ENVIRONMENTAL SCIENCE & POLICY 45 (2015) 79–91

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/envsci

# Effect of company size on potential for REACH compliance and selection of safer chemicals

*Caroline E. Scruggs* [a,b,*], *Leonard Ortolano* [c], *Michael P. Wilson* [d], *Megan R. Schwarzman* [d]

[a] *Emmett Interdisciplinary Program in Environment and Resources, Stanford University, Stanford, CA, USA*
[b] *Community and Regional Planning Program, University of New Mexico, Albuquerque, NM, USA*
[c] *Department of Civil and Environmental Engineering, Stanford University, Stanford, CA, USA*
[d] *Center for Occupational and Environmental Health, School of Public Health, University of California, Berkeley, CA, USA*

ARTICLE INFO

*Article history:*
Available online 28 October 2014

*Keywords:*
REACH
SMEs
Supply chains
Hazardous chemicals
Human and environmental health
Chemical regulation

ABSTRACT

REACH represents a global paradigm shift in chemical regulation, and it has introduced a new, complex regulatory process to which chemical producers and users throughout supply chains must adapt. This paper presents results of survey research to illustrate whether and how the business members of a large Scandinavian trade organization understand and comply with REACH. It also explores how these businesses obtain information about the chemicals they use in their products, and whether they feel that the information they have is sufficient to meet their needs. In addition, the paper describes how business size affects these issues. The survey results show that, at the time of this study, many small and medium-sized enterprises (SMEs) and a number of larger firms were unaware of REACH. Survey results consistently showed that the size of a company is an important factor in both understanding of and compliance with REACH, with respondents from large firms having a better grasp of REACH and its implications than smaller companies. An effective implementation of REACH will require, at the most basic level, more attention to educating EU companies, especially smaller ones, on how and why REACH applies to them. Survey respondents who were aware of REACH and its applicability to their firms also reported the types of support they needed in order to better understand and comply with the regulation, with nearly 40% of all respondents expressing a need for help with data systems or tools to manage REACH requirements and communicate REACH requirements to suppliers and customers. Many companies reported needing more information from their suppliers on chemical composition and related health impacts of materials and products. Ensuring that this information is readily available throughout supply chains is essential to reducing the negative impacts of chemicals and products on human health and the environment.



* *Corresponding author at*: Community and Regional Planning Program, School of Architecture and Planning, University of New Mexico, 2401 Central Ave. NE, MSC04 2530, Albuquerque, NM 87131-0001, USA. Tel.: +1 505 277 2283.
E-mail address: cscruggs@unm.edu (C.E. Scruggs).

http://dx.doi.org/10.1016/j.envsci.2014.10.001
1462-9011/

## 1. Introduction

Synthetic chemicals are essential to most industrial processes and formulated products, yet it continues to be difficult for product manufacturers to obtain useful information about chemical hazards and the risks associated with chemicals' various applications. In addition, with today's complex and globally dispersed supply chains, the vast number of businesses and other actors that purchase components and finished products find it challenging – if not impossible – to know the *identity* of chemicals that make up those products. It is common for businesses not to know which chemicals compose finished products or the hazards and risks associated with those chemicals (Scruggs and Ortolano, 2011).

In 2006, the European Union passed sweeping new legislation to control the use of hazardous chemicals: the Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH). The law applies to most chemicals (both new and existing) produced in or imported into the EU in quantities above 1 tonne/producer/year, as well as to chemical mixtures, and to finished products (known as ''articles'' in REACH). Full or partial exemptions exist for medicinal products, food additives, cosmetics, polymers, and radioactive substances, as well as for substances classified as waste, chemical intermediates, unaltered minerals, ores, oil, gas and coal, chemicals used exclusively for research, or those that are solely transported through the EU (REACH, 2006; UK REACH Competent Authority, 2012). The regulation became effective in 2007, with requirements phased in through 2018. In some respects, REACH has placed the burden of proof on chemical producers, who must provide basic information about their products to the European Chemicals Agency (ECHA) before placing them on the European market, a requirement dubbed ''no data, no market''. The data gathering and information reporting requirements are unprecedented worldwide, and those requirements increase with production volume and for chemicals designated as of higher concern (based on their potential health or environmental effects) (REACH, 2006). Since REACH extends to European imports, it has effectively raised chemical reporting standards internationally, and several nations around the world are considering, or are in the process of, enacting similar legislation.

In many ways, REACH represents a global paradigm shift in chemical regulation, and it has introduced a new, complex regulatory process to which chemical producers and users throughout supply chains must adapt. The European Commission recently expressed concern that small and medium-sized enterprises (SMEs) are not keeping pace with REACH and may need additional accommodation in order to meet the regulation's requirements (European Commission, 2013a).

This paper presents results of survey research to illustrate whether and how the business members of a large Scandinavian trade organization understand and comply with REACH. It also explores how these businesses obtain information about the chemicals they use in their products, and whether they feel that the information they have is sufficient to meet their needs. In addition, the paper describes how business size affects these issues.

## 2. Background

### 2.1. *The REACH regulation*

In an effort to improve management and reduce the use of hazardous chemicals, REACH requires that: (1) chemical producers provide basic information on the identity and hazardous properties of their products as a condition of placing them on the market, with higher data requirements for higher production-volume chemicals; (2) suppliers of articles containing chemicals placed on the Candidate List for designation as Substances of Very High Concern (SVHCs) communicate sufficient information throughout the supply chain to insure safe use of their products; and (3) producers of SVHCs that progress to Annex XIV (the Authorization List) must immediately cease production or obtain use-specific authorization for continued use (Schwarzman and Wilson, 2009; REACH, 2006). Theoretically, for EU firms and those exporting to the EU, every actor in consumer product supply chains has obligations under REACH due to its information provision for all eligible chemicals and communication requirements governing chemicals on the Candidate List.

Five years after REACH entered into force, the European Commission performed a review to determine if the regulation was on track toward achieving its goals of protecting human health and the environment from hazardous chemicals. In general, the Commission found that REACH has improved the safety of chemical use in the EU; however, it also identified shortcomings. Significant among these were the need for improved quality of chemicals data submitted by industry and increased support for SMEs to meet the regulation's requirements (European Commission, 2013a).

The Commission expressed particular concern about SMEs after poll results showed that SMEs were finding REACH compliance to be extraordinarily difficult and burdensome compared to other EU regulations (European Commission, 2013b). Regarding SMEs, the Commission stated:

> The registration has impacted downstream users [of chemicals] who are, in general, less aware of their role in REACH. Their situation has to be monitored further. . .. Given that the great majority of downstream users are SMEs, they should be a focus in improving the implementation of REACH [*sic*]. It is *believed* that a significant number of SMEs are unaware about their role and obligations related to REACH, and those who are aware, may have a false impression of the exact scope of their duties, which calls for further action to support and guide these types of companies (European Commission, 2013a, emphasis added).

