Organisational innovations, social innovations and societal acceptability in the context of sustainability

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Content

0 Summary 6

1 Background and objectives 9

2 Selection of case studies 11

3 Analysis of public attention 14

3.1 LexisNexis 14
3.1.1 Data source 14
3.1.2 Advantages and disadvantages of LexisNexis 15
3.1.3 Results from LexisNexis 17
3.1.4 Conclusions and feasibility 20
3.2 Google Trends 20
3.2.1 Data source 21
3.2.2 Advantages and disadvantages of Google Trends 23
3.2.3 Results of the Google Trends searches 24
3.2.4 Conclusions and feasibility for future studies 29
3.3 Plausibility of LexisNexis and Google Trends results 30

4 Attitudes towards sustainability and resource efficiency 33

4.1 Data sources 33
4.2 Relevant questionnaires and their coverage 34
4.3 Results 40
4.4 Conclusions and feasibility for future studies 49

5 Activities of firms 50

5.1 Method 50
5.2 Differentiation of the text analysis from NACE code classification 52
5.3 Analysis of the retrieved firms 52
5.3.1 Analysis of countries and sectors 52
5.3.2 Analysis of selected NACE codes 55
5.3.3 Analysis of individual keywords 57
5.4 Summary 59

6 Synopsis of evidence and first preliminary conclusions 60

7 References 65

Annex 1: Overview of media sources available in LexisNexis for selected countries 70

List of Figures

Figure 1: Typology of environmental strategies 12
Figure 2: Number of global media reports per year and search string 18
Figure 3: Number of German media reports by year and search string 19
Figure 4: Comparison of number of global and German media reports per year 19
Figure 5: Number of Google searches for new models of repair and maintenance services, worldwide, 2004-2017 25
Figure 6: Number of Google searches for new models of repair and maintenance services, Germany, 2004-2017 25
Figure 7: Country Comparisons - Maker movement vs. new models of repair and maintenance services, 2016 26
Figure 8: Number of Google searches for established models of repair- and maintenance services, worldwide (English keywords), 2004-2017 28
Figure 9: Number of Google searches for established models of repair and maintenance services, Germany (German keywords), 2004-2017 29
Figure 10: Number of open workshops and open creative labs in Germany in 2016 30
Figure 11: Comparison of the number of global attendees at Maker Faires with the number of global media reports and Google searches on Maker Faires 31
Figure 12: Comparison of the number of global repair café initiatives, the number of countries with repair cafés, the amount of global media attention to the topic and the average number of annual Google Trends searches 32
Figure 13: ENVI - Country Comparisons 42
Figure 14: EFFI - Country Comparisons 43
Figure 15: INNO - Country Comparisons 44
Figure 16: WVS - Country Comparisons 45
Figure 17: Shares of firms with “repair services”, identified through keyword-based analysis of all firms for each country. 53
Figure 18: Shares of firms with “repair services”, identified through keyword-based analysis of all firms in each sector worldwide. 54
Figure 19: Shares of German firms with “repair services”, identified through keyword-based analysis in each sector. 55
Figure 20: Shares of firms with “repair services”, identified through keyword-based analysis for some selected sub- sectors. 57
Figure 21: Firms retrieved through a keyword as a share of all firms retrieved based on the keyword set. 58

Figure 22: Firms retrieved through a keyword in a sector as a shares of all firms retrieved through the respective keyword 59

List of Tables

Table 1: Search strings used in LexisNexis 14
Table 2: Search strings used in Google Trends 22
Table 3: Coverage of "Attitudes of European citizens towards the environment" (ENVI) 36
Table 4: Coverage of "Attitudes of European citizens towards waste management and resource efficiency" 37
Table 5: Coverage of "Attitudes of European entrepreneurs towards eco-innovation" 38
Table 6: Coverage of the WVS variables 39
Table 7: Summary Statistics Eurobarometer 41
Table 8: Summary Statistics WVS 42
Table 9: Factor Analysis - Eurobarometer 47
Table 10: Factor Analysis WVS 48
Table 11: Synopsis of key case study results for Germany 61
Table 12: Potential of selected data sources for analysing soft innovations 63
Table 13: Overview of media sources available in LexisNexis for selected countries 70
Table 14: Overview of sub-sectors used in the analysis of firm activities 71

0 Summary

Background and goal of study

The innovation literature has recently emphasized the importance of various forms of non-technical innovations, in particular organizational and social innovations. A somewhat diffuse picture emerges of what organizational and social innovations encompass. Therefore, we use the term “soft” innovations to characterize this kind of innovations. Environmental sustainability is one area in which soft innovations have received a particularly high level of attention. Thus, we use two cases from this field – the maker movement and repair cafés – to investigate from a bottom-up perspective the possibilities to build additional indicators for soft innovations.

Organizational and social innovations are multi-faceted, and cannot be taken into account by a single indicator. Novel configurations of social practices, including collaborative actions, require social acceptability and changing behavioral patterns of the actors involved. Public attention and attitudes fostering sustainability and resource efficiency can be attributed to various factors influencing acceptability and behavior and give an indication for processes taking place in the formation of “soft” innovations. Looking at the number of institutions active in performing these “soft” innovations gives an analogue to the indicators for market activities used in traditional indicator systems. Thus, we look into the feasibility of building indicators in the three areas of attention, attitudes and activity for the two case studies selected.

Media Analyses

A first element of this feasibility study is the evaluation of public attention for soft innovations using a LexisNexis-based media coverage analysis on the repair café and maker movements. In terms of feasibility, we find that the advantages of this methodology outweigh the disadvantages resulting from certain source- and language biases. The types of topics that can be examined is almost limitless, the range of sources is extensive and the geographic coverage is considerable. The data are suitable for analyses over time (here 1990 - 2016) as well as for crosscutting analyses comparing different countries or regions (here: Germany vs. global level).

The results show that media coverage, and consequently public awareness, to both the maker and repair movements has grown significantly and on a global scale since 2011. It is clear that these soft innovations are currently on the rise, although both are certainly still niche phenomena. Based on the media data alone, no prediction is possible to date as to whether this increase in media coverage is a temporary hype associated with the novelty of the movements, or whether public interest in these innovations will continue to stay high over a longer period. Comparing Germany to the rest of the world reveals that, in the German media, attention payed to the maker movement is much lower than at global level.

In addition to the analyses of public attention in classic media, we provide an analysis of awareness regarding new modes of repair- and maintenance services on the Internet with the help of Google Trends. It allows the quantification of search queries by Internet users across countries and in given period. Although it suffers from certain biases and language issues, it provides an interesting platform for the analysis of public awareness over time as well as across regions and countries.

The results of the analyses show that new modes of repair- and maintenance services have gained large attention especially since 2011 when 3D-printing and related techniques became available to private users. Although conventional modes of repair- and maintenance services still outweigh the new modes, it seems that the boom of new modes of repair services has also triggered a growth in the classic models, implying a direct and an indirect effect of new repair initiatives.

Attitudes towards sustainability and resource efficiency

There are many surveys with regard to the topic of sustainability in its different facets. Large-scale surveys, measuring the attitudes towards sustainability issues that are comparable over time and across countries, however, are scarce. We analyze two of them, namely the Eurobarometer and the World Values Survey with regard to their suitability for further analyses regarding organisational and social innovations in the context of environmental protection and sustainability. With regard to feasibility, our results show that the Eurobarometer and the World Values Survey appear to be excellent potential sources for further analyses, especially with respect to country comparisons. Yet, there are limitations regarding analyses over time, at least when it comes to more specific questions or environmental issues.

Though the focus of our analyses is methodological, they show that the general attitudes towards environmental protection are similar across countries. When more detailed questions on resource efficiency or waste management are taken into account, however, larger country differences can be revealed. The international comparisons show that the importance of looking after the environment is larger in Europe than in the U.S. and China.

Activities of firms

In this study, we use a new method based on a set of keywords in order to identify firms that offer repair services. For the search, we use the description of economic activities of the enterprises. The set of keywords is developed iteratively based on these descriptions starting from an initial set of keywords. The extraction of firms based on our keyword analysis results in a set of firms that is clearly different from the set of firms assigned to NACE codes related to repair services. It easily lends itself to country and sector comparisons. However, analyses over time are difficult.

Concluding, we can say that the text analysis provides valuable information about repair services offered by companies in addition to a NACE code-based analysis. With a share of 1 %, the proportion of firms worldwide is small but visible. We can identify differences between the company profiles in different countries and find that some countries show a significantly higher share such as China, Finland and India. The major part of firms offering repair services can be found in the area of manufacturing.

Outlook

The study has shown the feasibility of building indicators, which represent attention, attitudes, and activities: The indicators for attention show diffusion of ideas, and level of interest of individuals to take a look into new ideas, whereas the indicators for activities show the level of activities taking place. Both types of indicators can be matched to each other based on the classification used. On the other side, the indicators for attitude indicate that the increase in development of activities might not just be a temporary hype, but might be rooted in deeper developments taking place over the longer run. However, the aggregation level of the issues is much higher so that the indicators on attitude cannot be easily matched to the observations on attention and activity.

From a strategic point of view, it remains open how to assess soft innovations as an aggregate. Such an approach would increase the generality of results and could also serve as a benchmark for assessing the performance of sub-fields. A bottom-up approach, which consists of aggregating numerous case studies, might look feasible from the point of view of retrieving data for attention and activity data. However, this would require developing a pre-defined list of soft innovation cases, which is representative for soft innovations as such and continuously updated to newly emerging soft innovations. Future research should develop the perspective on the aggregate of ‘soft innovations for sustainability’ further with a view to incorporating an updating representative cases of soft innovations while ensuring that, for all soft innovations on the list, indicators can be derived from a common set of data sources. Furthermore, the role of indicators for attitudes has to be further refined. A possible role might be to look at attitudes related to soft innovations per se, regardless in which area or for which specific case they apply. This would require finding a common set of attitudes, which are related to all forms of soft innovations.

1 Background and objectives

Innovation indicator systems have gone through a long period of development. Various indicator types have been used to describe innovations related to technological development and to account for the capabilities necessary to perform them. At the same time, however, there has also been a trend emphasizing the importance of various forms of non-technical innovations, which are generally harder to measure.

Organizational innovations, which themselves comprise a wide array, are among these. In the last years, social innovations have become another important term. Nevertheless, this concept remains contested (see e.g. the discussion on definitions of social innovations in Neumeier 2012). On the one hand, the key characteristic of social innovations is seen in a positive impact on society (e.g. Moulaert et al. 2013); on the other hand, social innovations are seen as novel configurations of social practices with the goal of fulfilling the innovators' own purposes (Howaldt et al. 2010). The importance of non-technical innovations is further pronounced by various trends such as the presence of new innovation actors, including communal users and collaborative innovators, or grassroots innovations and community actions (Warnke et al. 2016; Seyfang, Longhurst 2015). Taken together, these trends show a somewhat diffuse picture of what organizational and social innovations encompass. In this report, we also use the term “soft” innovations to characterize these kind of innovations.

Nevertheless, environmental sustainability seems to be one area in which the different trends occur simultaneously. Sustainability is one of the great global challenges, requiring a multitude of innovations to support these goals and as eco-innovations are becoming increasingly complex, non-technological innovations are gaining in importance. Thus, measuring innovations towards sustainability increasingly requires taking organizational and social innovations into account. Based on analyses of existing approaches and data, it can be concluded that additional efforts are called for to develop new indicator concepts, which address the nexus between organizational innovations and behavioural changes, and which look at the structural conditions for transformations (see Walz 2016; Walz et al. 2017).

Sustainable products and value added concepts as well as the transformation of entire systems towards sustainability require innovations of increasing complexity and lead times. In this context, the importance of organizational and social innovations as well as the development of completely new business models (such as e.g. sharing concepts) rises and new actors with new roles emerge, for example prosumers, citizen-driven initiatives such as repair cafés, or social entrepreneurs. Those phenomena cannot be grasped with the traditional concepts of innovation indicators, because at this stage, the activities and actors are not yet well defined. Therefore, new complementary indicators for measuring green transformation processes are needed. Taking the perspective of a feasibility study, this report explores the question of how „soft“ phenomena of green transformation processes (i.e. organizational and social innovations) can be captured in innovation indicators. This in-

cludes the question of adequate data sources that allow analyses over time and country comparisons. In order to look into the feasibility of new approaches, we use two examples of soft phenomena where we can currently observe a lot of activity: the maker movement and repair cafés (for details see section 2).

For the same reason as existing innovation indicator systems, soft innovation indicators should provide information on the state of innovation activity and its dynamics, and should allow for international benchmarking. Furthermore, we start from the notion that organizational and social innovations are multi-faceted, and cannot be taken into account by a single indicator. They should reflect the complex nature of such innovations emerging. In traditional indicator systems, this complexity is addressed by building different kinds of indictors, which address input and output of the innovation process and related market activities. Generally, soft innovations are characterized by novel configurations of social practices, including collaborative actions, which require social acceptability and changing behavioral patterns of the actors involved. Changing behavioral patterns is in itself a complex process, which – according to the integrated framework for explaining environmental behavior - involves norm activation, motivation, and evaluation (Bamberg, Möser 2007; Klöckner 2013). Using this framework, high public attention and attitudes fostering sustainability and resource efficiency can be attributed to various factors influencing norm activation and motivation. Thus, it can be argued that measuring public attention and attitudes indeed give an indication for processes taking place in the formation of “soft” innovations. In addition, looking at the number of institutions performing these “soft” innovations gives an analogue to the indicators for market activities used in traditional indicator systems.

Thus, our assumption is that we have to look into three elements in order to address organizational and social innovations for sustainability:

- The first element of this feasibility study is the analysis of **public attention**. By definition, public attention implies "at least a minimum degree of shared attention" and communication about a certain issue" (Newig 2004, p. 158). It can be inferred that an increase in communication about and therefore public attention to a particular soft innovation implies that the innovation is growing and spreading. This is particularly relevant in the context of soft sustainability innovations such as the maker movement and repair cafés, because it is only through this publicity that an issue can become sociologically and, more importantly, politically relevant (Newig 2004).
- Following the concept of the “Great Transformation” as proposed by the German Advisory Council on Global Change (Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU) 2011), a change in people's values counts among its necessary prerequisites. More closely related to our case examples, the acceptance of repaired products and new modes of production are also related to changes in consumer behavior, which is again related to **changes in atti-**

tudes. Therefore, the second element of our analysis is the evaluation of survey data on attitudes towards environmental issues.

- The third element is the analysis of economic **activities** of firms. Focusing on repair services as an extension to conventional business activities, it complements the perspective on the soft innovations analysed in the first step. Thus, our indicator approach aims to examine to what degree the demand for repair services - evident in the citizen-driven maker and repair initiatives - is matched by an offer from conventional suppliers.

The report is organised as follows: In chapter 2, we will present the two cases that we use as examples for organizational and social innovations, i.e. the maker movement and repair cafés. Chapters 3-5 are devoted to present the indicator approaches developed to address the three elements mentioned above. Chapter 6 elucidates the plausibility of our approaches and concludes with next steps which should be taken.

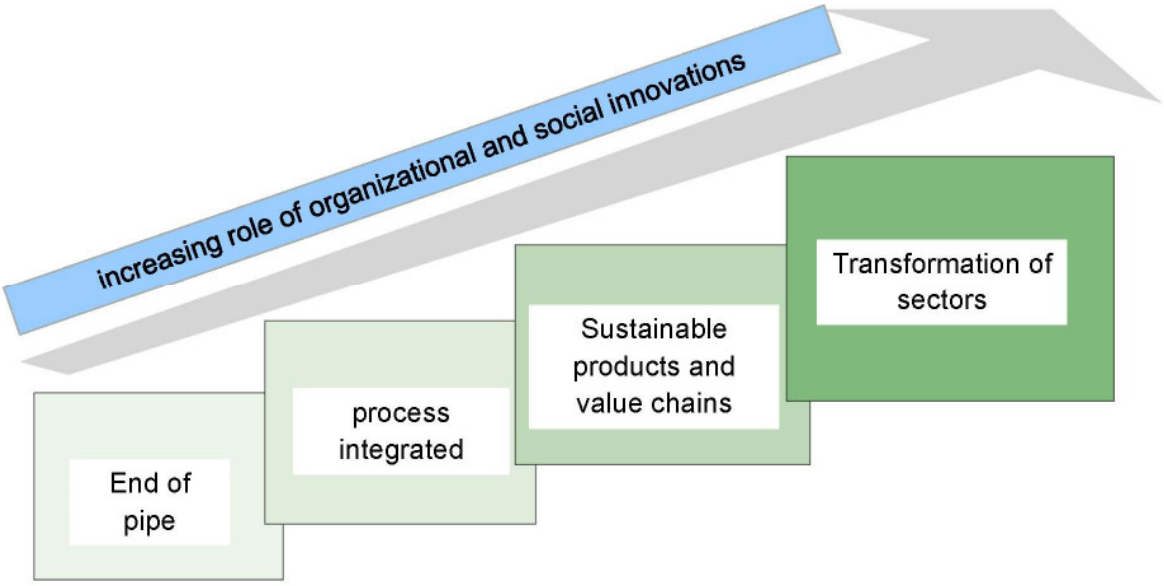
2 Selection of case studies

There have been several developments with regard to environmental strategies taking place over the last two decades. These differences are most pronounced with regard to the role innovation plays within the different strategies (Figure 1):

- At the beginning of environmental protection, mostly end-of-pipe solutions were deployed. They do not alter the production process, but are rather add-on technologies. Thus, the core business of production was not affected by them, and key innovation tasks were the lowering of costs and improvements of emission reduction. The reduction in pollutants such as SO_2-emissions can be attributed to this strategy.
- Process-integrated technologies substitute new, clean technologies for older ones. They are a technological innovation which, however, does not change the product. Typical for these strategies are more energy or material efficient processes, or renewable energy technologies which allow for substitutions of fossil fuels by renewable energy.
- Sustainable products and value chain concepts are characterized by changes across the entire value chain. This requires communication among manifold actors, and quite often the development of new business models. With changing product concepts, acceptance and consumer behavior are becoming key issues for these innovations. Organizational and social innovations gain in importance, compared to the first two strategies.
- The enormous tasks of reaching sustainability have increased the awareness that a transformation of whole sectors is necessary. Especially in the field of energy, water, mobility and materials, there is a need to shift the resource base and to engage in substantial structural changes of the sector. Such transformations bundle various forms of the innovation types described above, and require substantial co-evolution of technologies with surrounding institutions such as sector organizations, standard-

ization and regulations, but also within the system of education and skill development. At the same time, new roles and actors (e.g. prosumers) and changing values and norms (e.g. role of common use of products instead of private ownership) are addressed. New actors and new institutional arrangements further add to the increasing importance of social innovations within this strategy.

Figure 1: Typology of environmental strategies



Source: Walz 2016

Two exemplary case studies – one on the maker movement and one on repair cafés – are selected to assess the feasibility of the soft sustainability innovation indicators proposed here. Both cases follow the logic explained for the two latter types of environmental strategies. They can be considered soft innovations, as defined above, and are believed to have experienced a lot of dynamic over the last decade.

The maker movement is a growing community of individuals who engage in various forms of making or creating in their spare time. In contrast to earlier craftsmanship, the maker movement is characterized by a very active global community of enthusiasts who share designs, ideas and tips about modern technologies and means of production (such as 3D-printers) through digital networks (Hagel et al. 2014). Locally, makers often meet up in communal 'open workshops' (such as FabLabs or open creative labs) that are equipped with the requisite technologies for making and create a physical space for the exchange of knowledge and ideas as well as project collaboration (Simons et al. 2016). In addition, large international community events called Maker Faires, which take place in multiple locations throughout the year, provide a further opportunity to discuss new ideas and show off finished projects (Dougherty 2012; Maker Media 2017).

A number of current research projects[1] examine whether and to what degree the maker movement contributes to greater sustainability. While research is ongoing, preliminary results show that the movement has significant potential to increase sustainability, for example by reducing waste, producing on-demand replacement parts for repairs and encouraging reuse and upcycling, as well as increasing awareness and discussion of environmental sustainability issues among participants (Kohtala, Hyysalo 2015; Zirngiebl 2017; Unterfrauner et al. 2017). However, researchers also point out that the movement is highly heterogeneous and not all local maker spaces or individual participants are sustainability-minded (Kohtala, Hyysalo 2015; Unterfrauner et al. 2017). To what degree the maker movement is able to contribute to increased sustainability therefore still remains to be seen.

The concept of repair cafés originated in 2009 in the Netherlands and describes public meetings in which volunteers with some expertise in repairing help visitors to fix broken objects, often including electronics, household appliances, clothing and bicycles (Stiftungsgemeinschaft anstiftung & erthomis gGmbH 2015; Simons et al. 2016). The aims of the repair café movement include a reduction in waste and a change away from the "throwaway culture" as well as fostering a sense of community and upholding and passing along repair skills (Simons et al. 2016). There are two large umbrella organizations that most European repair cafés belong to, the Dutch Repair Café Foundation[2], which includes 1291 repair cafés, and the German Netzwerk Reparatur-Initiative[3], which lists 534 initiatives (as of June 2017, likely some overlap). In 2015, the Repair Café Foundation began a cooperation with iFixit Europe, "a free, publicly editable online repair manual with a mission to empower people to fix their stuff" (Repair Café International Foundation 2015).

Based on wide-ranging international survey results, almost all repair café participants cite environmental sustainability and the desire to encourage others to repair as their biggest motivations for participation in the movement (Charter, Keiller 2016, p. 4). First attempts have also been made to quantify the contribution of repair cafés to reducing waste. For example, the Dutch foundation Repair Café International estimated that in 2016 alone, the almost 1200 repair cafés known to them prevented approximately 250,000 kg of waste (Repair Café International Foundation 2017), thus extending product lifecycles and providing a viable alternative to the 'throwaway society'.

1 See for example the projects MAKE-IT (http://make-it.io/) and COWERK (http://www.cowerk.org).

2 https://repaircafe.org/en/.

3 https://www.reparatur-initiativen.de/.

