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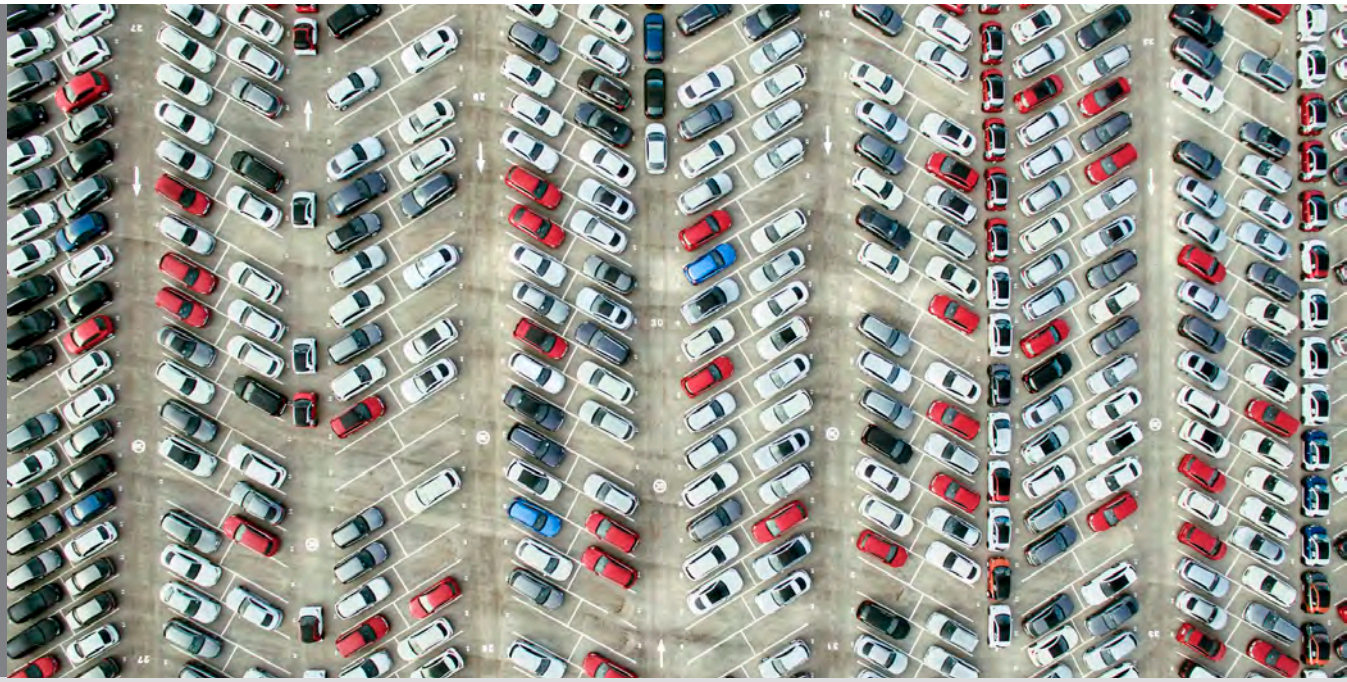

New Approaches to Predicting Cluster Emergence

Gerd Meier zu Köcker, Matthias Künzel, Michael Nerger

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In the context of regional development, there is increasing interest in identifying industrial transformation processes that lead to the emergence of new clusters. This demand is further fuelled by the concept of Smart Specialisation (S3), which concentrates its approach on transformative activities. Without doubt, traditional cluster mapping can be considered to be an important tool for the identification and monitoring of (existing) clusters but it often fails to identify new clusters that emerge as a result of industrial transformation processes. Conventional statistical approaches provide limited information about these emerging clusters. This is because they are based on statistics, which reflect the present situation or the recent past but do not provide information about the future.

This paper introduces a new approach to predicting emerging clusters more effectively through the regional mapping and clustering of applied R&D activities. The methodology is based on the assumption that if a critical mass of regional actors independently invests in a same new area, with the objective of developing new products, technologies and services with high cross-sectoral innovation potential, this will likely lead to an emerging industry and the formation of a new cluster – once these products and technologies are successfully commercialised. The paper successfully verifies this approach by considering e-mobility cluster development in Germany. It also shows where traditional automotive clusters are transforming and becoming e-mobility clusters and where entirely new e-mobility clusters are emerging. Furthermore, although e-mobility is still an emerging industry, regional specialisation patterns are already becoming visible in Germany.

Introduction

The recent economic crisis and ongoing global industrial transformation have emphasised the need to modernise regional industrial structures. One of the rationales for this trend is the emergence of new industries and an increase in technological convergence, which leads to the continuous reshaping of the business environment and calls for new business models, strategies and policy approaches. The concept of Smart Specialisation Strategies (S3) (Foray 2015) makes it even more important that regions implement future-oriented regional strategies and related policies (Meier zu Köcker 2017).

Subsequently, the focus of policy discussions is shifting towards emerging industries that can react to business opportunities immediately, supporting the emergence and growth of new firms driven by entrepreneurship, technology or reactivity and catalysing the transformation of existing value chains and the formation of new value chains (Ketels 2013). The question that regional policy makers are facing is how to develop and better implement regional development policies that will establish a more robust and resilient industrial base within their respective regions (Izsak et al, 2016). Consequently, there is an increasing need to identify the regional processes of industrial transformation that lead to the emergence of new clusters in new industries. This is accompanied by the need for policy interventions for improving the framework conditions that enable transformative activities to reach emerging industries (Dermastia et al, 2015).

