Sustainable supply chain management and climate change engagement

ABSTRACT

Climate change poses significant new risks and challenges for businesses and their supply chains. Additionally, in many sectors scope 3 indirect greenhouse gas (GHG) emissions resulting from the sourcing and distribution of goods and services are larger than firms' own carbon footprints. Here we study how firms engage their key stakeholders in their supply chains in obtaining, processing and transferring relevant climate change related information designed to overcome information asymmetry and drive sustainable development. Grounded in organisational information processing theory (OIPT), we draw on data from the Carbon Disclosure Project's (CDP) Climate Change Supply Chain initiative for a qualitative content analysis of a large sample of global firms. Consistent with OIPT, we find that while firms primarily engage their supply chain partners in a variety of ways to reduce information uncertainty around indirect emissions data, effectively interpreting and managing broader sustainability information equivocality becomes a growing priority. Our findings further suggest that firms engage suppliers, customers and other supply chain partners through basic, transactional and collaborative types of engagement. We contribute to literatures on inter-organisational information processing and sustainable supply chain management by providing a more detailed understanding of how firms engage supply chain partners in the context of climate change.

Keywords: *Climate change; sustainable supply chain management; organisational information processing theory; stakeholder engagement; sustainable development; information asymmetry; Carbon Disclosure Project*

1. INTRODUCTION

Extant literature examines why and how individual firms seek to reduce their impact on the natural environment by focusing their efforts on challenges and concerns within their supply chains (e.g. Ansari and Kant, 2017; Busse, 2016; Busse et al., 2017; Grosvold et al., 2014; Lamming and Hampson, 1996). Much of this research draws on the concept of green or sustainable supply chain management (GSCM/SSCM) (Ahi and Searcy, 2013; Linton et al., 2007; Sajjad et al., 2015), but concerns remain about a lack of understanding of whether and how firms collaborate with their supply chain partners to respond to specific SSCM issues such as climate change (Finke et al., 2016; Hofmann et al., 2013; Montabon, 2016; Rodriguez-Melo and Mansouri, 2011; Seuring and Müller, 2008).

Prior studies have highlighted valuable business opportunities and enablers of progress (Plambeck, 2012), but also stressed the significant legal, strategic and operational barriers in terms of engaging supply chain partners in collective climate change responses (Finke et al., 2016; Roehrich et al., 2014). Although firms increasingly request their suppliers to share information on how they address climate change (Jira and Toffel, 2013), information gathering on its own is unlikely to result in substantial action on climate change (Huang et al., 2016; Howard-Grenville et al., 2014; Sammer and Wüstenhagen, 2006). More specifically, the importance of stimulating information flows between different core supply chain partners as part of engagement has been highlighted conceptually (Harland et al., 2004; Sarkis, 2012) and studied empirically by focusing on the circumstances in which such information sharing is more likely to occur (Jira and Toffel, 2013). However, while our understanding of why firms engage in information sharing is growing, limited attention has been paid to understanding how information processing unfolds between focal firms and their supply chain partners (Busse et al.,

2017). Knowledge of such processes is critical for the evaluation of their efficacy in terms of addressing climate change and to provide industry guidance on best practices.

Theoretically, organisational information processing theory (OIPT) offers a lens for new insights into the processes involved in managing information asymmetries (Galbraith, 1974; Busse et al., 2017; Turner and Makhija, 2012). However, the application of OIPT to sustainable supply chain management phenomena remains comparatively underexamined (Busse et al., 2017; Touboulic and Walker, 2015). Therefore, we explore the following research question: *How do focal firms use information processing as part of their climate change engagement with supply chain partners?*

We make two key contributions: First, our study advances understanding of how climate change related information processing unfolds between organisations rather than just within individual firms. We find that consistent with OIPT firms engage with their supply chain partners through a variety of information processes designed to reduce uncertainty and manage equivocality. Unlike the more linear sequence identified in intra-firm OIPT, however, findings suggest that inter-organisational information processing is characterised by multi-lateral and often circular information flows between different upstream and downstream supply chain partners.

Second, we characterise three types of climate change engagement which vary in the degree to which focal firms involve different supply chain partners and the nature of the engagement. Specifically, basic, transactional and collaborative types of engagement reflect different time frames, purposes and aspects of information asymmetry addressed. As such we provide a more nuanced contribution to sustainable supply chain management literatures on the different practices employed when focal firms engage their supply chain partners.

The remainder of the paper is structured as follows: The theoretical background is presented in section 2, bringing together key studies on sustainable supply chain management and stakeholder engagement as well as OIPT. The methods section outlines our research context, data sampling and analysis before our findings are presented in section 4. Then, the discussion section brings together key findings in light of extant studies before drawing out theoretical and practical contributions. Research limitations and further research avenues are presented too.

2. THEORETICAL BACKGROUND

2.1 Sustainable supply chain management and supply chain partner engagement

The need for firms to engage with buyers and suppliers as part of SSCM has been widely recognised and defined as: 'The creation of coordinated supply chains through the voluntary integration of economic, environmental and social considerations with key inter-organisational business systems designed to efficiently and effectively manage the material, information and capital flows associated with the procurement, production and distribution of products or services in order to meet stakeholder requirements and improve the profitability, competitiveness and resilience of the organisation over the short- and long-term' (Ahi and Searcy, 2013, p.339). The study adopts this broader definition of SSCM for the purpose of research on climate change partner engagement.

Supply chain engagement is characterised by the extent to which a focal firm works with other key stakeholders in its supply chain to address sustainability and/or social issues through, for instance, information exchange and/or collaboration (e.g., Yawar and Seuring, 2017; Tidy et al., 2016). Supply chain partner engagement is driven by intrinsic or extrinsic motivations. SSCM approaches based primarily on extrinsic motivations are focused on gaining financial

benefits, while approaches based primarily on intrinsic motivations are focused on ethical considerations and values of the decision maker (Muller and Kolk, 2010). Information exchange is vital for engagement and includes sharing of a range of viable information including inventory data, demand forecasts and emission data. Collaboration between supply chain partners supports information exchange and is characterised by both parties' frequent interactions to, for instance, deliver joint business practices (Vereecke and Muylle, 2006). Collaboration plays an important role in improving the competitive advantage of supply chains and drive engagement (Gold et al., 2010). The development of joint efforts between the supply chain partners motivates changes (Klassen and Vachon, 2003) and can foster innovations that can lead to an improved sustainability performance. Collaboration in the supply chain may offer opportunities for joint learning (Vachon and Klassen, 2008) and adopting, for instance, sustainable and social initiatives. Extant research has also explored the adjacent concept of supplier development (e.g. Yawar and Seuring, 2018) in the context of sustainable supply chain management. This study focuses on supply chain partner engagement in the context of SSCM.

Prior studies have drawn out the positive effects of supplier engagement by, for example, investigating supplier involvement in the design phase when developing new products (Ragatz et al., 1997; Petersen et al., 2005) or when driving sustainable practices (Zhang et al., 1997; Walton et al., 1998). While Jira and Toffel (2013), for example, studied the factors behind suppliers sharing climate change information with their buyers, Cantor et al. (2012) found that employee engagement with environmental issues in the supply chain varied considerably depending on individual perceptions and attitudes. Climate change information shared between partners include, for instance, emission and environmental performance data from supplier plants, transportation and distribution data as well as investment plans for climate change initiatives.

