature was admired in the business and NGO press, but the company does not offer this feature any more. Therefore, there companies need to map out their strategy to implement transparency (Werbach 2009) and a useful question to research is:

> *5. How are companies evaluating costs and benefits from transparency and implementing disclosure? How should they do so to maximize shareholder value?*

## 5.2 Consumers and Consumer Advocacy Groups

Recently, some researchers have explored how consumers respond to transparency. Buell and Norton (2011) showed using laboratory experiments that consumers value a service more when the firm discloses information about labor effort on its website. Similarly, Buell et al. (2016) conducted laboratory experiments in food service settings and showed that customers valued the service more when they can observe the employee's effort in the production process. This finding is consistent with the international

success of Ding Tai Fung, an acclaimed Chinese restaurant in which customers can observe the dumpling making process through a glass-enclosed kitchen (Hwarng and Yuan 2016). Using laboratory experiments, Kraft et al. (2017) showed that consumers' willingness to pay increases with a higher level of transparency into the firm's payment to the worker when workers are disadvantaged.

Similarly, Craig et al. (2017) conducted surveys in China, Europe, and the U.S. to examine customer's intention to purchase (a) when materials cost is higher than labor cost translating into high product quality but low social responsibility, and (b) when the situation is reversed. They find that, in general, female customers are willing to pay more for products produced by firms with higher perceived social responsibility.

These studies gauge consumers' *intent*, not their actual purchasing, being based on laboratory experiments. However, intent to purchase may not be a good predictor of actual purchasing behavior (Chandon et al. 2005). Therefore, there is need to conduct field studies to understand actual consumer purchasing behavior rather than intent (Gupta and Zeithaml 2006). Mohan et al. (2016) have conducted a field experiment and replicated it in a controlled laboratory setting where the firm discloses the cost information (materials, labor, duties, and transportation) to potential customers. They find evidence that cost transparency can increase sales, at least in the field experiment, but only when the company discloses cost information voluntarily.

These issues motivate the following research topic:

> *1. How does transparency offered by a company impact consumers' (a) willingness to pay, and (b) actual purchasing of the company's products and services?*

When a company discloses supply chain information selectively, consumers may respond even more negatively to poor practices in company's supply chain that are exposed by NGOs or the press. Therefore, it is essential for firms to understand how consumers respond to supply chain information disclosed by different parties. For instance, it would be useful to examine settings in which an

independent party communicates cost information to the public. For example, although Apple keeps its cost information secret, the Economist reported that the total materials cost of an iPhone 4 was $178 against the retail price of $560 (Economist 2011). This report raised questions about Apple's price markup especially in light of the company's aggressive tax avoidance in many countries. In this case, would the consumer's reaction have been different had Apple disclosed its cost information on its own like Everlane? Nonetheless, there does not seem to be any negative impact on Apple's revenues since 2011. Conversely, would information be more credible if a company got a third party to disclose information about its supply chain as Unilever's Lipton brand did with Rainforest Alliance? The reporting third party could be a consortium as with Accord in the apparel industry.

Also, it would be of interest to examine the different responses from consumers when supply chain information is disclosed voluntarily instead of under regulatory pressure. For example, Kalkanci et al. (2016) conduct experiments and show that a firm can gain trust from consumers and obtain additional market share if the information about the level of greenhouse gas (GHG) emissions or the amount of conflict minerals used in a product is disclosed voluntarily by the firm. More importantly, they show that voluntary (mandatory) disclosure will encourage (discourage) firms from measuring the impact of GHG emissions and conflict minerals in their supply chains.

Therefore, it would be useful to investigate:

> *2. Do consumers react differently to supply chain information when it is (a) is disclosed by the company versus a third party such as an NGO or a consortium, and (b) provided by the company voluntarily versus that provided under regulatory or other mandatory requirements?*

## 5.3 Competitors

If transparency is a strategic choice for one company, it makes sense for its competitors to follow. For example, after Nike disclosed their supply base in 2005, its competitor Adidas began revealing all Tier-1

and Tier-2 suppliers and even its licensee factories.[19] On the other hand, after Everlane shared its supply cost structure with the public, no other apparel retailer revealed its supply chain costs. Therefore, it is of interest to examine the business setting (e.g., market competition, market segmentation, product quality) under which imitation is a good strategy or not. Lim et al. (2018) explore this issue and provide some preliminary results. A useful theoretical lens to study the means by which competitors may or may not adopt similar levels of transparency is *institutional isomorphism* (cf. Lai et al. 2006). The question of interest is:

> *1. When a company implements supply chain transparency, should its competitors follow?*

