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# GEMEINSAM STÄRKER - STRONGER TOGETHER

SUCCESSFUL BUSINESS RELATIONS  
BETWEEN BADEN-WÜRTTEMBERG  
AND THE UNITED KINGDOM

STUDY COMMISSIONED BY THE MINISTRY FOR  
ECONOMIC AFFAIRS, LABOUR AND HOUSING  
BADEN-WÜRTTEMBERG

**ECONOMIC  
PARTNERSHIP**  
BADEN-WÜRTTEMBERG | UNITED KINGDOM



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## Imprint

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## Forewords

The economic relations between the United Kingdom and Baden-Württemberg have a long tradition. The United Kingdom is one of our most important trading partners and leaving the European Union has not changed this.

It is a matter of great concern to me that we look ahead and continue to positively shape our economic ties with the United Kingdom in the future. That is why I have initiated a new economic partnership this year – together with our British partners.

The *Economic Partnership Initiative* is intended to enable further development of value chains and more intensive economic policy cooperation between politicians and business organisations.

The present study, which was commissioned by my ministry, ties in with this initiative and shows the economic strengths of Baden-Württemberg and the United Kingdom. It thus identifies economic sectors that have great potential for successful business relations in the future.

The results make it clear that cooperation and business relationships with companies from the United Kingdom are economically significant and worthwhile for companies in Baden-Württemberg in the future as well. The complementary strengths can be exploited particularly in the automotive industry, the healthcare industry or the fields of digitalisation and artificial intelligence.

In newly designed event formats, the partnership initiative offers concrete and

Picture: Martin Stolberg



unbureaucratic starting points for a deeper exchange and stronger interdisciplinary cooperation. In addition, companies can benefit above all from cluster initiatives and networks, both in their own and in potentially unrelated sectors. The study offers a wealth of practical advice in this regard. I would like to encourage all companies to take advantage of these offers.

Dr. Nicole Hoffmeister-Kraut MdL

Minister for Economic Affairs, Labour and Housing of the state of Baden-Württemberg

I am delighted to jointly introduce the UK-BW report “Stronger Together”, which will help companies from the United Kingdom and Baden-Württemberg secure greater access to each other’s world beating economic and research ecosystems. This work forms part of the new economic partnership initiative between the UK’s Department for International Trade and the UK Science and Innovation Network (SIN) and the Ministry for Economic Affairs, Labour and Housing Baden-Württemberg. The United Kingdom is the fifth largest economy in the world, the number one destination in Europe for FDI and Technology, a science superpower, and home to the world’s leading financial centre. Following our exit from the European Union and the resumption of our independent membership of the WTO, we will be a forceful champion for free, fair, rules-based trade. The United Kingdom has always



Picture: Private

been at the forefront of the world’s greatest economic advances, and we are fully committed to the critical investment required in research and development to tackle the global grand challenges, build more resilient environments and embrace the potential of new technologies.

The United Kingdom will always be an open and outward looking nation, and we will continue to have a relationship with our German friends inspired by our shared history and values. The UK shares a two-way £13 billion trade relationship with Baden-Württemberg. We share an ambition to take our economic relationship to the next level and as this study sets out, there are huge opportunities for future collaboration in the pursuit of shared prosperity: from Artificial Intelligence to cyber security, from clean growth to future mobility. Our governments, companies, academia, and research institutions are world leaders in all these fields, and working together, we can help shape the world around us. My colleagues in the Department for International Trade in Germany are ready to support more Baden-Württemberg companies in doing business with us and invite those who have not considered the United Kingdom yet, to take a closer look.

A handwritten signature in black ink, consisting of a large, stylized 'S' followed by a smaller 'K' and a horizontal line extending to the right.

Simon Kendall

*British Consul-General, British Consulate-General in Munich*

# Table of Contents

<b>TABLE OF TABLES</b> .....	<b>12</b>
<b>TABLE OF FIGURES</b> .....	<b>13</b>
<b>ABSTRACT</b> .....	<b>15</b>
<b>1. Stronger Together: Successfull Business Relations between BW and the UK</b> .....	<b>17</b>
<b>2. Methodology of Data Collection and Analysis</b> .....	<b>21</b>
2.1. <b>Key Questions</b> .....	21
2.2. <b>Methodology and Data Collection</b> .....	23
2.2.1. Secondary Data Collection .....	23
2.2.2. Primary Data Collection .....	24
2.3. <b>Methodology of Data Analysis</b> .....	30
<b>3. Strengths, Challenges and a Look Into the Future: The Economic Structures of BW and the UK in Detail</b> .....	<b>35</b>
3.1. <b>Industries BW</b> .....	38
3.1.1. Automotive Industry .....	39
3.1.2. Healthcare Industry .....	49
3.1.3. Cultural and Creative Industries .....	55
3.1.4. Mechanical Engineering and Manufacturing Industry .....	61
3.2. <b>Industries UK</b> .....	66
3.2.1. Automotive Industry .....	66
3.2.2. Healthcare Industry .....	74
3.2.3. Cultural and Creative Industries .....	80
3.2.4. Mechanical Engineering and Manufacturing Industry .....	85
3.3. <b>Further Industries</b> .....	89
3.3.1. Food Industry .....	89
3.3.2. Aviation and Aerospace Industry .....	91
3.4. <b>Cross-Cutting Topics Relevant to the Future</b> .....	93
3.4.1. Automation and Robotics .....	94