Based on these concerns, the Commission plans to ''explore ways to reduce the financial impact'' of REACH on SMEs. Possibilities include reducing SMEs' chemical registration fees and administrative burdens as well as improving transparency, communication, and cost sharing with regard to REACH's data requirements.[1] The Commission has called on Member States and ECHA to do more to support SMEs in

[1] Fee reductions for SMEs occurred in March 2013 (Gubbels et al., 2013).

meeting their REACH obligations (European Commission, 2013a).

### 2.2. Motivation for this research

*Previous case studies*. In 2009, we conducted an interview-based study with environmental managers from a diverse set of multinational consumer product companies; seventeen European companies and three U.S. companies met the inclusion criteria. The 20 companies were identified and selected on the basis of their records as leaders in chemicals management by several non-profit organizations and government agencies whose work focused on protecting health and the environment from hazardous chemicals. The interviews provided insights into gaps in chemical regulations and the information and tools companies need to fill those gaps in order to produce safer products (Scruggs and Ortolano, 2011; Scruggs, 2013).

The interviewees highlighted specific challenges that their companies faced in obtaining chemicals-related information. Most notably, information on chemical identity, hazards, and uses was not routinely communicated in supply chains, such that companies were forced to use their own resources to seek out that information from myriad sources, ranging from government publications to online searches. Most of these sources were highly variable in both the scope and quality of the data they provided. Notwithstanding these efforts by the companies, in the end the needed information often was simply not available.[2] Reflecting the minimal chemical regulations in effect prior to REACH, most of these proactive companies developed their own Restricted Substance Lists (RSLs) of chemicals that they prohibited their suppliers from using (Scruggs and Ortolano, 2011; Scruggs, 2013).

Interviewees described the sheer complexity and depth of their companies' supply chains, which typically extended around the globe. Even if basic chemicals-related information was provided upstream in a supply chain, it was often lost as products and materials made their way downstream. Interviewees were hopeful that REACH would eventually improve chemicals-related information flow in supply chains and lead to restrictions on the use of hazardous chemicals; this would simplify their operations and "level the playing field" with their competitors who did not devote resources to voluntary chemicals management.

*Concerns about SMEs' challenges*. While the focus of the previous interviews was not on company understanding and compliance with REACH, many of the interviewees chose to discuss these issues in their responses. None of the interviewees had concerns about their own company's compliance with REACH, but interviewees who worked closely with SMEs, particularly those from large retailers that routinely contracted with SMEs to create their store-brand products, expressed concerns about these enterprises. They believed that the SMEs in their supply chains would have difficulty complying with REACH's requirements for provision of chemical-related data and communication in the supply chain. For example, the Director of Chemicals Management at a major retailer of consumer goods based in the EU said that he worked to ensure REACH compliance for both his company and the many SMEs with which his company contracted. He felt that SMEs were not adequately represented in REACH-related negotiations, and as a result, the regulation was not designed to account for their needs. The interviewee described what his company was doing to help the SMEs in its supply chain understand and comply with REACH:

> We spend a lot of energy trying to "teach" REACH to suppliers. My suppliers are mainly in Europe, and we went to each company – the majority of them – to audit them, to train them, and to make sure that they understood the text [of REACH]. We prepared their IT systems properly, so that they can provide us with the information we ask for anyway. For the SMEs, it was difficult for them to follow a text of more than 1,000 pages – it was very difficult for them to follow the debate and be prepared. . .it's kind of a social responsibility as well – to make sure [SMEs] stay "legal" to work with us and [to] keep them from going out of business.

The concerns about SMEs raised in our case study interviews were borne out in the results of the later European Commission (2013a) report, noted above, on the problems SMEs face in complying with REACH.

*Follow-up survey research*. Our 20 case study interviews were conducted with companies that were selected for their demonstrated leadership in chemicals management. As a follow up to that study, and to further examine some of the concerns about SMEs described above, we conducted a survey to explore how well a more general population of companies understands the REACH regulation and how they obtain and use chemical information. We also sought to investigate what actions, if any, companies took to obtain additional information when they were not satisfied with the amount of chemicals-related information available through their supply chains. Finally, the survey explored the extent to which SMEs were prepared to comply with REACH, and, assuming SMEs would face difficulties complying, what types of assistance they would need to become compliant.

The answers to these questions may provide the European Commission and ECHA with additional information about companies' awareness of their roles and obligations related to REACH, as well as insights into how to support REACH compliance and the creation of safer products in all companies, including SMEs. Given the ubiquity of SMEs, the findings may also be useful to policymakers in countries where chemicals policy reform is being crafted or debated.

### 2.3. Other studies concerning REACH compliance and company size

This section summarizes results of five studies related to REACH understanding and compliance.[3] REACH includes

[2] In some cases, the information was protected by trade secrets. In others, different information sources provided conflicting data, and in a number of cases, the required information was nonexistent in the public domain.

[3] Some of these studies also emphasized findings related to Substance Information Exchange Forum (SIEF) management and costs, but that information is not highlighted here because it is outside the scope of this paper.

three registration deadlines (in 2010, 2013, and 2018), and the number of dossiers submitted by SMEs is expected to increase with each subsequent deadline. Except for the ECHA (2014) study described below, all studies summarized here were conducted prior to the end of the 2013 registration period.

A 2005 study examined the likely impacts of REACH on the European textiles industry, which is comprised primarily of SMEs. Among the many findings, the study concluded that textile chemical suppliers will likely rationalize their portfolios of chemicals in order to minimize REACH-related costs; companies were concerned about the lack of information and communication in their supply chains and how this will affect their ability to comply with REACH's information provision requirements; and textile finishers were concerned about their limited resources to "cope with the costs, administrative requirements, and required adaptations induced by REACH." Further, "the human capacity in terms of man power and expertise required to deal with the downstream user obligations in REACH is clearly limited" within SMEs, so these businesses will likely be reliant on external consultants for compliance (Sedlak and Pellizari, 2005).

In 2012, the UK Manufacturers' Organization, EEF, conducted a survey to better understand its members' awareness, activity, and perceptions regarding REACH. The survey demonstrated that many respondents were not aware of their REACH-related obligations (i.e., 20% of manufacturers did not think REACH applied to them and 30% did not think it was important to their business); the smallest companies had the least awareness of REACH (i.e., only about one-third of the small manufacturers were aware that REACH impacted them, whereas almost two-thirds of the large manufacturers were aware); and companies of all sizes that were aware of REACH's impact were making changes to their products and processes (e.g., substituting substances of very high concern, redesigning processes or products, etc.). REACH awareness varied by industry sector, with the chemicals sector having the highest level of awareness. In addition, small companies were found "unlikely to have the expertise and experience" needed to comply with many REACH requirements, and many manufacturers (about half of small and large companies and a third of medium companies) had hired a staff member dedicated to managing REACH compliance (EEF, 2012).