Cluster mapping is a well-established approach to measuring the strength and development of clusters. The US cluster portal[1] and the European Cluster Observatory[2] are both well-known approaches. These mapping approaches can undoubtedly capture existing clusters well and they can provide good evidence on how they developed over time (Brenner, 2016). Nevertheless, these approaches struggle in terms of identifying transformative activities on a regional level and properly mapping new emerging clusters. New industries and emerging clusters cannot be understood as fitting into the NACE code classifications,

1 https://clustermapping.us
2 http://ec.europa.eu/growth/smes/cluster/observatory/index_en.htm

which are often the basis of traditional sectoral approaches to cluster mapping. Furthermore, related statistics are often backwards-oriented. Identifying transformative activities and mapping emerging clusters requires new approaches that take into account the individual characteristics of emerging industries and use more future-oriented statistical data.

This paper introduces a new technique for better predicting the emergence of clusters in new industries by regionally mapping applied R&D funding streams. The approach is based on the assumption that if a critical mass of regional actors invests significantly in the same new area, an area with high cross-sectoral innovation potential and a transformative nature, notable transformative activities will take place in that region and these activities may result in the emergence of a cluster. 'Applied R&D' is the period during which prototypes and business models are developed and are likely be turned into marketable products or services within a period of 2–3 years.

By considering the e-mobility industry, which can indisputably be considered as an emerging industry, this paper analyses the R&D funding streams of collaborative applied R&D in the period from 2008 to 2015. The results demonstrated that emerging clusters and regional industrial agglomerations could be identified even at an early stage. Furthermore, the authors were also able to analyse the regional industrial structure and specialisation pattern of e-mobility within these regional hotspots.

Industrial Transformation and Emerging Industries

The term 'transformation' can be considered as one of the hot topics of our time, especially in combination with digitalisation or e-mobility. Industrial or technological transformation is, without doubt, a major force behind the business model disruptions in many industries. It started with Amazon, Google, and Apple but that was only the beginning. Recent examples show how young companies such as WhatsApp, Tesla, Uber, and Airbnb are transforming entire industries by dismantling existing value chains and introducing new business models. Traditional industries and companies are seriously challenged by small newcomers, unless they prepare for them early enough and digitalise their own business models. Periods of industry transformation pose grave threats and tremendous opportunities to companies and entire regions.

We consider transformative activities to be a number of innovation-related activities undertaken by a group of actors targeting the same (technical, market or industrial) area and having the potential to significantly transform existing industries. Transformative activities are positioned on "a mid-grained level of granularity that is situated between the micro level of individual units and the macro level of sectors and industries" (Foray 2017). Regions are becoming more interested in identifying and supporting industrial transformation processes by improving framework conditions and making targeted investments in R&D and innovation. Furthermore, even regions with limited

Original business model	New business sectors resulting from transformation
▶ HOCHTIEF Aktiengesellschaft: Construction company with development and management competencies	▶ HOCHTIEF Airport GmbH: Airport investor, manager, and consultant
▶ Deutsche Lufthansa AG: Airline, including airport competencies	▶ Lufthansa Consulting GmbH: Air traffic consultancy
▶ BLG LOGISTICS GROUP AG & Co. KG: Port handling company, including automobile competencies	▶ BLG AUTOMOBILE LOGISTICS GmbH & Co. KG: Automotive finisher and logistics services
▶ Porsche AG: Automotive manufacturer, including restructuring competencies	▶ Porsche Consulting GmbH: Consultancy for operative business optimisation
▶ BASF SE: Chemical company, including material competencies	▶ BASF Battery Materials division: Lithium ion battery component manufacturer
▶ geobra Brandstätter GmbH & Co. KG (Playmobil); Lego A/S, Ravensburger AG: Toy manufacturers, including entertainment competencies	▶ Playmobil FunPark; Legoland Freizeitparks; Ravensburger Spieleland: Amusement park operators
▶ JCDecaux SA: Outdoor advertising specialist, including inner-city decoration competencies	▶ Cyclocity: Bicycle rental system
▶ Fjällräven: Clothing manufacturer with outdoor competencies	▶ Fjällräven: Outdoor, expedition, event organiser
▶ Betty Bossi Verlag AG: Cookbook publisher with culinary cooking and baking competencies	▶ Betty Bossi Kochschule: Culinary school operator

Table 1: Selected business model transformation (Zentes 2013).

resources can significantly benefit. This is because transformation can give even new companies unusual latitude to influence the future structure of industry. Industry and market leaders are often unseated during such times, replaced by underdogs and entrants. Whereas there are also plenty of examples of market leaders enjoying above-average benefits from industrial transformation processes (see Table 1). A challenge that remains is that of predicting and identifying those transformation processes that are of relevance for a given region and are likely to become an emerging industry.