Pagell and Wu (2009) investigated the elements necessary to create sustainable supply chains and identified both traditional best practices, such as collaboration and certification, as well as more innovative approaches, including wholesale redesign of supply chains, as important initiatives to improve social and environmental performance. This suggests that supply chain engagement is not a uniquely defined concept, but rather acts as an umbrella term for a range of both firm and individual level practices.

2.2 OIPT and information asymmetry across the supply chain

Sarkis (2012) argued that information is important for managing supply chains. While information boundaries in supply chains limit the availability of information, information flows across supply chain partners provide opportunities for organisational learning and performance improvement as part of the development of sustainable supply chains. Therefore, the way in which firms manage information is critical in their engagement with supply chain partners. For example, extant literature provides insights into the aspects, contingencies and variations in information management for the development of sustainable supply chains (Oelze et al., 2016; Schnittfeld and Busch, 2016; Solér et al., 2010). Within the context of climate change, findings suggest that economic reasoning, weak actor bonds and differing perceptions of the rules of the game together act as barriers hindering firms to develop collective responses within their supply chains (Finke et al., 2016). But while collaboration and closeness are important factors for the development of sustainable supply chains, they remain insufficient as sustainability challenges introduce new forms of uncertainty to the existing task uncertainties from managing supply chain partners (Busse et al., 2017). In other words, sustainability-related uncertainties that arise from

managing specific environmental and ethical concerns across supply chains add to the existing task uncertainties of improving general supply chain performance (Busse, 2016).

Importantly, climate change imposes new and complex informational asymmetries that are only beginning to enter academic research questions (Howard-Grenville et al., 2014). For example, there is significant information uncertainty about the climate change impact of products and materials, as well as about the vulnerability of firm processes and practices to physical and regulatory risks across whole supply chains (McKinnon, 2010; Plambeck, 2012). Furthermore, firms are faced with significant information asymmetries since critical information may reside with buyers and suppliers. Here, organisational information processing theory (OIPT) becomes helpful as OIPT views firms as an interrelated set of problem solving and decision making systems performing a variety of tasks (Tuggle and Gerwin, 1980). The effective accomplishment of these tasks creates information processing requirements, and the ways and means in which firms handle these define their information processing capabilities. The appropriate matching of requirements and capabilities ('fit') is key in shaping the resulting task quality (Galbraith, 1974; Zhao et al., 2018). OIPT is widely used in the study of new product development (Brown and Eisenhardt 1995), information technologies (Gardner et al., 2015), and to research issues of diversity in organisations (Bhave et al., 2010). The majority of OIPT scholars have also applied the theory to the study of multinationals (Wolf and Egelhoff 2002; Tihanyi and Thomas 2005).

From an OIPT perspective, information is central to reducing information asymmetry between exchange partners, where asymmetry is characterised by both information uncertainty and information equivocality (Corner et al., 1994; Egelhoff, 1991; Rogers et al., 1999). Uncertainty is defined by a lack of the appropriate amount and quality of information needed to perform tasks (Galbraith, 1974; Zhao et al., 2018). The more uncertainty a firm is exposed to, the

more information needs to be gathered and processed to realise a given performance level (Bode et al., 2011). While uncertainty is characterised by an absence of information, equivocality describes situations in which information is messy and ambiguous, leading to potentially conflicting interpretations and a lack of understanding (Daft and Lengel, 1986). Whereas collecting more data helps managers reduce information uncertainty, equivocality requires cognitive skills to make sense of the data. This is particularly true when the information required is ill-structured or wicked, data are difficult to evaluate and require more than one individual for their interpretation, and interventions are risky and harbour the potential for significant unintended consequences (Daft and Lengel, 1986).

Engagement between supply chain partners is likely to create even higher levels of uncertainty and equivocality, given the involvement of two (or more) firms with different objectives and stakeholders (Premkumar et al., 2005). This makes effective information processing, as characterised by the three key stages of information gathering, interpreting and transferring, absolutely critical (Harland et al., 2004; Lamming and Hampson, 1996). However, while the majority of research adopts OIPT for internal organisational issues and research questions (e.g., Turner and Makhija, 2012; Qrunfleh and Tarafdar, 2014), still comparatively little is known about its application to inter-organisational settings (Busse et al., 2017).

OIPT helps to explain organisational behaviour ‘in terms of information that must be gathered, interpreted, synthesized, and coordinated in the context of decision making’ (Burns and Wholey, 1993, p. 110). This is done by a process loop – attention, encoding, storage, retrieval, action, and assessment of outcomes - as positioned by Corner et al. (1994). Activities such as collecting relevant data, processing and transferring them (Tushman and Nadler, 1978) to and between supply chain partners is vital in addressing information asymmetries. Information

processing is considered essential to 'bridge disagreement and diversity' (Daft and Lengel, 1986, p. 556) between two (or more) organisations that have different objectives and values (Tihanyi and Thomas, 2005; Premkumar et al., 2005). Even though OIPT has predominantly been applied to understanding intra-organisational issues (Premkumar et al., 2005) recent work suggests that it is also useful for studying cross-organisational information exchanges (Bode et al., 2011). In this paper, we seek to better understand how information processing between different supply chain partners unfolds in the context of climate change.

3. METHOD

3.1 Research context and data

Following recent calls for more methodological diversity in qualitative research (Bansal et al., 2018; Eisenhardt et al., 2016), in this paper we draw on rich secondary data available from the Carbon Disclosure Project (CDP) with a special focus on its 'Supply Chain Program'. One advantage is that unlike information provided in CSR/sustainability reports and on firms' websites, the CDP provides a more comprehensive and structured source of information which allows comparison across a large number of firms in the context of the study's research question (Pinkse and Gasbarro, 2016).

Since 2002, CDP has collected data on a yearly basis, and, as of 2007, included the collection of data related to the impact of climate change on supply chain partners. Targeting suppliers across the full spectrum of size, CDP claims it is 'developing an emerging body of knowledge and best practice on how to increase visibility and have a positive impact on their supply chain' (CDP, 2017, p.6). Specifically, focal firms such as Unilever, Walmart, L'Oreal and Microsoft select key suppliers on the basis of purchasing spent, high risk industries, geographies

or criticality and which, too, are then asked to respond to the CDP supply chain questions (CDP, 2017).

Of particular importance in this context is the identification of so-called Scope 3 greenhouse gas (GHG) emissions. Unlike direct Scope 1 (i.e. on-site burning of fossil fuels) and indirect Scope 2 emissions (i.e. 'imported' emissions from purchasing electricity), Scope 3 emissions are essentially those caused by activities within firms' supply chains and product portfolios (Greenhouse Gas Protocol, 2011; Jira and Toffel, 2013). These supply chain emissions are significantly contributing to firms' carbon footprints and can amount to as much as four times their own direct operational emissions (CDP, 2017). Despite this impact, a recent assessment found that 'only 36% of all respondents are engaging with either their suppliers, partners or customers on climate change, and that, even more concerning, two-thirds of suppliers are not able to report quantifiable emissions reductions' (CDP, 2017, p.14). However, the need to respond to and manage a variety of new stakeholder pressures, information requests, and the choice of appropriate supply chain carbon footprint calculation and verification methodologies are growing.