An extensive study, including interviews and a survey, was conducted in 2013 to understand the impact of REACH on Dutch SMEs. Even though the sample selection design screened out a number of sectors that were assumed to be less affected by REACH, the study found that "an unexpectedly high percentage of companies in industry and trade" did not think that REACH applied to them (i.e., 25% of SMEs in the chemistry and petro chemistry sectors and 79% from other industry sectors). In addition, 70–80% of downstream users of chemicals claimed to know nothing about REACH. Of the Dutch SMEs that believed REACH applied to their businesses, 23% of respondents reported adapting company processes in reaction to REACH, and 35% indicated that they were strategically eliminating certain substances from their products. Over half of respondents impacted by REACH reported cost increases due to increased staff time dedicated to REACH-related activities, purchase of needed software and/or data management systems, and hiring of consultants. Many of the reported compliance problems and additional costs were related to "insufficient knowledge or available information" due to poor communication between adjacent actors in the supply chain (Boog et al., 2013).

A 2013 investigation for the European Parliament used a literature review and interviews with a dozen SMEs and industry association representatives in the chemicals sector to examine the consequences of REACH for SMEs (Pelkmans et al., 2013; Gubbels et al., 2013). The conclusions of this report echoed a number of the SME-related findings from the studies described above: SMEs may rationalize their portfolios in reaction to REACH, or suffer as needed chemicals are taken off the market as a result of others' rationalizations; they often do not have adequate dedicated internal human resources to manage their REACH responsibilities; they are hiring external consultants to help them meet their REACH obligations at substantial cost; and they need IT solutions to help them manage the flow of information in their supply chains. Also, the authors predicted that downstream users of chemicals might move certain operations to outside the EU in order to lessen REACH's impact (Pelkmans et al., 2013; Gubbels et al., 2013).

Following the studies described above, ECHA conducted a survey in 2013 to better understand how to improve REACH-related assistance and support for SMEs. ECHA's survey targeted SMEs that were first-time registrants for the 2013 deadline (i.e., the second registration period) in order to learn how to improve the dossier submission process in time for the third wave of registrations, in which many SMEs are predicted to participate. Most survey respondents were manufacturers (39%) or importers (35%) of chemicals. Among ECHA's findings, SMEs learned about their REACH-related obligations primarily from their industry and trade organizations (44%) and through publications from ECHA and others (36%), and many SMEs contracted with consultants to handle various aspects of their REACH obligations. In addition, SME respondents suggested that ECHA could improve the registration experience by providing practical examples, improving guidance documents, and enhancing IT tools (European Chemicals Agency, 2014).

**Table 1 – Details of stratified sample for industry organization survey.[a]**

| Company size | Number of companies included in sample | Percent of Industry organization companies in each size category included in survey sample[b] |
|---|---|---|
| Small (1–49 employees) | 366 | 15 |
| Medium (50–249 employees) | 132 | 20 |
| Large (250 to >10,000 employees) | 158 | 100 |

[a] The distribution of company size within the sample was selected for consistency with other studies conducted by the trade organization, and thus included an oversampling of small companies.

[b] Percentages are approximate to protect the trade organization's identity.

These studies were conducted with a wide variety of businesses in a range of sectors throughout the EU. Though the studies' authors asked different research questions and used different methodologies to answer those questions, many common themes emerged in the findings. Taken together, the results offer important insights into SMEs' experiences with REACH, and we compare the results with our survey findings in Section 5.

## 3. Methods

We designed a survey instrument based on knowledge gained from our previous case study interviews as well as information gained at REACH-related conferences and meetings in the EU. We worked with a staff member of a large Scandinavian industry organization[4] to administer the survey to the organization's members. The staff member was supportive of REACH and its expected benefits for health and the environment, and the focus of his job was to provide workshops and other assistance to help member companies understand and comply with the regulation. The staff member used his experience in working with the organization's member companies to add options to our response choice sets in a few instances; for instance, our survey included the question: ''Has your company done any of the following in response to REACH?'', and the staff member suggested that we add a response choice about engaging in Ecodesign in order to use less hazardous substances, materials, or processes. The industry organization's member companies were all part of consumer product supply chains, and all member companies were affected by REACH – this was why the organization had a staff member dedicated to helping companies understand how the regulation affected them.

We recruited ten volunteers to pre-test an electronic version of the survey to ensure that the questions were clearly worded, all important or relevant issues and/or response options were included, the electronic format was user-friendly, and the survey could be completed in a timely manner. Four of these volunteers were from non-profit organizations in the EU that interacted with business and industry on chemical-related issues, and six were business members of the trade organization. We revised the survey instrument based on feedback from the pre-testers. The final survey contained 22 questions, about half of which were constructed as ''yes/no/I don't know'' type questions and half as multiple choice. The survey questions included options such as ''I don't know'' and ''Other'' so that respondents would not feel forced into selecting a response choice that was not accurate.

For the survey sample, the industry organization members were divided into three categories based on number of employees: small (1–49 employees), medium (50–249 employees), and large (250 to >10,000 employees).[5] From these categories, we selected a stratified sample. The ''small'' and ''medium'' categories contained thousands of companies, and a simple random sample was taken of each group for inclusion in the survey. The ''large'' category contained only 158 companies; all of these companies were included in the survey sample. In all, 656 companies were included in the survey sample.[6] Details of the stratified sample are shown in Table 1.

The industry organization provided the email address for the person responsible for chemicals management at each member company included in the sample. In December 2010 through January 2011, we sent a letter of introduction with a link to the electronic survey by email to the chemicals management representative at each company. Respondents had approximately six weeks to respond. The survey was administered using SurveyMonkey®.

## 4. Results

Of the 656 emails sent to companies in the sample, 612 (93%) were received successfully by a company representative; 44 emails were returned. We received 220 (36%) responses; of these, nine respondents did not fully complete the survey and six opted out, resulting in a total of 205 (33%) complete responses. Table 2 shows the distribution of the 205 survey respondents among the groups.

A survey question asked, ''What is your company's role in the supply chain?'' Respondents could choose from any (or all) of several roles. As shown in Fig. 1, most of the respondents reported that their companies produced components, assembled products, and/or sold finished goods to other businesses. A minority of companies produced chemicals or materials or sold finished goods to consumers.

The key survey results are presented below in two sections: the first concerns companies' self-reported understanding of and compliance with REACH, and the second provides the views of survey respondents regarding access to and sufficiency of chemicals-related information in supply chains. In both sections, data were disaggregated by company size: small, medium and large.

### 4.1. *REACH understanding and compliance*

Respondents were asked a series of questions to gauge their understanding of and compliance with REACH. Fig. 2 shows respondents' answers to the following two questions: (1) ''Are

[4] The organization specialized in assisting technology companies with legal, labor, environment, and other issues to enhance their competitiveness. The member companies were involved in production of technological products and components, such as fabricated metal products; computer, electronic, and optical components; machinery; and transportation equipment. Because the survey was conducted under the condition of anonymity, the industry organization's name is not specified here.