In addition to what has been mentioned above, emerging industries are defined as the establishment of entirely new industrial value chains, or the radical reconfiguration of an existing one, driven by a transformative activities (e.g., disruptive ideas or technologies) and leading to these transformations/opportunities being turned into new products/services with higher added value (Heffernan et. al 2009). As such, emerging industries can but do not necessarily need to be completely 'new' industrial sectors. They are new combinations of narrowly defined activities that can also comprise existing industrial sectors that are evolving into emerging industries in response to new technologies, market demands and value chain configurations (European Commission 2015). Thus, emerging industries thrive on cross-sectoral linkages; they combine narrow activities in new ways and it is this combination, rather than the individual activity, that generates economic value (Agrawal et al 2014).

A good example of the emergence of an entirely new, emerging industry that is driven by transformative activities is the development of the e-mobility industry (Schwedes et al 2013). What started with a mere focus on the development of cars and batteries was recently shown to be a much broader pattern of industrial development. Today, e-mobility is no longer considered from the perspective of the car industry, but from an angle that includes several industries that have very few or no linkages with each other at all (Werther et al 2011). Besides electricity generation, grid infrastructure and the car industry, it also covers creative industries that play a role in the development of mobility concepts or even smart homes (Ramsbrock 2013). The e-mobility value chain is displayed in Figure 1, which shows that actors from entirely different sectors need to cooperate and collaborate in this emerging industry.

Research Question and Methodology

As mentioned in the previous sections, predicting and identifying emerging clusters is still a challenge. Consequently, the research questions were defined as follows:

- Is it possible to identify emerging clusters at a time when related industries are still emerging?
- At that stage of industry emergence, is it already possible to detect specific regional industrial structures?

History has shown that strong applied R&D involving industry and academia has often taken place at the very beginning of a life cycle of emerging industries. Good examples are nanotechnologies or microsystems technologies (MST). In the mid-1980s the main focus of MST R&D activities was on the development of new enabling technologies (Botthof et al 2003). In the 1990s, R&D&I focused more on the future application areas of MST (creating markets for MST applications) and changed from being a transformative activity to an emerging industry (Becher et al 2012). Nowadays, MST is a well-established industry that is constantly moving in the direction of Smart Systems Integration (Botthof et al 2013). Such patterns are very common for many emerging industries.

Companies become the driving force in applied R&D since the outcomes are comparatively close to the market (Bierhals et al 2013). Companies already have clear ideas about market needs, so applied R&D has a strong demand-oriented component. In this phase, 'development' gains more importance than 'research' and firms set the development agenda; academia can be understood as being an 'enabler'. In other words, high levels of investment within a similar R&D scope, undertaken by a critical mass of regional actors, can be considered as a good indicator that transformative activities are located in a certain region and that it is a nucleus of emerging clusters and new industries.

In many countries, applied R&D is strongly co-financed by public funds. Even where it is close to the market, applied R&D is risky and it requires some level of involvement from academia. Consequently, many governments match private investments with public funding. Tracking the destinations of private and public investments in applied R&D makes it possible to locate

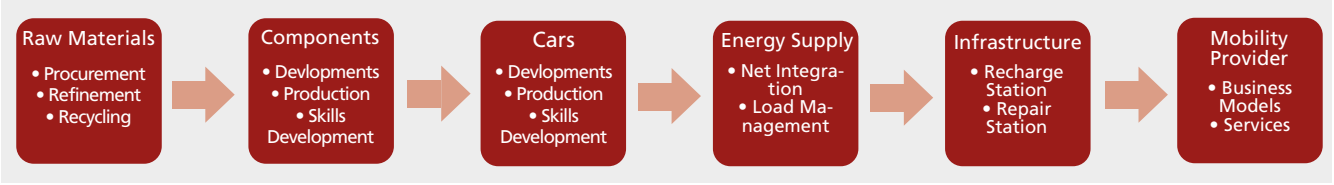


Figure 1: New value chain for e-mobility (Meier zu Köcker et al 2015).

the critical masses of regional actors who are active in certain transformative activities, which are likely to become emerging clusters.

The requirements for using public and private investments in applied R&D funding as a tool for identifying emerging clusters are:

- Applied R&D projects shall be the result of competitive calls in order to avoid bias through strong regional subsidiaries (no institutional funding shall be considered).
- Applied R&D projects must be highly innovative and targeting new fields (industrial excellence).
- A good mixture of generic and sector-specific support schemes (grant programmes) covering a wide spectrum of technologies and markets.
- The funding rate shall be 50% or less in order to ensure significant co-investment of firms to avoid entering applied R&D&I that is mainly done in order to attract funding.
- Up-to-date data on the level of involvement from companies and universities (not older than one year in order to accurately capture current developments).
- The research topics of the corresponding R&D projects must be able to properly classify the funding streams.
- Differentiation between global companies, small and medium enterprises (SMEs) and academia must be possible

Findings

Emergence of e-mobility clusters in Germany

E-mobility has been selected to validate the proposed methodology for the following reasons:

- E-mobility can be easily classified in terms of several sub-sectors, which the available data set covers well.
- E-mobility is characteristic of an emerging industry whereby traditional industries, such as the automotive, manufacturing and energy sectors, develop new partnerships and business patterns.
- Excellent availability of data on public and private investment in applied R&D funding streams for Germany (from 2009 up to now).
- Critical mass of data available due to the existence of more than 1,800 applied R&D projects in Germany.

