

Battling information asymmetry: Supply chain partner engagement for climate change mitigation

Frederik Dahlmann

Warwick Business School, University of Warwick, Coventry, U.K.

Jens K. Roehrich

HPC Supply Chain Innovation Lab, Information, Decisions and Operations Division,

School of Management, University of Bath, UK

(J.Roehrich@bath.ac.uk)

Abstract

Climate change poses significant information asymmetries in form of physical and regulatory challenges and opportunities for businesses. Using rich secondary data, we explore how companies engage with their supply chain partners drawing on organisational information processing theory (OIPT). We find that while companies' chief information uncertainty relates to measuring their scope 3 emissions, effectively interpreting and managing this information equivocality becomes a subsequent priority. Further, OIPT provides a valuable lens for characterising the dynamics behind information flows and utilisation in climate change supply chain engagement. We contribute to knowledge on the significance of inter-organisational information processing in addressing important sustainability outcomes.

Keywords: Organisation information processing theory; sustainable supply chain management; information asymmetry

Introduction

Extant literature examines why and how individual companies seek to reduce their impact on the natural environment by focusing their efforts on challenges and concerns within their supply chains (Busse et al., 2016; 2017). Much of this research draws on the concept of green or sustainable supply chain management (GSCM/SSCM) (Ahi & Searcy, 2013) with numerous reviews attesting its abundance and “theoretically rich and methodologically rigorous” character (Carter & Easton, 2011, p.46).

Concerns remain about our lack of understanding of whether and how companies collaborate with their supply chain partners to respond to specific GSCM issues such as climate change (Finke et al., 2016; Howard-Grenville et al., 2014; Montabon, 2016). Extant research has highlighted valuable business opportunities and enablers of progress (Plambeck, 2012), but also stressed the significant legal, strategic and operational barriers in terms of engaging upstream and downstream partners in collective climate change responses (Finke et al., 2016; Roehrich et al., 2014). A key challenge identified relates to companies' apparent inability to overcome upstream suppliers' inaction in

terms of making substantial reductions in carbon footprints (CDP, 2017; Roehrich et al., 2017). Although companies increasingly request their suppliers to share climate change information and data (Jira & Toffel, 2013), there is an urgent need to better understand the factors and conditions shaping suppliers' and buyers' engagement in substantial action on climate change (Bonilla et al., 2015; Huang et al., 2016; Chen, 2017; Howard-Grenville et al., 2014).

Within the literature on green supply chain engagement, extant conceptualisations examine supply chain practices from a variety of perspectives (Pagell & Wu, 2009; Schmidt et al., 2017). More specifically, the importance of stimulating information flows between different core supply chain partners as part of engagement has been highlighted conceptually (Sarkis, 2012) and studied empirically by focusing on the circumstances in which such information sharing is more likely to occur (Jira & Toffel, 2013). But while our understanding of why companies engage in information sharing is growing, we still know comparatively less about how this information processing unfolds. Particularly in the context of sustainable supply chain management we are only beginning to appreciate companies' additional information processing requirements (Busse et al., 2017).

Theoretically, organisational information processing theory (OIPT) offers a lens for new insights into the processes involved in managing uncertainty and equivocality (Galbraith, 1974; 1977) caused by the emerging nature of many GSCM issues. Although OIPT features widely in both the operations management and information systems literatures its application to SSCM phenomena remains comparatively under-examined (Busse et al., 2017; Touboulic & Walker, 2015). Especially in the emerging and complex field of climate change, companies are faced with numerous new issues and concerns challenging their more traditional approaches towards supply chain management (Busse, 2016; Howard-Grenville et al., 2014).

In this research, therefore, we address the following questions: (i) What are the climate change related information asymmetries that lead to focal companies engaging with their downstream buyers and upstream suppliers? (ii) How do focal companies seek to reduce these information asymmetries with their supply chain partners? Grounded in organisational information processing theory and using rich data from the CDP Supply Chain survey, we explore the drivers and processes behind companies' engagement strategies with their supply chain partners to overcome information asymmetry from climate change.

Theoretically, we make two key contributions to organisational information processing theory (OIPT) by applying and extending it to the context of green/sustainable supply chain management (GSCM/SSCM). First, we examine how information asymmetry, and specifically its key components of information uncertainty and equivocality, are shaping companies' engagement with supply chain partners. We find that because of information asymmetry companies first need to address information uncertainty before they can start overcoming information equivocality. Our phased account therefore provides a more fine-grained and temporal understanding of how information asymmetry affects engagement with supply chain partners.