[5] EU law defines a ''small'' enterprise to be one that has fewer than 50 employees and a turnover or balance sheet total of less than or equal to €10M. It defines a ''medium-sized'' enterprise to be one that has fewer than 250 employees and either a turnover of less than or equal to €50M or a balance sheet total of less than or equal to €43M (European Commission, 2014). We did not have access to companies' financial information and therefore based our size categories on number of employees only.

[6] The European industry association that helped facilitate the survey plans to repeat the survey every few years to track changes in chemicals-related information flow and REACH compliance.

**Table 2 – Survey responses by company size (total complete responses = 205).**

| Company size | Number of companies responding | Percent of total 205 respondents |
|---|---|---|
| Small (1–49 employees) | 91 | 44.4 |
| Medium (50–249 employees) | 47 | 22.9 |
| Large (250 to >10,000 employees) | 67 | 32.7 |

you aware of REACH, the EU's legislation on chemicals?'' and (2) ''Do you consider your company to be a user of chemicals or materials/components that are regulated by REACH?'' Company awareness of REACH increased notably with company size: respondents reporting awareness increases from about 60% of small firms to nearly 100% of larger firms. Fig. 2 also demonstrates that 25%, 40%, and 79% of small, medium, and large companies, respectively, report that REACH applies to their operations and products. Results for respondents who did not report that REACH applied to their work are not included in descriptions of the survey responses for Figs. 3–11 below.

Respondents who indicated that they believed REACH applied to their company were asked, ''Do you think your company understands its obligations under REACH?'' The number of companies with a full understanding of their REACH obligations increased substantially with company size, with 17% of small companies, 42% of medium-sized companies, and 62% of larger companies reporting that they ''felt fully confident'' of their understanding (see Fig. 3). The number of companies that reported not understanding their obligations was highest in the small and medium size companies, at 13% and 9%, respectively, while no large companies reported such lack of understanding or uncertainty. Across all size categories, a large number of firms reported only a ''partial'' understanding of their REACH obligations.

For those respondents who reported understanding their REACH obligations either completely or partially, we asked, ''Do you think your company is meeting its REACH obligations?'' (e.g., registering the chemical substances they were producing and communicating with adjacent actors in the supply chain about chemical use). Fig. 4 suggests that not all companies believed they were meeting REACH's regulatory requirements. Again, company size played a role in compliance, with 17%, 12%, and 6% of small, medium, and large companies, respectively, reporting that they believed their companies were *out* of compliance with their regulatory obligations.

We anticipated that some companies would report having difficulty complying with REACH; we therefore asked survey recipients, ''What information or assistance do you think would be helpful to your company for it to better understand and meet its REACH obligations?'' They were asked whether any (or all) of the following would be useful to their companies:

- data systems or tools to manage REACH requirements;
- legal support to understand and interpret REACH;
- support to communicate REACH requirements to suppliers and customers; and/or
- internal coordinators to disseminate knowledge about REACH.

Surprisingly, the large companies, which as a group reported the highest degree of confidence in their understanding of – and compliance with – REACH were more likely to report an interest in technical assistance, compared to small companies, which reported the least understanding and compliance with REACH, but were least likely to report an interest in receiving assistance (see Fig. 5). This might be due to the fact that larger companies have a greater number of products and complex, often globally distributed, supply chains. Alternatively, it might reflect the ignorance of REACH requirements among smaller firms, which then express less need for support. Concerning support for communication of REACH requirements to suppliers and customers, over 60% of medium-sized companies reported a need for technical assistance, compared to less than 40% of small companies and less than 50% of large companies. It is not evident why the need for communication assistance was so much higher for medium-sized companies; one possibility is that medium-sized companies' supply chains and product offerings are complex and large enough that the companies needed

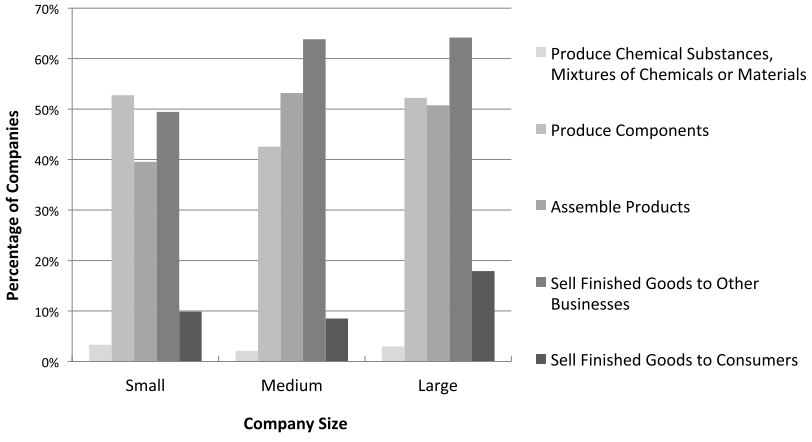


**Fig. 1 – Company role in supply chain.**

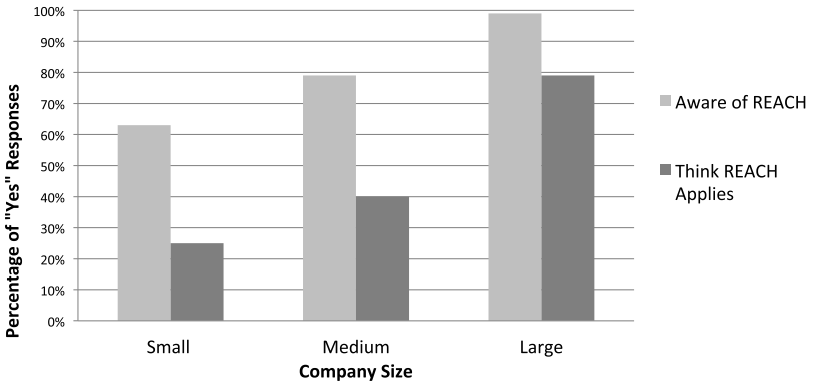


**Fig. 2 – Company awareness of REACH and applicability to operations and products.**

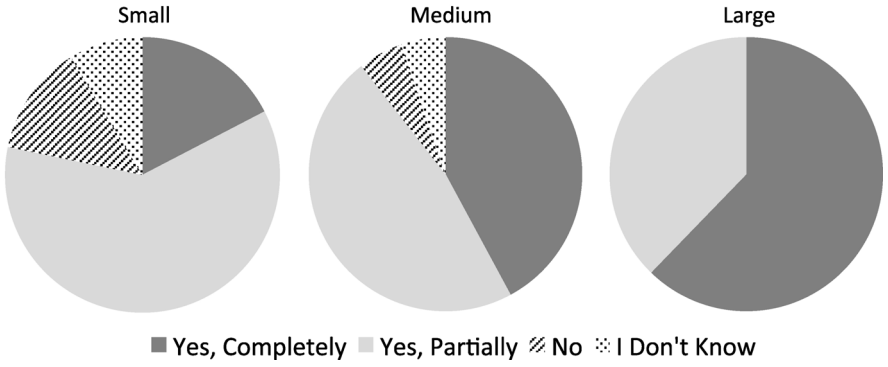


**Fig. 3 – Companies' understanding of their REACH obligations (for companies that think REACH applies).**

additional communication support, but unlike larger companies, they lacked the resources to dedicate staff to this task.