3 Analysis of public attention

As already discussed in the introduction, we start from the notion that organizational and social innovations are multi-faceted and we have to look into three elements in order to address organizational and social innovations for sustainability. The first element is the analysis of public attention that we will discuss in the following. In detail, we present two separate indicators of public attention. Chapter 3.1 focuses on media coverage, while Chapter 3.2 analyses search behavior on the Internet using Google Trends analyses.

3.1 LexisNexis

In democratic societies, the media is a primary vehicle of public communication and, as such, agenda-setting in society. Media coverage of a topic is therefore an appropriate indicator for public issue-attention and following the work of Newig (2004), we will measure the level of media coverage as the number of articles on a specific topic per year.

3.1.1 Data source

The media searches are conducted as keyword searches in the database "LexisNexis News and Company" (hereafter LexisNexis). This database includes 23,000 international press sources, such as newspapers, magazines, trade journals, news wires and agency news. For Germany, the database comprises 170 journalistic publications and 160 further German sources, including company profiles, as well as financial, market- and industry-level data.

Table 1: Search strings used in LexisNexis

Case Study	Short Title	Search String
Maker Movement	Maker Movement	(("maker movement") oder ("offene Werkstatt") oder ("offene Werkstätten") oder FabLab oder ("fab lab") oder ("fabrication laboratory") oder makerspace oder ("maker Bewegung") oder ("fixer movement")) nicht (("fab- and lab-based") oder ("maker of the movement") oder ("makers. the movement"))
	Techniques	("3D Druck" oder "3d print" oder "on demand produktion" oder "on demand production" oder "digital fabrication" oder "digitale Fertigung" oder "peer production")
	Maker Faire	"maker faire"
Repair Café	RepairCafé	("reparatur cafe" oder "repair cafe" oder "Reparaturcafe" oder "reparatur initiative")
	iFixit	ifixit oder (ifixit.com) nicht vanity

The global search results are generated using the database's pre-defined source list "All News, All Languages", while the Germany-specific results are based on the source list "German Language News", which consists of all 333 sources from Germany. All search strings are run from January 1, 1990 through December 31, 2016. Duplicate articles are

counted multiple times, since the diffusion of a single article through multiple sources increases the size of the readership and thus the potential for public awareness.

The analysis includes four search strings regarding the 'maker movement' and two search strings about repair cafés. The search strings, shown in Table 1, are each made up of multiple keywords drawn from background research on the two case studies (see Chapter 2). As Lacy et al. (2015) point out, the use of single-keyword searches can lead to imprecise results and be tainted by the researcher's bias. By combining a series of literature-based keywords into search strings, the search validity is increased.

The search strings were created in an iterative process using Boolean search operators. Manual spot-checks were used to check for precision, i.e. the relevance of articles found (Stryker et al. 2016). Where necessary and possible, the operator AND NOT was used to exclude obviously irrelevant search results. However, for some plausible search terms it was not possible to delimit the searches appropriately, either because the terms were too general, such as "ready-to-print design" or because they had too many alternate meanings, like "prosumer" and "mass collaboration". These terms were therefore not included in the search strings.

3.1.2 Advantages and disadvantages of LexisNexis

The analysis of public attention using media coverage as a proxy has a series of advantages over other methods of measurement. First, it is widely applicable to any topic of interest and comparatively cheap and efficient. In contrast to other methods of measuring public attention, such as polls or surveys, there are no inherent limits to the issues that can be quickly and easily analyzed using media coverage. Search strings on any topic can be used without the added cost and time otherwise necessary to design and carry out large-scale data collection projects, since newspaper archives present a readily available data set of enormous size (Newig 2004).

Second, using searches in a large database like LexisNexis, rather than searching through the archives of individual archives is both more time- and cost-efficient and more likely to catch innovative issues early on. Reporting on innovations may only reach major, large-scale newspapers once they have reached a more advanced degree of diffusion, whereas smaller local newspapers or industry-specific magazines may write about them at a much earlier stage.

Third, media analyses allow for the creation of both historical and current time series on any issue of interest, allowing for a quickly accessible overview of the development of the level of public attention to any topic over a broad range of time. The database LexisNexis is updated daily, although the historical coverage of the included sources is strongly variable.[4] Because the database is updated daily, another big advantage of the LexisNexis search is that, if requested, the data can be analyzed on a daily basis. As a consequence, daily peaks can be identified and conclusions on specific events - that might also influence the results of the search - can be drawn. Though this is not in the focus of the current study, it might serve as an interesting starting point for other analyses.

Finally, a comparison of public attention in different countries to a particular issue can be created by carrying out searches using country-specific sources only, as was done exemplarily in this study for Germany. An overview of the number of sources available in LexisNexis for selected countries can be found in Table 13 (see Annex).

The interplay of these advantages allows this methodology to be applied particularly well to issues that are still in the early stages of development: "Polls, by contrast, most often only cover issues already ‘established’, thereby excluding the most sensitive first stages of attention cycles" (Newig 2004, p. 159). Yet an early identification of soft innovations is key in the context of socially desirable sustainability innovations, since these should be identified and fostered early on to ensure their diffusion to a larger scale.

Nevertheless, there are also a number of disadvantages to using LexisNexis as the basis for media coverage and public attention analysis that should be taken into consideration when interpreting the results. The most critical of these are the possible biases inherent in conducting searches in any database with limited sources. While LexisNexis at present includes over 23,000 international press sources, not all of these sources provide the same historical coverage. For example, while some sources extend quite far back in the database (*Washington Post*: 1977; *The New York Times*: 1980; *Neue Zürcher Zeitung:* 1993; *Süddeutsche Zeitung:* 1994), others have only been added quite recently and provide much less coverage (such as *Die Zeit:* 2008; *Financial Times Daily:* 2013; *BILD:* 2017).[5]

4 This issue and its implications are discussed in greater detail below.

5 While it is possible to ascertain the historical coverage of each individual source, LexisNexis unfortunately cannot provide summary details of how many sources are available for each year in the past. Given the large number of available sources, checking each source individually to reach a total per year is not economically feasible.

Similarly, while the database covers native-language publications for many European and North American countries, its coverage is less extensive for other areas of the world, in particular Asian languages (see Annex 1). This problem is addressed to some degree by the inclusion of local English-language newspapers, such as the *The Japan News,* which is published by the most high-circulation newspaper of the world *The Yomiuri Shimbun* and includes translations of its Japanese articles. Given that most research cannot be conducted in dozens of translations, however, the inclusion of many local English-language newspapers can also be seen as an advantage, since they allow searching at least some local coverage for most countries.

Finally, some issues, including certain types of soft innovations, are difficult to capture adequately in keywords. This can be the case when relevant keywords are not distinct or unambiguous enough, such as "prosumer" and "ready-to-print design" in this case study (see Chapter 3.1.1). Related to this are questions of recall and precision: recall is a search string's "ability to accurately call up items of interest," while precision refers to the relevance of articles found (Stryker et al. 2016, p. 413). In theory, both measures can be quantified for the use in statistical analyses (see e.g. Lacy et al. 2015). However, to achieve an accurate measure, all search results would need to be manually coded, which is a very time-consuming and involved process that is not realistic for large numbers of search results.

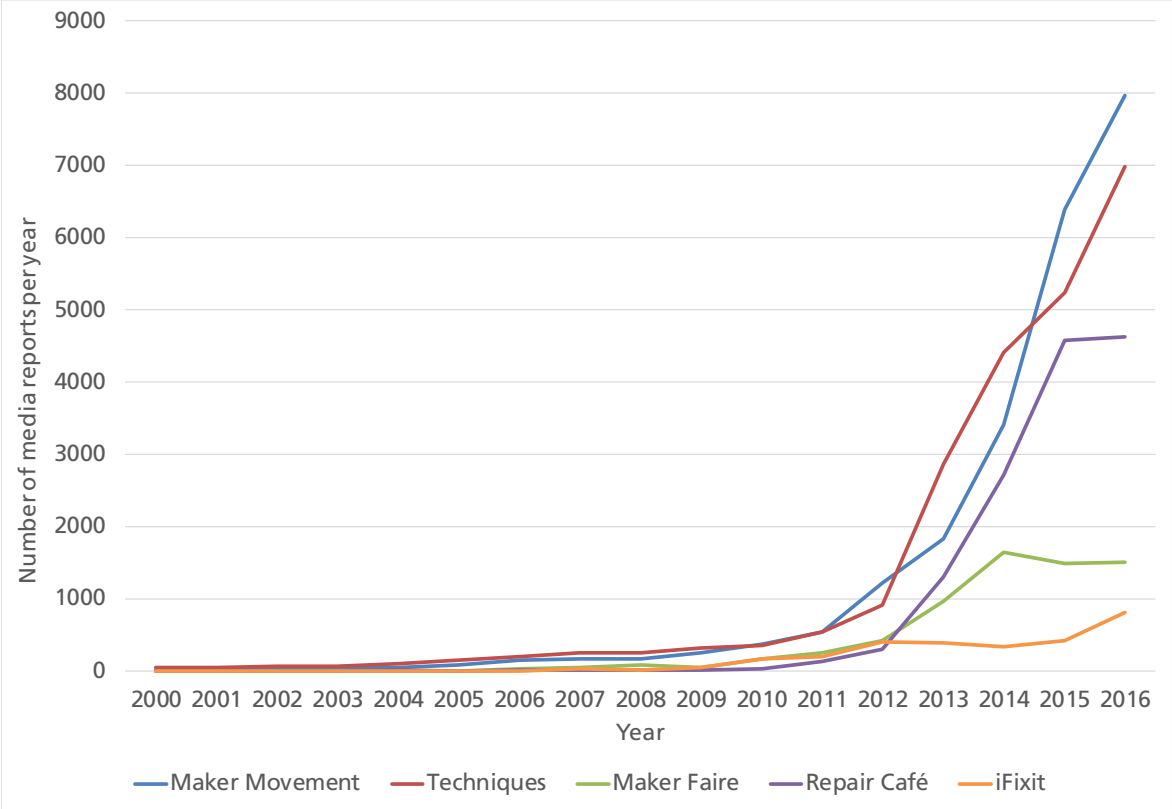
3.1.3 Results from LexisNexis

Figure 2 shows the number of global media reports per year for each search string.[6] While a handful of media articles for the maker movement search string appeared as early as the mid-1990s, beginning in 2006, the topic produced between 100 and 500 articles per year. Beginning in 2012, a steep increase in media attention can be seen that has continued unabated through 2016. As would be expected, the search for techniques commonly used in maker spaces and fab-labs follows a very similar trend. The reporting on Maker Faires, which have been organised since 2006, also increased steadily during this time period, albeit at a somewhat lower level. For the time being, the topic of Maker Faires appears to have reached a peak in reporting in 2014, after which there was a slight decrease in media attention not seen in the maker movement and techniques searches.

6 While all searches were conducted starting in 1990, there were very few results for the first decade. The figures below therefore begin only in or after 2000 to focus in on relevant trends and make the data more easily legible.

Reporting on repair cafés increased slowly until 2012 and as steeply as that on the maker movement and associated techniques beginning in 2013. Media attention in 2016 increased only very slightly as compared to 2015. News on iFixit, finally, picked up beginning in 2010, but has increased much more slowly than the other topics.

Figure 2: Number of global media reports per year and search string



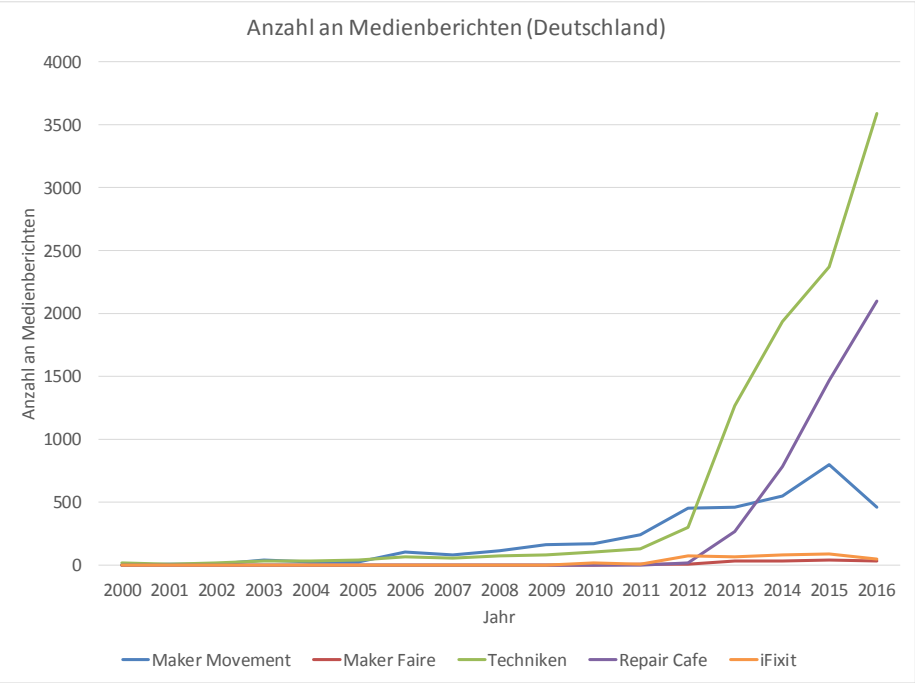
Source: LexisNexis, queries and calculations by Fraunhofer ISI

Looking at the two case studies as a whole, it is clear that there has been a strong increase in media interest in both the maker and repair café movements beginning in 2011/2012. In terms of absolute numbers, the maker movement has received more attention than the repair café movement, although interest in this area also started a few years before the repair café movement began, so that the difference in absolute numbers may result from this temporal lead.

Figure 3 shows results for the same search strings, but with a focus on only German media, while Figure 4 highlights the share of German media reports as compared to global reporting. The most notable difference in comparison to the global results is the much smaller amount of media interest for the maker movement. This is of particular interest since a significant proportion of the global media attention on techniques associated with the maker movement stems from Germany (see Figure 4). Since the search strings were bilingual, this does not appear to be a linguistic bias in the search results. Reporting on Maker Faires

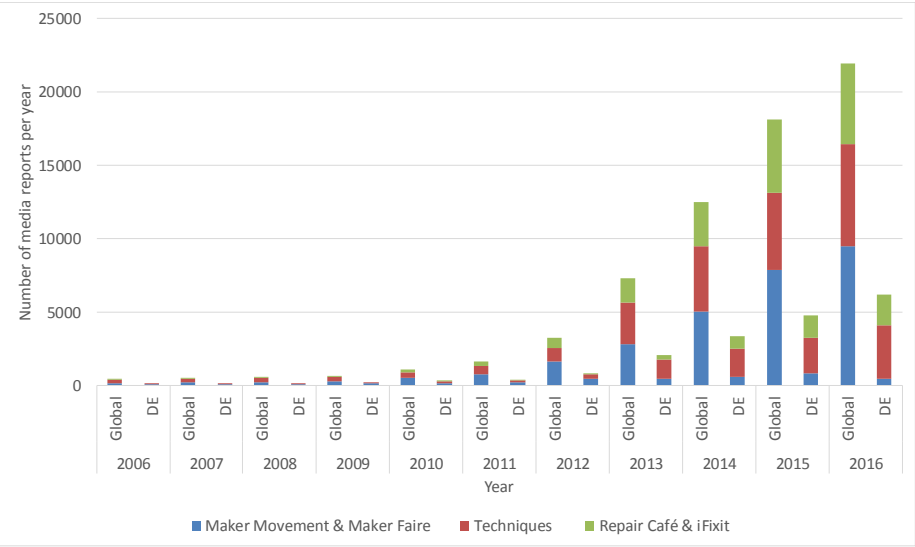
and iFixit remains quite low in Germany, while the attention paid to the repair café movement mirrors the global trend.

Figure 3: Number of German media reports by year and search string



Source: LexisNexis, queries and calculations by Fraunhofer ISI

Figure 4: Comparison of number of global and German media reports per year



Source: LexisNexis, queries and calculations by Fraunhofer ISI

3.1.4 Conclusions and feasibility

The results presented in Chapter 3.1.3 show that media coverage, and consequently public awareness, to the maker and repair movements has grown significantly since 2011. Globally, the coverage of the maker movement has outpaced that of the repair movement, while in Germany, both repair cafés and techniques associated with the maker movement, but not the maker movement itself, have been particularly dominant.

More generally, the LexisNexis results show that these soft innovations are currently on the rise, although both are certainly still niche phenomena. To date, it is not possible to tell whether this increase in media coverage is a temporary hype associated with the novelty of the movements, or whether public interest in these innovations will continue to stay high over a longer period of time. However, insofar as there is interest from a political point of view to promote these soft innovations further in support of sustainability, it may be conducive to do so while public attention to them is high.

In terms of feasibility, we find that the advantages of conducting media coverage searches with LexisNexis as a proxy for public attention outweigh the disadvantages overall. The range of topics that can be examined is almost limitless, the range of sources - particularly for more recent years - is extensive and the geographic coverage is considerable. Nevertheless, the limits of the methodology explained in Chapter 3.1.2 need to be kept in mind when interpreting the results.

3.2 Google Trends

In the preceding chapter, we analyzed public attention with regard to the maker movement and repair cafés based on LexisNexis, i.e. international press sources such as newspapers etc. were at the foreground. What was not taken into account, however, is the Internet as a potential source for analyzing public attention with regard to a given topic. This will be the focus of the following chapter by analyzing "Google Trends".

"Google Trends" (or Trends) is a tool set up and maintained by Google, which allows the user to assess the number of search queries that the public has performed with regard to a given search term at a certain point in time and at a given location (countries, partly regional level). It therefore mirrors trends in Internet search activity (Ripberger 2011). In contrast to the analysis of classic press sources via LexisNexis, where an author writes about a certain topic that is in the interest of the public, Google Trends enables researchers to directly assess what raised people's attention at a given point in time. Yet, this also comes with certain limitations and drawbacks that will be discussed in section 3.2.2. Before discussing the advantages and disadvantages of the method, however, we will first of all describe the data source and its potential. We will then provide an analysis on the public interest regarding the maker movement and repair cafés analogously to the analysis of LexisNexis. In a final step, we will discuss the feasibility of the approach for further studies.

3.2.1 Data source

As already stated above, Google Trends delivers insights on the amount of searches with regard to a given search term. The amount of searches can be analyzed over time, back to the year 2004 (in daily windows). Google Trends also allows the user to differentiate the analyses by country and category, which enables country comparisons and comparisons across categories.[7]

Google Trends is an unbiased sample of Google search data[8]. Yet, only a percentage of searches is used to compile the Trends data. There is a difference between real time data and non-real time data (Google 2017), while we only focused on non-real time data for comparisons over time:

- real time data is a random sample of searches from the last seven days.
- Non-real time data is a random sample of Google search data that range back until 2004 and up to 36 hours prior to the search.

After collecting the search data, Google categorizes it and removes any personal information. Searches made by very few people[9], repeated searches from the same person over a short period of time (duplicate searches) and searches with special characters are excluded from the Trends analysis.

Afterwards, Google Trends adjusts search data proportionate to the time and location of a query by dividing each data point by the total searches of the geography and time range it represents, i.e. a "relative popularity" is estimated. The resulting figures are then scaled on a range of 0 to 100 (based on a topic's proportion to all searches on all topics). The values thus indicate the search interest relative to the highest point in the graph for the selected region in the specified period. The value of 100 stands for the highest popularity of this search term. The value 50 means that the term was half as popular and the value 0 corresponds to a popularity of less than 1% compared to the maximum value (Google 2017).

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7 Google uses its own category system, e.g. "arts & entertainment", "autos & vehicles", "beauty and fitness" etc., to search by category. Unfortunately, this system does not follow other standardized classification systems. In addition, there is no further information on how these categories are formed, which sub-categories exist etc. We therefore did not apply the category system as it might limit our results to a subset that is out of our control.

8 This and the following information has been taken from the Google Trends Help Center available at: https://support.google.com/trends/?hl=en#topic=6248052, last accessed: 08/10/2017.

9 In case there are too few Google search queries for a given search term. Trends will not display any results.

Consequently, absolute search volumes are not available from Google Trends and different countries/regions that show the same number of searches for a term will not always have the same total search volumes (Google 2017).

Google Trends does not only allow a search for a single search term, but also for a combination of search terms. The search terms for the 'maker movement' and repair cafés were chosen according to the LexisNexis search to get comparable results. The list of search terms for Google Trends is provided in Table 2. The list of search terms is slightly different from the LexisNexis search, which is due to the fact that Google only allows searches of maximum 100 characters (including spaces) and some of the LexisNexis searches are longer than 100 characters. We thus restrict the search to those keywords that overall provide the largest number of hits. Furthermore, we exclude the search term "ifixit" from the search. "ifixit" is an internet platform that provides repair solutions to users in the form of (online) video manuals. Using "ifixit" as a keyword thus results in a large number of searches by users that do not want to find out something about "ifixit" but only search for repair solutions provided on the "ifixit" platform, i.e. they want to use the service offered by "ifixit". Including the term would thus bias the results for our analysis, which lead to the exclusion of the keyword.

Table 2: Search strings used in Google Trends

Case Study	Short Title	Search String
Maker Movement	Maker Movement	"maker movement" + "makerspace" + "FabLab" + "Fab Lab" + "maker Bewegung" + "offene Werkstatt"
	Techniques	"3D Druck" + "3d print" + "on demand prod*" + "digital fabric*" + "digitale Ferti*" + "peer prod*"
	Maker Faire	"maker faire"
Repair Café	RepairCafé	"reparatur cafe" + "repair cafe" + "Reparaturcafe" + "reparatur initiative" + "repair initiative"
Established repair- and maintenance services	German	"Wartung" + "Aufarbeit*" + "Wiederverwendung*" + "Reparatur*" + "Produktverwertung" + "Instands*"
	English	"maintenan*" + "refurbis*" + "remanuf*" + "reuse*" + "repai* serv*" + "prod* recov*" + "recondi*"

Note: The "+" sign in the search represents an "OR", the "*" is a wildcard.

In addition to the keywords used in LexisNexis, we introduce a third category, namely a search for established repair and maintenance services. This is supposed to provide us with the information to what degree classic models of repair services still receive public attention. This search is provided in German and English, while the searches for the maker movement and repair café are not separated due to the use of Anglicisms in the search.