The use of secondary data sources has a long tradition in management research (e.g., Swan and Ettlie, 1997), but has only recently attracted more attention and calls in operations and supply chain contexts (e.g. Calantone and Vickery, 2010; Chatha et al., 2015). The annual CDP initiative is enjoying growing legitimacy among businesses as the standard of climate change disclosure (GRI, 2013; Knox-Hayes and Levy, 2011) and has been increasingly subjected to a variety of both quantitative and qualitative analyses (e.g., Dahlmann et al., 2017; Kolk and Pinkse, 2005; Pinkse, 2007; Pinkse and Gasbarro, 2016). This study therefore draws on the breadth and relevance of this secondary data source (Mauthner et al., 1998) including the

comprehensive access to an unparalleled range and detail of firms from different countries and industries. While the resulting sample is neither completely random nor theoretical, it instead leverages the advantages of a quasi-representative sample of firms engaging with supply chain partners with the benefits of studying a specific selection of cases that can generate a deeper understanding of the general 'messiness' involved in tackling grand challenges such as climate change (Eisenhardt et al., 2016). Inevitably, using secondary data also has limitations, including a lack of influence over the questions and their administration, but here these concerns are outweighed by the advantages of sample size, detail and objectivity achieved from the external collection process (Calantone and Vickery, 2010; Mauthner et al., 1998).

3.2 Sample overview

The study's initial dataset is based on a sample consisting of a total of 3,536 responses taken from across the CDP's 2014 and 2017 supply chain surveys. While 2017 reflects the latest publically available dataset, 2014 was chosen to enable a sufficient degree of longitudinality in our research that was not based on short-term trends. From this sample we delete 659 responses from firms which provide no explicit details about their supply chain partner engagement strategies. The remaining 2,877 responses from 2014 and 2017 combined correspond to 2,330 unique firms from 69 countries and 51 industry groups. In 1,191 of those cases firms explicitly declare they do not engage with any of their supply chain partners on climate change. Some of the reasons provided by firms reflect the still evolving field of corporate climate change action and is shaped by the varying perceptions of drivers and barriers including a lack of incentives and a belief that the firm is too small and therefore does not have the relevant resources and

knowledge. Other firms state they are not yet engaging but claim to be making progress towards doing so in the near future.

By contrast, 1,686 respondents indicate they do engage supply chain partners in addressing climate change. Of those firms that provide details on their engagement strategies, 28% of firms engage with customers only, closely followed by 24% engaging with both suppliers and customers, and 21% with suppliers only. 17% state that they engage with both customers and suppliers as well as other stakeholders such as universities and industry associations. Relatively speaking, the biggest change in engagement patterns between 2014 and 2017 is found among firms that engage both suppliers and other supply chain partners. Table 1 provides an overview of the engagement partners over time covered by the final sample of firms.

<Please insert Table 1 about here.>

3.3 Data analysis

Given the desire for developing generalisable insights for theory and practices of sustainable supply chain partner engagement, our research approach was driven by an attempt to improve understanding and enhance theory (Bansal et al., 2018). As part of the CDP's data collection, firms are asked to describe their: i) methods of engagement, ii) their strategy for prioritising engagements, and iii) measures of success. The dataset was carefully examined using a two-stage qualitative content analysis (Chatha et al., 2015) to produce a contextually detailed account of the supply chain partner engagement process (Pinkse and Gasbarro, 2016). As an illustration, the initial analytical process of the total database of firms with engagement partners - comprising more than 289,439 words (on average 172 words per firm) - was first uploaded and coded using

NVivo software. In addition, we examined 20 firms listed in our sample by downloading their respective CSR/sustainability reports to cross-check information provided to the CDP. Generally, information was either identical or tended to be more detailed in the disclosure to the CDP.

For the data analysis process (Miles and Huberman, 1994) first we sought to explore *how firms engaged* with their supply chain partners on climate change. For this, we examined firms' responses to a related closed-ended question on which type of supply chain partner they engage with. Comparing data from 2014 and 2017 allowed us to understand possible changes over time and to offer a solid grounding of evolving supply chain engagement, before delving deeper into the underlying processes. We then applied the three key stages of OIPT – information gathering, processing and transferring – as key codes for the qualitative data to capture firms' varied engagement practices with different partners. Using these stages as analytical lenses allowed the grouping of relevant first order codes into summary second order codes under each of the three processes. The data analysis process went through multiple iterations across the whole dataset to ensure correctness and consistency with regard to the coding structure. While seeking to maintain comparability and reducing variability across the codes the authors resolved differences through debate and with the help of an independent researcher familiar with research on supply chain management.

In the second stage of our qualitative analysis, we sought to *characterise these engagement processes* more deeply. For this we inductively coded data resulting in three types of engagement patterns based on how information was processed, with whom and the nature of these engagements. While stage one provided insights into the engagement practices and partners, here we also paid close attention to the purpose, temporal outlook and information asymmetry involved in these engagement patterns. In combination with the codes from stage

one, the overarching aim was to summarise the nature of engagement patterns identified across our multi-sector and global sample of focal firms (Bansal et al., 2018).

4. FINDINGS

Before studying firms' engagement with their supply chain partners and characterising the nature of firms' information processing in the context of climate change, we begin by exploring the dynamics of climate change supply chain engagement over time.

4.1 Dynamics of supply chain engagement on climate change

To examine whether and how supply chain engagement on climate change has evolved in recent years, first we compare only those 350 firms which did engage different supply chain partners in both 2014 and 2017. Specifically, for each firm we sum the number of engagement partner types for each year respectively. Thus, in a given year the total of engagement partners could range from concentrating on just one type to a total of three consisting of suppliers, customers and other supply chain partners. Table 2 below summarises the respective dynamics in terms of absolute firm numbers and percentages of grand total.

<Please insert Table 2 about here.>

The results suggest that first, over time the majority of firms continue to engage with only one type of partner (31%). This picture is further compounded by the fact that 65% of firms remain with their engagement strategies over time as highlighted by the grey shaded diagonal cells. Moreover, while a total of 13% of firms have reduced their engagement in terms of engagement

partner types (dark shading), 23% added at least one other type of engagement partner over time (non-shaded cells). Noteworthy, however, is also the fact that 13% firms continue with a broad engagement strategy which includes all three engagement partners of suppliers, customers and other supply chain partners. Similarly, a further 17% increased their commitment from one partner in 2014 to at least one other or two additional engagement partners in 2017.

In summary, these findings suggest that for firms that have been disclosing their engagement commitments since 2014, engagement appears to remain relatively stable over time. While many continue with their engagement strategies, others have increased their engagement to at least one other supply chain partner. A relative minority has reduced its level of commitment. These figures, however, only illustrate the changes in types of partners that firms engage with. Next we investigate in depth how this engagement is characterised.

4.2 Organisational information processing in climate change engagement

To study the responses of those firms that engage with their supply chain partners, we apply the three key stages of OIPT as analytical lenses (table 3).