3.4.2. Digitalisation and Artificial Intelligence .....	100
3.4.3. Sustainable Economics .....	113
3.5. <b>Summary: Economically Important Industries and Cross-Cutting Topics</b> .....	120
3.5.1. Opportunities .....	121
3.5.2. Challenges .....	122
3.5.3. Summary .....	123
<b>4. Synergies and Complementarities: Success through Economic Cooperations</b> .....	<b>125</b>
4.1. <b>Synergies within Individual Industries</b> .....	125
4.1.1. Automotive Industry .....	126
4.1.2. Mechanical Engineering and Manufacturing Industry .....	130
4.1.3. Healthcare Industry .....	131
4.1.4. Cultural and Creative Industries .....	134
4.2. <b>Synergies Between Industries</b> .....	135
4.2.1. Automotive and Healthcare Industry .....	136
4.2.2. Automotive and Cultural and Creative Industries .....	136
4.2.3. Healthcare Industry and Cultural and Creative Industries .....	137
4.2.4. Mechanical Engineering and Manufacturing Industry: Cross-thematic Synergies .....	138
4.3. <b>Synergies with Cross-Cutting Topics</b> .....	139
4.3.1. Automation and Robotics .....	139
4.3.2. Digitalisation and Artificial Intelligence .....	144
4.3.3. Sustainable Economics .....	149
<b>5. Recommendations for Action</b> .....	<b>157</b>
5.1. <b>Future Fields for Strategic Cooperation</b> .....	157
5.1.1. Digitalisation and Artificial Intelligence .....	157
5.1.2. Automation and Robotics .....	161
5.1.3. Sustainable Economics .....	162
5.2. <b>Political Recommendations for Action</b> .....	164

5.2.1. Overview.....	164
5.2.2. Proposal for an Implementation Process.....	167
5.3. <b>Starting Points for SMEs: Discovering Synergies and Stimulating Cooperation as well as Markets</b> .....	170
<b>6. Conclusion: Gemeinsam Stärker – Stronger Together!</b> .....	<b>173</b>
<b>References</b> .....	<b>177</b>
<b>Annex</b> .....	<b>188</b>

#### TABLE OF TABLES

<b>Table 1.</b> <i>Overview of interviews</i> .....	27
<b>Table 2.</b> <i>Synergies between automation and robotics and other industries</i> .....	141
<b>Table 3.</b> <i>Synergies between digitalisation and artificial intelligence and other industries</i> .....	147
<b>Table 4.</b> <i>Synergies between sustainable economics and other industries</i> .....	153
<b>Table 5.</b> <i>Exemplary interview guide</i> .....	189
<b>Table 6.</b> <i>Table of resources for SMEs (Status: 31.08.2020)</i> .....	190

#### TABLE OF FIGURES

<b>Figure 1.</b> <i>Key questions</i> .....	22
<b>Figure 2.</b> <i>Methodological approach</i> .....	23
<b>Figure 3.</b> <i>Criteria for selection of industries and cross-cutting topics</i> .....	31
<b>Figure 4.</b> <i>Key figures automotive industry BW</i> .....	39
<b>Figure 5.</b> <i>Key figures healthcare industry BW</i> .....	49
<b>Figure 6.</b> <i>Key figures cultural and creative industries BW</i> .....	55
<b>Figure 7.</b> <i>Key figures manufacturing industry BW</i> .....	61
<b>Figure 8.</b> <i>Key figures automotive industry UK</i> .....	67
<b>Figure 9.</b> <i>Key figures healthcare industry UK</i> .....	74
<b>Figure 10.</b> <i>Key figures cultural and creative industries UK</i> .....	81
<b>Figure 11.</b> <i>Key figures manufacturing industry UK</i> .....	85
<b>Figure 12.</b> <i>Complementarities automotive industry BW-UK</i> .....	126
<b>Figure 13.</b> <i>Heat map “hydrogen” for BW and the UK</i> .....	127
<b>Figure 14.</b> <i>Heat map “battery” for BW and the UK</i> .....	128
<b>Figure 15.</b> <i>Complementarities manufacturing industry BW-UK</i> .....	130
<b>Figure 16.</b> <i>Complementarities healthcare industry BW-UK</i> .....	132
<b>Figure 17.</b> <i>Heat map “digital health” for BW and the UK</i> .....	133
<b>Figure 18.</b> <i>Matrix of cross-sectoral synergies</i> .....	135
<b>Figure 19.</b> <i>Synergies between industries and cross-cutting topics</i> .....	139
<b>Figure 20.</b> <i>Heat Map “automation and robotics” for BW and UK</i> .....	141
<b>Figure 21.</b> <i>Heat map “autonomous driving” for BW and UK</i> .....	142
<b>Figure 22.</b> <i>Heat map “Industry 4.0.” for BW and UK</i> .....	143
<b>Figure 23.</b> <i>Heat map “artificial intelligence” for BW and UK</i> .....	146
<b>Figure 24.</b> <i>Heat map “sustainable construction” for BW and UK</i> .....	150
<b>Figure 25.</b> <i>Heat Map “circular economy” for BW and the UK</i> .....	151