3.2.2 Advantages and disadvantages of Google Trends

Google Trends is an interesting tool to analyze public attention to a certain topic on the Internet as it is the only platform that allows analyzing internet searches in an aggregate manner over time and space. Besides giving the user the opportunity to analyze Google search terms on the web, it also provides the opportunity to assess search terms on "Google News", "Google Shopping" and "Youtube".[10]

Like LexisNexis, Google Trends searches can likewise be conducted on a daily basis to identify daily peaks and their corresponding trigger events. Furthermore, Google Trends provides "Top Trends" for the day. This turns the logic of the analysis upside down, i.e. the user does not proactively search for given search terms over time (or space) but Google uses real-time data and provides (only) the top results on a daily basis to compile the "Top Trends". Once again, this does not lie in our focus but might serve as an interesting starting point for further research.

Yet, Google Trends also comes with a number of limitations that users should keep in mind for the interpretation of the results as well as the future analyses based on Google Trends. Probably the major drawback of Google Trends is that the sample is basically unknown and biased towards "internet users". This group of people cannot be fully identified but it also cannot be seen as representative for the whole society. This might lead to selection effects and potential biases in the results.[11] The second major problem related to Google Trends is the language of the search query and the comparability of results across countries. For searches within a country, the language spoken in the respective country can be applied. For international comparisons, however, the search query should be translated to the language for each country under analysis, which is not possible in many cases.[12] In consequence, researchers have to rely on queries in English for international searches, knowing that major parts of the world (in terms of Google searches) are left out as people in non-English speaking countries commonly search in their mother tongue. In our case, fortunately, the language issue is less of a problem as the topics are described mostly by anglicisms ("maker movement", "repair café", etc.). Still, it might be the case that some of

10 This has not been analyzed in the current study as it does not provide an added value in the given context.

11 This is not specific to Google Trends. Many analyses that use internet sources, e.g. download or reading statistics, suffer from this problem.

12 An option for the translation to several languages would be machine translation, e.g. Google Translate. However, these translations cannot easily be checked or controlled.

these Anglicism are not used in English-speaking areas, which might induce another bias. We will come back to that later with an example in the analysis. The third drawback of Google Trends is that only Google searches are taken into account, while searches on other platforms are neglected. This might lead to another bias as Google as a search engine might be used more often in one country than another.

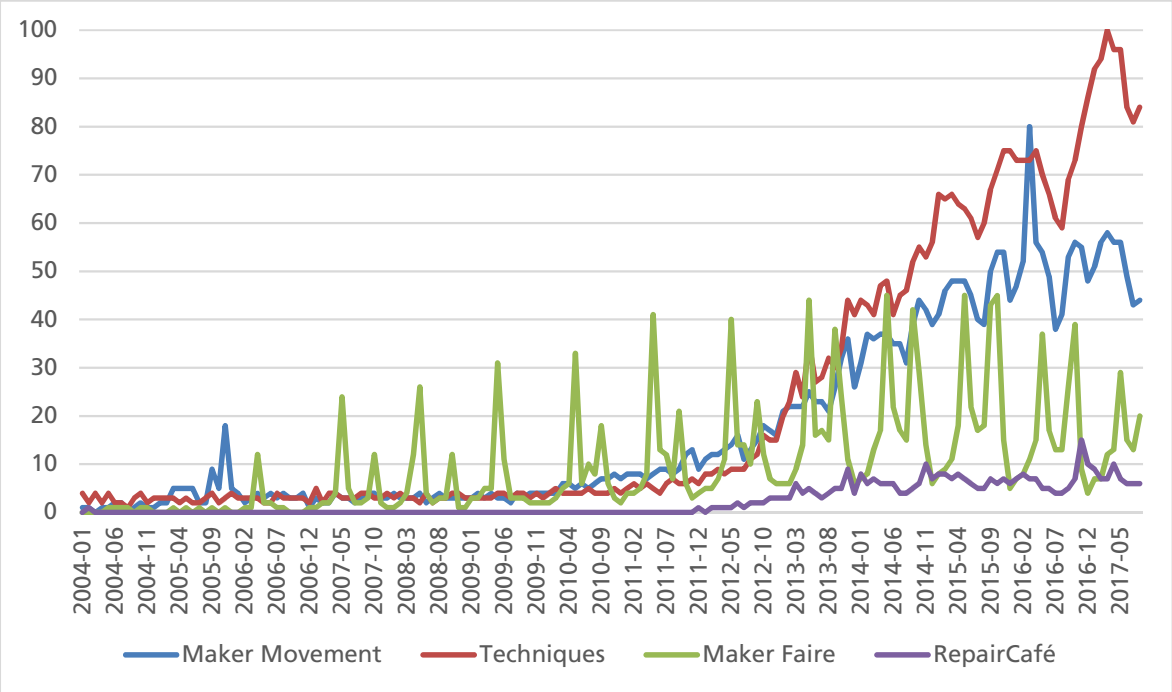
Fourth, there are a number of limitations that are directly related to the Google Trends platform that has to be used for the searches. One major drawback is that the search is limited to 100 characters. Large queries with many keywords thus cannot be performed. Second, there is no clear information on how searches are counted and normalized. The normalization further leads to the fact that the results of the analyses cannot be compared across searches. Third, only single graphs (and underlying data in .csv form) can be downloaded from the platform. Finally, the category classification that Google uses does not follow any international standard.

In sum, Google Trends offers a unique analytical potential as it allows the analysis of search trends on a large scale basis, which can be used to capture public attention towards a given topic. Yet, there are biases with regard to sampling (sample of "internet users", language, Google usage in the respective countries) that have to be kept in mind for the interpretation of the results. Furthermore, Google Trends only offers limited potential to adjust searches and adapt the outcome of the search and the normalization limits the analytical breadth and flexibility with regard to more detailed and comparative analyses.

3.2.3 Results of the Google Trends searches

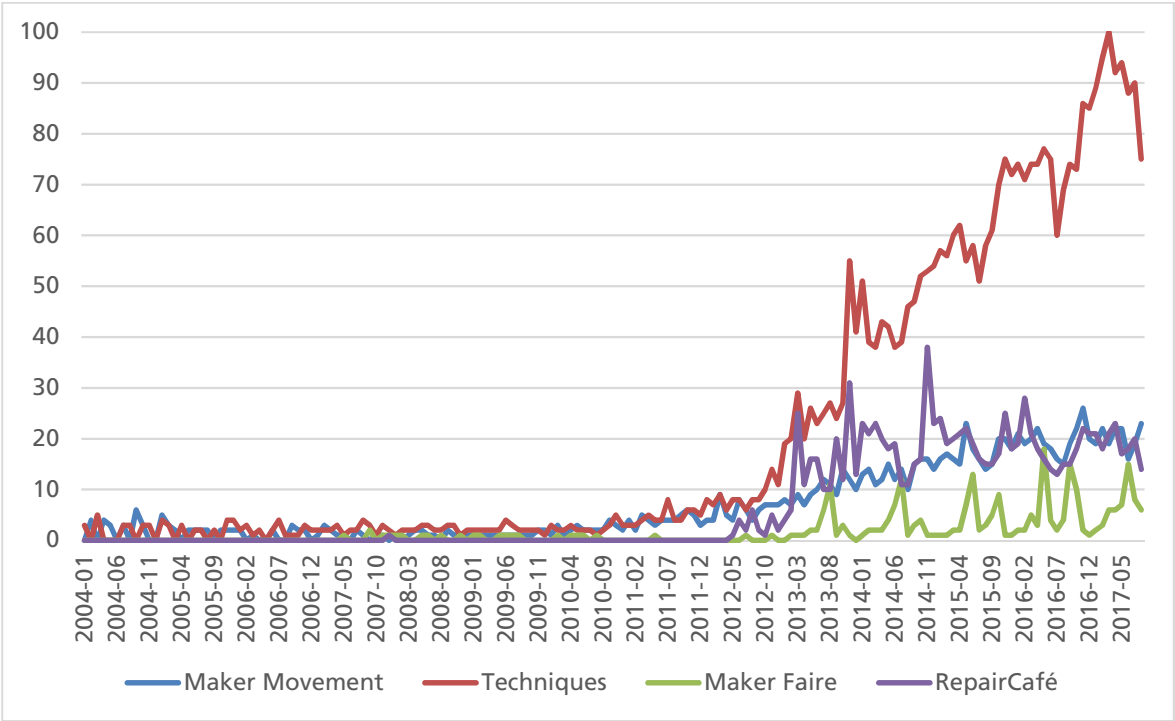
The number of monthly global Google searches for each search string is plotted in Figure 5. There is a rising trend in terms of searches for new models of repair- and maintenance services since 2004. While the increase has been only moderate until the middle of 2011, a rather steep increase can be found afterwards. The only exceptions are the "Maker Faires" that lead to peaks in searches usually before larger Maker Faires take place. In sum, however, it can be stated that public attention towards new models of repair and maintenance services on the internet has been booming since 2011. This probably has to do with the advent of 3D-printing (and related techniques) that has become affordable for private and "home" users since about 2010. Currently, the novel techniques, e.g. 3D-printing and digital fabrication per se, are also where the largest public interest on the internet is targeted towards. The maker movement, including FabLabs and other "makerspaces", scores second in terms of Google searches in 2017. Repair cafés are searched less often, at least on a global scale.

Figure 5: Number of Google searches for new models of repair and maintenance services, worldwide, 2004-2017



Source: Google Trends

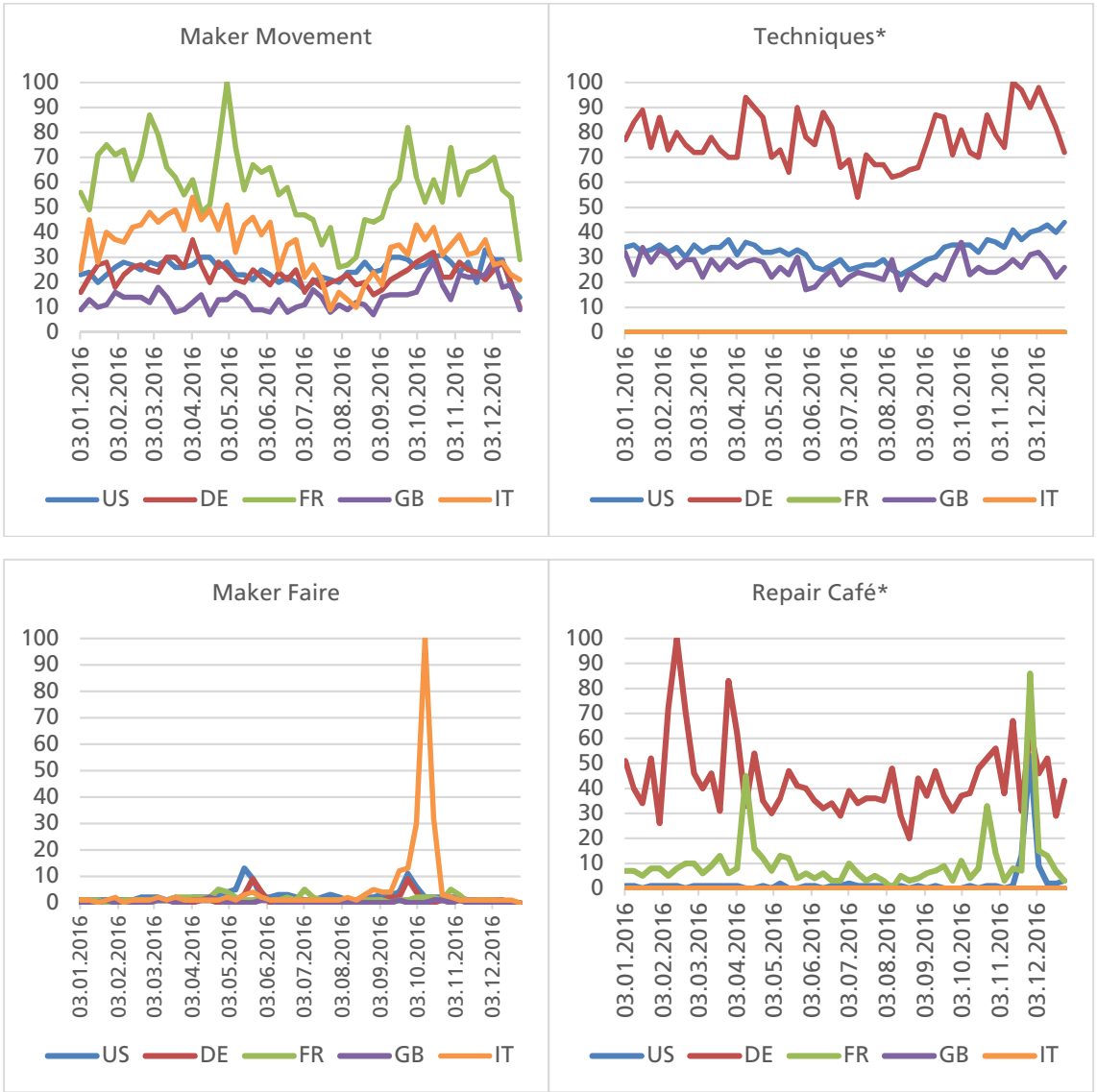
Figure 6: Number of Google searches for new models of repair and maintenance services, Germany, 2004-2017



Source: Google Trends

With regard to Germany (Figure 6), a similar growth pattern can be observed. Public attention towards new models of repair and maintenance services as measured by Google searches have grown moderately until 2011. From then, however, a boom with regard to all topics can be found. The specialty for Germany, however, is that the techniques are by far most important. The terms for "maker movement" are searched less often. The terms related to repair cafés have gained large public attention compared to the worldwide scale, indicating the relative importance of repair cafés in Germany. Yet, this might be related to the fact that the word "repair café" is mostly used in Germany, while the terms related to the maker movement are more popular in other countries. These two effects, however, cannot be disentangled with the data at hand.

Figure 7: Country Comparisons - Maker movement vs. new models of repair and maintenance services, 2016



Source: Google Trends
Note: Graphs marked with a * can only be interpreted for Germany, the U.S. and Great Britain.

Besides analyses over time, Google Trends also allows country comparisons. In Figure 7, this is shown for all of the new models of repair and maintenance services for the year 2016. It has to be kept in mind for the interpretation that, due to the normalization of Google Trends, the results cannot be compared across the analyses. A value of 100 for Germany in one graph does not directly correspond to a value of 100 in another graph as the relative dimensions (here differences between countries) and the absolute values differ. However, country comparisons for the single keyword searches are possible.

With regard to the "maker movement" it can be found that the largest number of search queries (in relation to all search queries) stem from French users, followed by Italy. The U.S. and Germany mostly score third and fourth throughout 2016, while the keyword is less often searched by users from Great Britain. When it comes to techniques, the results show a very different pattern. However, this is (at least partly) due to a methodological problem described above, namely the language bias. In our query, only English and German keywords are used but not French or Italian ones. This is not a problem for the query on maker movement as the keywords for maker movement mostly consist of Anglicisms that are used all over the world. Yet, for the techniques, the words "3d-printing" or "3d-druck" are used, but the French and Italian equivalents are left out. Therefore, only Germany, Great Britain and the U.S. can be compared in this graph.

It becomes obvious, however, that the keywords related to techniques are most often used for searches by German users. This result has already been found in the aforementioned analyses, pointing to the fact that public attention towards techniques is higher in Germany than in the U.S. and in Great Britain. With regard to Maker Faires, the largest attention in (October) 2016 came from Italian users. However, this is because the Maker Faire in Rome (in October) is one of the largest Maker Faires worldwide, so it is not surprising that it got a quite large attention in Italy. With regard to repair cafés, that largest attention in 2016 came from Germany. Yet, there were three peaks where also French users applied the search term rather frequently, which might once again be related to single events.

Besides the new models of repair and maintenance services, we can, in a final step, also take a closer look at the public attention towards established repair- and maintenance services. This is plotted in Figure 8 (worldwide) and Figure 9 (Germany).[13] On the left hand side of the respective figures, the time trend is plotted, while it is compared to the number

13 The two lines cannot be plotted in one graph as this would imply a comparison across languages. Combined with the normalization by Google Trends, this would lead to results that are not comparable within one graph.

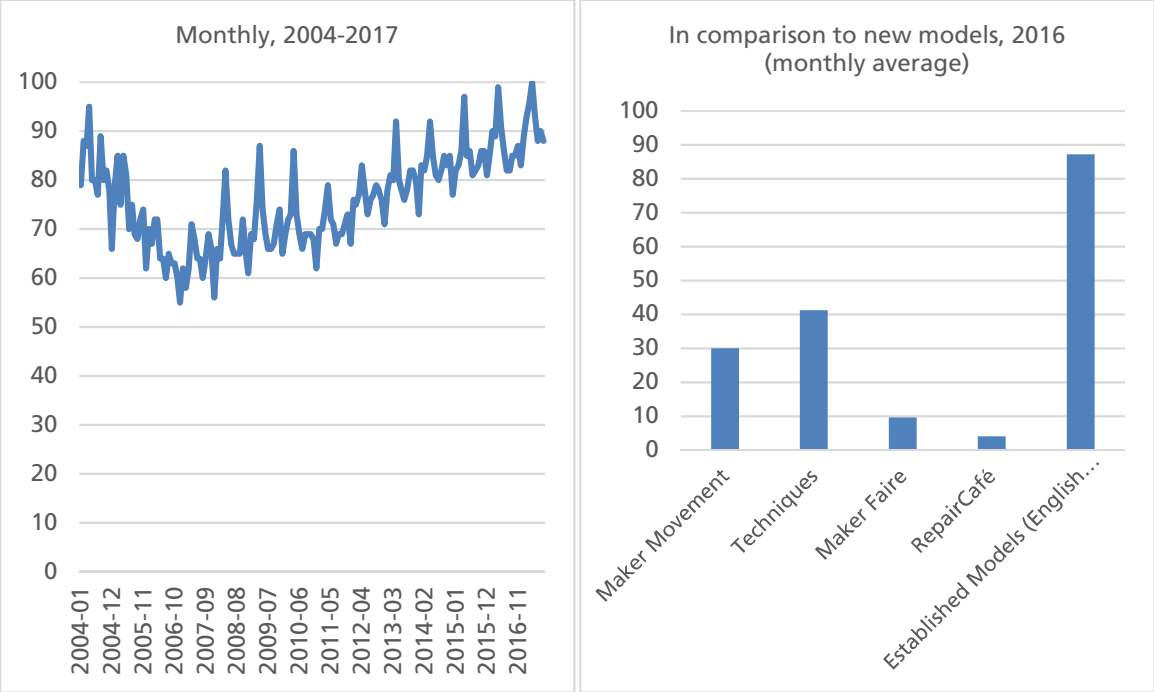
of searches on new models of repair and maintenance services on the right hand side of the figure.

The worldwide public attention towards established models of repair and maintenance services has decreased between 2004 and 2007 (Figure 8). After 2007, however, a constantly increasing trend can be found. Compared to the new models of repair and maintenance services, the established models still have a larger weight when it comes to worldwide Google searches.

This is slightly different for Germany. Here, a decrease in public attention becomes obvious until 2011. Afterwards, we see a slight increase that coincides with the increase of the new models. As we can see from the right hand side of the graph, established models have gained larger public attention in Germany compared to new models than this is the case on a worldwide scale (thought this is hard to compare due to the normalization by Google Trends).

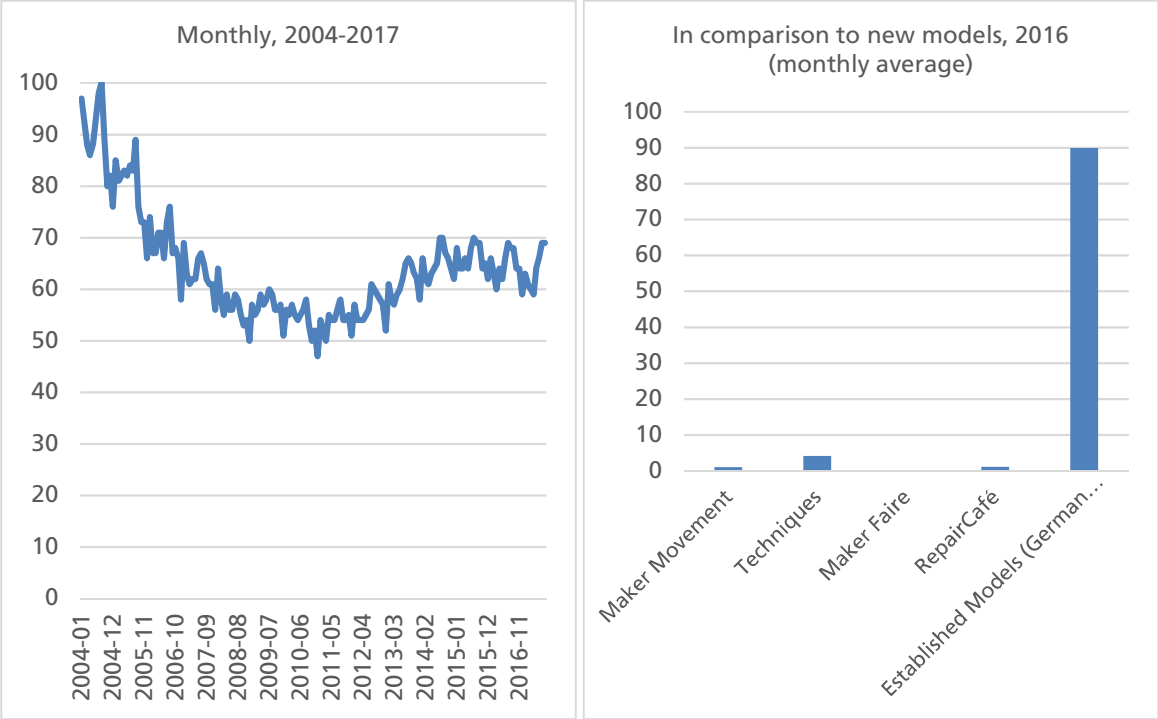
In sum, however, it seems that established repair models have had a larger weight in Germany than they had worldwide. On a worldwide scale, we see a larger (positive) dynamic with regard to public attention for established models. The discussion of new models thus might have had an indirect effect by also fueling the attention towards classic models on a worldwide scale.