<Please insert Table 3 about here.>

4.2.1 Information gathering

Firms collect climate change related information through two key channels which shape the nature of the information gathering process. Primarily, firms rely on a variety of formal and structured communication channels with both suppliers and customers. Typically, focal firms achieve this by drawing on the distribution of self-created and structured surveys as a means to

engage. This involves requests for specific emissions and other environmental performance data, or calls on suppliers to respond to the CDP supply chain initiative, thus giving this external data collection process wider legitimacy. *'We answer customer questionnaires on the way we reflect their values by reporting on numerous 'sustainability' programmes that they are interested in'* (Director Sustainability; Waters Corporation). Several firms also use the consultancy EcoVadis as an emerging business standard of climate change information gathering. More formally, firms use the supplier selection process to gather information by specifying contract clauses that include climate change information requests and that can be followed up with site visits and (third-party) audits. *'Customers request data on our percent recycled, types of items recycled, landfill tonnage, carbon footprint and participation in the CDP during the RFI/RFP* [request for information/request for participation] *process'* (Vice President of Engineering & Sustainability; Taylor Communications).

Perhaps less predictable in terms of response levels, firms also elicit data and information from supply chain partners through feedback and suggestion schemes as well as broader industry surveys and initiatives to obtain insights into changing market trends and customer demands, including those relating to climate change. '*[We have] a stakeholder engagement plan to ensure that through focus groups and interviews, we systematically engage with a range of interest groups on a regular basis, at least once every two years, on the issues that are of importance to Cathay Pacific Airways, including climate change, and those that are of importance to the different stakeholder groups'* (Environmental Projects Manager; Cathay Pacific Airways Ltd). The latter are particularly relevant where firms have committed to developing industry-wide standards and benchmarks on managing climate change issues and risks.

Beyond these formal arrangements firms also draw on a range of informal channels to gather data and information which heavily rely on personal dialogue with customers particularly during the early stages of product development. The focus here is on collaboration and consultation to ensure climate change considerations are integrated from the outset of designing new products and solutions. To obtain a wide range of views and insights related to climate change firms also cite the importance of hosting and attending sustainability focused business summits with suppliers, customers and other supply chain partners. While these meetings are less likely to provide orderly data and information, they too are important for firms to understand the wider direction of travel of supply chain partners with regard to acting on climate change. *'We recently hosted a Global Supplier Summit where we engaged with 80 key suppliers on cost reduction and innovation, incorporating sustainability as a critical consideration for both. During the summit our Director of Global Sustainability presented information about our programs'* (President and CEO; AptarGroup).

4.2.2 Information processing

Once information has been obtained, firms process them in a variety of ways to different ends. In the first instance, firms use them for deeper analysis regarding their exposure to climate change. At the product level this entails conducting life cycle assessments (LCA), for example, to calculate product carbon footprints. Data and information also directly feed into materiality assessments and scorecards at the organisational level, or are used in some other form as part of proprietary analytical systems. Beyond general GHG emissions data, information is processed through in-house R&D efforts or externally as part of standard environmental management systems (EMS) accreditations. *'We work with new suppliers on the profile of specific materials*

to understand their CO2 impact through LCA. Our LCA platform is routinely evaluating the CO2 footprint of products, including assessment of raw materials' (Senior Vice President and Chief Financial Officer; Sealed Air Corporation).

Following the initial diagnostics, firms further process data and information in a more strategic manner, either by driving strategic priorities for future engagement with climate change at the organisational level, and/or by using insights gained to develop innovative products with lower carbon footprints. *'Honeywell Turbo Technologies (HTT) works very closely with our customers through meetings and collaborative projects to reduce CO2 emissions. Our automotive manufacturing customers have goals to reduce the CO2 emissions of new vehicles and we work with them to provide new designs that support their goals. For example, we worked with an automotive manufacturer on a design for a 2.2 L engine which goes into a global Light Commercial Vehicle Platform. This customer wanted to develop a 'Fuel Economy' version of the engine and HTT supported this effort through the development of a more efficient version of the turbo which generates 2% less CO2'* (Corporate Director of Product Stewardship & Sustainability; Honeywell International, Inc.).

Finally, the strategic plans are turned into operational guidelines and policies. Specifically, this entails a commitment to continuous process and performance improvements to reduce GHG emissions across the supply chain as well as setting internal carbon targets, for example, particularly through the optimisation of distribution and logistics that affect scope 3 emissions. Data and information are also used to inform and improve risk management procedures in terms of physical, operational and regulatory risks. *'Bloomberg conducts a Vendor Risk Management Assessment (VRMA) on all new vendors, which includes a sustainability assessment'* (Global Head of Sustainable Business & Finance; Bloomberg).

Lastly, information gathered and processed significantly shapes firms' approaches to vendor management, for example, by informing and tightening supplier selection criteria as well as (contractual) expectations regarding scope 3 emissions. *'A supplier scorecard is used to evaluate the supplier's performance and this tool is used in our supplier selection process or when a supplier is mandated by customer this information is communicated to the customer'* (Director of Environmental Health & Safety/Sustainability; Tessy Plastics).

4.2.3 Information transferring

Closely aligned with the efforts of information processing, firms also need to communicate with and feed back to supply chain partners. This is particularly true for suppliers that now have to adhere to new codes of conduct and supply contract terms and conditions. Beyond contractual engagement, many respondents also mention the importance of training, supporting and coaching suppliers that struggle to comply with these new additional expectations. At the same time, firms use awards and prizes for well-performing suppliers to create incentives, recognise efforts and raise wider awareness. *'We have a 'Sustainability Award' at our yearly Supplier Appreciation Event, which honours one supplier who excels, and our criteria for this score heavily weights performance on energy/GHG emissions because that is Cisco's most material environmental issue'* (SVP, Operations; Cisco Systems).

Outside contractual partners, focal firms also engage in a range of broader feedback and disclosure mechanisms. These include voluntarily sharing their results from the information processing stage such as best practices, as well as responding to sustainability surveys, reporting GHG emissions data to other interested parties (e.g., CDP), and supporting wider industry initiatives on climate change similar to the information gathering stage.

Importantly, however, information transferring is key in the context of engagement with customers. Here, a clear difference in approaches emerges between different customer types. While some firms take a rather compliance and least-effort driven approach of responding only reactively to specific customer information requests on climate change, others use information transferring to market and push their sustainable products and services to customers proactively. Whereas firms in the former category evidently see customer engagement as either too sporadic or inconsequential, firms in the latter group appear to understand the wider ramifications of scope 3 emissions. By highlighting the environmental benefits of their innovative products and services these firms seek to demonstrate their contribution to addressing climate change by reducing their customers' own supply chain emissions. *'We supply our GHG emissions figures to some customers through their survey process'* (AVP Environmental Affairs; Smithfield Foods, Inc.). By contrast, *'we offer our customers carbon neutral flooring through our third-party verified Cool Carpet program. We educate customers on the environmental benefits of our low VOC installation system, TacTiles'* (Chairman of the Board; Interface, Inc.).