As discussed in earlier sections, transparency offers a company differentiation and competitive advantage over its competitors. Thus, transparency can be viewed as a resource in the resource-based view of the firm. This competitive advantage can be sustained only until its competitors offer similar level of transparency. That leads to the question:

> *2. What are the barriers to entry for a firm to offer supply chain transparency, when its competitor already offers it?*

On one hand, transparency should lower the effort of competitors to offer transparency because they know what is being disclosed (and to what extent this transparency is attractive to consumers or investors) including possibly the identity of suppliers at Tier 1 or even below and most likely how the information is being gathered. The competitor knows then what suppliers would easily provide the information it needs for transparency. On the other hand, a company can raise the barriers to entry for its competitors. A case in point is Unilever's transparency about palm oil sourcing and the supply chain changes that were necessary to make this possible, which have rendered similar transparency extremely difficult for Procter and Gamble to achieve.

## 5.4 Suppliers

Many firms keep their suppliers at arm's length. Consequently, firms may have simple information about their suppliers, but the actual operations at the supplier factories remain opaque. As firms face pressure to accept social and environmental responsibility across the companies in their supply chains, collaborating with suppliers would be a crucial first step to gain visibility about supply chain operations as regards environmental and social sustainability. After the collapse of Rana Plaza in 2013, Li & Fung created the Vendor Support Services (VSS) unit in 2014 to work closely with its suppliers to improve their operations as well as to help them become socially and environmentally compliant. By working closely with suppliers to measure greenhouse gas emissions and water usage, VSS develops ways to help these suppliers to use energy and natural resources more efficiently. Through this collaboration, these suppliers became more cost-efficient and environmentally compliant, and Li & Fung can improve its track-and-trace capability along the supplier chain (Lee and Tang 2017). With supply chain visibility, Li & Fung can then decide on what supply chain information, if any, to disclose to the public. This example motivates the following topic:

*1. How do and how should companies collaborate with its suppliers to improve transparency?*

Through collaboration with suppliers, a company can improve supply chain visibility for itself and transparency for consumers. Such partnership can reduce, for instance, counterfeit products thus helping not only the company but also the suppliers themselves and customers. World Health Organization (WHO) estimates that 10% or more of drugs sold in developing countries are fake and tens of thousands of children die due to counterfeit medicines each year.[20] As many as 50% of goods sold on Taobao in China are fake or at least infringing on the intellectual property rights of others despite Alibaba suing sellers of counterfeit goods in 2017.[21] Blockchain technology[22] is a potential solution that, if adopted across the supply chain, can help the consumer (and others) authenticate a product. The usage of this and

related technology requires further research as more companies and entire industry sectors seek to implement this technology in the supply chain:

> *2. How should a company (or a consortium) use Blockchain in collaboration with suppliers to enable greater supply chain visibility as well as transparency?*

## 5.5. NGOs and Monitoring Agencies

We refer here to NGOs as advocacy groups or other non-profit organizations that monitor and publicize environmental or social sustainability in the regions or communities where companies have supply chain operations. Examples of such NGOs include IPE, Greenpeace, and Fair Labor Association. Funded by donations and grants, many NGOs monitor and report environmental or social sustainability especially in developing countries, where many western companies have upstream operations (raw material production, contract manufacturing, etc.). Traditionally, companies have viewed these NGOs as adversaries who expose non-compliance regarding child labor, environmental norms, health safety, and human rights (Lee et al. 2009). However, as more companies experienced or feared loss in sales from damage in reputation from negative findings published by NGOs (cf. Lo et al. 2018), they are under pressure to improve supply chain transparency.

The public (and consumers) may find information from independent NGOs more trustworthy especially if there is good news about the company. On the other hand, the public perceives companies to be reluctant to share bad news. As such, if the company strategically discloses bad news before NGOs, it may win public trust; likewise, it could let an NGO disclose positive findings to avoid being seen as self-serving. At the same time, an NGO would be more willing to publish negative information quickly and if it publishes only positive news about companies, it may lose public trust.

As companies and NGOs gather similar supply chain information, one question is

1. *How should NGOs and companies publish information about the companies' compliance with environmental and social norms?*

Alternatively, companies and NGOs could cooperate. Indeed, some companies are asking some NGOs for help. Examples include the partnership between Apple and IPE for monitoring environmental compliance and between HP and Fair Labor Associate for monitoring labor compliance, in both cases of contract manufacturers in China. There are also examples where companies have formed partnerships with NGOs to promote specific products. For example, Greenpeace helped RWE, the German utility giant, to promote its renewable energy product in the UK as a clean energy option (Webb 2005). Certification of products, as in the same of Unilever's partnership with Rainforest Alliance for Lipton Tea is a case in point.[23] However, NGOs may be sensitive to such partnerships with companies as they can no longer be perceived as impartial. For a company, the risk is that the NGO may discover and publish more negative information than it had envisioned. As such, there is a need to examine:

