Informating Transport Transparency

Magnus Andersson
Viktoria Swedish ICT, Lund University
magnus.andersson@viktoria.se

Henrik Sternberg
Lund University
henrik.sternberg@plog.lth.se

Abstract

This paper reports on an ongoing design-driven action research effort using information systems to promote transparency in the European freight transport industry. The current lack of transparency is linked to a growth of unsustainable business practices. This can be countered by reducing information asymmetry. However, access to reliable information is hampered by the severely fragmented organizational landscape of the transport industry coupled with the ephemeral nature of services and the inherently mobile and easily reconfigured resources of the trade.

The research presented here utilizes mobile crowdsourcing techniques as a means to overcome these challenges and to reduce information asymmetry in the focal transport seller-transport buyer relation. The findings point to the positive impact of a crowdsourcing approach, yet highlight the importance of a balanced holistic network approach empowering all participants — end customers, authorities, NGOs, buyers, intermediaries and sellers — by reflecting their diverse incentives for information sharing.

1. Introduction

Have you ever considered how the goods you consume are transported? Were they transported by a new, clean truck driven by a driver with decent working conditions, or by an old truck with massive emissions, where the social conditions of the driver equal those of a sweatshop? [1, 2]

“The cost of dishonesty, therefore, lies not only in the amount by which the purchaser is cheated; the cost also must include the loss incurred from driving legitimate business out of existence” [3, p.495]. Ever since Akerlof’s seminal work, information asymmetry has been a key research topic. Information asymmetry is essentially a substantial information advantage on behalf of the seller. This advantage promotes moral hazards, which in turn can have destabilizing market effects. A buyer will no longer pay the price of the premium product, since most sellers cannot be trusted. Information asymmetry causes a general decline in price as well as quality to the detriment of the buyer of products or services. It also forces the firms selling good quality products or services to either (if possible) sell lower quality goods or services or eventually close shop. This type of market failure is further related to wider sustainability issues. When a market average price declines low enough, it generates pressure on behalf of the sellers of products or services to transform internal cost to negative externalities. This has a direct negative effect on all three pillars of sustainability: social, economic and environmental [4].

In order to impede this kind of development, two types of measures are recommended: increased regulation and information transparency. With the growth in recognition of the importance of sustainability, demands for information transparency to ensure sustainable business practices are becoming increasingly vocal. In the era of digitalization and big data it seems reasonable that the wealth of information available, predominately through the internet, would have a direct effect on transparency. One such example is the apparel industry, where transparent information systems and brand-owner actions have had an impact [e.g., 5, 6].

However, difficulties arise when addressing the sustainability related information on services. Due to their ephemeral and adaptive nature, services are elusive phenomena. One typical example is the European road freight transport industry, where deregulation and market mechanisms have created a “race to the bottom”. For some time, actors in many transport segments have been competing mainly to deteriorate drivers’ working conditions and compensations [2, 7]. As of today, suppliers of transport services are typically not included in environmental certifications of end-consumer products, despite transportation’s huge impact on the environment [8, 9].

Through design-driven action research, the research reported here aims to achieve sustainable transparency in the transport industry. Specifically, this paper depicts the initial lessons learned from a crowd-sourced transparency approach.
The paper is structured as follows. First, we present an overview of sustainability and transparency in IS. We then describe how various IS innovations have been received by the transport industry. This is followed by a presentation of our research design, findings and concludes with a discussion.

2. Sustainable Transparency in Information Systems

While the academic output on IS and sustainability is still scarce, it has gained attention in recent years [see e.g. 10, 11-13]. Reviews are being carried out [e.g. 14] and themes are emerging. Malhotra et al. [15] in the 2013 MISQ special issue, IS & Environmental Sustainability, analyzed and derived three themes: green IS for organizational transformations [10], green IS for supply-side transformations [16], and green IS for consumption-side transformations [17]. There is a growing stream of research that utilizes institutional theory focusing on the organizational adoption of “green IS” [see e.g. 18, 19]. Chen et al. [18] point to the power of IS to change organizational practice to become more sustainable through the mechanisms of automation, transformation or informating [see 20]. While IS automation is seen primarily as a way to create eco-efficiency, and IS transformation as a means to create overall eco-effectiveness, it is through informating [21] that IS can assist in promoting social sustainability and eco-equity (Fig. 1).