Second, our research advances understanding of how information processing of climate change related issues unfolds across supply chains rather than just within individual companies. We show that companies engage with their supply chain partners through a series of iterative and circular information processing steps designed to reduce uncertainty and manage equivocality. This sequence of information processing is largely identical across suppliers, but varies depending on the level of buyer proactivity regarding climate change. Unlike the more linear order identified in intra-organisational

OIPT, we find that organisational information processing in supply chains is characterised by multi-lateral information flows, with important differences across upstream and downstream supply chain partners. Our research therefore expands the theory's established validity for intra-organisational and dyadic phenomena, and contributes also methodologically to emerging research on the wider application of OIPT to inter-organisational supply chain relationships (Busse et al., 2017; Qrunfleh & Tarafdar, 2014).

Empirically, we provide rich insights into the practices of and processes behind climate change engagement across supply chain partners. By using an OIPT perspective, we extend knowledge on the significance of information processing in addressing organisational sustainability outcomes and performance in supply chains. Knowledge of such characteristics will complement extant GSCM literature and can help provide normative advice for practitioners.

Theoretical background

Sustainable supply chain management and supply chain partner engagement

The need for companies to engage with buyers and suppliers as part of sustainable supply chain management has been widely recognised (Longoni & Cagliano, 2015). Conceptual definitions vary with authors distinguishing between green (GSCM) and sustainable supply chain management (SSCM). Notwithstanding unanimity among scholars on the need for greater engagement with the wider supply chain network for the promotion of environmental and social issues, the operationalisation of engagement in research remains diverse suggesting that supply chain engagement is not a uniquely defined concept, but rather acts as an umbrella term for a range of both company and individual level activities. In this paper, our methodological contribution consists of investigating focal companies' climate change engagement with both buyers and suppliers in their supply chain, a yet underdeveloped lens for engagement.

Sarkis (2012) argues that supply chains consist of and span nine overlapping boundaries and five flows that influence how supply chains are managed and perceived, with information being a central issue. Beyond the more traditional aspects of supply chain relationships, therefore, managing information is deemed a critical element in companies' engagement with supply chains. For example, a vast literature provides insights into the aspects, contingencies and variations in information management for the development of sustainable supply chains (Sarkis et al., 2011; Schnitfeld & Busch, 2016; Oelze et al., 2016). Important examples include concerns about purchasing (e.g., sourcing, supplier certification and selection processes), manufacturing (e.g., production design and pollution prevention), and logistics (including reverse logistics and other issues surrounding transportation, inventory management, recycling and facility planning) (Min & Kim, 2012).

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 companies to develop collective responses within their networks (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). Broadly, sustainability-related uncertainties arise from managing specific environmental and ethical concerns across complex and extended supply chains that add to existing task uncertainties of improving supply chain performance (Busse, 2016).

Climate change imposes new and complex challenges that are only beginning to enter academic research questions (Howard-Grenville et al., 2014). More importantly, there is significant information uncertainty on the climate change impact of products and materials, and on the vulnerability to physical and regulatory risks of processes and practices across whole supply chains (Plambeck, 2012). Consequently, companies are faced with significant information asymmetries since critical information may reside with buyers and suppliers. Extant research therefore highlights the need for companies to develop significant information processing capabilities (Galbraith, 1974; 1977) to gather, interpret, and synthesise this information (Tushman & Nadler, 1978).

OIPT and information asymmetry across the supply chain

Organisation information processing theory views business as an interrelated set of problem-solving and decision-making systems performing a variety of tasks (Tuggle & Gerwin, 1980). The effective accomplishment of these tasks creates information processing requirements for organisations and the ways and means they 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; Stock & Tatikonda, 2004).

From an organizational information processing theory perspective, information is central to reducing information asymmetry between exchange partners, which is characterised by information uncertainty and information equivocality (Corner et al., 1994; Rogers et al., 1999) which can lead to conflicts. Uncertainty is defined by a lack of the appropriate amount and quality of information needed to perform tasks (Galbraith, 1974). The more uncertainty an organisation is exposed to, the more information it needs to gather and process to realise a given performance level (Bode et al., 2011). While uncertainty is characterised by an absence of information, equivocality describes messy and ambiguous information situations, leading to potentially conflicting interpretations and presenting a lack of understanding (Daft and Lengel, 1986). Collaborations across supply chain partners are likely to face higher levels of uncertainty and equivocality, given the involvement of two (or more) organizations with different objectives and stakeholders (Premkumar et al., 2005). This makes information processing across supply chain partners even more critical. While most early research applied OIPT to internal organisational issues (Qrunfleh & Tarafdar, 2014), there is an increasing interest also in expanding its application to inter-organisational settings (Busse et al., 2017). In this paper, therefore, we seek to advance our understanding of the role that information processing plays for focal firms in addressing climate change concerns through engagement with supply chain partners.