*2. How should a firm collaborate with NGOs to improve transparency and be rewarded for it?*

Besides NGOs, there are monitoring agencies that seek to publish and penalize violations by companies as regards their supply chains and their products. Typically, these agencies are national and are hampered in their remit being limited to the country where they operate, and their being subject to political pressure. For instance, since 1973 at least, the FDA (Food and Drug Administration) has sought to require US companies to disclose added water in their "juice" products.[24] One way the company Ocean Spray, which would have to disclose the 75% water content in the company's "cranberry juice" product, has fought back is to offer paid speaking engagements to senators and contributions -- in one case, $375,000 -- to political action committees (Akerlof and Schiller, 2015: p.81). Recently, the FDA has drafted disclosure on added sugar in "pure" honey, maple syrup and cranberry juice (FDA, 2018) given the public perception of obesity tied to added sugar, but its timid approach seeking consultation from the same

companies suggests lack of political support.[25] Indeed, there are many other instances from the food and pharmaceutical sectors. As such, one research topic is:

> 3. *How should monitoring agencies require transparency for the benefit of consumers (or workers and their communities) in the face of political lobbying by companies?*

Perhaps food companies will see transparency in their own interest. Recently, food giant Mars broke with food industry's current practice about "transparency on research" by updating its science policy to ensure disclosure of funding sources for any research it funds, and to ensure that funding "is not linked to the achievement of a specific research outcome." This speaks volumes about the other companies' funding of research.

## 5.6. Communities and the Environment, post Consumption

Thus far, we looked at supply-side transparency in relation to upstream operations only. There is growing awareness of the 'sea' of post-consumer micro-plastic waste in the Pacific called The Great Pacific Garbage Patch and similarly other oceans and how the resulting micro-plastics and leaching chemicals harm marine life and eventually humans.[26] Indeed, one of the authors has seen miles of Arabian Sea off the coast of Mumbai, India covered with plastic, mostly from Frito Lay Chips bags and Coke and Pepsi bottles. Animals and birds on land are also harmed by eating plastic packaging. Besides food and beverage packaging, waste from electronics is a rapidly growing problem worldwide. The Indian city of Bangalore alone produced an estimated 17,000 metric tonnes of e-waste in 2012 alone growing at 20% per year.[27] Post-consumer waste has also come into prominence as China adopted "Operation Green Fence" prohibiting import of unwashed post-consumer plastics and other "contaminated" waste shipments.[28] Apparel is another sector of interest, being the second largest polluter after the oil industry, including pollution from post-consumer waste. Before monitoring agencies or NGOs start 'naming names,' companies can be proactive in transparency. As such, a question of interest is:

1. *How can companies measure (a) the quantity of post-consumer waste from their products and packaging and (b) its impact on communities and the environment? How should they disclose this information?*

## 6. Conclusion

In this paper, we discussed how some companies disclose supply chain information to the public as a mechanism. Noting that gaining supply chain visibility is a prerequisite for providing supply chain transparency, we discussed the key drivers and the potential benefits of supply chain visibility and supply chain transparency separately. Using our understanding of supply chain transparency and the related literature, we have proposed some research questions for OM researchers to explore. As companies understand and seek to implement different strategies for disclosing supply chain and product-related information to the public, there will be even more research opportunities for OM researchers to explore. We hope that researchers will find the disentangling of visibility and transparency, as well as the questions proposed in this paper to be a useful initial step.