4.3 Three types of climate change engagement with supply chain partners

Based on our observations from across the sample of engaging firms, next we characterise three different types of climate change supply chain partner engagement: *Basic, transactional and collaborative engagement* (Tables 4 and 5). These types represent summaries of engagement patterns reflecting the broadly similar approaches found among our firms across different industries and countries. However, while there appears to be a qualitative progression in terms of comprehensiveness between these three types, we do not suggest that firms necessarily proceed from one type to another in an evolutionary manner (cf., Schaefer and Harvey, 1998). In fact,

some firms adopt different engagement types with different partners at the same time, although many firms could be characterised by just one engagement type. All three types are also present among firms both in 2014 and 2017, thus particular engagement types are not germane to any of the time periods. We also could not detect clear differences between industry sectors and countries of origin. On balance, therefore, these types describe generally recurring patterns in firms' approaches towards climate change engagement.

<*Please insert Tables 4 and 5 about here.*>

4.3.1 Basic engagement

Basic engagement practices typically reflect the early information driven stages of firms' engagement with supply chain partners on climate change. Specifically, motivated by a variety of factors (Jira and Toffel, 2013), either a customer is demanding climate change specific GHG emissions data from the focal firm, or the focal firm itself decides to gather this information from its suppliers. In the basic form of engagement, information gathering primarily entails firms' initial efforts to address information uncertainty by obtaining an initial or revised assessment of their scope 3 GHG emissions. While such data are often requested by external stakeholders, basic engagement is driven less by considerations of their usefulness for process and product improvements within the focal supply chain firm and more by a concern for establishing baseline data on scope 3 GHG emissions. *'Engagement in rollout of climate change initiatives by assessing baseline (emission performance, internal benchmarking, forecast of future scenarios taking into account long term business plans)'* (Group Director Environment; Tata Steel). Due to the relatively short-term and reactive nature, internal information processing is limited to basic

data collection (mainly GHG emissions) and returning (transferring) them in the required format. *'Emissions data is shared with our customers when they request information'* (Director, EHS/Corporate Responsibility; Avaya). Perhaps tellingly, responses from firms drawing on basic engagement were relatively shorter in length and qualitatively less detailed.

4.3.2 Transactional engagement

In addition to basic engagement, transactional engagement differs in that the focal firm decides to process the emissions data internally to more productive ends. Whereas basic engagement reflects a largely reactive stance of responding to external stakeholder requests for scope 3 emissions data, transactional engagement entails a more proactive attitude towards processing and utilising these data.

Importantly, firms use the GHG emissions data obtained to calculate their carbon footprints and to identify opportunities for performance improvements. Together with data from downstream service providers (e.g. distribution) this aids the broader process of life cycle assessments. In firms with more experience of gathering climate change information, this is then used to drive environmental performance improvements across the supply chain through the use of targets and other incentive mechanisms. *'The success of our supply chain engagement projects is continually monitored as we aim for successive reductions in emissions each year'* (Sustainability Manager; Virgin Atlantic Airways Ltd). *'We established a strategic plan that includes supplier goals for reducing GHG emissions and supply chain goals for reducing energy use, a direct proxy for GHG emissions'* (Senior Vice President Corporate Strategy and Chief Innovation and Sustainability Officer; Exelon Corporation).

Further, information is used during the procurement process by determining the knowledge base from which firms engage with their suppliers, designed to raise their awareness of climate change and associated sustainability issues, and/or to provide them with incentives to improve. Internally, the processed information is transferred into revised guidelines for procurement staff or reflected in updated codes of conduct for suppliers and tightened contract clauses. *'We have engaged our suppliers in a variety of ways including integrating a sustainability score into our strategic suppliers' scorecards. […] Some suppliers voluntarily share data and are then rewarded with a better score for disclosing this information and receive a further improved score for reductions in energy consumption on an absolute or normalised basis'* (Director, Global Environmental Performance; Steelcase).

Information is then utilised either to select a supplier or to decide on continued relationships through performance assessment against a range of key performance indicators (KPIs). Firms use this information to dispatch improvement notices to underperforming suppliers, or to include demands for eco-alternatives. Overall, therefore, transactional engagement typifies firms' efforts to go beyond initial information uncertainties stemming from a lack of scope 3 emissions data, and to integrate climate change concerns into their supplier engagement more operationally. Importantly, however, firms approach this largely in a transactional manner by relying on contracts, internal and external incentives and sanctions (cf. Dahlmann et al., 2017), and by focusing on efficiency improvements, cost reductions and risk management in products and processes. *'The aim of this engagement is to provide benchmarking to suppliers regarding their GHG emission reduction and water conservation programs, in order to identify sustainability improvement opportunities'* (Executive Vice President, Business Operations and Chief Financial Officer; Pfizer, Inc.). *'Eaton uses the supplier reported climate*

change qualitative and quantitative data in a variety of ways to develop an improved understanding of our footprint, as well monitoring climate change-related risks and opportunities within our supply chain' (Chairman and Chief Executive Officer; Eaton Corporation).

4.3.3 Collaborative engagement

Collaborative engagement is typically the result of firms including both upstream and downstream partners in their engagement practices and strategies, though it may also be found in engagement with one type of partner. Similar to the transactional engagement model, it reflects a more sophisticated understanding that addressing information uncertainty per se has limited value on its own. *'We believe it is important that the companies we deal with have in place initiatives to reduce their overall carbon footprint, rather than just concentrate on providing carbon data to ourselves'* (Kier Group). Instead, firms involved in collaborative engagement extend their information gathering, processing and transferring processes to customers, suppliers and beyond for more shared value-driven approaches. *'Through this engagement, we used an influence/collaborative model to share our company's environmental sustainability strategy including our new absolute greenhouse gas reduction targets, and learned of the sustainability plans of our suppliers'* (Executive Vice President, Chief Financial Officer; Brown-Forman Corporation).

Transactional, and particularly collaborative, engagement types differ from basic engagement in the variety and richness of communication channels used for information gathering (Daft and Lengel, 1986). For example, collaborative engagement also includes more informal and ad hoc communications through personal letters and phone calls, meetings,

discussion groups or web-based communication platforms as well as sustainability events. '*We initiate contact directly with our suppliers each year via a letter from our procurement executive. The sustainability function follows up after CDP sends its Supply Chain initiative invitations with assistance, particularly with first responder. We also follow up with outreach by our supplier relationship managers and through the EICC* [Electronic Industry Citizenship Coalition] *and CDP to provide support via shared best practices in measurement and reduction opportunities'* (SVP, Operations; Cisco Systems Inc.).

Unlike the more transactional use of tight performance controlling of suppliers, information gathered through collaborative engagement practices plays a vital role during the establishment of mutually beneficial relationships designed to develop eco-innovation as well as product and service alternatives. Findings suggest some firms recognise that addressing the multitude of inherent risks and opportunities requires cooperation and collaboration. For example, information is incorporated into more supportive supplier training and development courses, briefings, summits and even award ceremonies to identify joint development and innovation projects. *'LG Chem has recently signed the MOU* [memorandum of understanding] *for Energy Saving with Korea Energy Management Corporation to help small- and medium-sized companies and clients manage energy and GHG emissions. With this program, we will support our partner companies to be more competitive in management and rationalisation of energy usage'* (General Manager; LG Chem).