For our study, we used the German government's public R&D database, which contains data sets concerning over 110,000 completed or ongoing R&D projects[3]. Co-funded projects supported by six federal ministries are listed within 60 days of approval, which guarantees that the data is up-to-date. The only projects that were considered were those that represent joint applied R&D efforts by German industry and academia in the field of e-mobility between 2009 and 2016. More than 1,840 applied R&D projects were investigated. These projects represent a private investment of around 750 million euros as well as a public investment of 1.3 billion euros, adding up to 2 billion euros of total investment in e-mobility.

After the data set was classified according to the aforementioned indicators, a pivot analysis was conducted in order to reveal regional agglomerations of e-mobility actors. These results were obtained by using georeferencing and GIS analysis.

Public investment from regional sources was not considered due to the fact that this would have caused significant bias, seeing as some federal states invest much more in e-mobility than others. Furthermore, regional funding programmes often target incremental innovation, which, by its nature, is not as highly transformative as applied R&D that is financed by federal resources.

The following data was applied for the purposes of further investigation:

- Abstracts of R&D projects in order to group a given project by its scientific scope and the relevant sub-sector
- Amount of funding
- Beneficiaries (name, size, location)

The applied R&D projects were classified according to 10 different sub-sectors within e-mobility in order to capture the entire industry, but also to facilitate the identification of regional specialisation patterns in each sub-sector (Table 2). The authors were supported by an expert team in order to ensure that the applied R&D projects being analysed were properly classified.

3 for further information: http://www.foerderdatenbank.de/

In total, more than 150 academic actors and 680 companies have been actively involved in collaborative applied R&D between 2009 and 2016. As is to be expected, many of these actors were involved in several projects.

Figure 3 displays the share of different actors involved in the applied R&D projects and confirms that applied R&D in e-mobility is industry-driven to a significant extent (almost 75% of actors are industrial players). Furthermore, small and medium-sized enterprises are particularly active (56%) and most of them are not automotive suppliers and were not involved in the traditional automotive sector before 2009. This observation confirms that e-mobility is a cross-cutting emerging industry because in such industries, it is typical for entirely new actors to move in.

Figure 4a illustrates the R&D hotspots for e-mobility in Germany. The redder the marking for a region, the more investment there is from industry and academia in the area of applied R&D. Figure 4b reveals the regional agglomeration of industry according to actor types.

From Figures 4a and 4b, the following key observations can be made:

- Traditional automotive clusters are becoming e-mobility clusters.
  - There are regions that are known as being traditional automotive clusters. As a consequence of the strong involvement of many of these cluster actors in applied R&D activities in the field of e-mobility, these clusters are transforming and becoming e-mobility clusters. As such, these e-mobility clusters are located in Bavaria, Baden-Wuerttemberg, Lower Saxony and Saxony.
- Traditional automotive clusters that do not seem to be turning into e-mobility clusters.
  - There are regions, especially around Cologne and Bochum in North Rhine Westphalia, where there are strong (traditional) automotive industries but not many visible R&D activities in e-mobility. This leads to the conclusion that these clusters are not (fully) transforming to become e-mobility clusters.
  - E-mobility clusters are emerging in metropolitan areas. Whereas this observation is to be expected in Stuttgart and Munich due to traditional automotive production, it is something of a surprise in Berlin and Dresden.

The latter observation provides evidence that metropolitan regions are good incubators for e-mobility clusters, especially if they serve as 'test beds'. Many of those actors, such as those in Berlin and Aachen, had little prior involvement in any automotive industry. Furthermore, Aachen became an e-mobility hotspot in North-Rhine Westphalia – more so than traditional car manufacturing areas such as Cologne or Bochum. The Aachen region is an interesting example of e-mobility cluster development in Germany. The development centres around a strong university, which is well-known for world-class automotive (production) research. Figure 4b illustrates the high agglomeration of SMEs engaged in e-mobility that are located near the university.

Sub-category	Number of applied R&D projects analysed
Workforce Development	60
Cars and Components	497
Fleet Management	350
Business Models	182
Storage/Charging	321
Net Integration	134
Manufacturing and Production	219
Recycling	31
Electro/Hybrid Buses	48

Table 2: Classification of the e-mobility sector.