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## Notes

[1] We do not to wish to suggest companies in sectors other than apparel are not practicing environmental or social sustainability or ensuring compliance upstream in their supply chains. However, relative to the apparel industry, other industries are less known for disclosing information about their supply chains.
[2] See www.respect-code.org. For instance, typing "094CDFY", a code associated with a Heidi product, shows provenance and supply chain information on a map and gives a list of eight steps: (1) Cotton – India, (2) spinning – SCM Textile Spinners, India, (3) knitting-weaving – Radaan Textiles, India, (4) dyeing – Sathya Process, India, (5) confection – Sri Nanthika Knitting Mills, India, (6) printing – Sri Nanthika Knitting Mills, India, (7) transport – Kuehne-Nagel, Tirupur, India, and (8) distribution – Heidi SA, Switzerland. The code refers to a specific batch of 300 items, and the webpage shows the batch was produced in 2017 and gives the name and contact details of the person-in-charge at Sri Nanthika Knitting Mills. Also provided are the $CO_2$ emissions (2.5 kg) and the water used (485 liters) associated with this batch. A third-party certificate of Heidi's environmental and social sustainability performance is also provided.
[3] Most companies keep their supplier identity secret to retain a competitive advantage. Not until 2005, Nike became the first company in the U.S. who discloses the identity of its suppliers (name and location) and the worker profile (number of employees, the percentage of female workers, the percentage of migrant workers, etc.) to the public. See: http://manufacturingmap.nikeinc.com/
[4]. This minimal level of transparency is demanded by NGOs so that they can conduct independent audits about forced labor, health and safety issues in contract factories.
[5] Nike manufacturing map (http://manufacturingmap.nikeinc.com/)
[6] Marks and Spencer's interactive map with suppliers (https://interactivemap.marksandspencer.com/)
[7] http://www.patagonia.com/footprint.html
[8] See Kering's sustainability website (www.kering.com/en/sustainability/epl).
[9] Everlane (https://www.everlane.com/about).
[10] See Accord website (www.bangladeshaccord.org) and Alliance website (www.bangladeshworkersafety.org). The Accord is committed to providing funds to improve building safety whereas the Alliance is not. Both have been set up for a limited time only, and it is not clear at the time of this writing how either initiative will progress beyond 2018.
[11] Besides these two consortia that focus on the workplace safety in Bangladesh, Sedex (www.sedexglobal.com) is an international non-profit organization that develops an online platform for it members to share their supplier audits data on labor rights, health & safety, the environment and business ethics.
[12] Patagonia's down traceability initiative (http://www.patagonia.com/traceable-down.html).
[13] Intel's efforts include: (1) audits of smelters; (2) cooperate with both governmental agencies and NGOs to ascertain source location. For details, see: https://www.intel.com/content/www/us/en/corporate-responsibility/conflict-free-minerals.html
[14] Apple's supplier responsibility program (www.apple.com/supplier-responsibility)
[15] See Apple's Supplier Responsibility Report for details, https://images.apple.com/supplier-responsibility/pdf/Apple_SR_2012_Progress_Report.pdf
[16] See: https://www.usatoday.com/story/money/business/2016/04/23/24-7-wallst-economy-manufacturers-jobs-outsourcing/83406518/. See http://www.reshorenow.org/companies-reshoring/ for a list of companies who re-shored their operations back to the U.S.
[17] http://www.logisticsmgmt.com/article/report_says_amazon_is_focusing_on_in_house_delivery_service

[18] According to a survey of 335 global manufacturing executive respondents of the KPMG's 2013 Global Manufacturing Outlook (a report from the Economist Intelligence Unit), 49 percent of the respondents admitted that their companies currently do not have visibility of their supply chain beyond Tier-1 suppliers. Only 7 percent of the US respondents claimed that they have complete visibility of their supply

chains. This result is consistent with a 2013 survey of Australian fashion companies in which 93% of the respondents admitted they did not know the identity of their raw material suppliers (Nimbalker et al. 2013).

[19] Source: https://www.adidas-group.com/en/sustainability/compliance/supply-chain-structure/

[20] Source: https://www.theguardian.com/global-development/2017/nov/28/10-of-drugs-in-poor-countries-are-fake-says-who. The Guardian. November 28, 2017.

[21] Forbes, March 10, 2017. Is Alibaba doing enough to fight fakes? See https://www.forbes.com/sites/ywang/2017/03/10/is-alibaba-doing-enough-to-fight-fakes/#20a87c4e5587

[22] Blockchain technology is a distributed ledger managed by a peer-to-peer network collectively adhering to a protocol for recording, verifying, and validating new entries (Economist, 2015).

[23] See https://www.lipton.com/us/en/our-story/lipton-and-sustainability.html.

[24] See NY Times, 1987. Truth in juice. https://www.nytimes.com/1987/12/16/opinion/topics-of-the-times-truth-in-juice.html

[25] The inability of the EU countries to tax the profits of technology-based companies like Apple and Google as well as others such as Amazon and Starbucks also points to a similar lack of political support for such measures despite public outcry.

[26] See for instance the numerous reports available from the US National Oceanic and Atmospheric Administration at https://marinedebris.noaa.gov/reports-and-technical-memos. The National Geographic is another source on the Great Pacific Garbage Patch.

[27] Source: The Hindu, Sep 9, 2013. E-waste capital, are we? Downloaded from http://www.thehindu.com/news/cities/bangalore/ewaste-capital-are-we/article5109292.ece.

[28] See for instance the Washington Post, 9 March, 2013, at https://www.washingtonpost.com/news/wonk/wp/2013/05/09/chinas-crackdown-on-trash-could-make-it-harder-for-u-s-cities-to-recycle/?utm_term=.edfa730960ef