Method

Research context and data

Following calls for more work on sustainable supply chains using secondary data (Carter & Easton, 2011), in this research we draw on data available from the CDP with a special focus on their Supply Chain Program. Specifically, we explore companies’ responses from the 2014 CDP Supply Chain survey, constituting the most comprehensive dataset on the issues under investigation. This dataset is based on 1,426 focal companies from 63 countries and 10 key industries or 128 subsectors. From our total set of responses, 264 companies make no statement about their engagement strategies. For the remaining 1,162 responses, 508 (36%) declare they do not engage with any of the supply chain partners on climate change; by contrast, 654 (46%) respondents state they do engage on climate change. We extract both quantitative and

qualitative data from survey question CC14.4 about companies' engagement strategies with their supply chains. Given our interest in developing first insights into climate change engagement with supply chain partners, the CDP dataset offers a unique opportunity to pursue academic research questions in the context of a database that is increasingly establishing its legitimacy among business as setting the standard for voluntary climate change disclosures.

Data analysis

The rich dataset was carefully analysed in a multi-stage process to produce a contextually detailed account of the supply chain partner engagement process and its various challenges. The initial analytical process of the total database – comprising more than 128,000 words – was first coded based on key concepts guided by extant literature such as the three core phases of OIPT. The analysis then entered a more iterative stage involving the creation of several meta-code sets, analysis of co-coding and the addition/further refinement of codes as well as cycling back and forth between the dataset and extant literature (Miles and Huberman, 1994). Eventually, both authors engaged in a process of re-arranging emerging codes under the three key stages of OIPT, information gathering, processing and transferring.

Findings

Engagement with supply chain climate change information asymmetry

Turning our attention to those 654 companies that do engage with their supply chain partners on climate change, we are specifically interested in the underlying information asymmetries shaping the engagement process. We find that companies primarily engage their supply chain partners to measure their scope 3 GHG emissions. Essentially, engagement is about determining and understanding the exact level of GHG emissions in the supply chain, whether they relate to upstream emissions, embedded in the production and sourcing of materials, commodities, parts or services, or downstream in the distribution of products and services, employee travel as well as overall life-cycle impacts of products. Information asymmetry here primarily stems from information uncertainty and indicates that without requesting such emissions data from buyers and suppliers, companies cannot know the scale of their scope 3 emissions. While knowledge of such data is not currently a legal requirement, growing pressure from investors, insurers, customers and non-governmental organisations increases managerial perceptions that ignorance can no longer be treated as bliss.

Beyond scope 3 emissions data, information asymmetry derives from a variety of strategic, operational, innovation and stakeholder management issues. Some companies refer to the need for obtaining wider sustainability performance data and information, in other cases they highlight companies' determination to implement rigorous quality and procurement policies and procedures. These expectations need to be communicated with suppliers and demand that information is shared, which is then evaluated during supplier selection processes. In other cases, companies seek to affect stakeholder perceptions and broaden organisation-wide awareness of sustainability issues and concerns. The main difference, however, is that once scope 3 emissions data have been obtained, companies increasingly need to address information equivocality. Specifically, while initial engagement efforts are driven by a desire to overcome the absence of key emissions data, further engagement seeks to address messiness across a multitude of information sources and flows. If information uncertainty seeks to fill a gap in fundamental information availability, information equivocality expresses the ensuing need for data order and usefulness.

In our context of climate change engagement, we find that, consistent with its conceptual origins, information asymmetry exists because of information uncertainty and equivocality. Uncertainty and equivocality provide a more fine-grained understanding of the overarching information asymmetry problems companies are facing. Moreover, we see evidence of a sequence emerging where companies first seek to overcome information uncertainty before they can address information equivocality with their supply chain partners. While this staged process can occur within the same company, it is likely to be more pronounced among companies that have only recently decided to explore their supply chain climate change challenges and where thus overcoming information uncertainty forms a greater priority than equivocality.

The supply chain climate change engagement process

Given the presence of climate change related information asymmetry, next we examined how companies conduct their engagement with different supply chain partners. We find again that there are overlaps in the engagement processes between suppliers and buyers which reflect similar actions and processes. More importantly, however, using the OIPT lens enables clear identification of the wider processes involved in gathering, processing and transferring information across the supply chain. Typically, when viewed from the perspective of focal companies, climate change engagement proceeds through a series of steps which tend to be similar for suppliers but which also show important variation across different types of buyers. This sequence is characterised by requests for, collection, sense-making and dissemination of GHG emissions data and other climate change and sustainability-related information. Table 1 summarises the key characteristics of the activities occurring in each of the three OIPT categories.