![Figure 1: Informating eco-equity, [19]](image)

However, while sustainability is widely recognized as a complex phenomenon involving economic and social dimensions, IS research tends to focus on the environmental dimension. Moreover, while useful, the dominating intraorganizational perspective is a simplification of the open and networked reality of contemporary society.

Ever since the first reports on the poor conditions of factory workers producing Nike shoes [5], ethical considerations in production have been a concern for companies worldwide. Novel mobile services are slowly changing consumer behavior. For instance, the OpenLabel mobile app aims to provide users with added ethical information about products accessed by scanning product barcodes with a smartphone. A recent example of overwhelmingly negative publicity is the deregulating effects of Uber on the taxi industry. In an effort to advocate radical transparency as a means of brand building, firms are increasingly publishing customer reviews.

The organizational transformation of sustainability requires the engagement of people and technologies beyond a single organization [22]. Indeed, to gain and disseminate knowledge of environmental and social performance, the transparency sought by leading firms requires the enrollment of an entire stakeholder web [23]. Thus, to erect strategic sustainability information systems, organizations need to address environmental, economic as well as social issues by harnessing a transparent web of subcontractors, customers, media, government agencies, NGOs and individual citizens in various communities.

The research on the effects of informating has mainly focused on top-down dissemination and change within a hierarchical organizational structure [see e.g. 24]. In the field of e-government, information systems are seen as a contributor to transparency on the governmental level. In many societies there is a societal transparency “readiness” that can be tapped. This includes the technology penetration, technology capabilities and social readiness of the populace [25]. A powerful combination of social media and mobile technology has been used in a number of national-level high-impact cases of bottom-up informating, and crowdsourcing is a growing topic in IS in terms of citizen science [26] or “crowd work” [27], for example. In sum, mobile and social IS offer promising components for sustainable development [28].

However, as of yet, little is known about how the power of crowd-sourced transparency can be used in the business to business economy. Extant IS literature on transparency has focused primarily on the effects of electronic markets such as price transparency [29]. The transparency of the nature of the product or service on offer has been studied to some degree [30]. There are rationales that work against digital transparency: Participants, for instance, often avoid electronic markets that demand identity disclosure to avoid showing their cost structure [31].

In the following section, we present the transport research setting followed by a brief summary of how IS have been used in attempts to automate, transform and informate the transport industry.

3. Transparency in the Transport Industry

Between 1966 and 2005, the average number of actors in supply chains increased from of an average
of 2.2 to 5 companies [32]. As companies are focusing on core competencies, outsourcing is bound to continue and deregulation of goods and services is fueling the trend [33]. World-wide, freight transportation is a service partly or fully outsourced by a clear majority of companies today. In Sweden, for instance, 95% of all companies purchase transports from an intermediary, referred to as a logistics service provider (LSP) [34]. LSPs typically own only 1-2% of the trucks moving their freight and the LSPs purchase transports either directly from motor carriers or from freight brokers. The motor carriers themselves often outsource to other subcontracted haulers or partner haulers. In addition, drivers are many times subcontracted. Sternberg et al. [35] found that fragmentation and lack of control is a global characteristic of a fragmented industry, where for example 43% and 75% of all motor carriers in Sweden and the U.S., respectively, are owner operators (i.e., have only one truck).

Since 1998, the international traffic between EU countries is completely deregulated. The official motive for the deregulation has been the creation of an open market and economic and environmental efficiency. The domestic freight transport markets are still regulated, currently through Regulation (EC) 1072/2009 [36]. A foreign hauler is allowed to carry out three domestic transports (also known as “cabotage”) within 7 days after the completion of an international transport. In addition, an unlimited number of domestic transports can be carried out by a foreign hauler if certain special conditions are met (i.e., “combined transportation”, which is intermodal transportation with shorter road distances and workers reported as being stationed in the country where they are driving) [37]. The only public information on the road trucking industry is published by Eurostat and is based on each Member State reporting their respective haulers’ activities [38, 39]. Minor cabotage volumes are reported by Eurostat, but no statistics for combined transportation are given.