Figure 8: Number of Google searches for established models of repair- and maintenance services, worldwide (English keywords), 2004-2017



Source: Google Trends

Figure 9: Number of Google searches for established models of repair and maintenance services, Germany (German keywords), 2004-2017



Source: Google Trends

3.2.4 Conclusions and feasibility for future studies

In sum, the results point to the fact that new models of repair and maintenance services have gained large attention especially since 2011 when 3D-printing and related techniques became available to private users. This technology has enabled non-experts to create new modes of repair and maintenance services. At least partly, a technological innovation has thus triggered a "social innovation" in the form of maker movements, repair cafés, Fab-Labs etc. Yet, the results show that the conventional modes of repair and maintenance services still outweigh the new modes, at least when it comes to public attention on the internet. Interestingly, especially German users seem to be most interested in the techniques that drive the maker movement, while this is of less importance in other countries.

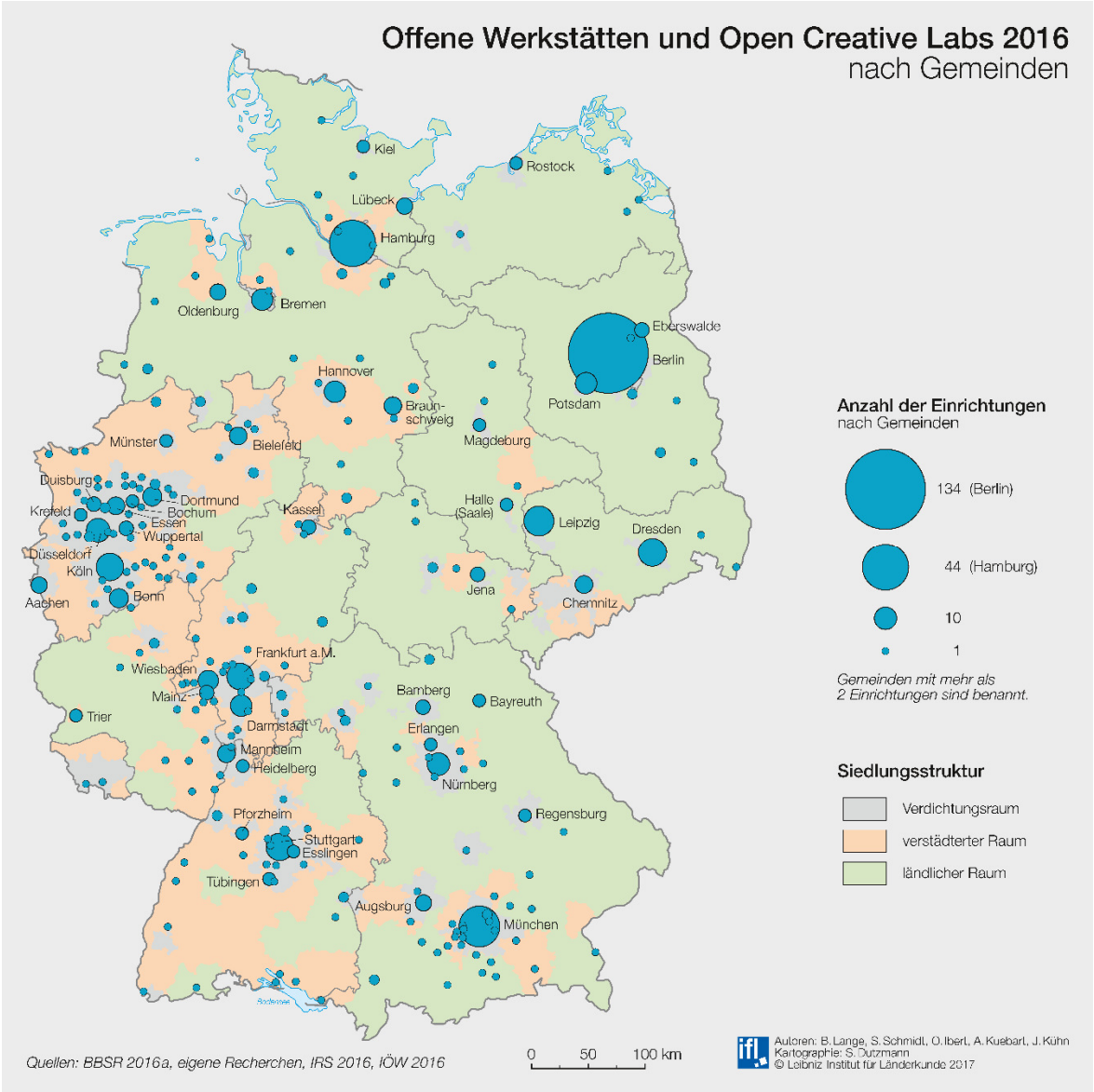
With regard to feasibility, it can be stated that Google Trends is an excellent tool when it comes to generating an overview about public awareness with regard to a given topic on the internet. It allows comparisons over time and across countries. Furthermore, a categorization and a comparison across categories are possible. However, from a scientific point of view, Google Trends has some major drawbacks as it comes with some systematic biases that are out of control of the researcher, i.e. language issues, country biases, etc. It furthermore restricts the flexibility of the researcher regarding the use of the search and the display and analysis of the results. In sum, Google Trends should be used with caution, keep-

ing in mind its limitations. However, it can be used to provide a first look at the public attention towards certain topics and enables analyses that are otherwise not possible.

3.3 Plausibility of LexisNexis and Google Trends results

A key question in the exploration of new indicators for soft innovation is whether the results they yield correspond to actual activities in society. To answer this question for the use of public awareness as measured by media coverage and Google searches as a proxy for soft innovation, this section will compare the results of the public awareness analyses with other statistics that represent actual activities on the ground in the two case studies.

Figure 10: Number of open workshops and open creative labs in Germany in 2016

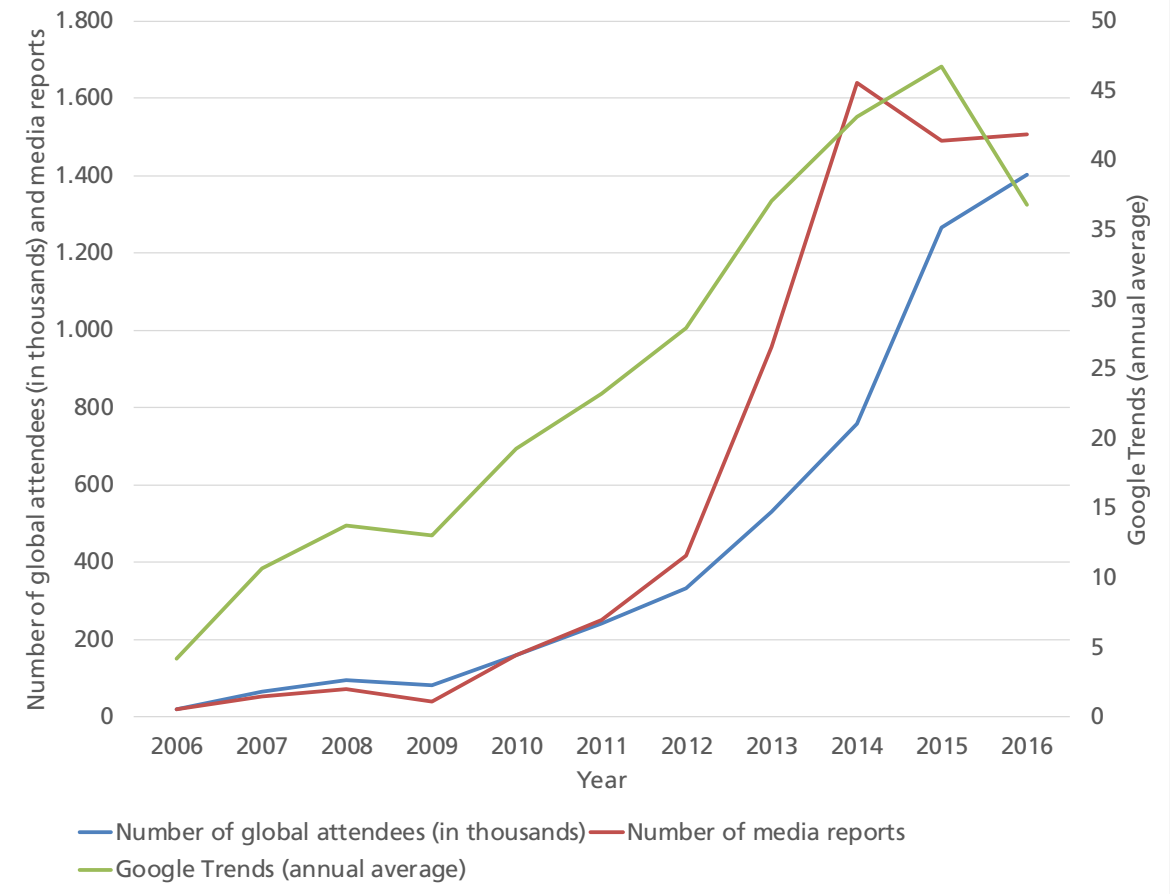


Source: Lange et al. 2017

Figure 10 depicts the number of open workshops and open creative labs in Germany in 2016. While it is a static representation that does not allow for an analysis of the development of the maker movement over time, it does show that, by 2016, these types of communal institutions have reached a significant degree of diffusion in Germany. Most larger cities have multiple such venues and they have also begun to spread to more rural areas.

Looking back at Figure 3 and Figure 6 and comparing these with this national development, it appears that both the German media and German Google users are more interested in the types of activities and technologies (i.e. the search string 'techniques') that take place in maker spaces than in the social movement that accompanies it (i.e. search string 'maker movement'). This fact illustrates the importance of using multiple and varied keywords to describe a soft innovation when conducting a media analysis as a proxy for the innovation's degree of relevance and development.

Figure 11: Comparison of the number of global attendees at Maker Faires with the number of global media reports and Google searches on Maker Faires



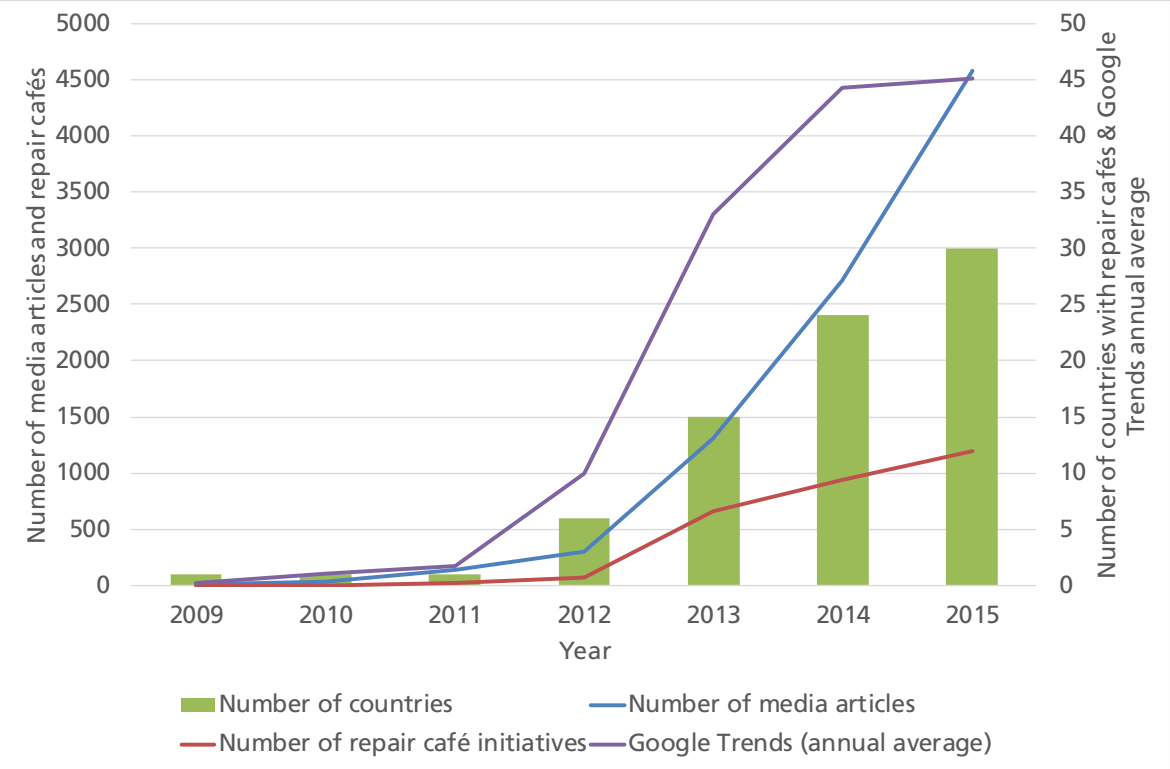
Source: Maker Media 2017, Google 2017

A measure that does allow for consideration of the development over time is the number of global attendees at Maker Faires as compared to the amount of global media and Google user attention to these events. Figure 11 shows that media reports matched the number of

attendees fairly closely from 2006 to 2012, but increased more quickly between 2013 and 2015. The Google Trends results, shown as index values and on the secondary axis, mirror the trend of the number of attendees quite well through 2015, with an anomalous result in 2016. In spite of the fact that both measures do not match the number of attendees exactly, the comparison nevertheless shows that both media attention and Google Trends results can serve as reasonably accurate proxies for the development of Maker Faires.

Figure 12, finally, shows how the number of global media articles and the number of Google searches on repair cafés compare to both the number of repair café initiatives and the number of countries in which these are active (as reported by the Dutch foundation Repair Café International). The data shows that both the increase in media attention and Google searches correspond quite closely to the diffusion of the movement to different countries. The fact that these indicators are higher than the number of individual initiatives shows that interest in repair cafés is present not only when a new repair café opens, but also continues more long-term thereafter.

Figure 12: Comparison of the number of global repair café initiatives, the number of countries with repair cafés, the amount of global media attention to the topic and the average number of annual Google Trends searches



Data sources: Stichting Repair Café 2010, 2011, 2012; Stichting Repair Café Nederland 2013, 2014, 2015; Stichting Repair Café International 2016; Google 2017

Individual repair cafés generally offer regular events once they have been founded and it is likely that the local "market" for such communal spaces will be saturated once a certain number of initiatives have been established. As a result, the level of media attention and

number of Google Trends results should be seen as an important complementary measure to the total number of repair café initiatives in existence when measuring the diffusion and development of the repair café movement as a social innovation.

4 Attitudes towards sustainability and resource efficiency

There is a big difference between public attention and public opinion (Newig 2004; Ripberger 2011). Public attention - and this is what we focused on in the preceding analyses on LexisNexis and Google trends - denotes the resources that people dedicate toward thinking about a certain issue. (Public) opinion, on the other hand, relates to (aggregated) individual attitudes, values or predispositions that can be measured with the help of surveys. There are many surveys with regard to the topic of sustainability in different facets. However, large scale surveys measuring the attitudes towards sustainability issues that are comparable over time and across countries are scarce. Two of them are the Eurobarometer and the World Values Survey. Both try to capture values and attitudes of people in an international comparison, though they are not specifically designed to indicate attitudes towards sustainability. Both surveys, however, include questions that address the attitudes of people towards sustainability issues in certain waves.

In this chapter, we will therefore take a closer look at these two sources. We will mostly target them from a methodological viewpoint. This means we examine whether and how they can be used to assess different facets of attitudes towards sustainability in general as well as attitudes on more specific sustainability issues related to our case studies. Related issues comprise mainly resource efficiency and waste reduction but also the role of selected actors. Thus, we first provide an overview of the coverage of the two sources and we will address how they can be used to answer questions related to sustainability. After that we will provide some exemplary results including international comparisons with a focus on Germany. In a final section, we will examine how the questions from the Eurobarometer and the WVS can be integrated to form a more general measure with the help of a factor analysis. In a final step, we will conclude and address the issue of feasibility of the two sources for further analyses regarding sustainability.

4.1 Data sources

The mission of the Eurobarometer programme is to monitor the public opinion in the European Union member and candidate countries. It is basically comprised of two instruments (European Commission 2017):

- Standard & Special Eurobarometer: The Standard Eurobarometer was established in 1974. It is set-up as a bi-annual cross-national longitudinal study and consists of approximately 1000 face-to-face interviews per country (in each wave) with a constant set of questions that has been constantly enlarged. Reports are published twice a year. The Special Eurobarometer is repeated irregularly to investigate special top-

ics for various services of the European Commission or other EU Institutions. The Special Eurobarometer is integrated in the Standard Eurobarometer's waves.

- Flash Eurobarometer: Flash Eurobarometers are thematic telephone interviews conducted at the request of any service of the European Commission. Flash surveys are ad hoc, i.e. they are available much faster and enable the Commission to obtain results relatively quickly and to focus on specific target groups if necessary.

The surveys are conducted on behalf of the European Commission and the responsible Directorate-General(s), particular modules are commissioned by the European Parliament. The survey results are regularly published in official reports by the European Commission or by the European Parliament.

The primary data at the micro-level and the related documentation are published for research and training since the 1970s. They are curated at the GESIS data archive department (formerly Central Archive for Empirical Social Research) and at the Interuniversity Consortium for Political and Social Research (ICPSR). They are made available in the long term and worldwide for re-use in statistical analysis in the context of the European social science data archive network (CESSDA) (GESIS 2017).

The World Values Survey (WVS) is a survey on public values and beliefs and their effects on social and political life (World Values Survey Association 2017). It is led by an international team of scholars, with the WVS association and secretariat headquartered in Stockholm, Sweden. The survey started in 1981 and consists of nationally representative surveys conducted in almost 100 countries using a common questionnaire. It is the largest non-commercial, cross-national, time series investigation of human beliefs and values and currently includes interviews with almost 400,000 respondents. Samples are drawn from the entire population of 18 years and older, with the minimum sample size being 1,000. Currently, the WVS is in its 7th wave, with data for wave one to six being available for researchers. For each wave, a final master questionnaire is developed in English - based on suggestions for questions by social scientists from all over the world. This implies that the questionnaire is not fixed, some questions are available in several waves, others are not. In addition to the datasets for the single waves, a longitudinal dataset covering country aggregates for the period 1981-2014 is available. This longitudinal dataset is used for all further analyses.

4.2 Relevant questionnaires and their coverage

In the course of the analysis, we searched for datasets within the Eurobarometer that include questions with regard to values and public opinion towards the environment, sustainability and eco-innovation in general and also towards more case study specific issues such as waste management, resource efficiency and the role of citizens and municipalities. The most relevant questionnaires from the Eurobarometer are:

- ENVI[14]: Attitudes of European citizens towards the environment (latest wave: Special Eurobarometer 416/Wave EB81.3 (European Union 2014b)),
- EFFI: Attitudes of European citizens towards waste management and resource efficiency (latest wave: Flash Eurobarometer 388 (European Union 2014a)),
- INNO: Attitudes of European entrepreneurs towards eco-innovation (latest wave: Flash Eurobarometer 315 (European Union 2011)).

From these questionnaires, we selected the most important questions with regard to social innovations and societal acceptability in the context of sustainability. Some of the questions are more general in nature, i.e. most of the variables from the ENVI dataset, while some are more specialized and target case study specific issues such as new modes of repair and maintenance services or remanufacturing more specifically (EFFI). The INNO dataset is special in that only entrepreneurs were asked with regards to specific types of eco-innovation.

An overview of the questions we have taken into account in the Eurobarometer and the WVS can be found in Table 3 to Table 6. We show for which years and countries the data is available, which is stated in more detail in the respective tables. It has to be noted that not all variables are on the same scale, i.e. there are nominal and ordinal variables. In addition, not all variables point in the same direction. These variables were reversed to make them comparable for our analyses. After reversing the variables, large values now always imply positive attitudes towards the environment and sustainability. The Eurobarometer as well as the WVS further differentiate between different types of missing variables, e.g. "not applicable", "no answer", "don't know". Since this is not important for our analyses, we have coded all those variables to missing. For the WVS, we have dropped all questions with regard to sustainability that are not available in any wave after 1999 as these would only allow analyses in the longer past.

14 The abbreviations for these questionnaires are artificial and have been introduced by the authors for the use within this analysis.