Collaborative engagement is thus decidedly relational, forward-looking and comparatively less transactional. While basic climate change engagement primarily serves largely operational data collection and supply chain control purposes, once baseline benchmarks have been established, supply chain partners can enter more strategic and innovative

relationships. These collaborations take the context of climate change as an important stimulus for new product and process improvements, to overcome pre-competitive barriers and to create competitive advantage. *'The Sustainability Consortium uses collaborative processes to drive scientific research and the development of standards and information technology tools to enhance the ability to understand and address the environmental, social and economic implications of products'* (Chief Sustainability Officer; Kellogg Company).

Importantly, collaborative engagement also differs from the transactional type in that it typically seeks to include downstream partners such as customers and consumers in information gathering and transferring processes. For example, it is used to disseminate solutions already developed whereby firms often have to make extra efforts to stimulate demand by convincing their customers of the additional or new value provided from less carbon intensive innovations. The intensity of engagement tends to reflect customers' relative degrees of climate change progressiveness or responsiveness. Where customers are already active, focal firms use knowledge and capabilities gained from previous information processing to further support them through collaborative innovation of products and services. But when customers are comparatively reactive, focal firms have to rely on the passive impact of their environmentally beneficial product suites. Together with the sharing of best practices, firms therefore engage in a variety of two-way information exchanges with multiple supply chain partners. *'We partner with our customers to increase their efficiency, improve their sustainability performance and enhance their business results at more than 1.3 million locations globally. Through helping our customers we play an important role in meeting the changing needs of our evolving world, and we strategically work with our customers to reduce their energy demands and GHG emissions'* (RD&E Vice President, Global Sustainability Technical Leader; EcoLab Inc.). A more proactive,

strategic and innovative approach to engagement here is clearly aligned with addressing information equivocality whereby some information exists but has yet to become orderly and useful.

Information is not only gathered and processed as an end in itself, but also forms part of a broader information flow with all supply chain partners. In particular, once information has been analysed and utilised internally by the focal firm, some of it is also sent out again, either in raw or processed form. For example, GHG emissions data collected from suppliers is passed on to customers, reflecting their breadth and depth of scope 3 emissions. Finally, outside the immediate supply chain partners firms also engage in a wide range of stakeholder dialogues encompassing engagement with end-consumers (if they were previously not already involved), partnerships with industry associations as well as academic collaboration with and support of universities and research institutions. *'We also fund academic research for example through the membership of a Sustainable Sourcing Chair managed by Euromed School of Management in Marseilles'* (Executive VP Strategic Planning and Government Relations, Marketing Offer, Supply Chain, Client Relations, Sustainable Development; Sodexo). Collaborative engagement therefore entails the most comprehensive approach towards managing a variety of upstream and downstream supply chain partners.

5 DISCUSSION

Understanding how firms effectively engage their supply chain partners is critical to address climate change. Our findings show that climate change engagement is characterised by heterogeneity among global firms and still entails relatively different practices. Our analysis focused on the interactions between upstream and downstream supply chain partners whereby

firms engage with suppliers, customers and other supply chain partners to overcome information asymmetries from climate change.

5.1 Climate change engagement across supply chain partners

Our research highlights that, interestingly, many firms' engagement has not changed significantly over time in terms of the types of partner they engage with. While some firms clearly draw on very comprehensive approaches including suppliers, customers and other supply chain partners, many others continue with a more limited scope (CDP, 2017).

At the same time, there is significant variation in the way in which firms engage and the extent to which this is underpinned by information processing. Consistent with OIPT, we find that generally firms gather, process and transfer information from and between supply chain partners designed to overcome emerging information asymmetries in the context of climate change, yet there is variation between firms and the extent to which they execute these different stages (Tuggle and Gerwin, 1980; Galbraith, 1974; Zhao et al., 2018). While scope 3 indirect emissions data and exposure to supply chain risk factors play a fundamental role as part of these information exchanges, many firms have moved beyond simplistic data gathering and are instead more concerned about managing and utilising the underlying messiness and ambiguity through advanced forms of information processing and transferring (Corner et al., 1994; Egelhoff, 1991; Rogers et al., 1999). This suggests that while climate change imposes new information uncertainties, focal firms then respond by focusing on the inherent information equivocality.

Specifically, we characterise three different types of engagement approaches identified across our sample. Differentiating between basic, transactional and collaborative types of engagement, the study highlights the increasing degree of comprehensiveness involved in

overcoming supply chain information uncertainty before improving information equivocality. Conceptually, each type of engagement provides a clear foundation for further engagement by adding new layers of the different supply chain partners involved, how to manage relationships, and the purpose of these interactions. For example, the basic form of engagement is vital in informing more transactional approaches towards addressing scope 3 emissions. Meanwhile, the use of collaborative approaches does not rule out process improvements from transactional engagement as well, but rather complements them in areas where this focus would be inappropriate. We also find that it is possible for focal firms to employ transactional and collaborative modes of engagement simultaneously with different suppliers and customers. Using an OIPT lens therefore enables examining the wider processes involved in gathering, processing and transferring information between different supply chain partners, characterised by requests for collection, utilisation and dissemination of GHG emissions data and other climate change and sustainability-related information.

Our research extends organisational information processing theory to inter-organisational supply chain settings and specifically responds to calls for its application to the context of SSCM (Busse et al., 2017; Qrunfleh and Tarafdar, 2014; Touboulic and Walker, 2015). While our data and analysis cannot comment on the true underlying motives of firms' varied forms of engagement, from their responses we discern that different time frames, anticipated outcomes, degrees of responsiveness and the practices involved suggest that firms have different interpretations of and intentions behind SSCM. While profitability and competitiveness are often explicitly mentioned, resilience can only be inferred in some cases (Ahi and Searcy, 2013); meanwhile there are no references to ethical or ecological values driving firms' engagement practices (Muller and Kolk, 2010). At the same time, collaboration and development of joint

efforts to drive innovation for improved sustainability performance are fundamental to the collaborative engagement type (Gold et al., 2010; Grosvold et al., 2014; Klassen and Vachon, 2003). In contrast to more transactional approaches, particularly firms with collaborative engagement also place clear emphasis on supplier support and development (Yawar and Seuring, 2018). Based on information transferring such as dialogue, sharing of best practices and benchmarking both within and beyond the supply chain, findings suggest that collaborative engagement approaches also entail a significant element of organisational learning resulting from such information flows (Sarkis, 2012).

Complementing its application to intra-organisational processes, our analysis suggests that information processing in the context of climate change engagement with supply chain partners is not a linear process (e.g., Qrunfleh and Tarafdar, 2014), but rather based on multiple information exchanges. These iterative and circular information pathways often overlap and span across upstream and downstream supply chain partners, rather than being purely focused on processes within a focal firm. Specifically, we find that while information gathering marks the beginning of a variety of engagement processes, it is both information processing within firms and varied forms of information transferring between supply chain partners, which explain the extent to which firms engage. These processes are particularly important in the context of addressing the still emerging and evolving understanding of the many risks and opportunities associated with climate change. Our three types of supply chain partner engagement therefore provide a more nuanced depiction of inter-organisational information processing in the context of climate change.