In the European Union, Member States are obliged to recognize each other’s official documents, among them traffic permits and driver licenses. The deregulation sparked major debate, in particular from road hauler associations and unions in Western and Northern Europe, expressing concern about domestic haulers’ chances of surviving low cost competition. Another concern was the regulation compliance, as some EU countries face serious corruption issues. Investigations estimate the number of bribe transactions to be as high as 200 000 per month in Bulgaria [40]. As an effect of this, counterfeit passports and driver licenses are regularly detected by police in other EU countries, resulting in thousands of European drivers protesting [41].

3.1 IS innovation in freight transport

There has been a considerable number of research projects on novel information technologies in the freight transport industry. However, previous reviews of European research projects show that efforts have largely been technology oriented and lacking in terms of adoption studies [42].

In terms of transformation, the ongoing disruptive digitization is clearly reducing the need for transports altogether for example by removing the need for physical documents being transported, which is a distinct sustainability advantage. However, this development is more than offset by, for instance, IS innovations in the field of e-commerce that drive the growth of transports.

In terms of automation, there are numerous IS innovations that have made transport operations increasingly efficient, an early and widespread example being electronic data interchange (EDI). However, recent initiatives in transport automation such as electronic freight documents, mobile stationary standardization, or “intelligent” self-routing goods have not been widely adopted, in spite of attracting significant research funding for a number of years. These initiatives have failed to have any impact largely due to the fragmented and opaque characteristics of the transport industry [43].

Conversely, some of the more successful recent sustainability innovations are concerned with informating [21]. On the individual level, embedded vehicle systems used for eco-driving or routing and guidance have become widespread, reducing fuel consumption [44]. However, such effects exist at the individual level. As yet, there are no reports on targeting the social sustainability of the industry. Nonetheless, informating is a proven approach to promote transparency in other contexts [24].

4. Research Design

This paper reports findings from an ongoing action-oriented research effort [45] focusing on transparency in the transport industry. The goal is to alleviate an industry-wide problem situation (outlined in section 3) by designing and utilizing information systems together with the client system [cf. 46]. Action research is an iterative method where researchers and clients perform multiple cycles, applying an action based on applicable theory...
designed to alleviate a practical problem situation, and then recording the effects and specifying learning [47].

Thus, the research presented here draws on several activities that together provide a holistic, multilevel picture of the stakeholders involved. This paper outlines the initial action and describes lessons learned, forming the basis of a renewed research effort. As shown in Table 1, there are two main groups of data: crowdsourcing data about individual trucks, and feedback from the client system about the initial effects of our efforts.

The crowdsourcing data on individual trucks was gathered by volunteers using a mobile app designed by the research team. The use of the app is detailed in section 5.1. A crowdsourcing effort of this kind requires specific safeguards in terms of research design in terms of safety, ethics and validity. First, due to our awareness of safety concerns, the app contained warning texts, strongly advising against using it while driving. Instead, observations were intended to be made while at e.g. freight terminals and parking lots.

Second, in the information material as well as continuously in social forums, volunteers were informed and reminded to respect the privacy of foreign drivers and individual companies. According to European laws on privacy, individual entities (such as license plates) can be handled for research purposes, as long as the end results (reports, web sites, etc.) is anonymized. In a deregulated market, shippers’ transport purchasing policies are governed by the strategy of the company. The advice to participants has always been to encourage informed consumption, that is, using their power as end consumers rather than stigmatizing foreign truck drivers who in many cases already live under harsh social conditions. During a field trip, the app’s functionality was demonstrated to several groups of drivers and they were told how their privacy and the license plates of their trucks were to remain confidential.