Table 3: Coverage of "Attitudes of European citizens towards the environment" (ENVI)

Variable	Label	Scale	Reversed y/n	Years
envi_qa1	How important is protecting the environment to you personally?	1: Not important at all; 4: Very important	y	2014, 2011, 2007
envi_qa2_1	Main environmental issues that you are worried about: Depletion of natural resources	1: Mentioned 0: Not mentioned	n	2014, 2011, 2007, 2004
envi_qa2_2	Main environmental issues that you are worried about: Our consumption habits	1: Mentioned 0: Not mentioned	n	2014, 2011, 2007, 2004
envi_qa2_3	Main environmental issues that you are worried about: The growing amount of waste	1: Mentioned 0: Not mentioned	n	2014, 2011, 2007, 2004
envi_qa2_1to3	Main environmental issues that you are worried about: all three from above	1: Mentioned 0: Not mentioned	n	2014, 2011, 2007, 2004
envi_qa10	Willing to buy environmentally friendly products even if they cost a little bit more	1: Totally disagree; 4: Totally agree	y	2014, 2011, 2007
envi_qa11_2	Done for environmental reasons in the past month: Reduced waste e.g. by avoiding over-packaged products and buying products with a longer life	1: Mentioned 0: Not mentioned	n	2014, 2011, 2007
envi_qa12_6	One of top-three priorities in daily life to protect environment: Reduce waste e.g. by avoiding over-packaged products and buying products with a longer life	1: Mentioned 0: Not mentioned	n	2014, 2011, 2007, 2004
envi_qa13_1	You can play a role in protecting the environment.	1: Totally disagree; 4: Totally agree	y	2014, 2011, 2007
envi_qa16_2	Doing to protect the environment: Citizens themselves	1: Doing too much; 3: Not doing enough	n	2014, 2011
envi_qa16_3	Doing to protect the environment: Your city, town or village	1: Doing too much; 3: Not doing enough	n	2014

Note: 2014: EU28, 2011, 2007: EU28 without Croatia, 2004: EU28 without Bulgaria, Croatia and Romania

Source: European Union 2014b

Table 4: Coverage of "Attitudes of European citizens towards waste management and resource efficiency"

Variable	Label	Scale	Reversed (y/n)	Years
effi_q1	How important is it for you that Europe uses its resources more efficiently?	1: Not important at all; 4: Very important	y	2013
effi_q3_3	Biggest difference in how efficiently we use resources: Setting more efficient, environmentally-friendly product standards	1: Mentioned 0: Not mentioned	n	2013
effi_q4_3	You make efforts to reduce the amount of household waste that you generate.	1: Totally disagree; 4: Totally agree	y	2013
effi_q5a_8	You make an effort to get broken appliances repaired before buying new ones.	1: Mentioned 0: Not mentioned	n	2013
effi_q11_1	Most important aspects when buying a durable product: Use the product for a long time	1: Mentioned 0: Not mentioned	n	2013
effi_q11_2	Most important aspects when buying a durable product: Producer gives you a longer warranty/guarantee.	1: Mentioned 0: Not mentioned	n	2013
effi_q14_1	Ever done: Bought a remanufactured product	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_1	Prevents you from buying a remanufactured product: never heard of	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_2	Prevents you from buying a remanufactured product: prefer a new product	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_3	Prevents you from buying a remanufactured product: not confident in the quality	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_4	Prevents you from buying a remanufactured product: design is outdated	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_5	Prevents you from buying a remanufactured product: not available in your area	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_6	Prevents you from buying a remanufactured product: price is not advantageous compared new product.	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_7	Prevents you from buying a remanufactured product: Other	1: Mentioned 0: Not mentioned	n	2013
effi_q15a_8	Prevents you from buying a remanufactured product: DK/NA	1: Mentioned 0: Not mentioned	n	2013

Note: Coverage: EU28

Source: European Union 2014a

Table 5: Coverage of "Attitudes of European entrepreneurs towards eco-innovation"

Variable	Label	Scale	Reversed (y/n)	Years
inno_q0	Relevance of innovation you have introduced in the past 24 months in terms of resource efficiency (only if there were any)	1: < 5% reduction of material use per unit output 2: 5% to 19% 3: 20% to 39% 4: 40% to 60% 5: > 60%	n	2011
inno_q5_a	Implemented any changes to reduce material costs in the past 5 years: Changing business model	1: Mentioned 0: Not mentioned	n	2011
inno_q5_b	Implemented any changes to reduce material costs in the past 5 years: Improving the material flow in the supply chain	1: Mentioned 0: Not mentioned	n	2011
inno_q5_c	Implemented any changes to reduce material costs in the past 5 years: Substituting expensive materials for a cheaper ones	1: Mentioned 0: Not mentioned	n	2011
inno_q5_d	Implemented any changes to reduce material costs in the past 5 years: Purchasing more efficient technologies	1: Mentioned 0: Not mentioned	n	2011
inno_q5_e	Implemented any changes to reduce material costs in the past 5 years: Developing more efficient technologies in-house	1: Mentioned 0: Not mentioned	n	2011
inno_q5_f	Implemented any changes to reduce material costs in the past 5 years: Outsourcing production or service activities	1: Mentioned 0: Not mentioned	n	2011
inno_q5_g	Implemented any changes to reduce material costs in the past 5 years: Recycling	1: Mentioned 0: Not mentioned	n	2011
inno_q5_b_g	Implemented any changes to reduce material costs in the past 5 years: Any one of inno_q5_b to q5_g	1: Mentioned 0: Not mentioned	n	2011
inno_q6	Over the last 5 years, what share of innovation investments in your company was related to ecoinnovation?	1: None 2: < 10% 3: 10% to 29% 4: 30% to 49% 5: > 50%	y	2011

Note: Coverage: EU28 without Croatia

Source: European Union 2011

Table 6: Coverage of the WVS variables

Variable	Label	Scale	Reversed y/n	Years
A103	Active/Inactive membership of environmental organization	0: Not a member; 1: Inactive member; 2: Active member	n	2010-2014, 2005-2009
A197	Schwartz: It is important to this person looking after the environment	1: A little like me; 4: Very much like me	y	2010-2014, 2005-2009
B001	Would give part of my income for the environment	1: Strongly disagree; 4 Strongly agree	y	2005-2009, 1999-2004
B002	Increase in taxes if used to prevent environmental pollution	1: Strongly disagree; 4 Strongly agree	y	2005-2009, 1999-2004
B003	Government should reduce environmental pollution	1: Strongly disagree; 4 Strongly agree	y	2005-2009, 1999-2004
B008	Protecting environment vs. Economic growth	1: Economy growth and creating jobs; 2: Protecting environment	y	2010-2014, 2005-2009, 1999-2004
B009	Human & nature	1: Human beings should master nature 2: Human beings should coexist with nature (3: Both 4: Neither 5: Other answer)*	n	1999-2004
B018	Environmental problems in your community: Poor water quality	1: Not serious at all; 4: Very serious	y	2005-2009
B019	Environmental problems in your community: Poor air quality	1: Not serious at all; 4: Very serious	y	2005-2009
B020	Environmental problems in your community: Poor sewage and sanitation	1: Not serious at all; 4: Very serious	y	2005-2009
B021	Environmental problems in the world: Global warming or the greenhouse effect	1: Not serious at all; 4: Very serious	y	2005-2009
B022	Environmental problems in the world: Loss of plant or animal species or biodiversity	1: Not serious at all; 4: Very serious	y	2005-2009
B023	Environmental problems in the world: Pollution of rivers, lakes and oceans	1: Not serious at all; 4: Very serious	y	2005-2009
B030	Past two years: given money to ecological organization	1: No 2: Yes	y	2010-2014
B031	Past two years: participated in demonstration for environment	1: No 2: Yes	y	2010-2014
E069_14	Confidence: The Environmental Protection Movement	1: Not at all; 4: A great deal	y	2010-2014, 2005-2009, 1999-2004
E136	Who should decide: protection of the environment	1: National governments 2: United Nations 3: National governments, with UN coordination 4: Regional organizations 5: Non profit / Non governmental org 6: Commercial enterprise	n	2005-2009, 1999-2004
E140	Country cannot solve environmental problems by itself.	1: Strongly disagree; 4 Strongly agree	y	1999-2004

Note: Country Coverage: AD, AL, AM, AR, AU, AZ, BA, BD, BF, BG, BH, BOS, BR, BY, CA, CH, CL, CN, CO, CS, CY, CZ, DE, DO, DZ, EE, EG, ES, ET, FI, FR, GB-GBN, GE, GH, GT, HK, HR, HU, ID, IL, IN, IQ, IR, IT, JO, JP, KG, KR, KW, KZ, LB, LT, LV, LY, MA, MD, ME, MK, ML, MX, MY, NG, NL, NO, NZ, PE, PH, PK, PL, PR, PS, QA, RO, RS, RU, RW, SA, SE, SG, SI, SK, SV, TH, TR, TT, TW, TZ, UA, UG, US, UY, VE, VN, YE, ZA, ZM, ZW. *: not used for the analysis

Source: World Values Survey Association 2017

Based on the Eurobarometer and WVS data, we created two datasets that will be analysed in more detail in the following chapter. For both datasets, we aggregated the values per country and year (based on averages), resulting in a country-level panel. These panels were merged to form one panel for the Eurobarometer and one panel for the WVS that allows us to run estimates across datasets. Furthermore, it allows us to compare the values of the single studies across countries.

As can be seen from the tables, the Flash Eurobarometer variables only contain values for one year. The more general "Attitudes of European citizens towards the environment" dataset is a "Special Eurobarometer" questionnaire that has been in the field in three waves (2007, 2011, 2014). As for the WVS, some variables are available across all waves, but many questions also have only been included in one or two waves. In addition, some questions are available for a given country in a certain wave, but are missing for the same country in other waves. However, it is generally possible to generate panel datasets for the "Special Eurobarometer" and the WVS to analyse time trends. Yet, we focus on the most recent years for our analyses.

4.3 Results

Within this section, the results of our analyses are presented. We will focus on the methodological aspect with regard to the coverage and availability of indicators in the light of the feasibility of the approach for future studies. Nevertheless, we will provide some international comparisons with regard to the sustainability indicators. First, Table 7 shows the summary statistics for the Eurobarometer variables. As can be seen from the table, the Eurobarometer provides a broad coverage of countries, i.e. data for all EU-28 members is available except for Hungary, where no data is available in the INNO dataset.

This is a bit different for the WVS dataset. Here, we analyze only the most recent survey wave (2010-2014) as the coverage of questions differs across waves. Six questions of interest are available for this wave, all with a similar coverage across countries. This implies that it is meaningful to make cross-sectional analyses across different questions. This is available for a large number of countries. Longitudinal analyses, however, have to be treated with care as the coverage of questions across waves differs. Although a question might be available for country A in wave X, it might not be available for country A in wave Y. The most promising avenue for panel analyses thus seems to be to reduce the number of countries to a certain core that can be analysed over time.

Table 7: Summary Statistics Eurobarometer

ENVI (2014)					
Variable	Obs.	Mean	Std. Dev.	Min	Max
envi_qa1	28	3.52	0.13	3.33	3.83
envi_qa2_1	28	0.32	0.08	0.14	0.52
envi_qa2_2	28	0.23	0.07	0.15	0.41
envi_qa2_3	28	0.46	0.09	0.30	0.60
envi_qa2_1to3	28	0.11	0.06	0.03	0.28
envi_qa10	28	3.02	0.21	2.62	3.50
envi_qa11_2	28	0.31	0.11	0.15	0.52
envi_qa12_6	28	0.21	0.06	0.11	0.36
envi_qa13_1	28	3.25	0.21	2.95	3.70
envi_qa16_2	28	2.67	0.08	2.48	2.81
envi_qa16_3	28	2.48	0.13	2.29	2.72
EFFI (2013)					
Variable	Obs.	Mean	Std. Dev.	Min	Max
effi_q1	28	3.67	0.13	3.38	3.89
effi_q3_3	28	0.28	0.06	0.13	0.38
effi_q4_3	28	3.56	0.09	3.38	3.74
effi_q5a_8	28	0.73	0.10	0.54	0.92
effi_q11_1	28	0.38	0.08	0.28	0.59
effi_q11_2	28	0.34	0.06	0.21	0.45
effi_q14_1	28	0.27	0.07	0.10	0.42
effi_q15a_1	28	0.30	0.11	0.08	0.49
effi_q15a_2	28	0.50	0.12	0.25	0.75
effi_q15a_3	28	0.38	0.10	0.18	0.60
effi_q15a_4	28	0.10	0.06	0.02	0.24
effi_q15a_5	28	0.30	0.11	0.11	0.53
effi_q15a_6	28	0.19	0.07	0.10	0.33
effi_q15a_7	28	0.06	0.03	0.02	0.13
effi_q15a_8	28	0.04	0.02	0.01	0.08
INNO (2011)					
Variable	Obs.	Mean	Std. Dev.	Min	Max
inno_q0	27	1.85	0.14	1.52	2.08
inno_q5_a	27	0.37	0.12	0.19	0.58
inno_q5_b	27	0.59	0.12	0.25	0.77
inno_q5_c	27	0.45	0.07	0.31	0.58
inno_q5_d	27	0.65	0.09	0.50	0.80
inno_q5_e	27	0.59	0.13	0.24	0.77
inno_q5_f	27	0.38	0.12	0.17	0.67
inno_q5_g	27	0.57	0.17	0.31	0.85
inno_q5_b_g	27	0.92	0.06	0.78	0.99
inno_q6	27	2.56	0.23	2.02	3.03

Source: European Union 2014b, 2014a, 2011

Note: The variables printed in italics are nominal variables. Mean values can be interpreted as shares. The minimum and maximum values for nominal variables are not necessarily 0 and 1 as we are working with aggregated data.

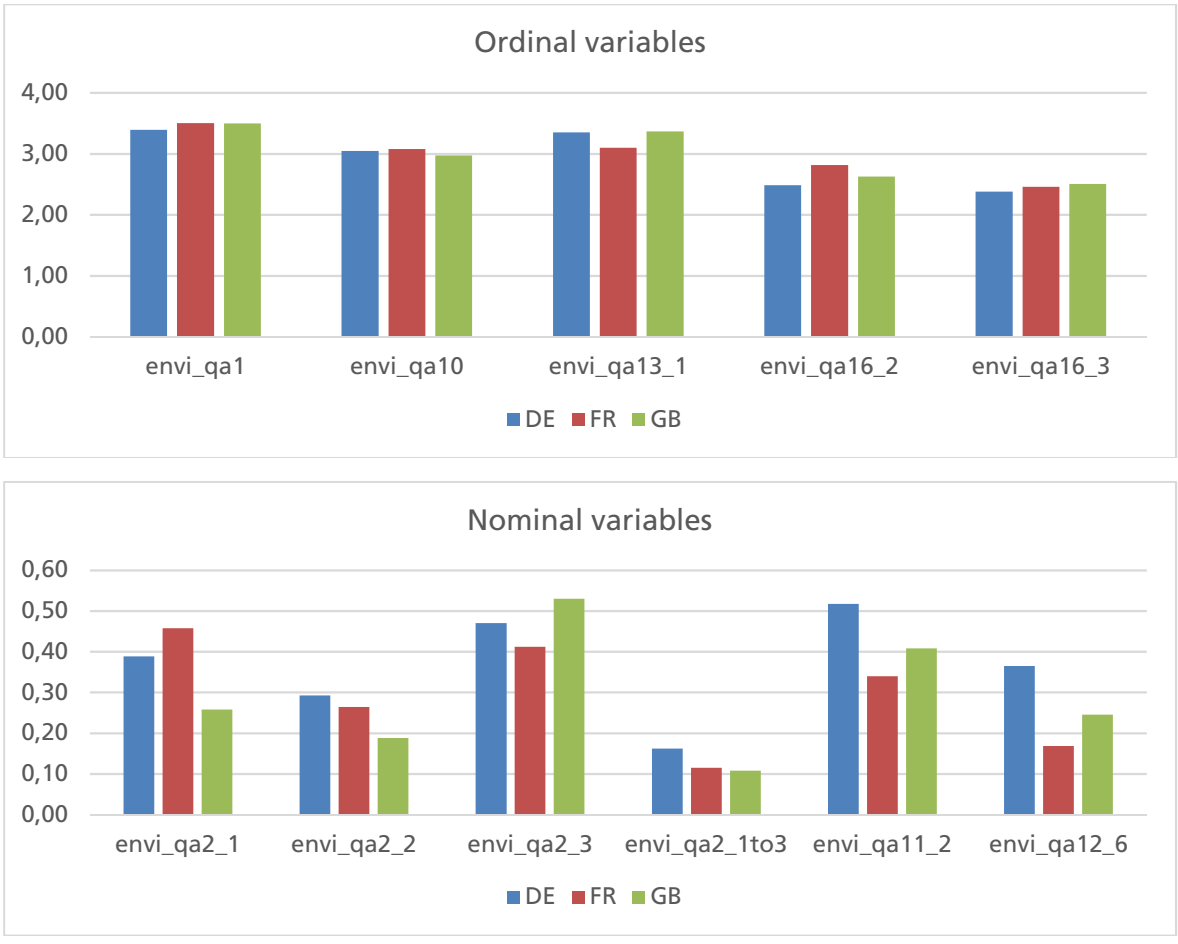
Table 8: Summary Statistics WVS

v	Obs.	Mean	Std. Dev.	Min	Max
A103	57	0.14	0.13	0.00	0.63
A197	57	1.83	0.38	1.00	2.83
B008	56	1.52	0.12	1.32	1.77
B030	57	1.12	0.09	1.00	1.40
B031	56	1.07	0.06	1.00	1.31
E069_14	57	2.39	0.24	1.89	3.08

Source: World Values Survey Association 2017

Note: The variables printed in italics are nominal variables. Mean values can be interpreted as shares. The minimum and maximum values for nominal variables are not necessarily 0 and 1 as we are working with aggregated data.

Figure 13: ENVI - Country Comparisons



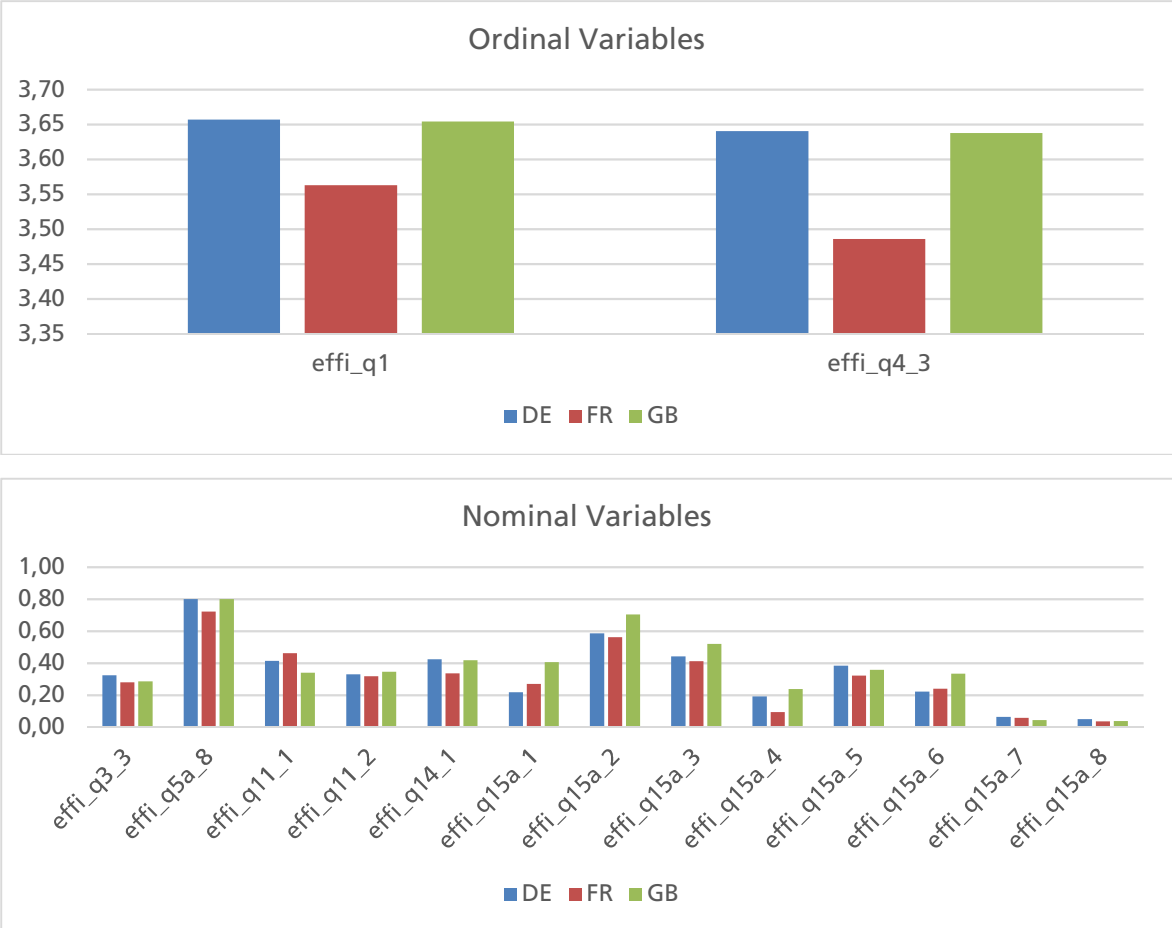
Source: European Union 2014b

When looking at the country comparisons with regard to the attitudes of European citizens towards the environment (ENVI) in Figure 13, it can be found that the general importance of environmental protection (envi_qa1) is similar across all three countries in our comparison, i.e. Germany, France and Great Britain. This is also true for the remaining variables,

i.e. only smaller variations can be observed. The largest deviations can be found for France where the thought that the person itself can play a role in protecting the environment (envi_qa13_1) is less strongly pronounced, while the thought that citizens themselves are not doing enough to protect the environment is more strongly pronounced (envi_qa16_2). With regard to the nominal variables, some larger deviations between the countries can be found. In general, Germany shows somewhat larger values than the other countries with the exception of envi_qa2_1 and envi_qa2_3, i.e. worries about the depletion of natural resources and worries about the growing amount of waste are more strongly pronounced in France and Great Britain, respectively.

Within the questionnaire regarding the attitudes of European citizens towards waste management and resource efficiency, some larger country differences especially with regard to France can be found (Figure 14). For both ordinal variables - i.e. the questions "How important is it for you that Europe uses its resources more efficiently?" and "You make efforts to reduce the amount of household waste that you generate" - are rated as less important by French survey participants, while the values are similar for Germany and Great Britain. Similar effects can be found for the nominal variables (lower panel of the Figure), where the values for France are lower than for Germany and Great Britain in most cases.