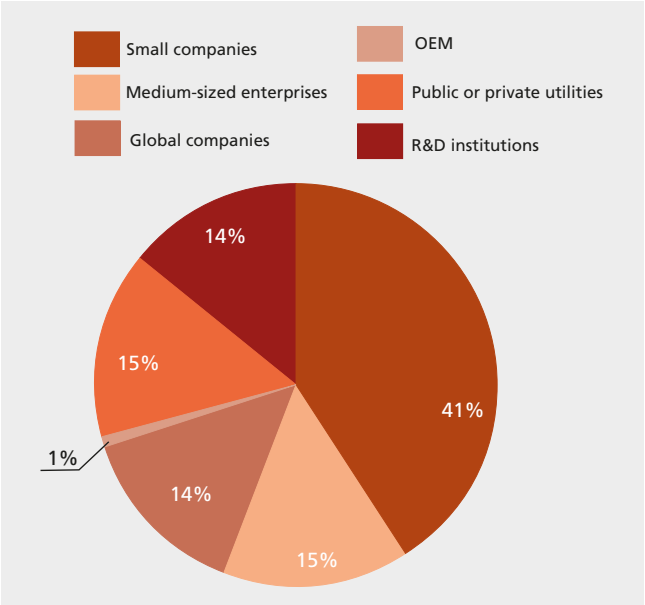
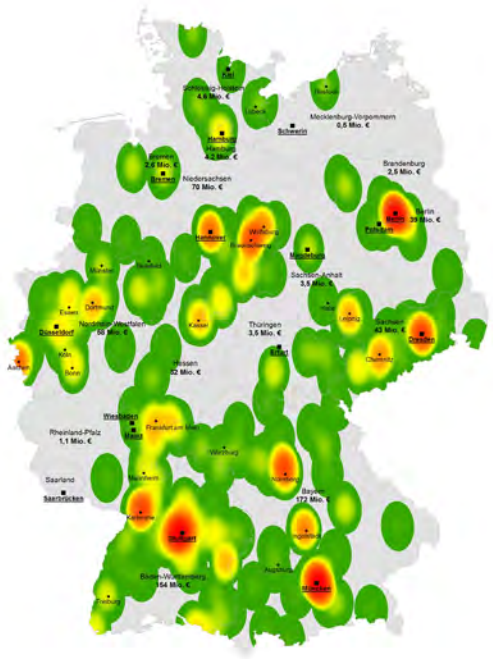


Figure 3: Share of different actor groups involved in applied R&D in e-mobility.

Allocation of funding hot spots → **Industrial agglomeration pattern**

Hot spots grants



Location of beneficiaries (companies)

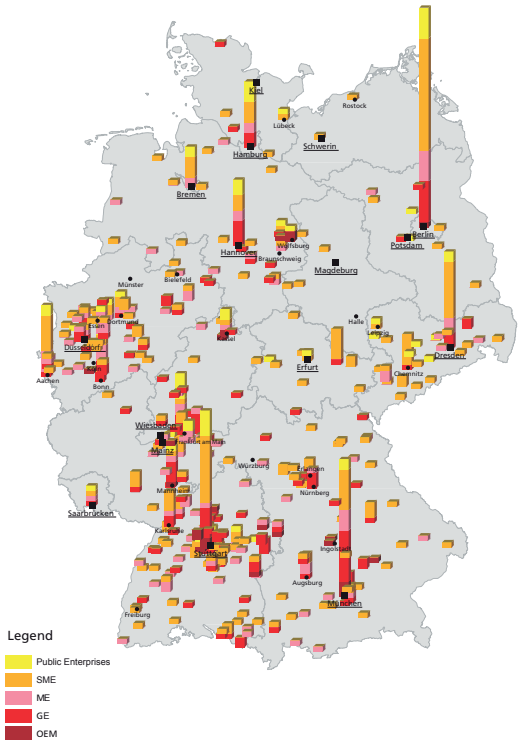


Figure 4a: Regional R&D hotspots; 4b: Agglomeration pattern of e-mobility in Germany.

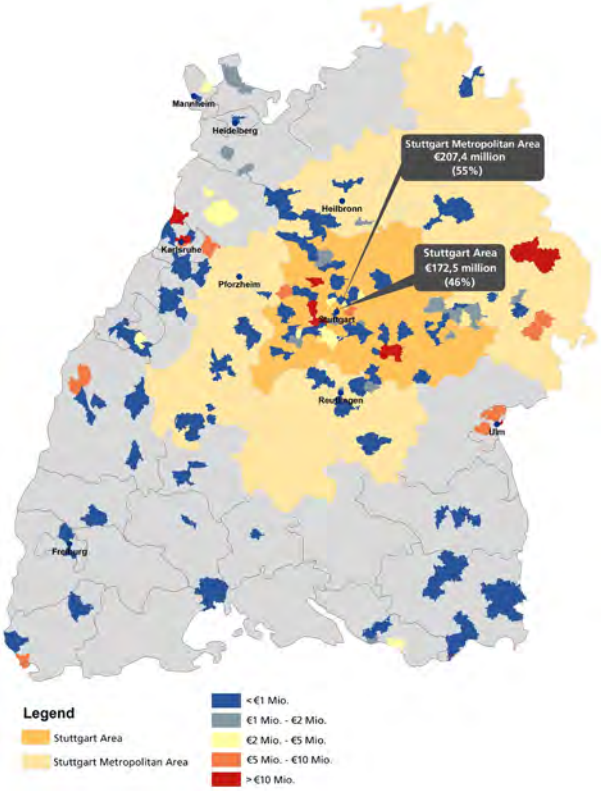


Figure 5: Regional distribution of private and public spending in applied R&D in e-mobility.