5.3 Practical implications

Our findings provide practitioners with a clearer understanding of the different approaches involved in basic, transactional and collaborative types of engagement on climate change. Seeing the development of such processes as complementary layers should provide particularly those without any such practices in place with a starting point for engagement, and the means by which to expand their activities with growing information availability obtained from such exchanges.

While it is conceivable to begin supply chain engagement directly with collaborative approaches, managers planning to build up their competencies and capabilities more gradually will find the three different types a useful conceptualisation for orienting their practices. Specifically, we recommend firms begin by collecting basic GHG emissions data from their suppliers to address information uncertainty, then evaluate these data internally before engaging with suppliers and customers on means to reducing these emissions.

5.4 Limitations and further research

Inevitably, our paper has limitations that offer future research opportunities for evaluation and extension of our findings. First, due to the voluntary nature of our database, a certain self-selection bias cannot be ruled out (Jira and Toffel, 2013). Despite this bias, however, one advantage of our data is that it also allowed respondents to make active declarations about their engagement. Thus, while initial participation in the survey may be biased, we also have responses from firms that declared they did not engage with the supply chain partners. As the majority of our data are also from larger firms headquartered in developed countries, particularly the U.S., future research should work with samples where such biases are minimised.

Second, content analysis of responses to the CDP are based on claims and self-reported statements rather than empirically observed activities. As such, they are likely to suffer from

social desirability bias whereby firms attempt to present a more positive picture than may actually be true. At the same time, responses from particularly large firms can be cross-checked against CSR reports and other information provided. Similarly, our research and data are entirely focused on the processes of engagement. As such, we cannot comment on their actual effectiveness in terms of achieving scope 3 emissions reductions and other forms of impact and output. Conducting detailed case studies and field observations should allow researchers to evaluate and corroborate our insights gained from studying a large sample of secondary data.

6 CONCLUSION

There is growing evidence to suggest that in many sectors firms' individual corporate carbon footprints are smaller than the emissions produced across their supply chain partners. Climate change poses significant new information asymmetries in form of physical and regulatory risks and opportunities for businesses. This study explored how firms engage with their supply chain partners drawing on organisational information processing theory. Findings show that while firms' chief information uncertainty behind their engagement strategies relates to measuring their scope 3 emissions, effectively interpreting and managing this information equivocality becomes a growing priority.

Further, OIPT provides a valuable lens for characterising information flows and utilisation in climate change engagement. Our findings suggest that information processing within supply chains occurs through a variety of exchanges which we conceptualise as basic, transactional and collaborative types of engagement. These types represent common patterns of engagement found across our global sample of firms with each reflecting a different level of comprehensiveness in the approach taken. Our paper contributes to knowledge on the

significance of inter-organisational information processing in addressing important sustainability outcomes and performance. An improved understanding of how firms engage with their supply chain partners will help overcoming increasingly complex information asymmetry in the context of climate change and SSCM.

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TABLES

Table 1: Descriptive sample statistics for firms involved in climate change engagement with supply chain partners in 2014 and 2017 (unbalanced sample; n=1,686)

Engagement partner	2014 only	2017 only	Total
Suppliers only	142	205	347 (21%)
Customers only	172	306	478 (28%)
Suppliers and Customers	176	221	397 (24%)
Suppliers, Customers and Other Supply Chain Partners	111	172	283 (17%)
Suppliers and Other Supply Chain Partners	8	41	49 (3%)
Customers and Other Supply Chain Partners	16	36	52 (3%)
Other Supply Chain Partners only	31	49	80 (5%)
Total	*656*	*1,030*	*1,686*

Source: CDP Supply Chain surveys 2014 and 2017

Table 2: Changes in engagement partner types between 2014 and 2017 (balanced sample only; n=350)

		2014		
	Number of engagement partner types	**1**	**2**	**3**
2017	**1**	107 (31%)	20 (6%)	10 (3%)
	2	44 (13%)	73 (21%)	14 (4%)
	3	13 4%)	23 (7%)	46 (13%)

Source: CDP Supply Chain surveys 2014 and 2017

Table 3: Coding structure based on stages of OIPT

Information Gathering	Information Processing	Information Transferring
Formal and structured ▪ Collecting data from suppliers and customers through structured surveys incl. CDP ▪ Collecting data through request for participations (RFP), supplier audits and screening pre-contract information ▪ Developing formal feedback and suggestion schemes ▪ Initiating and participating in industry initiatives, surveys and benchmarking exercises ***Informal and adhoc*** ▪ Collaborative information exchanges during product development ▪ Personal dialogue through phone calls, emails and letters ***Sustainability events*** ▪ Hosting sustainability focused business summits with suppliers, customers and other supply chain partners	***Diagnostic/analytical*** ▪ Conducting life cycle assessments (LCA) ▪ Using scorecards, materiality assessments and other proprietary analytical systems ***Strategic*** ▪ Driving and understanding strategic priorities ▪ Innovative product development with lower carbon footprints ***Operational*** ▪ Continuous process and performance improvement to reduce GHG emissions across the supply chain ▪ Setting internal and supply chain carbon targets ▪ Distribution and logistics optimisation ▪ Risk management ▪ Vendor or supplier selection	***Vendor management*** ▪ Developing and sharing codes of conduct and supply contract terms and conditions ▪ Training, supporting and coaching for underperforming suppliers ▪ Awards and prizes for well-performing suppliers ***General feedback and disclosure*** ▪ Voluntarily sharing information processing results, best practices, ▪ Responding to sustainability surveys and reporting GHG emissions data ▪ Supporting wider industry initiatives on climate change ***Customer engagement*** ▪ Reactively responding to specific customer information requests on climate change ▪ Proactive customer engagement to push sustainable products and services

Source: CDP Supply Chain surveys 2014 and 2017

Table 4: Overview of three types of climate change supply chain partner engagement

	BASIC	TRANSACTIONAL	COLLABORATIVE
Purpose/outcomes	▪ Information driven ▪ Scope 3 emissions 'fact finding' and 'baselining'	▪ Cost driven ▪ Performance improvement (scope 3) ▪ Efficiencies ▪ Risk management	▪ Shared value driven ▪ Innovation ▪ Strategic development ▪ Pre-competitive partnerships
Timeframe	▪ Short term ▪ Reactive	▪ Medium term ▪ Proactive	▪ Long term ▪ Proactive
Information gathering	▪ Formal and structured	▪ Formal and structured	▪ Formal and structured ▪ Informal and ad hoc ▪ Sustainability events
Information processing	▪ Minimal data processing	▪ Operational ▪ Diagnostic/analytical	▪ Strategic
Information transferring	▪ Reactive customer management	▪ Transactional vendor management	▪ Collaborative vendor management ▪ Proactive customer management ▪ General feedback and disclosure
Information asymmetry	▪ Information uncertainty	▪ Information uncertainty ▪ Information equivocality	▪ Information equivocality

Source: CDP Supply Chain surveys 2014 and 2017

Table 5: Exemplary quotes highlighting three characteristic types of supply chain engagement