Third, using crowd-sourced data places specific demands on securing validity. To safeguard the reliability of the study, volunteer haulers from Denmark, Bulgaria, Romania, Germany, Sweden, Latvia and Spain were asked to share information with the study. The haulers were selected based on either high observation frequency in the study or because they were connected to the authors through other research projects. After months of persuading and communication with various interest organizations, eight haulers (two Romanian, one Danish, two German and three Swedish) finally agreed to share their data. The most important data consisted of GPS logs from their trucks’ onboard systems. In one instance, additional consignment notes were acquired for one week for 20 of the Romanian trucks. The data matched data collection in time. In total, the data set contained over 350 trucks having carried out both international transports and cabotage during the period of the study. 45 were among the top 100 most frequently observed trucks (2013). In addition, one volunteer contributed data from a Bulgarian hauler with six trucks, continually carrying out illegal cabotage throughout all of 2014.

The comparison between the volunteer reports and truck GPS logs clearly indicated that the volunteers have a bias towards observing trucks from the new European Member States. Additionally, a few drivers and owner operators faked observations of trucks they had previously reported.

Firstly, we examined the volunteer observation bias. This bias resulted in the distribution between the EU15 (Member States as of Dec. 31, 2003) and new Member States’ vehicles being somewhat false. Thanks to the validation case data, the frequency of observations from the volunteers of EU15 and new Member States’ vehicles could be compared to the actual appearances. This showed that new Member States’ vehicles were reported 1.31 times a day, while EU15 vehicles were only reported 0.79 times a day.

Secondly, the comparison between the data collection and the validation data revealed that 4% of the Danish observations had to be discarded due to quality issues. A fit between the datasets was defined as being both a time match (max 10 minutes difference) and a position match (radius of 30 km), though nearly all of the remaining 96% matches were within 1 minute and 1 km. The authors tried to contact some of the antagonistic volunteers without success.

To gauge the effects of our initial action, we have conducted interviews with key respondents. They are heterogeneous in terms of roles and motives, which reflects the fragmented structure of the transport industry. To gauge the effects of the first action cycle on the client system, interviews were carried out with key personnel at stakeholder organizations. These were recorded and transcribed to facilitate analysis. More importantly, to gain insights into the community of the initial crowdsourcing initiative, we have used data from a social media account associated with this effort.

Table 1: Data sources

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Due to the potentially sensitive nature of the research conducted, all respondents and organizations (where applicable) have been made anonymous. An increase in news media coverage (e.g., in-depth investigations of companies carrying out illegal or unethical practices) of this topic in general and our research in particular has also been indicative of heightened interest. In combining these sources we are confident that we have been able to triangulate our findings sufficiently to inform the ongoing action research process. The analysis has taken place concurrently and the team has alternated between data collection and analysis throughout the duration of the research reported here. In this process, traditional media, social media and interviewees have been scanned for signs of effects and responses to our informing action. As with all research of an interpretive nature, particularly ongoing large scale interventions, it should be noted that our analysis is inherently subjective and emergent in nature. However, through detailed accounts of the research context, the results from the study can inform others by means of transferability.

5. Findings

This section presents the findings of the first cycle as viewed from a multiple stakeholders’ perspective.

5.1 The early phase (first cycle)

Due to the fragmentation of the transport industry, there is a dearth of reliable data on the conformance to rules, and policy making has to a large degree been based on guesswork. One month before the study, the Swedish infrastructure minister had declared that according to Eurostat, the statistical office of the European Union, cabotage was a minor phenomenon and that deregulation would be beneficial for Sweden. The research problem was thus defined as a lack of credible information on which to base policy that could in turn affect the opaque industry logic. Figure 2 summarizes our initial approach. The first action research cycle was inspired by previous research on informing efforts [24]. The goal was thus to informate policy makers (and, by proxy, affect transport companies) by improving the legitimacy of information, the means of acquiring and transferring the information (mobile app), by empowering and legitimizing the messengers (boundary spanners and influential “clan members”), and by facilitating an arena to discuss the information (social media).