When REACH first went into effect, industry actors and observers expected that it would trigger voluntary responses among European companies.[7] This expectation informed a question that we posed to survey respondents regarding voluntary changes to their products or operations prompted by REACH. We asked, "Has your company done any of the following in response to REACH?" Respondents were asked to select any (or all) of the following actions:

- removing certain substances from materials, components, or products because the substances might be hazardous;
- removing certain substances from materials, components, or products to avoid applying for authorization under REACH to use the substances;
- engaging in "Ecodesign[8]" of products and/or trying to use less hazardous substances, materials, or processes;
- hiring consultants for advice on how to make processes or products less risky; and/or
- moving production outside of the EU.

As shown in Fig. 6, the large companies reported the most actions prompted by REACH, leading in all types of voluntary changes, especially removal of hazardous substances. Product redesign was the most frequently reported means of accomplishing this goal. This is not surprising given the larger companies' greater reported understanding of, and compliance with, REACH, combined with the resources they would likely have available to commit to voluntary chemicals management. Smaller companies reported making fewer proactive changes. For all companies, the most frequently reported voluntary actions involved minimizing use of hazardous chemicals in their materials and processes. Interestingly, none of the companies reported moving production outside of the EU to circumvent some aspects of REACH (articles imported into the EU are subject to less strict standards compared to articles produced and assembled in the EU).

### 4.2. *Information access, flow, and sufficiency*

To assess companies' access to chemicals-related information, survey respondents were asked, "Do you rely primarily

[7] This sentence is based on the first author's experience at REACH-related conferences and industry meetings and conversations with numerous industry, government, and nonprofit representatives between 2006 and 2011.

[8] Ecodesign is a term used in European industry to mean that all environmental impacts of a product during its lifecycle are considered and minimized during the product's design stage. For more on Ecodesign, see European Commission (2012).

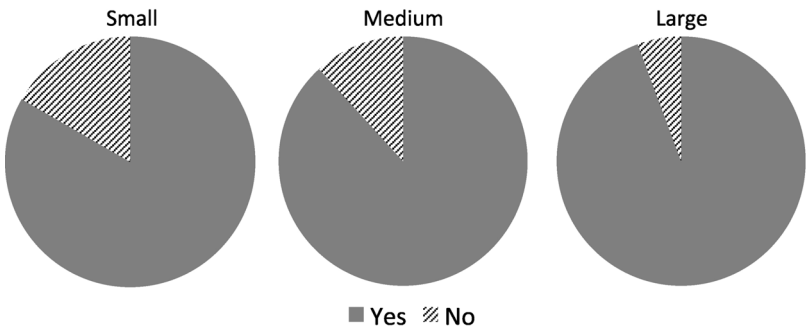


**Fig. 4 – Percentage of companies' meeting their REACH obligations (for companies that completely or partially understand of their REACH obligations).**

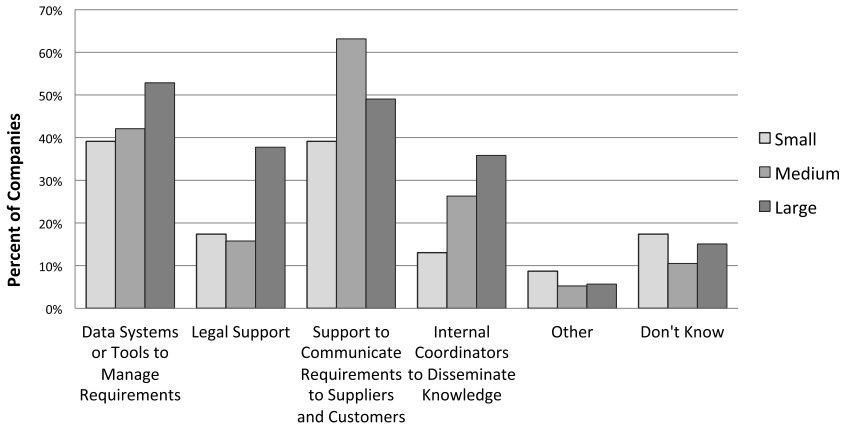


**Fig. 5 – Needed assistance for REACH understanding and compliance.**

on your suppliers for information about chemical substances in the materials and components they supply to you?'' About 90% of all companies, regardless of size, responded affirmatively to this question. A follow up question asked, ''Do you think your company receives information sufficient to meet its needs about the chemical substances in materials and components supplied by others?'' As shown in Fig. 7, over 40% of companies in each size category found that the information received from suppliers was only sufficient in *some* cases. Fewer than 40% of companies from each size category reported that the information was sufficient, and just 23% of large firms reported receiving sufficient information. This outcome may again reflect the complexity of larger firms' supply chains, or their greater awareness compared to smaller companies of what they need to know, relative to the information they have available.

To gauge how companies are seeking chemical information, respondents were asked, ''If your company investigates the chemical substances present in its materials, components, or products, what sources of information does it find useful?'' Fig. 8 illustrates the information sources used by companies. The Internet was the most commonly consulted source of information on hazardous substances for all company sizes. Indeed, it was the source of choice for small