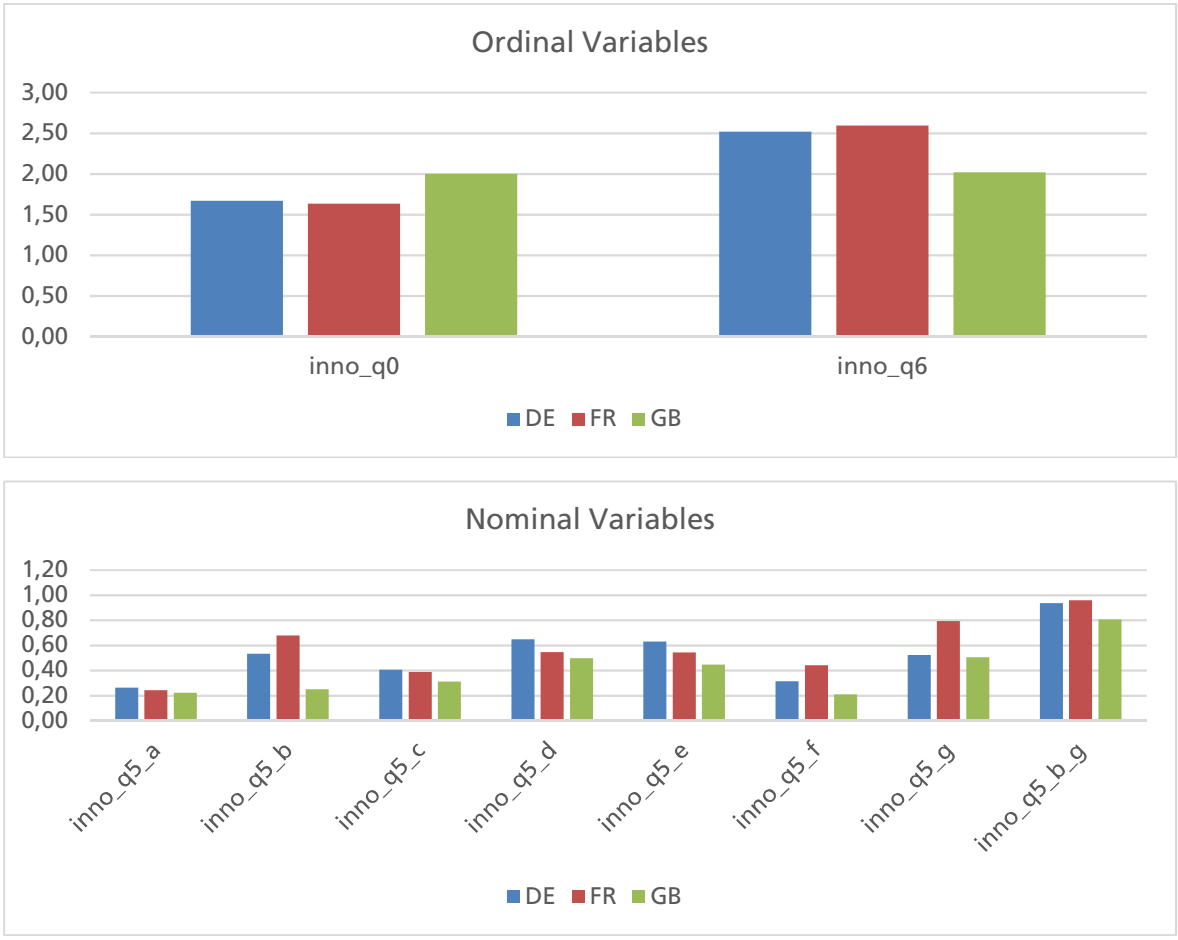
Figure 14: EFFI - Country Comparisons



Source: European Union 2014a

When looking at the attitudes of European entrepreneurs towards eco-innovation (Figure 15), the effect of lower values for France cannot be found. On the contrary, when it comes to eco-innovation, France shows comparably high levels of innovation in terms of resource efficiency (inno_q0) and even higher investments related to eco-innovation in the last 5 years (inno_q6). Also regarding the implementation of changes to reduce material costs in the past 5 years (inno_q5), France generally scores higher than Great Britain. Germany, on the other hand, has the largest values in terms of changing business models, substituting expensive materials, purchasing more efficient technologies, developing more efficient technologies in-house. Yet, with regard to recycling to reduce material costs and outsourcing production or service activities France shows larger values than Germany, resulting in the fact that France and Germany nearly have the same values across all of these categories (inno_q5_b_g).

Figure 15: INNO - Country Comparisons



Source: European Union 2011

For the WVS analyses, we had to resort to a different selection of countries. This is, on the one hand, due to the fact that countries worldwide (not only EU-28) are included, i.e. values for the U.S. and China can be observed. Other countries like France and Great Britain,

on the other hand, are not included as there are only missing values for the relevant questions with regard to these two countries.

The results are depicted in Figure 16. Interestingly, the U.S. shows the largest number of memberships in an environmental organization (A103), followed by Sweden and Germany. However, it has to be noted that the differences between the countries are not very high in general. When it comes to the importance of looking after the environment (A197), the European countries clearly show larger values than the U.S. and China. Within Europe, the values are largest within Poland, followed by Spain, Sweden and Germany. Regarding the confidence towards the environmental protection movement (E069_14), the values are similar across countries.

Figure 16: WVS - Country Comparisons



Source: World Values Survey Association 2017

The question of economic growth vs. protecting the environment (B008) is rather balanced at around 50 % for each of the countries under comparison, with China having the largest share of people opting for protecting the environment, followed by Sweden and Germany. The shares, however, are much lower with regard to giving money to ecological organizations (B030) or participating in demonstrations for environment (B031). In the country comparison, Sweden stands out when it comes to giving money to ecological organizations, followed by Germany and the United States. As for the demonstrations for the environment, there are no sharp country differences.

As a final step of the analyses, we perform a factor analysis for all the selected questions (variables) from each dataset. Factor analyses aim to deduce latent or unobserved variables or factors from the empirical measurement of individual variables and thus also serve to reduce the overall number of variables. In our case, we aim to find out whether some questions could be seen as substitutes or are highly related so it might make sense to calculate an index or similar measure based on these variables for future, more in-depth analyses.

In order to determine the number of factors to be extracted, we applied the "eigenvalues" of the variables from the correlation matrix. They specify how much (additional) variance is explained by adding an additional factor to the analysis. As soon as the eigenvalues fall below the value "1", it can be assumed that no sufficient variance in the data is explained by adding an additional factor. Thus, we extracted as many factors as there were eigenvalues above unity.

The results of the factor analysis (factor loadings) for the three questionnaires from the Eurobarometer are shown in Table 9. The factor charges represent the correlation between the indicators and the respective factor. For the sake of readability, only values above resp. below +/- 0.2 are shown. The color code represents a manual selection of variables that fit together and might thus form a common factor.[15]

From the ENVI dataset, four factors were extracted. The first factor comprises the main environmental issues people are worried about, i.e. depletion of resources and consumption habits (as well as the aggregate variable for this question). This is not surprising as all these variables are based on the same group of questions. Interestingly, however, the question on the growing amount of waste as the main environmental issue loads on its own factor (factor 4). It thus seems that the waste problematic is different to other environmental

15 Variables that are marked across the whole table do not seem to fit to any of the factors based on their factor loading.

issues (in general) and thus should also be treated separately. The remaining two factors comprise the questions if people have done something for their environment in the last month by reducing waste and if reducing waste has a priority in daily life. This factor thus targets what people can do in terms of waste reduction. The final factor (factor 3) comprises the questions related to more general environmental issues, i.e. the importance of protecting the environment in general etc.

Table 9: Factor Analysis - Eurobarometer

			ENVI (2014)		
Variable	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
envi_qa1	-0.31	-0.45	0.51	-0.24	0.39
envi_qa2_1	0.78			-0.25	0.31
envi_qa2_2	0.82		0.24		0.27
envi_qa2_3			-0.26	0.99	-0.10
envi_qa2_1to3	0.88			0.40	0.05
envi_qa10			0.83		0.26
envi_qa11_2		0.56	0.61		0.25
envi_qa12_6		0.97			0.00
envi_qa13_1			0.56	-0.35	0.55
envi_qa16_2		-0.50			0.73
envi_qa16_3	-0.24	-0.27		-0.44	0.65
			EFFI (2013)		
Variable	Factor 1	Factor 2	Factor 3	Factor 4	Uniqueness
effi_q1	-0.26	0.22	0.83	-0.27	0.12
effi_q3_3	0.46	0.43			0.59
effi_q4_3			0.74		0.42
effi_q5a_8		0.57			0.65
effi_q11_1		0.45	-0.61	0.38	0.27
effi_q11_2		-0.66			0.55
effi_q14_1	0.75				0.39
effi_q15a_1		0.86		-0.26	0.16
effi_q15a_2	0.77				0.36
effi_q15a_3	0.70			-0.35	0.36
effi_q15a_4	0.90				0.14
effi_q15a_5	0.50	0.68			0.28
effi_q15a_6	0.84	0.35			0.14
effi_q15a_7		-0.27		0.95	-0.01
effi_q15a_8	-0.34			0.36	0.75
			INNO (2011)		
Variable		Factor 1		Factor 2	Uniqueness
inno_q0					0.98
inno_q5_a				0.76	0.42
inno_q5_b				0.81	0.34
inno_q5_c				0.78	0.39
inno_q5_d				0.85	0.28
inno_q5_e				0.82	0.32
inno_q5_f				0.58	0.67
inno_q5_g		3.22			-9.39
inno_q5_b_g				0.89	0.19
inno_q6				0.43	0.81

Source: European Union 2014b, 2014a, 2011

For the EFFI dataset, also four factors could be found. Yet, the assignment of factor loadings looks rather artificial here. Factor 1 is quite straight forward as it mostly comprises

variables from one group of questions asking what prevents persons from buying products that have been remanufactured. The other questions, on the other hand, cannot easily be grouped on a theoretical level, i.e. no clear pattern can be derived. This implies that maybe the number of factors should be reduced for these questions based on theoretical considerations.

For the INNO dataset, only two factors are extracted. This is first of all the group of questions regarding the implementation of changes to reduce material costs including the question on eco-investments (inno_q6). The only question the stands out is the one regarding recycling, which loads on a factor on its own. Recycling thus seems to differ very clearly from other options to reduce material costs and should thus be regarded as a category on its own.

For the WVS, we also performed a factor analysis. Here, the results are relatively clear. Two factors have been extracted. Factor 1 loads highly on the questions regarding memberships in environmental organizations, participating in demonstrations or donating money to ecological organizations, coupled with a confidence in the movement. The questions grouped here thus basically revolve around devoting time or resources for the environment. Factor 2 is more comprised of questions regarding the importance given to the environment or environmental protection and confidence in the movement (although there is no clear cut assignment with regard to this question). It thus becomes obvious that there seems to be a large gap between attitudes and actual behavior. This, however, is a rather common phenomenon that is well covered in the sociological and psychological literature.

Table 10: Factor Analysis WVS

	Factor 1	Factor 2	Uniqueness
A103	1.02		-0.04
A197		0.23	0.95
B008		0.88	0.22
B030	0.59		0.64
B031	0.56		0.68
E069_14	0.47	0.63	0.38

Source: World Values Survey Association 2017

In sum, it can be stated that factor analyses can be helpful to reduce the amount of information within the context of sustainability. Questions regarding environmental issues in general, however, should be treated separately from more specific questions, like waste reduction. Still it needs an expert in the field to find out which questions can be analysed meaningfully in which context and where information can be aggregated for the ease of interpretation.

4.4 Conclusions and feasibility for future studies

In this section, we test if and how the Eurobarometer and the World Values Survey can be used to analyse questions regarding organisational and social innovations and societal acceptability in the context of environmental protection and sustainability. In particular, we focus on the ability to merge different datasets and generate international comparisons over time.

The country comparisons show that the general attitudes towards environmental protection are similar across the countries in our comparison, i.e. Germany, France and Great Britain. When it comes to more detailed questions on resource efficiency, in particular waste management, some larger differences between the countries can be found. This is especially true for France, where Europe's efforts to use its resources more efficiently and own efforts to reduce the amount of household waste are rated as less important than in Germany and Britain. In the survey of entrepreneurs, however, France shows comparably high levels of innovation in terms of resource efficiency. Regarding recycling to reduce material costs and outsourcing production or service activities, France shows even larger values than Germany, while in Germany changing business models, substituting expensive materials for cheaper ones, purchasing more efficient technologies and developing more efficient technologies in-house are more strongly in the focus. As for the WVS analyses, we have to resort to a different selection of countries, which makes the results hard to compare. Yet, the international comparisons show that the importance of looking after the environment is larger in Europe than in the U.S. and China.

More important in this chapter, however, is the feasibility of the approach for future studies as both data sources offer the potential for more in-depth analyses. We find that the different datasets, i.e. Flash Eurobarometer, Special Eurobarometer and WVS, can be merged at the aggregate level of countries to create a longitudinal dataset for further analyses. Yet, we also find that, although the possibility exists, it does not deliver much added value. This is due to the fact that large amounts of missing values are created, as not all studies are available for all (or even several years). This would result in a quite heavy imputation of single data points, which might bias the results. Especially the Flash Eurobarometer studies, that are only available for one year, should thus probably be treated separately. A further reason for treating the datasets separately are differences in the statistical population across datasets - e.g. entrepreneurs vs. total population - that make comparisons impossible.

Apart from the fact that the data should be treated separately, the two sources offer great potential for further analyses. While the WVS mostly provides information on general attitudes towards environmental issues, the Eurobarometer (especially the "Flash Eurobarometer", i.e. EFFI and INNO) offers more specific insights. The downside of the Eurobarometer, however, is that the data is only available for the EU-28, while the WVS offers the potential for wider international comparisons. With regard to analyses over time, the Spe-

cial Eurobarometer (ENVI) dataset has the largest potential, as it is available for three (annual) waves. The EFFI and INNO dataset, however, offer the largest potential for in-depth analyses for the specific topic of our case studies but are not available over time. With the WVS, panel analyses are also possible. Yet, it has to be kept in mind that the WVS waves cover a time period of about 5 years, implying that annual analyses are not possible, only analyses across time periods. Values for some countries might then still be lacking across waves, especially for non-industrial nations.

The factor analysis provides some more specific insights on how to treat the single questions within the dataset. It shows that especially the more general questions can be grouped together to provide an overview of the recent trends. Yet, for more specific questions, a grouping of the variables does not seem to be as useful as the loss of information is comparably high, i.e. there are no clear trends in the factor analyses that justify clear groupings apart from questions regarding attitudes vs. behavior.

5 Activities of firms

In this chapter, we analyze whether the demand for repair services evident in the citizen-driven maker and repair initiatives is matched by an offer from conventional suppliers, i.e. we look at the level of actual activities of firms by counting the firms active in the field. For the identification of these firms, in principle, NACE codes can be used. However, this approach has some shortcomings, which we will illustrate below. In order to identify companies that offer repair services, we instead conduct a text analysis on the (text) description of economic activities of firms. We extract the descriptions from the ORBIS database (Bureau van Dijk) that provides information about enterprises worldwide. Based on a set of keywords, the descriptions are searched and firms that offer repair services are identified. The resulting set of firms is analysed in terms of the shares of extracted firms within different countries, the composition with regard to different sectors by NACE classes and the influence of single keywords. Furthermore, the added value of a text based search as compared to a search solely based on NACE classifications is considered.

5.1 Data source and methodological approach

For the identification of firms that offer repair services, we create a set of keywords that are used in order to search the descriptions of economic activities. In order to select appropriate keywords that identify the relevant companies, we start by extracting descriptions of economic activities based on an initial set of selected keywords:

- maintenance
- warranty
- refurbishment
- remanufactur*
- return/take back
- repair*
- product recovery
- overhaul

- re-use/reuse
- reconditioning

In a first step, a random sample of matched descriptions is then used to validate the initial keywords. The initial set of terms includes for example the word “return”. However, the analyzed descriptions could not give evidence for a clear occurrence of this term in the context of repair services. An alternative term for “return” is “take back”, but this keyword does not match any of the descriptions. The term “maintenance” also poses some problems as it retrieves companies that offer for example building maintenance. However, since based on this term, we also find much information about relevant firms, we decide to keep this term in our set of keywords. Other terms show valuable results, as for example “warranty” that allows us to retrieve companies that offer warranty services.

In a second step, the descriptions of economic activities that are retrieved through the initial set of keywords are used in order to identify new relevant terms. For this purpose, the most frequent terms over all retrieved descriptions are examined and further appropriate terms are selected as new candidate terms:

- renovation
- servicing
- rebuilding
- replacement
- retrofit
- spare part*

The additional keywords are again validated against their context in the newly extracted descriptions. “Rebuilding”, “retrofit” and “spare part*” achieve good results. ”Renovation” poses problems similar to those caused by “maintenance”: the results include companies that offer renovation of buildings, however, it also retrieves much valuable information. “Servicing” addresses servicing in general which is not an innovative activity, but an increase in servicing activities is actually interesting in terms of sustainability. The term “replacement” is discarded since it results in many false positives, for example companies operating in the medical field, i.e. replacement of joints or hormones. Instead, the term “replacement part*” is included in the keyword set.

In the last step, a final set of keywords is established:

- maintenance
- overhaul
- product recovery
- rebuilding
- reconditioning
- refurbishment
- remanufactur*
- renovation
- repair*
- replacement part*
- retrofit
- reuse/re-use
- servicing
- spare part*
- warranty

This set of keywords is used in order to search descriptions of economic activities so that firms offering repair services can be identified.

Besides the description of economic activities, the ORBIS database also provides a NACE classification code for each firm. Hence, the retrieved firms can be analysed by sector.

5.2 Differentiation of the text analysis from NACE code classification

The NACE codes “33.1: Repair of fabricated metal products, machinery and equipment”, “43: Specialised construction activities”, “45.2: Maintenance and repair of motor vehicles” and “95: Repair of computers and personal and household goods” define the area of repair services. These codes provide a clear classification of the firms so that the focus of each firm can be easily identified. In order to evaluate the added benefit of our text analysis, we compare the result lists retrieved based on NACE codes to those based on the text analysis, specifically the keyword “repair”. We find that only 17% of the firms found through the term “repair” are assigned to one of the NACE codes specified above. The remaining 83% of firms would have been missed without the application of text analysis. Two examples of companies retrieved only based on their description are Kinki Co., Ltd. and E.I.S. Aircraft GmbH. Their economic activities descriptions include “It also has trained repair persons to handle the maintenance and repair of the electronic equipment and appliances.” (Kinki Co., Ltd.) and “It also performs aircraft repair and refurbishment services on commercial and military aircraft.” (E.I.S. Aircraft GmbH). The reason for the missing classification in a NACE code related to repair services is that each company is assigned only one NACE code which intends to characterize the main activity. Kinki Co., Ltd. is assigned the code “Wholesale and retail trade and repair of motor vehicles and motorcycles” and E.I.S. Aircraft GmbH the code “Manufacture of other transport equipment”. However, firms may still perform repair services, even though their main activity is different.

5.3 Analysis of the retrieved firms

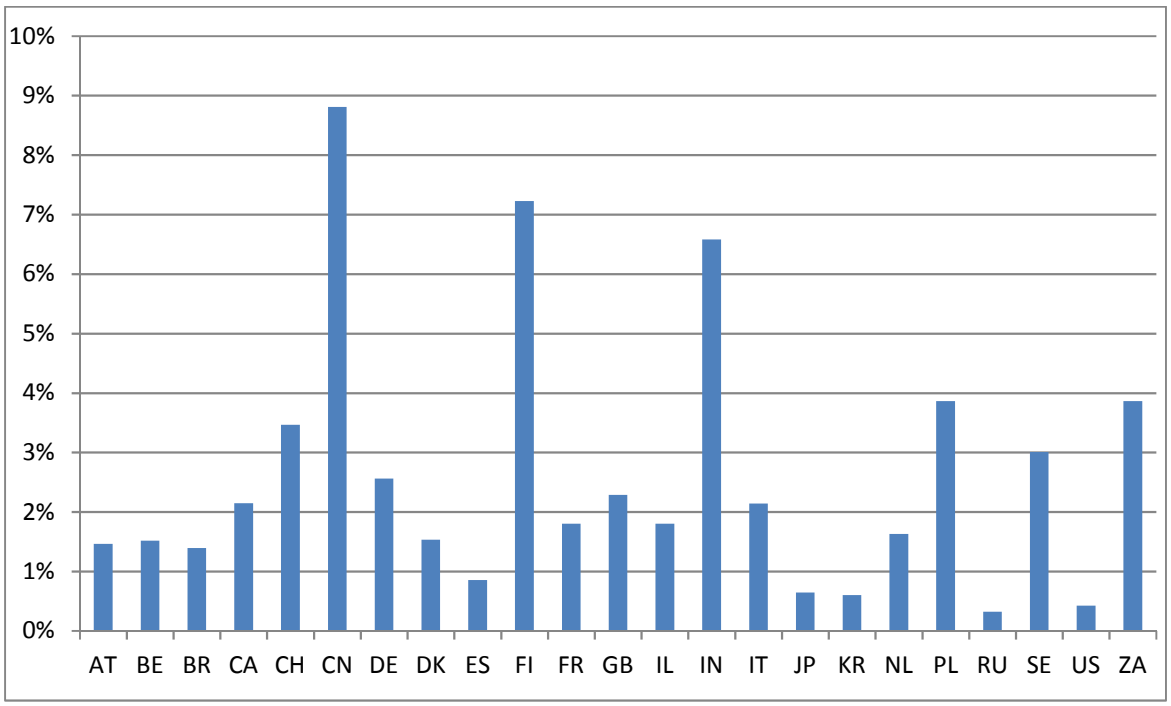
By applying our set of keywords to the descriptions of economic activities of firms in ORBIS, we retrieve 13,807 companies worldwide offering some kind of repair service which accounts for 1% of all firms.

5.3.1 Analysis of countries and sectors

In Figure 17, the shares of firms retrieved through the keyword search of all firms in a country are depicted. The share of firms related to repair services is highest in China, 9% of all Chinese firms are identified through our analysis. In Finland and India, we also find a high share of companies (7%). Germany is in the midrange (3%), while in the USA and Russia, the share of companies is vanishingly small.