To generate data, a crowdsourcing data collection effort was initiated in 2013. Though the setting contains many organizational and professional identities, the aim of this early initiative was to engage the grassroots (i.e. the truck drivers) to collect data on the movements of foreign trucks within Sweden. The study was named “Cabotagestudien” (“The Cabotage Study”), referring directly to the phenomenon to be examined.

In mid-April 2013 an app for iOS and Android was developed. The app consists of an input screen where license plates for vehicles can be manually entered. Once entered the data together with a timestamp and location data is sent to a server. The study was launched in Sweden and the authors opened the first Facebook page (www.facebook.com/cabotagestudien). To recruit volunteers, the authors contacted several other Facebook forums for truck drivers with more than 2000 members and encouraged them to spread the word of the scientific study aiming to calculate the actual extent of foreign trucks in Sweden. Users were urged to abide by traffic safety regulations and only enter data while stationary or as a passenger or copilot. Initially, graphic images of the study’s coverage were manually created and posted on the Facebook page. This was updated with a digital map displaying all reported movements of trucks (http://www.cabotagestudien.com/sv/rapporteringar/#/plates/). According to European legislation, collecting data on vehicle identities is allowed, as long as the final research results (the reports and the obfuscated
patterns) cannot be linked to individual people and organizations.

The reports revealed that some trucks appeared to stay in the country, in violation of current regulations. News about the study spread and several volunteers in the neighboring countries of Denmark and Norway started using the app as well. The researchers posted daily messages on the Facebook page. These messages were shared up to 350 times and viewed by 45 000 people (Sweden has 100 000 people working in transportation). The first stage (mid-April to the end of May 2013) resulted in over 163 000 observations collected by 5 000 volunteers. One week into the study, the trade press disseminated the initial findings and that triggered further interest. After three weeks, regular media, including radio channels, national newspapers and television began covering the study, attracting more users. Haulers and associations started to contribute to prizes for the participating drivers. This initial stage was followed up with two more data collection periods in October 2013 and May 2015.

The study immediately impacted policy makers. Four weeks into the study, their statement had changed to that “more facts about the phenomenon were needed”. At the same time, an ongoing government investigation on policy and regulation was given additional instructions — to address cabotage, legislation and enforcement. In a newspaper interview, the head secretary of the Swedish transport union commented on the impact of the study:

We have tried to push this view [market in crisis] for 10-15 years. We have known about the situation, but we couldn’t prove it. Now we have a scientific study proving it. This means incredibly much to us.

The drivers were enthusiastic about the study. As of today, the most frequent volunteer has reported 15 000 observations. He and many others started using the Facebook page to send photos of detected cheating. For the past two years, the project manager has received appreciation through social media, e-mails and even handwritten letters:

I just have to write and thank you so much for all the effort you put in. I don’t know if anyone has written and thanked you, but it is because of you that we can influence society. Sure we are the ones tagging [tagging = reporting foreign trucks through the app] but we couldn’t have done it without your knowledge. I think every driver who has a trucker heart can sign this mail. Hope you understand what a good job you are doing.

Industry wise, several companies started reviewing their transport purchasing policies. One large electronics retailer cancelled all contracts with logistics service providers using foreign haulers in domestic transportation and recently launched a campaign “Logistics with heart”. The two largest retailers in Sweden overhauled their transport networks and increased transparency. Some foreign haulers realized the business potential and agreed to share data with the study, in return for a certificate of compliance given by Lund University:

Some competitors have their drivers on the roads for up to 6 months. We wanted to show our customers that we do not operate cabotage and that our main business is international transport. Through ‘Cabotagestudien’ we could prove that our trucks return to Romania every, or every second week.

Indeed, as the following traffic police officer noted, there were clear indications that while the data collection was running (for two weeks), several intermediaries shifted their behavior and started hiring local haulers once more:

We think we have seen a clear reduction of illegal transports in just one month. Significantly more Swedes [on the road]. I was even called by a hauler who said that “I tell you, I haven’t worked for them for a long time”. That was a well-known big forwarder.