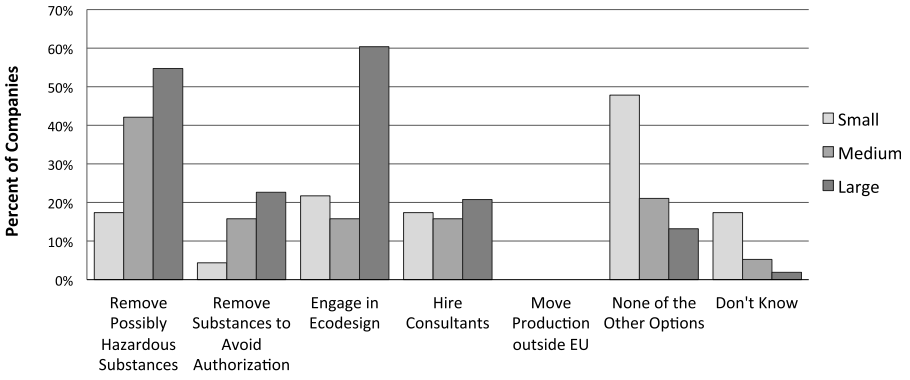


**Fig. 6 – Companies' voluntary responses to REACH.**

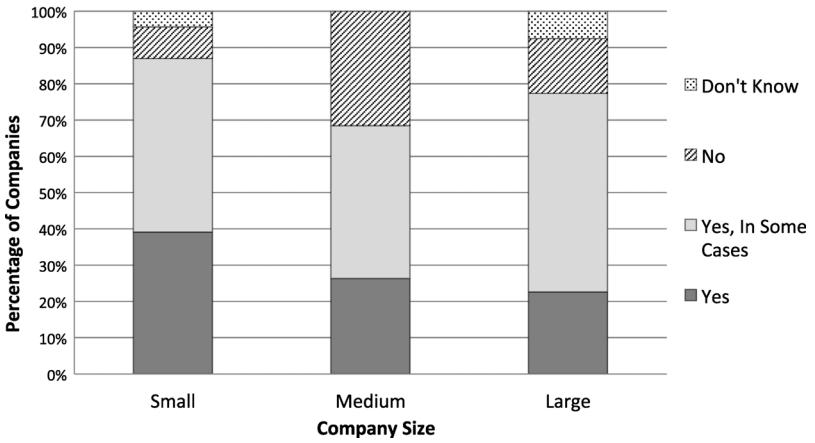


**Fig. 7 – Is chemical information from suppliers sufficient?**

and medium-sized firms, which did not appear to consult as wide a variety of sources as large firms. Consultants were the next most widely used source for the companies from the small- and medium-sized categories. And while the large firms' first choice for information was the Internet, their second choice was industry associations, a source used much less frequently by small companies. In addition, the large companies were much more likely to consult scientific publications, nongovernmental organizations, the media, and voluntary standards and certification systems than the small- and medium-sized companies. Almost twice as many small- and medium-sized companies (>30%) reported that they ''did not investigate substances'' at all compared to the large companies (17%).

Among firms that consulted sources of additional information, most – regardless of size – consulted only a single source (see Fig. 9). About 15% of large firms consulted three sources; the corresponding figures for small and medium firms are 4% and 11%, respectively. Not surprisingly, only large firms consulted more than three sources.

Our previous case study work was conducted only with large, multinational firms that were recognized leaders in chemicals management. Most of those 20 firms used internal research to create their own lists of chemicals that suppliers were barred from using (i.e., restricted substance list [RSLs], which do not include chemicals that are already restricted by law). We asked survey respondents: ''Does your company have its own restricted substance list to avoid unwanted substances in its products (not including substances that are already regulated by law)?'' Fig. 10 illustrates the major differences among the three categories of companies in their use of company-specific RSLs. Nearly 75% of the large companies we surveyed had developed an RSL, but the corresponding percentages were much smaller for the other categories of company size: 21% for medium-sized firms and 9% for small firms.

A final question posed to survey respondents concerned the nature of their information needs. Respondents were asked, ''Would you like to have any of the following additional information made available to your company?'' They were asked to select one or more of the following types of information:

- Chemical Abstracts Service (CAS) or European Commission (EC) numbers for chemicals supplied by others;
- disclosure of chemical substances used by suppliers in materials or components;
- information about possible hazards associated with chemical substances or materials supplied by others; and/or

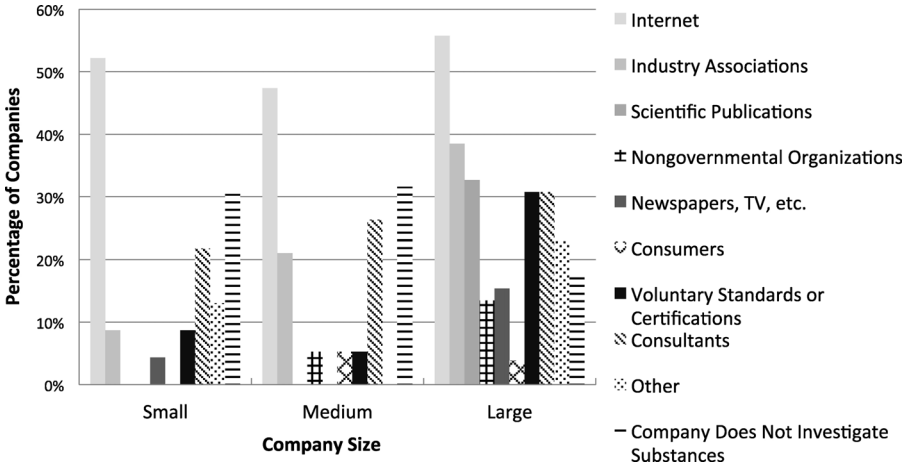


**Fig. 8 – Sources of additional information.**

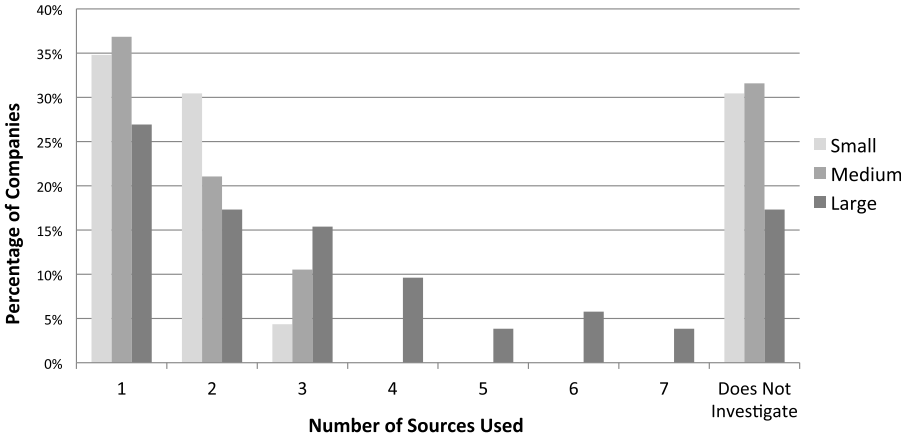


**Fig. 9 – Number of sources used to investigate chemicals.**

- weight or percentage composition of chemical substances in materials or components supplied by others.

Regardless of firm size, more than 40% of firms expressed a need for all four types of information; the corresponding figure for large firms alone is about 80% (see Fig. 11). The large firms reported a greater need for very specific information, such as CAS numbers and percent composition of substances provided by suppliers. While the small and medium companies also showed interest in this information, they reported a greater need for basic disclosure of the substances used by suppliers and information about hazards associated with chemical substances.

## 5. Discussion

### 5.1. *Limitations*

Several elements of the study potentially limit the applicability of the results. First, the nature and size of the sample limits the strength of the findings. While we surveyed a significant portion of members within this industry organization, the sample is restricted to members of this particular trade association, which may be inherently more (or less) knowledgeable about REACH compared to other industry sectors. Furthermore, respondents may represent a subset of firms that are more engaged than average in issues related to REACH. Finally, we assumed that the correct person was targeted at each company and that the survey respondents completely understood their companies' chemicals management policies. If other individuals within the company had better information about REACH, this survey would overestimate the knowledge gaps.