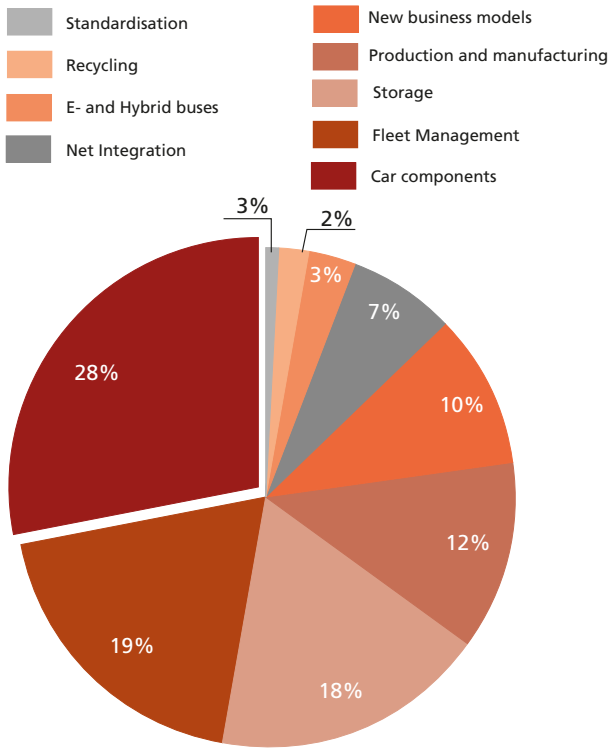
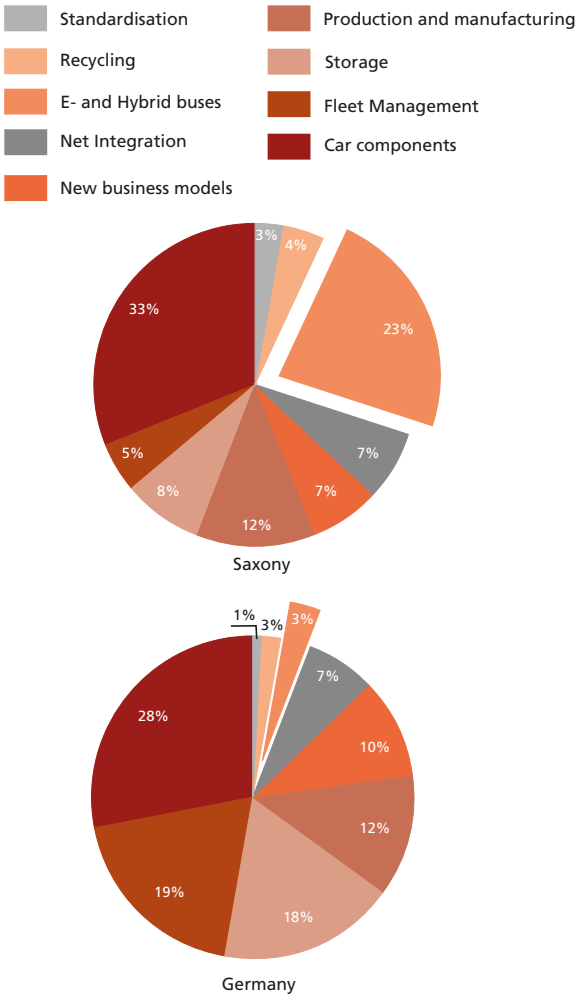


Figure 6: Distribution of R&D projects according to different nodes of the e-mobility value chain.



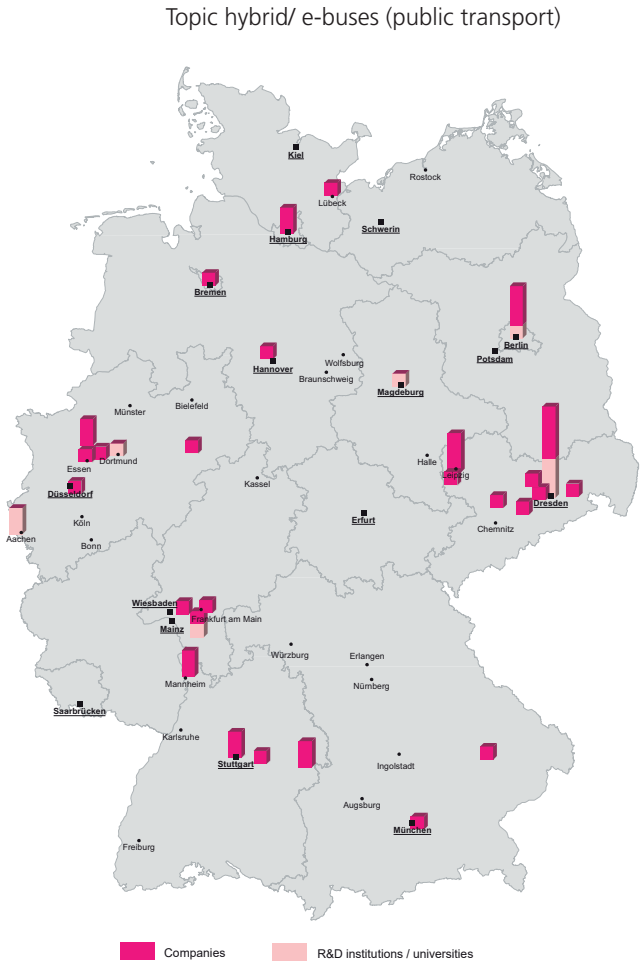


Figure 7a: Distribution of R&D&I projects according to different nodes of the e-mobility value chain for the Saxony region;
7b: Regional agglomeration of actors engaged in the development and testing of hybrid/e-buses.