Table 1 – How do companies engage with their supply chain partners on climate change?

	Suppliers	Buyers
Information Gathering	<u>Structured, formalised</u> <i>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.).</i>	<u>Informal, exploratory</u> <i>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, we 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 organizing 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).</i>
Information Processing	<u>Performance oriented</u> <i>For all contracts with significant spend, our procurement processes require that sourcing managers complete a business case addressing supplier risk including the use of ESG risk factors as appropriate to identify suppliers with high economic, environmental and social risks. Delta supplier risk summaries are presented by risk (economic, environmental social), business unit,</i>	<u>Innovation oriented</u> <i>For customers we are in daily engagement via our Compliance teams around the world and strategic engagement with Key Strategic Accounts via our Vice President Sustainability Partnerships. Additionally, our innovations team works with our customers to help reduce their product footprint by developing new more sustainable fragrances and flavours (Senior Vice President, Global Quality, Health, Safety & Environment; Firmenich SA).</i>

	<i>count of suppliers and by spend</i> (Managing Director Safety, Health and Environment; Delta Airlines).	
Information Transferring	<u>Directive, continuous improvement oriented</u> <i>Arcadis works directly with its office supply companies to offer more eco-friendly alternatives and has encouraged paper suppliers to provide paper with high post-consumer waste recycled content and worked with other office supply companies to recycle toner cartridges and electronic equipment</i> (Global Sustainability Coordinator; Arcadis).	<u>Proactive buyers: collaborative, consultative, direct</u> <i>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</i> (Senior Vice President, Sustainability and Technology Development; Metso). <u>Reactive buyers: responsive, advisory, indirect</u> <i>By having customers utilize 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</i> (Global Environment Center; Canon Inc.).

Discussion

Our research has shown that while for some companies a combination of external and internal factors continues to create significant barriers for engagement with supply chain partners, for those that do engage this process is characterised by heterogeneity across global companies suggesting the concept of engagement still means relatively different things to different companies (Bonilla et al., 2015; Huang et al., 2016; Chen, 2017). Our study focuses on an organisation-centric conceptualisation whereby companies engage with suppliers and buyers to overcome information asymmetry across their supply chain, and in the case of selecting suppliers, task uncertainty surrounding the effects of climate change on supply chain performance (Busse, 2016).

Companies' focal concern in terms of information asymmetry relates to overcoming uncertainty through the acquisition of clear scope 3 GHG emissions data (Busse, 2016; Busse et al., 2017). While some companies appear to have worked on their data collection for several years, many others are only just beginning to request these data from their suppliers and buyers. As the process of voluntary carbon disclosure – particularly for scope 1 and 2 emissions – becomes increasingly widespread and institutionalised, companies are only at the beginning of a journey towards accounting for their broader, indirect emissions levels. Developing a greater understanding of their corporate and product carbon footprints requires detailed life-cycle assessments including data from a variety of supply chain partners to obtain the right quantity and quality of information (Galbraith, 1974; Premkumar et al., 2005). Once information uncertainty is addressed, companies can turn their attention to broader questions surrounding information equivocality. Specifically, how to impose order and usefulness are important but comparatively secondary concerns. This suggests that information asymmetry comprises temporally different elements whereby priority is given to uncertainty over equivocality.

Dynamics of the supply chain engagement process: An OIPT perspective

Our findings also show that companies engage with their supply chain partners through a series of iterative and circular information processing steps designed to reduce

uncertainty and manage equivocality. We elaborate extant literature on OIPT and adopt a unique supply chain unit of analysis. This sequence of information processing is largely identical across suppliers, but varies depending on the level of buyer proactivity regarding climate change. Unlike the more linear sequence identified in intra-organisational OIPT, we find that organisational information processing in supply chains is characterised by multi-lateral information flows, with important differences across upstream supply chain partners.

More specifically, engagement with supply chain partners appears to proceed through the key stages summarised in organisational information processing theory (Tuggle & Gerwin, 1980) whereby GHG emissions data and other information are gathered, processed and transferred. We find, however, that, when viewed from the perspective of the focal company, a sequence of information flows and utilisation emerges which is much more iterative and cyclical. Based on our findings, we distinguish between seven typical phases that each relate to specific information asymmetries discussed above (figure 1).