### 5.2. *Ignorance of REACH was pervasive, and particularly notable in smaller firms*

Based on their knowledge of the firms involved, managers of the Scandinavian industry organization from which surveyed firms were selected believed *all* organization members to be subject to REACH requirements. However, nearly 40% of small firms and about 20% of medium firms were unaware of REACH. Moreover, 60% of the small firms and about 50% of medium firms that reported knowing about REACH said the regulation did not apply to them (Fig. 2). Although nearly all of the respondents from large firms were aware of the existence of REACH, only about 80% of those firms felt it applied to their work.

These findings are in line with those from other studies. In the 2013 study of Dutch SMEs, 70–80% of downstream users of chemicals were unaware of REACH, and 25% of chemicals

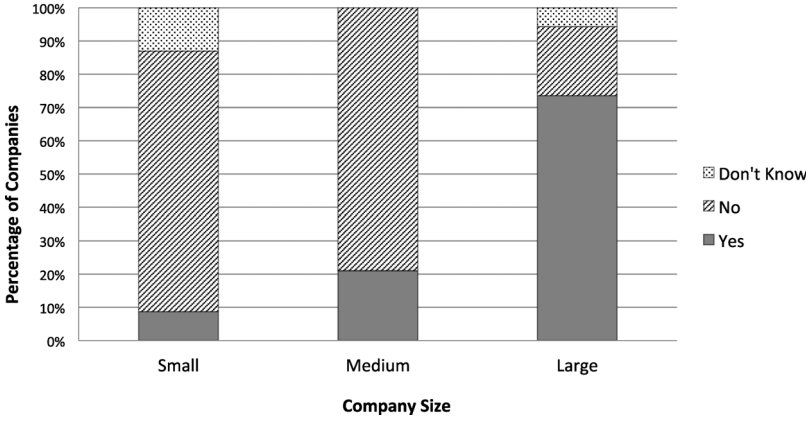


**Fig. 10 – Companies that have their own restricted substance lists.**

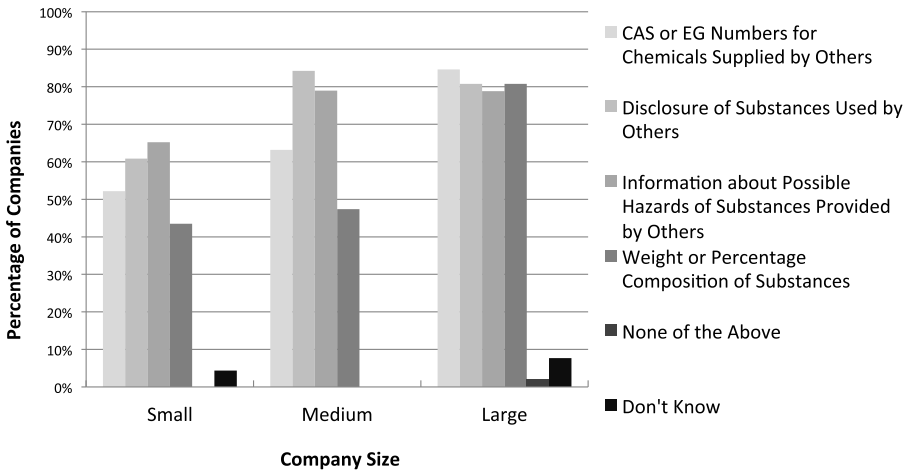


**Fig. 11 – Additional information that companies would like to have.**

sector businesses and 79% of other businesses did not think the regulation applied to them. These are surprisingly high percentages given that the study was conducted close to the second registration deadline. In addition, the 2012 study of UK manufacturers indicated that about two-thirds of small manufacturers were unaware that REACH applied to them, in comparison with about one-third of larger manufacturers (EEF, 2012). Clearly, work is needed to educate firm managers, particularly for small- and medium-sized companies, on the existence of REACH and its applicability to their products and operations.

Our results, as well as those from other studies, consistently showed that the size of a company is an important factor in both understanding of and compliance with REACH, with respondents from large firms having a better grasp of REACH and its implications than respondents from smaller companies. In that sense, the results provide evidence to support the conclusion of the European Commission (2013a) that "SMEs are unaware about their role and obligations related to REACH, and those who are aware, may have a false impression of the exact scope of their duties. . .." At the most basic level, SMEs need instruction on how and why REACH applies to them, and how it may affect their ability to sell their products in the EU.

### 5.3. *Firms request support in identifying and communicating chemical information*

Results also point to the types of support companies need in order to better understand and comply with REACH, as well as the types of information they need to make informed decisions about chemicals. As shown in Fig. 5, nearly 40% of firms (regardless of size) expressed a need for help with data systems or tools to manage REACH requirements and communicate REACH requirements to suppliers and customers.[9] These findings are in line with those from other recent studies, which specify the need for software, data management systems, and other IT solutions to help SMEs manage the flow of information in supply chains and prepare required REACH materials (Boog et al., 2013; Pelkmans et al., 2013; Gubbels et al., 2013; ECHA, 2014).

Firms of all sizes also expressed needs for legal, external communication, and internal coordination support to meet their REACH obligations (Fig. 5), and all sizes reported hiring consultants (Fig. 8). Similar themes have emerged from other studies, with reports of companies struggling to comply with REACH using existing limited (human and financial) resources (Sedlak and Pellizari, 2005; EEF, 2012; Pelkmans et al., 2013), and resorting to hiring external consultants for help with REACH compliance to compensate for lack of internal chemicals expertise and experience (Sedlak and Pellizari, 2005; Boog et al., 2013; Pelkmans et al., 2013; ECHA, 2014).

Respondents also described the information that they would like suppliers to provide about materials and components. Over 80% of respondents from large firms and over 40% from small and medium firms wanted their suppliers to disclose CAS or EC numbers, as well as the weight or percentage composition of chemicals in the materials or components supplied. Moreover, respondents from about 80% of large and medium-sized firms and over 60% of small firms called for increased disclosure of chemical identity and information on possible hazards associated with chemical substances or materials received from suppliers, even if precise CAS or EC numbers were not provided (Fig. 11). These results are consistent with results from our previous interview-based study with multinational firms (Scruggs and Ortolano, 2011). Despite their recognized leadership in chemicals management, many of those multinationals expressed a need for additional information to make safer consumer products. Our survey results demonstrate that substantial numbers of smaller firms also have a need for this information, and other studies have highlighted the need for improved communication of chemicals information in supply chains to make it possible for companies to comply with REACH (Boog et al., 2013; Sedlak and Pellizari, 2005).