Another interesting observation is that although Bavaria, especially areas around Munich, is undoubtedly becoming a leading e-mobility cluster in Germany, the academic sector is significantly underrepresented. Indeed, 80% of the investment in applied R&D in Bavaria is made by industrial players. A closer look at the R&D projects themselves confirmed this observation, since a significant majority of the industrial partners are cooperating with academic partners from outside Bavaria.

The methodology that was applied allows for an even higher regional resolution, which provides more information about the industrial and regional structure of emerging e-mobility clusters. This can be demonstrated by taking a closer look at the Baden-Wuerttemberg region. Figure 5 shows that the e-mobility cluster in Baden-Wuerttemberg is very much focused on the metropolitan areas around Stuttgart, where there has been by far the highest level of public and private investment in applied R&D in recent years. A few additional activities can be seen in Karlsruhe, but these are mainly carried out by the Karlsruhe Institute for Technology (KIT). Especially in the south of Baden-Württemberg, where the traditional automotive supplier industry is located, not much applied R&D can be detected for e-mobility-based activities.

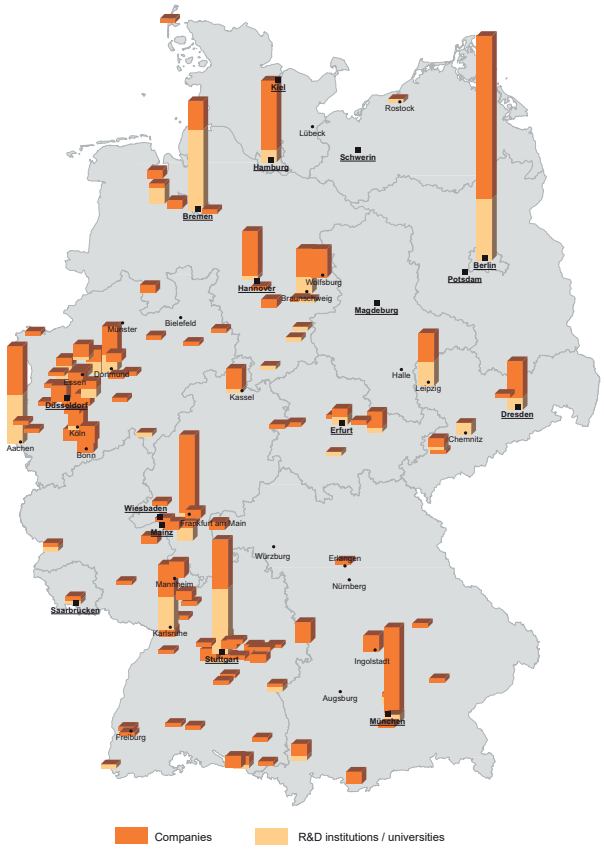
Regional Specialisation Patterns in the Field of E-Mobility

When taking a closer look at the R&D projects, Germany's industry is predominantly focussing its applied R&D activities in four main areas:

- New, e-mobility-specific vehicle components.
- Manufacturing and production.
- Innovative charging technologies.
- Demonstration projects with vehicle fleets.

More than 75% of all R&D activities focus on these research areas, as shown in Figure 6.

Topic Mobility concepts (fleet management, new business models)



8: Regional agglomeration of actors engaged in the e-mobility value chain nodes of fleet management and new business models.

When taking a closer look at the region of Saxony, the regional picture is entirely different to the rest of Germany. It is a good example of how regional specialisation patterns are already developing for an emerging industry. Actors in the e-mobility cluster in Saxony are tending to direct their R&D activities towards developing (and testing) hybrid/e-buses. Both industrial and academic partners are strongly involved here. 23% of all R&D projects in which Saxony's industry and academia are involved are devoted to this research field, compared to 3% on national level (Fig. 7a). Figure 7b further verifies this observation. The highest agglomerations of industrial and academic activity in this field can be found in the Dresden area – to a much higher extent than in other e-mobility strongholds such as the Stuttgart or Munich areas.

As indicated previously, the regional industrial specialisation pattern for Germany looks different in relation to fleet management and new business models. Regions that are actively engaged in the development of hybrid/e-buses (e.g., Saxony) only play a minor role in the development of new fleet management solutions (see Figure 8).

Conclusion

The findings confirmed the appropriateness of the approach of analysing public and private investments in applied R&D projects over a longer period in order to identify emerging clusters. In the given case, R&D investments from industry and academia were analysed between 2009 and 2016. By using e-mobility as a test case, several emerging e-mobility clusters were identified. Furthermore, it was possible to trace where traditional automotive clusters are transforming and becoming e-mobility clusters, as well as where entirely new e-mobility clusters are emerging. Detailed regional analysis confirmed that regional specialisation patterns are emerging.

Interestingly, it seems that traditional automotive clusters in Germany are developing into e-mobility clusters in different ways. There are regions, such as Baden-Wuerttemberg and Bavaria, where there are specific patterns and evidence for this kind of transformation. Other automotive regions, however, such as those in North-Rhine Westphalia, are not transforming or are only undergoing partial transformation. Furthermore, there are other regions that are in the process of turning into 'new' e-mobility hotspots. An example is Berlin, where industry has started investing in this new field, leading in turn to an agglomeration of cluster actors. Further investigation revealed that most of these industry players have not been involved in automotive issues before.