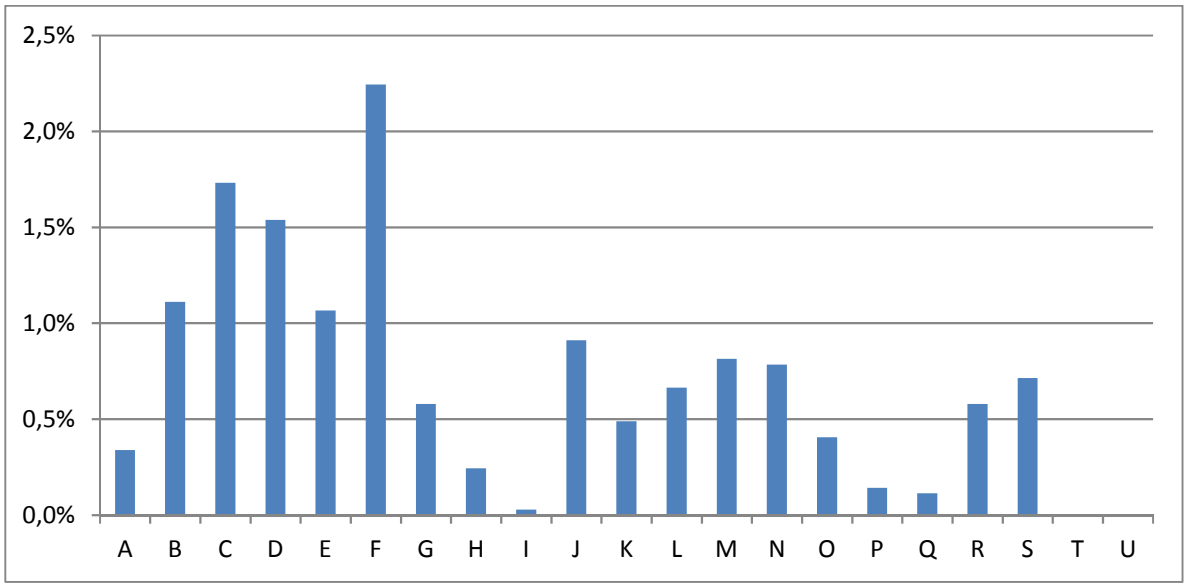
Figure 18 shows the shares of firms retrieved through the text analysis of all companies in each sector worldwide. The sectors consist of 11 high-level classes the NACE codes are assigned to. The sectors “F: Construction”, “C: Manufacturing” and “D: Electricity, gas, steam and air conditioning supply” show shares of around 2%. Around 1% of the firms in the sectors “B. Mining and quarrying”, “E: Water supply; sewerage, waste management and remediation activities” and “J: Information and communication” mention repair services within their descriptions.

Figure 17: Shares of firms with “repair services”, identified through keyword-based analysis of all firms for each country



Source: ORBIS (Bureau van Dijk), queries and calculations by Fraunhofer ISI

Figure 18: Shares of firms with "repair services", identified through keyword-based analysis of all firms in each sector worldwide

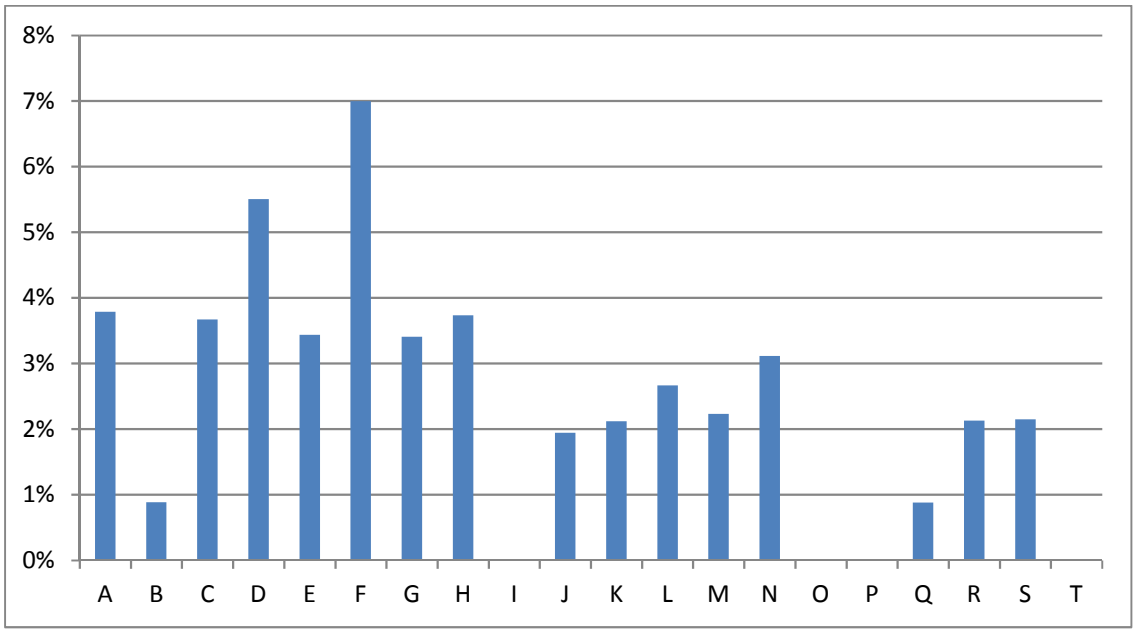


A. Agriculture, forestry and fishing
B. Mining and quarrying
C. Manufacturing
D. Electricity, gas, steam and air conditioning supply
E. Water supply; sewerage, waste management and remediation activities
F. Construction
G. Wholesale and retail trade; repair of motor vehicles and motorcycles
H. Transportation and storage
I. Accommodation and food service activities
J. Information and communication
K. Financial and insurance activities
L. Real estate activities
M. Professional, scientific and technical activities
N. Administrative and support service activities
O. Public administration and defence; compulsory social security
P. Education
Q. Human health and social work activities
R. Arts, entertainment and recreation
S. Other service activities

Source: ORBIS (Bureau van Dijk), queries and calculations by Fraunhofer ISI

In Germany, the sectors "F: Construction" (7%) and "D: Electricity, gas, steam and air conditioning supply" (6%) and "C: Manufacturing" (4%) also have shares above the average as well as "A: Agriculture, forestry and fishing" (4%) and "H: Transportation and storage" (4%) which show very small shares worldwide.

Figure 19: Shares of German firms with "repair services", identified through keyword-based analysis in each sector



A. Agriculture, forestry and fishing
B. Mining and quarrying
C. Manufacturing
D. Electricity, gas, steam and air conditioning supply
E. Water supply; sewerage, waste management and remediation activities
F. Construction
G. Wholesale and retail trade; repair of motor vehicles and motorcycles
H. Transportation and storage
I. Accommodation and food service activities
J. Information and communication
K. Financial and insurance activities
L. Real estate activities
M. Professional, scientific and technical activities
N. Administrative and support service activities
O. Public administration and defence; compulsory social security
P. Education
Q. Human health and social work activities
R. Arts, entertainment and recreation
S. Other service activities

Source: ORBIS (Bureau van Dijk), queries and calculations by Fraunhofer ISI

In summary, we find that shares of firms related to repair services are highest in China, Finland and India. Worldwide, the sectors "F: Construction", "C: Manufacturing" and "D: Electricity, gas, steam and air conditioning supply" contain the highest percentage of firms identified through our keyword-based analysis. In Germany, we find a similar situation, however in contrast to the worldwide average, "A: Agriculture, forestry and fishing" and "H: Transportation and storage" also show comparable shares.

5.3.2 Analysis of selected NACE codes

Based on the specific NACE codes that are assigned to the retrieved firms, we want to further analyze the firm profile that is extracted through the keywords. In Figure 20, the shares of retrieved firms within NACE codes in the sectors with high shares "F: Construction", "C: Manufacturing" as well as the remaining sectors containing NACE codes related to repair services "G: Wholesale and retail trade; repair of motor vehicles and motorcycles" and "S: Other service activities" are depicted.

The sector “C: Manufacturing” is composed of 24 NACE codes. The firms retrieved by our search are mainly in fields related to transport equipment, machinery, motor vehicles, electronic products and fabricated metal products. Other manufacturing areas show shares below the overall share in the sector “Manufacturing”.

The sector “D: Electricity, gas, steam and air conditioning supply” consists of only one field which has a share of 2%.

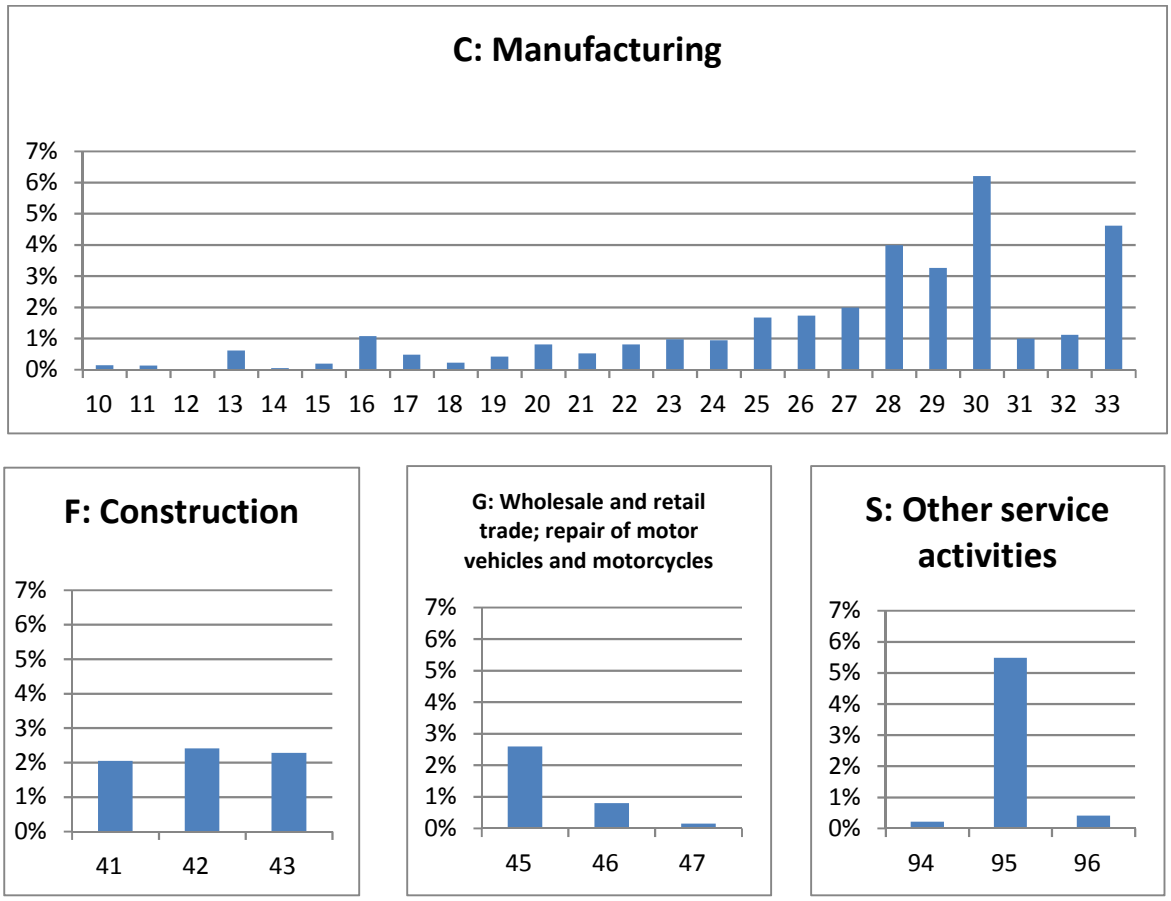
For the three fields in the sector “F: Construction”, “41: Construction of buildings”, “42: Civil engineering” and “43: Specialised construction activities”, we find similar shares of firms retrieved through our keyword analysis of all firms. We assume that, in this sector, most of the firms are rather related to the renovation of buildings, which does not match the services we are interested in. We will examine this in a further analysis investigating the relation between single keywords and fields.

In “G: Wholesale and retail trade; repair of motor vehicles and motorcycles”, the field “45: Wholesale and retail trade and repair of motor vehicles and motorcycles” shows a share of firms retrieved through our keyword analysis that is above the average (2%).

The extracted firms classified under “S: Other service activities” are mostly part of the field “95: Repair of computers and personal and household goods”.

In sum, we can say that the fields with higher shares of firms retrieved through our keyword-based search of all firms in the respective field are mainly related to repair services. This supports our definition of the set of keywords. However, the set of firms identified by NACE codes and by the keyword-based analysis clearly differ from each other (see also section 5.2), thus a benefit of a keyword-based analysis in addition to a NACE code-based analysis is given.

Figure 20: Shares of firms with "repair services", identified through keyword-based analysis for some selected sub-sectors[16]



Source: ORBIS (Bureau van Dijk), queries and calculations by Fraunhofer ISI

5.3.3 Analysis of individual keywords

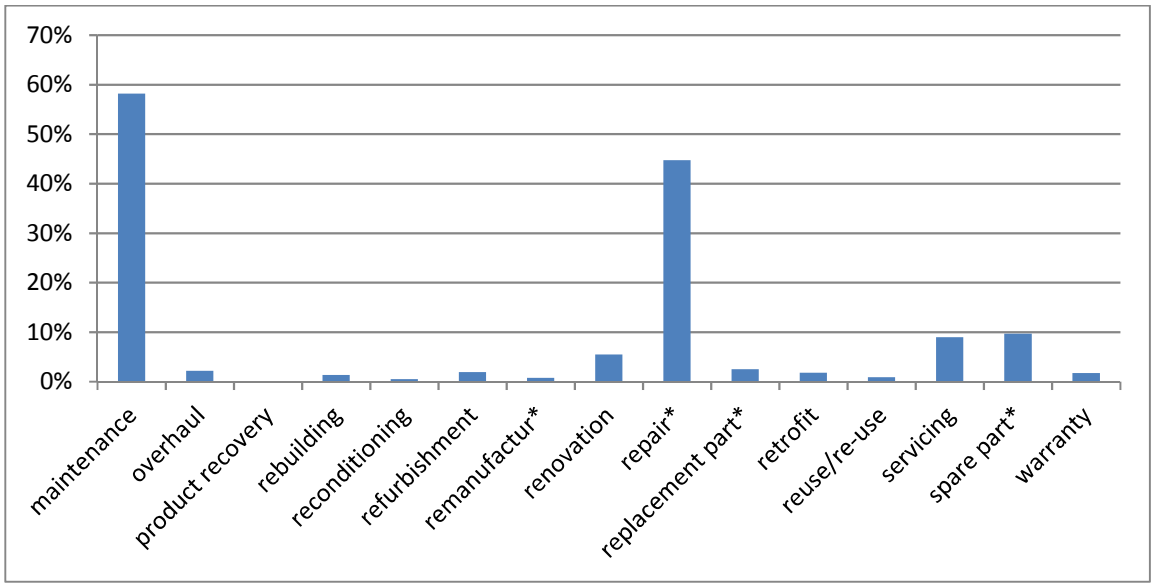
In the following, we examine the composition of the firms included in the search output in terms of matching keywords and sectors the firms are classified in.

In Figure 21, the shares of firms identified by a keyword of all firms retrieved by the whole set are depicted. The shares sum up to more than 100% since the descriptions of economic activities of firms may include several keywords. Most of the firms (80%) are retrieved by the keywords "maintenance" (58%) and "repair*" (45%). The terms "servicing" and "spare part*" identify 10% of the firms, respectively, the term "renovation" extracts 5%.

16 See Annex for a list of sub-sectors.

Three quarters of all identified firms are classified in "C: Manufacturing" (48%), "F: Construction" (15%) and "G: Wholesale and retail trade; repair of motor vehicles and motorcycles" (12%). Figure 22 shows the composition of the retrieved set of firms in terms of sectors for each keyword separately. In order to provide a better overview, only keywords that account for at least 2% of the results and sectors that are assigned to at least 5% firms for at least one keyword are shown.

Figure 21: Firms retrieved through a keyword as a share of all firms retrieved based on the keyword set.



Note: The shares sum up to more than 100% since some firms are retrieved through several keywords.

Source: ORBIS (Bureau van Dijk), queries and calculations by Fraunhofer ISI

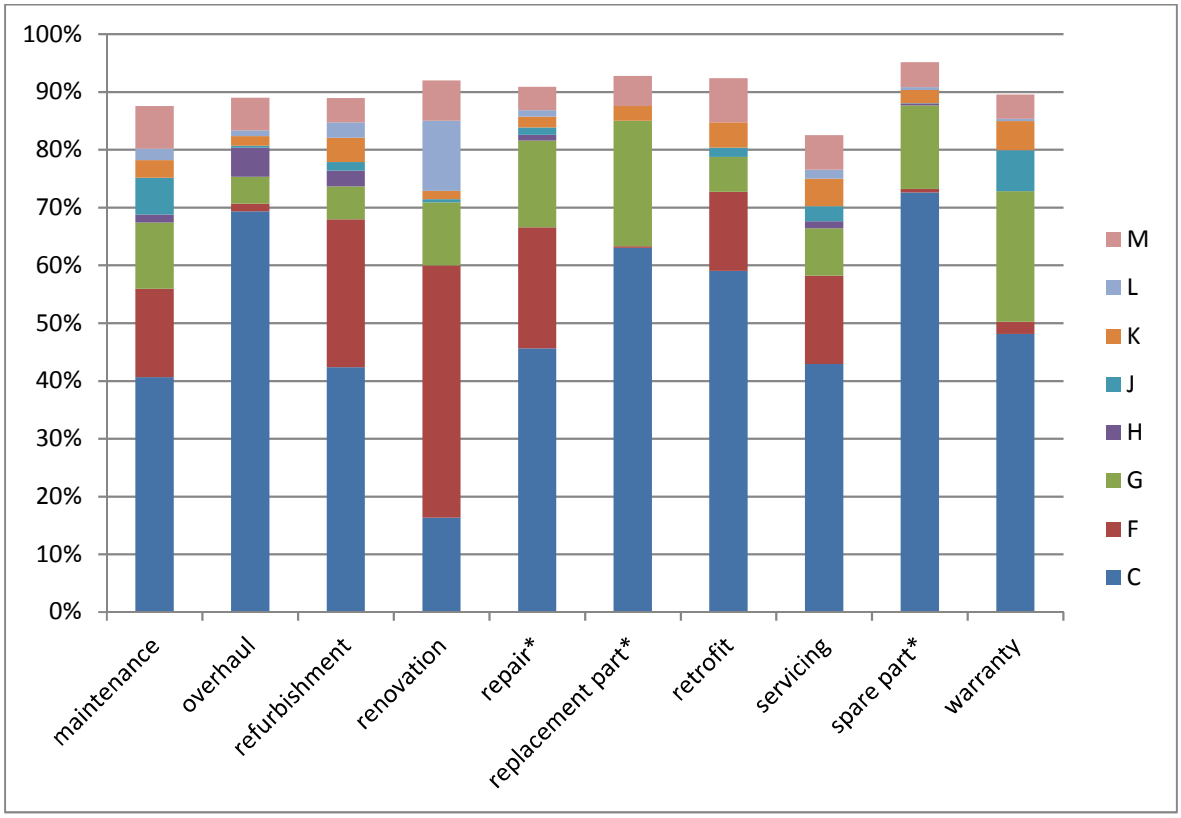
Except "renovation", all keywords extract mostly firms that are classified under "C: Manufacturing" (41-73%). A share of 44% of the firms that include "renovation" in their description are part of the sector "F: Construction", 16% are part of the sector "L. Real estate activities". This confirms the assumption that many of the firms identified by this keyword are actually related to the renovation of buildings. However, a third of the companies extracted through the term "renovation" are classified into other sectors, such as "C: Manufacturing", "G: Wholesale and retail trade; repair of motor vehicles and motorcycles" or "M: Professional, scientific and technical activities".

A relatively high share of firms assigned to the sector "F: Construction" is also found for the keywords "maintenance", "spare part*", "retrofit", "servicing" (ca. 15%) and "refurbishment" (26%). The sector "G: Wholesale and retail trade; repair of motor vehicles and motorcycles" is relevant for warranty (23%), "replacement part*" (22%), "spare part*" (15%) and "maintenance" (11%).

In summary, we can state that, for all relevant keywords except renovation, we find a similar composition of "C: Manufacturing" being the most important sector and "F: Construc-

tion" or "G: Wholesale and retail trade; repair of motor vehicles and motorcycles" ranking second. For "overhaul" and "spare part*", the share of firms in the manufacturing sector is especially high (70%). In contrast, the search based on "renovation" results in the major part of firms being in sectors related to the area of buildings (60%).

Figure 22: Firms retrieved through a keyword in a sector as a share of all firms retrieved through the respective keyword



C. Manufacturing
F. Construction
G. Wholesale and retail trade; repair of motor vehicles and motorcycles
H. Transportation and storage
J. Information and communication
K. Financial and insurance activities
L. Real estate activities
M. Professional, scientific and technical activities

Note: Only keywords that account for at least 2% of the firms found based on the keyword set are depicted. For a clearer presentation of the data, only sectors that are assigned to at least 5% of the firms for at least one keyword are included in the diagram.

Source: ORBIS (Bureau van Dijk), queries and calculations by Fraunhofer ISI

5.4 Summary on firm activities

In this study, we develop a method based on a set of keywords in order to identify firms that offer repair services. For the search, we use the description of economic activities of the enterprises. The set of keywords is developed iteratively on the descriptions starting from an initial set of keywords.

The extraction of firms based on our keyword analysis results in a set of firms that is clearly different from the set of firms assigned to NACE codes related to repair services. This is due to the fact that each enterprise is assigned to only one NACE code which represents the main focus of the company. However, firms may have several different activities that can be extracted from the descriptions.

We find that 1% of all firms in the ORBIS database are extracted by our keyword search. China, Finland and India show highest shares of extracted firms while Germany also has a share above the worldwide average. In contrast, the percentage in the USA and Russia is almost 0%.

Considering the proportion of retrieved firms of all firms in the different sectors worldwide, “F: Construction”, “C: Manufacturing” and “D: Electricity, gas, steam and air conditioning supply” rank in the top three positions. Germany shows a similar situation, in addition the sectors “A: Agriculture, forestry and fishing” and “H: Transportation and storage” are relevant.

In a more detailed analysis of the NACE codes, we find that the fields with highest shares of firms extracted by our set of keywords are mostly related to repair services which supports our method. However, the results based on the text analysis are clearly different from an analysis based on NACE codes alone, which proves the benefit of our method.

The analysis of the influence of the individual keywords reveals that most of the firms are retrieved through the keywords “maintenance “ and “repair*”. Over all keywords, we find a similar composition of the set of retrieved firms with “C: Manufacturing” being the most important sector and “F: Construction” or “G: Wholesale and retail trade; repair of motor vehicles and motorcycles” ranking second. An exception is the keyword “renovation” which mostly extracts companies related to the area of buildings.