Type of engagement	Exemplary quotes
Basic engagement	*'We request suppliers to collaborate with us at an explanatory meeting. We survey their activities using our own format. We give instructions and encourage suppliers' activities at seminars or individual meetings'* (President, Corporate Environmental Strategy Unit; Fujitsu Ltd.). *'The IBM Integrated Supply Chain (ISC) Organisation maintains a Social & Environmental Management System (S&EMS) which evaluates and addresses ISC's intersections between the environment and supply chain management'* (Director Corporate Environmental Affairs; IBM). *'Progress on our Supplier Engagement Strategy during FY14 included a second annual request to our Supply Chain suppliers to provide their scope 1 and 2 GHG emissions data'* (Manager, Global Corporate Responsibility; Symantec Corporation). *'Since 2009, we have invited vendors to respond to the Carbon Disclosure Project (CDP) Supply Chain Survey, which allows us to measure carbon and associated risks in our supply chain'* (Chief Financial Officer; Bank of America). *'In 2016 we introduced our first round of having our own suppliers submit to the CDP Supply Chain project. Our plan is to continue this project moving forward'* (President and CEO; Stanley Black & Decker).

Transactional engagement	*'We also have very extensive supplier evaluation and regular questionnaire where we ask about emission strategy of suppliers and for example their readiness to give carbon footprint information. This also enables us to select most effective partners to collaborate. Progress is monitored through internal KPI's and project targets, success from past year 2013 are for example joint implementation of renewable energy (wind and bio power solutions) and expanding utilisation of waste gasses'* (Head of Sustainability; Outokumpu Oyj). *'We push our suppliers to address resource conservancy on their end so that it provides additional emissions reduction through the value chain' (President and CEO; Kayser-Roth Corporation).* *'Effective in 2013, we expanded our existing procurement policy to include new additions related to green procurement. These new additions address the following: suppliers comply with applicable environmental legal requirements and regulations; suppliers have knowledge of the Southwest Environmental Policy, which is now included in our procurement policy; suppliers maintain an open dialogue with Southwest concerning environmental achievements, trends, and possible areas for improvement; and we ask that our suppliers provide environmental-related data upon request'* (Director of Environmental Services; Southwest Airlines Co.). *'The data will be used to further develop company specific carbon performance and opportunities for further engagement and risk reduction'* (Manager of Environmental Protection Office; Yonyu Plastics (Shanghai) Ltd.). *'HBS collaborates with customers to address all these challenges and develops a plan to reduce their environmental footprint. Since the 1980s, HBS has completed more than 5,000 energy-efficiency projects in facilities across the globe, which are expected to deliver nearly $5 billion in savings'* (Corporate Director of Product Stewardship & Sustainability; Honeywell International). *'To manage our supplier greenhouse gas emissions, we work with our suppliers to set expectations, build capabilities, track progress, complete scorecards and business reviews and provide feedback, and reward on performance. For suppliers that are performing well, a high score in the supplier scorecard could mean more business in the future'* (SVP, Operations; Cisco Systems, Inc.). *'We have set a new Scope 3 goal which will focus primarily on our emissions from the 'Purchased Goods and Services' category and represents greater than 75% of our 2016 Scope 3 emissions. By 2018, we will collect GHG emissions and water use data from > 90% of our strategic suppliers with the highest environmental impacts. By 2020, we will engage with those suppliers and request them to identify GHG emission and water use reduction opportunities. By 2025, > 90% of our strategic suppliers with the highest environmental impacts will set their own GHG emission and water use reduction targets'* (Senior Vice President, Head of the Group function Environment, Health, Safety, Security, Quality (EQ); Merck & Co., Inc.). *'In 2016 Micron initiated a global project entitled Supply Chain Business Optimization – an effort to reduce the overall number of suppliers to Micron. One of the many benefits of this project is the reduced carbon footprint of Micron's supply chain. By consolidating the number of suppliers providing raw materials to Micron, the transportation of those materials is also consolidated. Less shipments from fewer suppliers results in a reduced carbon footprint load'* (Principal Corporate EHS Program Manager; Micron Technology, Inc.).

Collaborative engagement	*'We engage directly with clients through meetings, written correspondence, advertising, collaborative projects, reports and follow-up work which communicate sustainable project outcomes. We strive to develop long term relationships with our clients, thereby building trust and this enables us to have discussions regarding potential sustainability projects, which the client might not have otherwise considered. We also engage with our clients indirectly by continuing to up-skill and train our work force to advise and design for a sustainable, low-carbon future'* (Chief Operating Officer; WSP). *'We engage with our customers on a very regular basis when we are delivering projects for them - particularly in the design phases of a project to discuss with them possible alternative designs that would decrease energy, emissions or wastage'* (Head of Sustainability; AMEC). *'Atos has an extensive supply chain engagement programme, which includes assessment by a 3rd party organisation for all CSR aspects. One of the aspects assessed is environment and particularly carbon emissions. Where suppliers do not meet our expected standards of environmental stewardship, Atos proactively engages them in order to encourage improvement'* (Head of Global Sustainability; Atos S.E). *'Establishing and maintaining stable and lasting relationships is a crucial element in creating shared value in the long term. By understanding specific needs and priorities, CNH Industrial can tackle any issues that may arise in advance and go through with the actions it undertakes in the interest of its stakeholders. Promptly identifying who its stakeholders are and organising the most effective channels, as well as constantly monitoring expectations, needs and opinions, are the first steps in setting an effective engagement process in motion'* (Corporate Controller and Chief Accounting Officer; CNH Industrial). *'Metso also engages with customers in R&D projects to develop solutions that meet customer needs with respect to e.g. climate change. The success of these initiatives is measured mainly through achieved process and product improvements, and impacts on Metso's sales'* (Senior Vice President, Sustainability and Technology Development; Metso). *'By having customers utilise the solutions and programs provided by Canon, not only are CO2 emissions in the life cycle of Canon products reduced, this also supports to lower customers' environmental impacts and costs, as their burdens are kept to a minimum'* (Global Environment Center; Canon Inc.). *'We are also working with the International Tourism Partnership as part of an industry working group to identify key risks in our supply chain. The group has completed a risk assessment which has identified cotton as a key issue for hotels and requires further investigation. This work is at an early stage but demonstrates the hotel industry's commitment to tackling supply chain impacts and ensuring a sustainable and secure supply chain for the future'* (Vice President Corporate Responsibility and Global Public Affairs; Intercontinental Hotels Group). *'For suppliers who have low scores, Program Managers provide hands-on one-on-one coaching and resources/training to help suppliers improve environmental performance'* (Chief Executive Officer and President; PG&E Corporation). *'Beyond managing our carbon footprint, we also support our customers' efforts to reduce their carbon impact through ICT deployment. The carbon-reduction value that Verizon products and services delivered to our customers was equivalent to the greenhouse gas emissions of taking more than 1 million cars off the road. Verizon's IoT* [internet of things] *products and services – from transit to agriculture – are not only providing significant revenue opportunities, but are also delivering increasing carbon-reduction value to our customers'* (Vice President, Supply Chain Operations and Chief Sustainability Officer; Verizon Communications, Inc.).