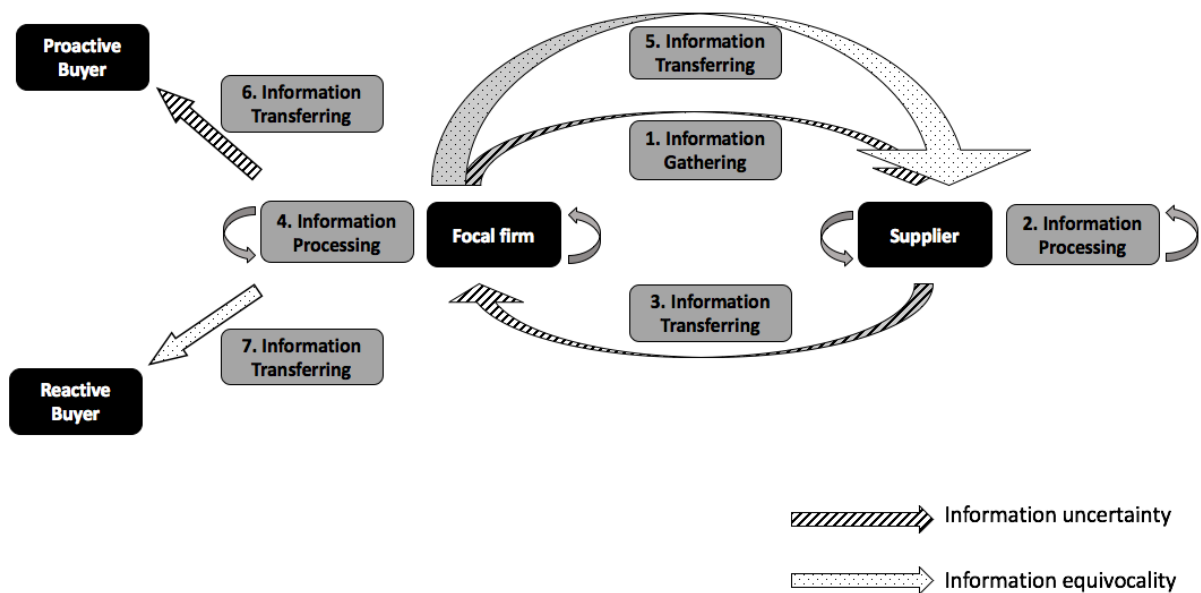


Figure 1 –Climate change engagement with supply chain partners (source: authors)

Generally, we note that information processing can be initiated by different supply chain partners: the surveyed focal companies themselves, suppliers, buyers, or any combination thereof. In other words, information processing does not need to be the result of a concerted effort of end-customer facing buyers to push information requests up the supply chain. Instead, we find evidence that information gathering can be initiated by companies up and down the supply chain. Reasons for such behaviour are likely to be manifold and deserve rigorous analysis in future research. Our research therefore provides new insights into the validity and application of organisation information processing theory in supply chain settings (Busse et al., 2017; Qrunfleh & Tarafdar, 2014; Touboulic & Walker, 2015).

Moreover, we find that while information pathways with suppliers tend to be similar, information transfer with buyers differ dependent on the level of climate change proactivity expressed by customers. Specifically, information transferring with buyers that are already themselves interested in mitigating their own carbon footprints and climate risks is characterised by information exchanges that seek to develop direct performance improvements through active collaboration and consultation on new

products and projects. By contrast, in the case of buyers without expressed concerns for climate change companies aim to create at least performance improvements indirectly through the sale of products and services that lower their buyers' carbon footprints. In this case, companies rely on responsive and advisory approaches to highlight the environmental benefits of their products and services and to increase buyer awareness. Our research therefore also aligns with extant findings on the impact of different buyer-supplier relationships by demonstrating how companies' level of pro-activeness shapes sustainable supply chain practices (Grosvold et al., 2014).

Overall, our research suggests that information processing in the context of climate change engagement with supply chain partners is not a linear process, but rather characterised by multiple information pathways. These iterative cycles are often overlapping and must therefore be drawn across whole supply chains, rather than being purely centred on a focal company. Starting points for the initiation of the information exchange may vary across different supply chain partners, thus explaining the circularity of our proposed process model.

Finally, our paper has limitations including self-selection bias and the cross-sectional nature of our data that offer future research opportunities for evaluation and extension of our findings.

Conclusion

There is growing evidence to suggest that most companies' corporate carbon footprints are outweighed by their impacts across supply chain partners. Climate change poses significant new information asymmetries in form of physical and regulatory challenges and opportunities for businesses. Our research contributes to both theoretical and applied knowledge on the significance of inter-organisational information processing in addressing important sustainability outcomes and performance.

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