However, once the collection effort had run its course, behavior quickly reverted to radical outsourcing again. In essence, though the issue of illegal cabotage had been illuminated, the effect was brief and had little impact on the overall scheme of things. The findings were also thoroughly debated and criticized by some proponents of the transport industry. However, in the end, no one has yet been able to refute the results that show instances of illegal transports, in particular as police initiatives have confirmed the validity through extensive fines on illegal cabotage. As well as reverting to prior behavior after a focused tagging effort, the context concurrently evolved beyond the initial problem definition. As reflected by a police officer, there is considerable ingenuity involved in the interplay of finding new ways of bending existing regulations through interpretation, followed by a response from law enforcement:

The regulations don’t change; the methods they use do. When we react to an illegal practice, within two weeks they have come up with something new. And
this is not a single firm. It’s more or less everybody. And again, after two weeks you won’t find that particular problem anymore. That’s the way it is.

This indicates a clear limitation of targeting regulations to counter the effects of information asymmetry.

Throughout this early initiative, it became clear that there were actors other than drivers who were interested in the crowd-sourced data. It became obvious that the approach was applicable beyond its initially intended use (truckers and general public as data collectors). As exemplified by the following transport manager writing on the project Facebook page, intermediaries were themselves also interested in gaining this kind of information:

"I don’t want to be associated with my job as a transport manager. It’s a bit sensitive when you deal with information on internal transports. I would like to tag vehicles that we use to see what they are up to when they are not booked by us."

Highlighted by the quote above, users are acutely aware of the sensitive nature and potential risks of crowd-sourced transparency, from their own vantage point in the combined network of actors. As another example, a major buyer of transports is joining the initiative. These instances were not isolated and currently several transport buying organizations, public as well as private, have shown interest in tapping into a burgeoning transparency network.

Another limitation of the coverage of the initial effort became evident through the challenges of enforcing regulations. Closely connected to the enforcement of actual routing and driving is the complex issue of taxation:

"The idea behind [these regulations], is that you could save the environment by increasing efficiency. That’s why they should follow the cabotage regulations. But they should not get away with not paying taxes and fees. But how can I check this up when I have a CMR saying “Düsseldorf, Germany, recipient Torslandaverken, Gothenburg, Sweden”? How can we possibly know how that transport has been carried out?"

In sum, the use of crowd-sourced transparency in the transport industry was successful, but the long-term effect is still hard to discern. There is clearly room for a renewed and improved approach, more adequately reflecting the entire transport transparency network. Clearly, empowering the grassroots had an effect. However, while successful at the policy level, it did not result in any notable sustained effects on the transport buyer-transport seller relation. In order to improve the opacity of transports and the associated long-term negative market effects, this relation is crucial.

5.2 Reflecting on early results

Informating the industry by using crowdsourcing was deemed a success by many industry actors in Scandinavia. However, it failed to shift the underlying logic of the industry. Consequently, the researchers have expanded the scope to gain a deeper understanding of the multifaceted incentive structure in the industry. New research funding has been secured and a project group with a broader scope was put together. A Fortune 500 company in the chemical industry was enrolled as an initial focal transport buyer. They are currently leaders in their group in the Fortune 500 sustainability index, indicative of their sustainability ambitions. They were also acutely aware of the effects of opacity. As an example, in an incident described by a transport manager of the buyer firm, they found themselves unable to actually switch from a transporting firm with subpar performance. The contract with the intermediate forwarding firm was cancelled, but a mere week later the very same trucks appeared again. These haulers and drivers were now acting as subcontractors to the new replacement intermediate forwarder. Running global logistics operations, the internal resources required for performing detailed conformance checks to root out such opportunistic behavior are prohibitively costly. The occurrence of incidents like these provided a clear incentive to join the research initiative.

In order to secure credibility and long-term effects, an environmental NGO was enrolled. They have a successful environmental certification. However, they are finding it increasingly challenging to isolate environmental from economic and social sustainability:

"It is becoming more and more focused on the social dimension. In the textile industry, there has been such massive problems with working conditions, but that has mostly concerned ILO conventions [International Labour Organization]. We see social requirements, we see environmental requirements, but they are not joined."