There is initial evidence to suggest that regions in Germany are starting to specialise according to different nodes in the e-mobility value chain. A good example is the region of Saxony, which has started to specialise in e-buses, whereas the Berlin region is focusing on fleet management. Nevertheless, further investigation is needed in order to better understand existing regional specialisation patterns. The outcome of this kind of investigation may help regions to adopt their regional smart specialisation strategies so that they can move from simply supporting e-mobility in a given region to taking a more tailor-made supportive approach.

The findings also confirmed the workability of the approach, which is based on the rationale that today's private and public investment in applied R&D is likely to lead to the emergence of clusters tomorrow, once the R&D outcomes are commercialised. The preconditions for this approach, however, are that there is a critical mass of related data, that the R&D projects have a dedicated focus on excellence and, in order to avoid any regional bias, that the R&D project selection was based on merit.

REFERENCES

Agarwal, R., Bayus, B. L., & Tripsas, M. (2014). Abandoning Innovation in Emerging Industries. Customer Needs and Solutions, 1(2), 91-104.

Becher, G., Kuhlmann, S. (Eds.). (2012). Evaluation of technology policy programmes in Germany (Vol. 4). Springer Science & Business Media.

Bierhals, R., Cuhls, K., Hüntrup, V., Schünemann, M., Thies, U., & Weule, H. (2013). Mikrosystemtechnik-wann kommt der Marktdurchbruch?: Miniaturisierungsstrategien im Technologiewettbewerb zwischen USA, Japan und Deutschland (Vol. 39). Springer-Verlag

Brenner, Th. (2017) Identification of Clusters – An Actor-based approach, Working Paper on Innovation and Space, Philipps-Universität Marburg

Botthof, A.; Pelka J. (2003), Mikrosystemtechnik, Springer Verlag Berlin-Heidelberg, 978-3-662-08759-6

Botthof, A., & Pelka, J. (Eds.). (2013). Mikrosystemtechnik:Zukunftsszenarien. Springer-Verlag.

Dermastia, M. Meier zu Köcker, G., Radic, D. (2016), Good Practice Guide On Cluster Policy Excellence For Structural Change In Emerging Industries, ISBN 978-961-6986-04-5, Chamber of Commerce and Industry of Slovenia, Ljubljana,

European Commission, Framework Conditions to Support Emerging Industries in the Area of Digital-based Services, Cluster Observatory, 2015

Foray, D. (2015): Smart Specialisation, Opportunities and Challenges for Regional Innovation Policy, Routledge.

Foray (2017), Advances in the Theory and Practice of Smart Specialisation, editor Slavo Radosevic,Adrian Curaj,Radu Gheorghiu,Liviu Andreescu,Imogen Wade, Elsevier

Heffernan & Phaal, 2009, 'The emergence of new industries', University of Cambridge Institute for Manufacturing Emerging Industries Programme, http://www2.ifm.eng.cam.ac.uk/service/events/info/thursday_slides/091105phaal.pdf

Izsak, K., Ketels, Ch., Lämmer-Gamp, L., Meier zu Köcker, G. (2016): Smart Guide to Cluster Policy, European Cluster Observatory, Brussels, http://ec.europa.eu/enterprise/initiatives/cluster/observatory/cluster-mapping-services/services/index_en.htm.

Ketels, Ch., Protsiv S. (2013): Clusters and the New Growth Path for Europe, WWWforEurope Working Paper, WIFO, Vienna

Meier zu Köcker, Künzel, Nerger, Schließer, May: Forschungsatlas Elektromobilität – Prioritäre Forschungsthemen und regionale Spezialisierung in Deutschland, Berlin, 2015, http://www.iit-berlin.de/publikationen

Meier zu Köcker, G., Lämmer-Gamp, Th (2017) , Core Design Feature of an Integrated Cluster Policy, published in The Life Cycle of Clusters - A Policy Perspective, Edited by Dirk Fornahl and Robert Hassink, ISBN: 978 1 78471 927 2, Elgar

Ramsbrock, J., Vilimek, R., & Weber, J. (2013). Exploring electric driving pleasure–the BMW EV pilot projects. In Human-Computer Interaction. Applications and Services (pp. 621-630). Springer Berlin Heidelberg.

Schwedes, Oliver, Stefanie Kettner, and Benjamin Tiedtke. „E-mobility in Germany: White hope for a sustainable development or Fig leaf for particular interests?" Environmental Science & Policy 30 (2013): 72-80.

Werther, B., & Hoch, N. (2011). E-mobility as a challenge for new ICT solutions in the car industry. In Trustworthy global computing (pp. 46-57). Springer Berlin Heidelberg.

World Bank Group (2016), How to Make Grants a Better Match for Private Sector Development , https://www.theciip.org/sites/ciip/files/CIIP%20Matching%20Grant%20Study%20Final%20Web.pdf (last access 5 February 2018)

Zentes and Steinhauer and Lonnes: Geschäftsmodell-Evolution: Unternehmensentwicklung als Dynamisierung von Kernprozessen, Institut für Handel und internationales Marketing (editor), Saarbrücken, 2013, p. 3, [Online] www.uni-saarland.de/fileadmin/user_upload/Professoren/fr13_ProfZentes/sonstiges/Zentes Steinhauer Lonnes_2013_-_Geschaeftsmo-dell-Evolution.pdf, [Access on 28-Apr-2016].

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