Our survey results also revealed several kinds of voluntary actions that firms have taken in response to REACH. Two actions involved removing possibly hazardous chemicals from

[9] Recall that for tables numbered 3 and above, the results are only for survey respondents who felt REACH applied to their companies' work.

products or processes and another involved Ecodesign; while firm size tended to dictate the level of activity in each area, there was activity in firms of all sizes (Fig. 6). Our findings are consistent with those from other studies. For example, EEF (2012) also saw voluntary changes (e.g., substitution of possibly hazardous chemicals and product redesign) in firms of all sizes. In addition, Boog et al. (2013) found that 23% of Dutch SMEs were adapting company processes and 35% were eliminating certain substance from their products; these levels that are slightly higher than the ones indicated for SMEs in our study, perhaps reflecting the fact that our study was conducted a few years prior to the Dutch study. Similarly, chemical suppliers – including SMEs – are reportedly rationalizing their portfolios in order to minimize REACH obligations (Sedlak and Pellizari, 2005; Pelkmans et al., 2013; Gubbels et al., 2013). Our results are not consistent with predictions that downstream users of chemicals will move certain operations outside of the EU to lessen REACH's impacts (Pelkmans et al., 2013), but it is possible that this reaction to REACH may become more prevalent closer to the 2018 registration deadline.

## 6. Conclusions

In targeting a group of Scandinavian businesses located throughout consumer product supply chains, this study provides another unique data set to potentially inform ECHA's design of REACH-related assistance and support systems for SMEs. This study complements several other studies on REACH understanding, compliance, and effects of company size, and adds potentially useful data about information needs and flows in supply chains. The combined results may provide valuable input to ECHA's 2018 Registration Roadmap for helping SMEs successfully meet their REACH obligations. Given the ubiquity of SMEs, the findings may also be useful to policymakers in countries where chemicals policy reform is being crafted or debated.

At the time of our study, many SMEs and a number of large firms were unaware of REACH; further studies in 2012 through 2014 do not indicate a substantial increase in awareness. An effective implementation of REACH will require, at the most basic level, more attention to educating EU companies on how and why REACH applies to them and how it may affect their ability to sell their products in the EU. The results corroborate the European Commission's conclusion that outreach to and support for SMEs will be particularly important.

SMEs often learn about their REACH-related obligations through their trade organizations (ECHA, 2014); thus it seems important for the trade organization participating in our study, and other similar organizations throughout the EU, to continue and potentially increase their educational efforts targeted at SMEs. Our study also supports recommendations for ECHA to enhance IT and data management tools for REACH registrants (ECHA, 2014).

Among respondents who were aware of REACH, many companies reported needing more information from their suppliers on substance or material composition and related health impacts of substances and materials. Ensuring that this information is readily available throughout the supply chain is essential to accomplishing one of the core goals of REACH: reducing the impact of chemicals and products on human health and the environment.

## Acknowledgements

The authors thank the collaborating industry organization for making this survey possible. We are also grateful to the numerous respondents who gave their time to complete the survey as well as the pre-testers who helped us to improve our survey instrument. In addition, we thank Jessica Sebring and Rachel Moore for assistance with the figures and the literature review, respectively, and the anonymous reviewer whose helpful comments improved this paper. The research described in this article was funded in part by the Environmental Protection Agency (EPA) (Grant number FP 916845) under the Science to Achieve Results (STAR) Graduate Fellowship Program. EPA has not officially endorsed this publication and the views expressed herein may not reflect the views of EPA. The Udall Foundation Doctoral Fellowship and the Landreth Foundation Fellowship provided additional support. The listed funding sources were not involved in study design, data analysis, or dissemination of results. The authors declare that they have no competing interests related to this paper.

## REFERENCES

Boog, J.J., van Broekhuizen, F.A., Krop, H.B., Veldhuis-Van Essen, C., 2013. Impact REACH op het MKB. Ministry of Infrastructure and the Environment, the Netherlands Available at: http://www.euconf.eu/reach2013/pdf/presentations/eindrapport_panteia_ivam.pdf (accessed 19.09.14).

EEF, 2012. REACH: Awareness, Activity, and Perceptions. EEF, London Available at: http://www.eef.org.uk/NR/rdonlyres/5225A7AD-B84B-4695-9570-14CE95B719CF/21915/Reachawarenessactivitiesandperceptions1.PDF (accessed 19.09.14).

European Chemicals Agency, 2014. Survey of 2013 SME Registrants: Summary of Results. European Chemicals Agency, Helsinki Available at: http://echa.europa.eu/documents/10162/21332507/survey_2013_sme_registrants_en.pdf (accessed 19.09.14).

European Commission, 2012. Ecodesign Your Future: How Ecodesign can Help the Environment by Making Products Smarter. European Commission, Brussels.

European Commission, 2013a. Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions in accordance with Article 117(4) of REACH and Article 46(2) of CLP, and a review of certain elements of REACH in line with Articles 75(2), 138(2), 138(3) and 138(6) of REACH. European Commission, Brussels.

European Commission, 2013b. Results of the Public Consultation on the TOP10 most Burdensome Legislative Acts for SMEs. European Commission, Brussels Available at: http://ec.europa.eu/enterprise/policies/sme/files/smes/top10report-final_en.pdf (accessed 27.10.13).

European Commission, 2014. What is an SME? Available at: http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/ (accessed 01.01.14).

Gubbels, I., Pelkmans, J., Schrefler, L., 2013. REACH: A Killer Whale for SMEs? Centre for European Policy Studies, Brussels Available at: www.ceps.eu (accessed 01.09.14).

Pelkmans, J., Schrefler, L., Gubbels, I., 2013. The Consequences of REACH for SMEs. Report prepared for the European Parliament Committee on Industry, Research, and Energy, Brussels Available at: http://www.europarl.europa.eu/studies (accessed 01.09.14).

REACH, 2006. Registration, Evaluation, Authorization, and Restriction of Chemicals. Regulation (EC) No 1907/2006 of the European Parliament and of the Council. Official Journal of the European Union. .

Schwarzman, M.R., Wilson, M.P., 2009. New science for chemicals policy. Science 326, 1065–1066.

Scruggs, C., Ortolano, L., 2011. Creating safer consumer products: the information challenges companies face. Environ. Sci. Policy 14, 605–614.

Scruggs, C., 2013. Reducing hazardous chemicals in consumer products: proactive company strategies. J. Clean. Prod. 44, 105–114.

Sedlak, D., Pellizari, F., 2005. Final Report: Analysis of the Potential Impacts of Reach on European Textile Supply Chains. A report for the European Commission by EnviroTex GmbH and CAST Consulting. Available at: http://ec.europa.eu/enterprise/sectors/chemicals/files/reach/text_final_report_051216_en.pdf (accessed 01.09.14).

UK REACH Competent Authority, 2012. Information Leaflet Number 8 – Exemptions. Available at: http://www.hse.gov.uk/reach/resources/exemptions.pdf (accessed 09.09.14).