Indeed, sustainability certification is frequently built on attaching local actors and other certified actors to form a complete service, as pointed out by an NGO representative:
In textiles, for instance, there are so many levels. It’s not like we go to China to perform compliance controls of the factories ourselves. To do this we accept other certifications.

The issue of compliance checks is, by necessity, in itself a highly distributed affair. The NGO does not perform this on its own accord. Rather, it relies on external accountants. This has intrinsic advantages for credibility as well as for practical reasons:

It is beneficial to have an external party. We have the right to perform spot checks ourselves. But the accountants are an independent party. It is easier to spot discrepancies from outside the organization.

However, these parties primarily deal with financial analysis and are less reliable in sustainability conformance controls resulting in varying quality of services:

We had an accountant calling in and saying “I am here now, in the middle of the field, checking where the fuel [biomass] comes from.” He was taking this very seriously. But sometimes you wonder if the person has inspected anything at all – he has not even entered the correct year...

Trucks and trailers are inherently mobile resources, traversing both national borders and contractual agreements with ease. Reflecting on the issue of control of these highly distributed services, a representative from the environmental NGO commented:

With chemicals, we are taking samples to check levels [so they do not exceed agreed levels]. I suppose I could stand and check on a truck, but that is a very difficult task.

The compliance control of international transports is also a big challenge in comparison with rather more stationary environmental spot checks.

6. Discussion

Through a review of literature, we have shown that the transport industry has been subject to failed strategic IS innovations to promote sustainable practice in terms of eco-efficiency through transformation and automation. The lack of sustainability progress through transformation can be traced to the effects of e-commerce and other IS innovations that conversely stimulate the rapid growth of physical transport. The recent lack of success in adopting IS automation innovations that promote sustainability can be explained by the industry logic, which is characterized by severe fragmentation resulting in a lack of transparency. However, this very lack of transparency can successfully be addressed by IS measures designed to informate. By informing information systems, the transparency needed to encourage sustainable business practice can be promoted.

We have shown the initial practical impact of a crowd-sourced IS initiative to promote transparency. This impact can be summarized as follows. First, there are strong indications that transport buyer preferences shifted during episodes of crowd-sourced data gathering. Second, there have been shifts in enforcement policies that at least partially can be attributed to the crowdsourcing initiative. However, it is also clear that these effects did not generate a longitudinal shift and business practice reverted after crowdsourcing initiatives ended. There are a number of lessons to be learned from this. A successful digital strategy for sustainability must include information transparency within a stakeholder web. On the firm level, passive reporting of numbers is not enough. On the government level, legislating and enforcement is insufficient or even impossible in many cases. A successful digital strategy promoting sustainability through transparency requires the active participation of multiple parties.

In terms of action design, to increase transparency through informating, information systems must operate on multiple levels, simultaneously bottom up and top down, using asymmetrical incentives.
Transparency is a multilevel phenomenon encompassing the individual, group, and organization levels as well as the entire supply chain and surrounding society. Attempts at erecting sustainable transparency using IS should combine initiatives at these levels.

Each missing component limits the impact. In a transparency web, all actors have unique incentives to participate. These are sometimes overlapping, but not always. They will range from reciprocal services, fees, regulatory conformance to job protection or competition. Transparency is multidirectional. A buyer of services should perform conformance checks on subcontractors. At the same time, subcontractors can check buyers of services. It is likely that this activity involves a combination of customers, citizens or competing subcontractors. Informed by these initial lessons learned, figure 3 describes our modified approach.

These findings largely conform with general literature on transparency [e.g. 23] to which we add a detailed understanding of the potential and intricacy of crowdsourcing. By showing and exploiting the linkage between ecological and social sustainability, we extend IS research on sustainability adding focus to a neglected yet important dimension.

In terms of research opportunities, there is a clear need to further the understanding of how IS can contribute to generate transparency and a permanent shift to a more sustainable industry logic. However, there is a growing debate about the societal effects of digital traces and big data, and legal and ethical concerns are critical. Indeed, the drawback of a “surveillance capitalism” [48] must be weighed against the overall goal of improving social sustainability.

7. References