Concluding, we can say that the text analysis provides valuable information about repair services offered by companies in addition to a NACE code-based analysis. With a share of 1% the proportion of firms worldwide is small yet visible. We can identify differences between the company profiles in different countries and find that some countries show a significantly higher share such as China, Finland and India. The major part of firms offering repair services can be found in the area of manufacturing.

6 Synopsis of evidence and conclusions

Measuring innovation towards sustainability increasingly requires taking organisational and social innovations into account. In a feasibility study, this report explores the question of how such „soft“ phenomena of green transformation processes can be captured in innovation indicators. While various indicator types have been used to describe sustainability innovations related to technological development, such ‘soft innovations’ seem generally

harder to measure. In this feasibility study, we examine two cases of soft sustainability innovations – the maker movement and repair cafés – to investigate from a bottom-up perspective the possibilities of building additional indicators for soft innovations. For this purpose, we distinguish the areas of attention, attitudes and activities and exploit a range of different data sources.

Table 11: Synopsis of key case study results for Germany

Area / Data Source	**Time series**	**Crosscutting comparisons (countries / sectors)**
Public attention / LexisNexis	Considerable increase in attention for case study issues since 2011 in Germany and worldwide	Compared to global figures, attention in Germany is relatively more focused on repair cafés and techniques and less on the maker movement / faire
Public attention / Google Trends	Considerable increase in attention for case study issues since 2011 in Germany and worldwide	Compared to US and GB, attention in Germany is more focused on techniques enabling maker movement and repair cafés
Attitudes / Eurobarometer	No data	DE-Citizens: show a more positive attitude towards waste reduction and resource efficiency than FR (and partly GB), while attitudes for environment in general are similar. DE-firms: no clear difference from FR or GB in favour of eco-/resource efficiency innovation
Attitudes / World Value Survey	No data	International comparison shows only small deviations in attitudes towards environmental issues - Germany does not stand out clearly.
Activities of firms / ORBIS	No data	Germany's share of firms with repair activities is above the worldwide average.
Activities of other market actors / Foundation 'Stichting Repair Café'	Since 2011 the number of countries with repair cafés and the number of repair country initiatives is increasing.	Not used

Given that the main goal of this study is to look into the methodological feasibility of indicators describing soft innovations, the empirical results of the case studies are summarised here only very briefly (see Table 11). Taking an integral look at the indicators and data sources it is interesting to note the sequence of events – indicating a possible causal chain –

for repair cafés: Google search indicates that activists became more interested after 2011. Media picked up the theme in 2012, and the number of activities increased from 2013 on. The data also signals that there are two trends regarding repair services: An increase in the attention for repair services as such, regardless whether provided by traditional forms or by new modes of production, and increases in the specific form. However, the data also shows that the traditional forms are still receiving more attention than the new modes of production. This is also supported by the results from the ORBIS database, which indicates that the actual repairing activities from companies are indeed much more widespread than indicated by the statistical classification.

The data also reveals differences in importance of the two case studies. Compared to the maker movement, repair cafés are more important in Germany. Compared to other countries, Germany's perspective of using new technologies such as 3D-printers seems to take place more in a technological framing (high importance of "techniques" keywords), and not so much in the framing of new modes of production. These differences are hard to detect in the results on attitudes of European citizens towards the environment. Clearly the questions addressed in these surveys are far too aggregated to be related to differences between importance of maker movement versus repair cafés.

The study has shown the feasibility of building indicators which represents attention, attitudes and activities: The indicators for attention show the diffusion of ideas and the level of interest of individuals to take a look into new ideas whereas the indicators for activities show the level of actual activities taking place. Both types of indicators can be matched to each other based on the classification used. On the other side, the indicators for attitude indicate that the increase in development of activities might not just be a temporary hype, but might be rooted in deeper developments taking place over the longer run. However, as explained above, the aggregation level of the issues is much higher so that the indicator cannot be easily matched to the observations on attention and activity.

Data availability and classification methods differ between the indicators. Table 12 shows that time series as well as crosscutting analyses are possible for many but not all data sources. The restrictions also have implications for their potential of being employed for other case studies:

- The indicators for attention use a keyword based search strategy; this results in a very flexible classification system, which can be tailored to many other different forms of soft innovation. The data allows for both building time series data, and performing international comparisons. However, there might perhaps be a country bias especially in media coverage. Furthermore, international comparisons require a careful translation of the search terms.
- The indicators for attitudes are based on data from existing surveys. Thus, the search and classification is limited by the set of questions used in the survey. The flexibility to address specific soft innovations is low. An international comparison is possible, depending on the countries covered by the surveys. To a certain degree, time series data

are available. However, the experience made points to substantial restrictions: Especially more detailed questions, which can be related more directly to specific soft innovations, are hardly represented as standard questions of the different waves, implying that time series analyses can hardly be provided at a more fine-grained level of analysis.

- The indicators for activity relate to institutional sources: For repair cafés, they are based on data from organizations, which were formed to support the innovation; for firms, they are based on descriptions in which the companies summarize their activities. The added value of using a text-based search in the ORBIS database is underlined by the differences compared to findings based on NACE classifications. The data allows comparisons between countries. Furthermore, the ability to use specific search strategies within the database points to the possibility to transfer this approach also to other soft innovations. It is more difficult to judge the possibility to build time series data. Different versions of the database, each of them representing a different year, would have to be available for the search. Furthermore, the data situation might be more difficult if soft innovations are analysed, which are neither part of business activity nor have led to the formation of specific institutions performing them. In these cases, additional data sources have to be tapped into. An alternative way to analyse text descriptions of firm activities could be to develop web crawlers or similar tools, which can be used to search internet pages of firms regarding descriptions of soft innovation activities. For time series analyses however, this would require access to earlier versions of these firm homepages.

Table 12: Potential of selected data sources for analysing soft innovations

Area	**Data source**	**Time series**	**crosscutting comparisons**
Public attention	Lexis Nexis (Media coverage)	Yes	Yes (e.g. country comparisons)
Public attention	Google Trends (Internet searches)	Yes (2004 onwards)	Yes (e.g. country comparisons)
Attitudes	Eurobarometer	No / limited	Yes (e.g. country comparisons)
Attitudes	World Value Survey	No / limited	Yes (e.g. country comparisons)
Activities of firms	ORBIS	No / difficult	Yes (e.g. country and sector comparisons)
Activities of other market actors (case study specific)	Foundation 'Stichting Repair Café': Annual reports	Yes (but limited to recent years)	Yes (but only few countries and variables - not exploited in the study)

The experience made in the feasibility study also leads to various open questions. From a strategic point of view, the following are especially important:

- In conventional innovation indicator studies a leading theme is to judge performance, for example of a specific technology field in relation to overall technological dynamics or of a country in a specific field in relation to a country's overall technological performance. For judging the performance, a benchmark is needed. In the analysis of technological innovations, this is for example the dynamics of or share in the total number of patents or of all exports. For soft innovations and the data sources and indicators proposed in this study, more work needs to be done to establish similar benchmarks in order to allow clearer statements on performance.
- This study looked at the feasibility from the perspective of two case studies. It remains open how to assess soft innovations as an aggregate. Such an approach would increase the generality of results and could also serve as a benchmark for assessing the performance of subfields. But how can soft innovations as an aggregate be addressed? Is it feasible to build this bottom-up, i.e. by aggregating numerous specific case studies? This would require developing a pre-defined list of soft innovation cases, which are representative for soft innovations as such. Such an approach is challenging, as it would require adapting the list of soft innovations continuously over time in order to incorporate new forms of soft innovation. On the other side, when you look to indicators for technological sustainability innovations, the aggregate of "green technologies" or "sustainability technologies" consists of exactly that: a bottom-up compilation of a large number of technologies from different fields of environmental protection (noise reduction, climate change mitigation etc.). Hence, it faces similar challenges of continuous adaptation. It seems essential, however, that all topics from the bottom-up compilation can be addresses through the same set of data sources, e.g. publications and patent data, trade data etc. Therefore, future research should develop the perspective on the aggregate of 'soft innovations for sustainability' further with a view to incorporating multiple cases of soft innovations while ensuring that, for all soft innovations on the list, indicators can be derived from a common set of data sources.
- On a more technical level, various issues with regard to data availability arise. As to time series, specific questions on soft sustainability innovations are rarely part of the standard questions in questionnaires. Increasing the availability of data on attitudes, which can be related to specific soft innovations would increase the number of surveys – and the costs to implement them – tremendously. In addition, the need to adapt the list of specific soft innovations over time cannot work for obtaining time series data on related attitudes. Thus, the role of indicators for attitudes as such has to be further refined. A possible role might be to look at attitudes, which are related to soft innovations per se, regardless in which area or for which specific case they apply. This means that one would have to search general attitudes that correlate with attitudes towards soft innovations and it would require finding a common set of attitudes, which can be related to all forms of soft innovations. Hypotheses have to be formulated, e.g. that actors likely to get active in soft innovations are generally more open to change, more self-reliant and characterized by a loss of trust into the innovation ability of established institutions such as government or business. It is up to future research to determine whether such a common set exists and what it would look like.

7 References

Bamberg, Sebastian; Möser, Guido (2007): Twenty years after Hines, Hungerford, and Tomera. A new meta-analysis of psycho-social determinants of pro-environmental behaviour. In *Journal of Environmental Psychology* 27 (1), pp. 14–25.

Charter, Martin; Keiller, Scott (2016): The Second Global Survey of Repair Cafes: A Summary of Findings. Centre for Sustainable Design of The University for the Creative Arts.

Dougherty, Dale (2012): The Maker Movement. In *Innovations* 7 (3), pp. 11–14. Available online at http://www.mitpressjournals.org/doi/pdf/10.1162/INOV_a_00135, checked on 6/28/2017.

European Commission (2017): Public Opinion. Available online at http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm, checked on 8/18/2017.

European Union (2011): Attitudes of European entrepreneurs towards eco-innovation. Analytical Report. Edited by European Union (Flash Eurobarometer, 315). Available online at http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_315_en.pdf, checked on 8/18/2017.

European Union (2014a): Attitudes of Europeans Towards Waste Management and Resource Efficiency. Edited by European Union (Flash Eurobarometer, 388). Available online at http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_388_en.pdf, checked on 8/18/2017.

European Union (2014b): Attitudes of European Citizens Towards the Environment. Edited by European Union (Special Eurobarometer, 416 / Wave EB81.3). Available online at http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_416_en.pdf, checked on 8/18/2017.

GESIS (2017): Eurobarometer Data Service. The European Commission's Eurobarometer Surveys. Available online at https://www.gesis.org/eurobarometer-data-service/home/, checked on 8/18/2017.

Google (2017): Google Trends Help Center. Available online at https://support.google.com/trends/?hl=en#topic=6248052, checked on 8/18/2017.

Hagel, John; Brown, John Seely; Kulasooriya, Duleesha (2014): A movement in the making. Edited by Deloitte Center for the Edge. Available online at https://dupress.deloitte.com/dup-us-en/topics/emerging-technologies/a-movement-in-the-making.html, checked on 6/6/2017.

Howaldt, Jürgen; Schwarz, Michael; Henning, Klaus; Hees, Frank (2010): Social Innovation: Concepts, research fields and international trends: IMA/ZLW.

Klöckner, Christian A. (2013): A comprehensive model of the psychology of environmental behaviour—A meta-analysis. In *Global Environmental Change* 23 (5), pp. 1028–1038.

Kohtala, Cindy; Hyysalo, Sampsa (2015): Anticipated environmental sustainability of personal fabrication. In *Journal of Cleaner Production* 99, pp. 333–344. DOI: 10.1016/j.jclepro.2015.02.093.

Lacy, Stephen; Watson, Brendan R.; Riffe, Daniel; Lovejoy, Jennette (2015): Issues and Best Practices in Content Analysis. In *Journalism & Mass Communication Quarterly* 92 (4), pp. 791–811. DOI: 10.1177/1077699015607338.

Lange, Bastian; Schmidt, Suntje; Domann, Valentin; Ibert, Oliver; Kühn, Juliane; Kuebart, Andreas (2017): Basteln – Gestalten – Experimentieren: Offene kreative Orte in Deutschland. Leibniz-Institut für Länderkunde (IfL). Leipzig (Nationalatlas aktuell 11 (04.2017), 3). Available online at http://aktuell.nationalatlas.de/kreative_Orte.3_04-2017.0.html/, checked on 6/6/2017.

Maker Media, Inc. (2017): Fast Facts. Available online at http://makerfaire.com/media-center/#fast-facts, checked on 6/6/2017.

Moulaert, Frank; MacCallum, Diana; Hillier, Jean (2013): Social innovation: intuition, precept, concept, theory and practice. In Frank Moulaert, Diana MacCallum, Abid Mehmood, Abdelillah Hamdouch (Eds.): The international handbook on social innovation. Collective action, social learning and transdisciplinary research. Cheltenham [England]: Edward Elgar Publishing, pp. 13–24.

Neumeier, Stefan (2012): Why do Social Innovations in Rural Development Matter and Should They be Considered More Seriously in Rural Development Research? - Proposal for a Stronger Focus on Social Innovations in Rural Development Research. In *Sociologia Ruralis* 52 (1), pp. 48–69. DOI: 10.1111/j.1467-9523.2011.00553.x.

Newig, Jens (2004): Public Attention, Political Action. The Example of Environmental Regulation. In *Rationality and Society* 16 (2), pp. 149–190. DOI: 10.1177/1043463104043713.

Repair Café International Foundation (2015): Repair Café Foundation and iFixit start cooperation. Available online at https://repaircafe.org/en/repair-cafe-foundation-and-ifixit-start-cooperation/, checked on 6/28/2017.

Repair Café International Foundation (2017): Repair Cafés prevent 250,000 kilos of waste. Available online at https://repaircafe.org/en/repair-cafes-prevent-250000-kilos-waste/, checked on 8/2/2017.

Ripberger, Joseph T. (2011): Capturing curiosity. Using Internet search trends to measure public attentiveness. In *Policy Studies Journal* 39 (2), pp. 239–259.

Seyfang, Gill; Longhurst, Noel (2015): What influences the diffusion of grassroots innovations for sustainability? Investigating community currency niches. In *Technology Analysis & Strategic Management*, pp. 1–23. DOI: 10.1080/09537325.2015.1063603.

Simons, Arno; Petschow, Ulrich; Peuckert, Jan (2016): Offene Werkstätten - nachhaltig innovativ? In *Schriftenreihe des IÖW* (212). Available online at https://www.ioew.de/fileadmin/user_upload/BILDER_und_Downloaddateien/Publikationen/Schriftenreihen/IOEW_SR-212_Offene_Werkstaetten-nachhaltig_innovativ.pdf, checked on 6/6/2017.

Stichting Repair Café (2010): Jaarverslag 2010. Edited by Stichting Repair Café. Stichting Repair Café. Amsterdam. Available online at http://repaircafe.org/wp-content/uploads/2015/09/Jaarverslag_2010.pdf, checked on 8/3/2017.

Stichting Repair Café (2011): Jaarverslag 2011. Edited by Stichting Repair Café. Stichting Repair Café. Amsterdam. Available online at http://repaircafe.org/wp-content/uploads/2015/09/Jaarverslag_2011_webversie.pdf, checked on 8/3/2017.

Stichting Repair Café (2012): Jaarverslag 2012. Edited by Stichting Repair Café. Stichting Repair Café. Amsterdam. Available online at http://repaircafe.org/wp-content/uploads/2015/09/Jaarverslag_2012_webversie.pdf, checked on 8/3/2017.

Stichting Repair Café International (2016): Jaarverslag 2016. Edited by Stichting Repair Café International. Stichting Repair Café International. Amsterdam. Available online at https://repaircafe.org/wp-content/uploads/2017/06/Jaarverslag_2016_webversie.pdf, checked on 8/3/2017.

Stichting Repair Café Nederland (2013): Jaarverslag 2013. Edited by Stichting Repair Café Nederland. Stichting Repair Café Nederland. Amsterdam. Available online at http://repaircafe.org/wp-content/uploads/2015/09/Jaarverslag_2013_webversie.pdf, checked on 8/3/2017.

Stichting Repair Café Nederland (2014): Jaarverslag 2014. Edited by Stichting Repair Café Nederland. Stichting Repair Café Nederland. Amsterdam. Available online at http://repaircafe.org/wp-content/uploads/2015/09/Jaarverslag_2014_webversie.pdf, checked on 8/3/2017.

Stichting Repair Café Nederland (2015): Jaarverslag 2015. Edited by Stichting Repair Café Nederland. Stichting Repair Café Nederland. Amsterdam. Available online at http://repaircafe.org/wp-content/uploads/2016/03/Jaarverslag_2015_webversie.pdf, checked on 8/3/2017.

Stiftungsgemeinschaft anstiftung & erthomis gGmbH (Ed.) (2015): Reparieren. Projekte, Orte und Akteure einer Bewegung. München, checked on 6/28/2017.

Stryker, Jo Ellen; Wray, Ricardo J.; Hornik, Robert C.; Yanovitzky, Itzik (2016): Validation of Database Search Terms for Content Analysis. The Case of Cancer News Coverage. In *Journalism & Mass Communication Quarterly* 83 (2), pp. 413–430. DOI: 10.1177/107769900608300212.

Unterfrauner, Elisabeth; Schrammel, Maria; Hofer, Margit; Fabian, Claudia Magdalena; Voigt, Christian; Deljanin, Sarah Roxenne et al. (2017): D3.2 Final case study report focusing on cross-case analysis. Edited by Zentrum für Soziale Innovation (MAKE-IT). Available online at http://make-it.io/wordpress/wp-content/uploads/dlm_uploads/2017/07/MAKE-IT_D3.2.pdf, checked on 8/1/2017.

Walz, Rainer (2016): Indikatorik von Innovationen im Kontext der deutschen Nachhaltigkeitsstrategie - Reflexion bisheriger Erfahrungen und Überlegungen zur Weiterentwicklung. Kurzgutachten im Auftrag des Rates für Nachhaltige Entwicklung. Karslruhe: Fraunhofer ISI. Available online at http://www.isi.fraunhofer.de/isi-wAssets/docs/n/de/publikationen/20160313_Fraunhofer_ISI_RNE_Studie_Indikatorik_von_Innovationen.pdf, checked on 8/1/2016.

Walz, Rainer; Gotsch, Matthias; Gandenberger, Carsten; Peters, Anja; Bodenheimer, Miriam; Günther, Edeltraud (2017): Nachhaltiges Wirtschaften. Stand der Transformation zu einer Green Economy. Edited by Fraunhofer Institut für System- und Innovationsforschung -ISI-. Karlsruhe (Working Papers Sustainability and Innovation, WP03-2017). Available online at http://www.isi.fraunhofer.de/isi-wAssets/docs/x/de/publikationen/Working-Papers/WP-03-2017_Nachhaltiges-Wirtschaften_RW.pdf, checked on 6/26/2017.

Warnke, Philine; Koschatzky, Knut; Dönitz, Ewa; Zenker, Andrea; Stahlecker, Thomas; Som, Oliver et al. (2016): Opening up the innovation system framework towards new actors and institutions. Edited by Fraunhofer ISI. Fraunhofer ISI. Karlsruhe (Fraunhofer ISI Discussion Papers Innovation Systems and Policy Analysis, 49). Available online at http://www.isi.fraunhofer.de/isi-wAssets/docs/p/de/diskpap_innosysteme_policyanalyse/discussionpaper_49_2016.pdf.

Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (WBGU) (2011): World in transition. A social contract for sustainability. Berlin: WBGU.

World Values Survey Association (2017): World Values Survey. Available online at http://www.worldvaluessurvey.org/wvs.jsp, checked on 8/18/2017.

Zirngiebl, Marthe (2017): Good intentions are not enough - the Maker Movement's current contribution to sustainability transitions. In. International Sustainability Conference 2017.

Göteborg, Schweden, 18. - 21. Juni 2017 (IST 2017). Available online at https://www5.shocklogic.com/scripts/jmevent/programme.php?client_Id=KONGRESS&project_Id=17361, checked on 6/6/2017.

A.1 Annex

Table 13: Overview of media sources available in LexisNexis for selected countries

Country	Number of Sources	Local language sources available?
Belgium	44	Dutch, French
Denmark	17	yes
Germany	333	yes
Finland	16	yes
France	280	yes
UK (Great Britain)	1249	yes
Israel	16	English, French, Arabic
Italy	32	yes
Japan	14	English, 1 Japanese
Canada	323	yes
South Korea	5	English, 1 Korean
Netherlands	135	yes
Austria	13	yes
Poland	17	yes
Sweden	17	yes
Switzerland	61	yes
Spain	59	yes
USA	2401	yes
Brazil	82	yes
Russia	307	yes
India	467	English, Arabic
China	81	English, 1 Chinese
South Africa	67	English, 1 Arabic, 1 Afrikaans

Note: English-language sources are available for all countries

Table 14: Overview of sub-sectors used in the analysis of firm activities

C	10	Manufacture of food products
	11	Manufacture of beverages
	12	Manufacture of tobacco products
	13	Manufacture of textiles
	14	Manufacture of wearing apparel
	15	Manufacture of leather and related products
	16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	17	Manufacture of paper and paper products
	18	Printing and reproduction of recorded media
	19	Manufacture of coke and refined petroleum products
	20	Manufacture of chemicals and chemical products
	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
	22	Manufacture of rubber and plastic products
	23	Manufacture of other non-metallic mineral products
	24	Manufacture of basic metals
	25	Manufacture of fabricated metal products, except machinery and equipment
	26	Manufacture of computer, electronic and optical products
	27	Manufacture of electrical equipment
	28	Manufacture of machinery and equipment n.e.c.
	29	Manufacture of motor vehicles, trailers and semi-trailers
	30	Manufacture of other transport equipment
	31	Manufacture of furniture
	32	Other manufacturing
	33	Repair and installation of machinery and equipment
F	41	Construction of buildings
	42	Civil engineering
	43	Specialised construction activities
G	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
	46	Wholesale trade, except of motor vehicles and motorcycles
	47	Retail trade, except of motor vehicles and motorcycles
S	94	Activities of membership organisations
	95	Repair of computers and personal and household goods
	96	Other personal service activities