## Abstract

As two strong economic regions, Baden-Württemberg (BW) and the United Kingdom (UK) look back on a long tradition of successful trade relations and business partnerships with each other. It is important that this positive exchange will continue in the future. However, in addition to the UK's withdrawal from the European Union, the global economic implications of the COVID-19 pandemic now add to the challenges of the future.

The aim of this study is therefore to identify the economic strengths and the respective challenges of BW and the UK in order to provide recommendations to small and medium-sized enterprises (SMEs) in both economic regions on which industries and cross-cutting topics have the greatest potential for future synergies. The study is based on a preliminary desk research and 22 interviews with technical and economic experts from BW and the UK. The findings of this knowledge collection were then analysed in order to identify potential synergies.

The data analysis showed that four industries could be classified as particularly relevant: the automotive industry, the healthcare industry, the cultural and creative industries, and the mechanical engineering and manufacturing industry. Both within and between these four industries, there is a high potential for synergies between BW and the UK, also for SMEs. However, the greatest potential for future synergies arises from overlaps with the cross-cutting topics of automation and robotics, digitalisation and artificial intelligence, as well as sustainable economics. There is thus a high potential for cooperation in areas such as autonomous driving, battery and hydrogen research, digital health, digital event formats, or Industry 4.0.

The results of this study have led to concrete recommendations for action, both for SMEs and for political and economic intermediaries of BW. The central recommendations consist of a thematic focus on innovative future technologies, an increased use of the services of existing state and cluster initiatives, and the proactive initiation of regular international and interdisciplinary exchange (expert workshops, delegation trips, events), both at a political and an economic level.



## 1. Stronger Together: Successful Business Relations between BW and the UK

The federal state of Baden-Württemberg, as one of the strongest economic states in Germany, and the United Kingdom, as one of the strongest economic nations in Europe, look back on a long tradition of successful trade relations and business partnerships with each other. This positive exchange shall continue in the future, now that the UK has left the European Union (EU). The end of the transition phase on January 1, 2021 will bring about economic changes and challenges but it will also lead to numerous opportunities for new business relations between Baden-Württemberg (BW) and the United Kingdom (UK). The aim of the study is thus not a comparison of BW and the UK - BW is a federal state, while the UK is a nation. Rather, the aim is to determine respective strengths and complementary competencies and consequently to identify those industries and issues where there is the greatest potential for future synergies between BW the two economic regions.



In 2015, the UK was BW's sixth most important trading partner in terms of exports<sup>1</sup>. However, since the start of discussions on the UK's possible withdrawal from the EU (also known as *Brexit*), the UK's economic importance to BW has declined: between the Brexit vote in 2016 and April 2019, there was a decline of 32%, mainly in the mechanical engineering and healthcare industries, although exports have now already somewhat recovered<sup>2</sup>. However, the UK's withdrawal from the EU also opens up numerous opportunities for new business models and business relationships for both economies, the potential of which this study aims to highlight. This is particularly important with respect to the *Economic Partnership Initiative* between BW and the UK, which has the following two overarching objectives:

- **Economic partnership:** More intensive cooperation in terms of economic policy (especially between business organisations (such as chambers and associations) and economic politicians) and
- **Innovation leadership:** Strengthening innovation cooperation (such as agreements to exchange information on future topics of the economy).

This close cooperation is important not only to maintain the prosperity achieved in both economic regions, but also to develop an economic partnership "based on shared values and a strategy that focuses on challenging future issues"<sup>3</sup>. In addition, it should help small and medium-sized enterprises (SMEs) from BW and the UK to work even closer together, to enter into new collaborations and to thus make a significant contribution to increasing their innovative capacity and, above all, their competitiveness. Consequently, the study aims to provide impulses for further, more in-depth exchange and technical discussions, from which precise areas of cooperation can then emerge.

The key questions of this study therefore deal with the identification of industries and cross-cutting topics where the future potential for successful cooperation between SMEs from BW and the UK is particularly high. Furthermore, the aim is to identify complementarities and thus high potential for cooperation. Existing business relationships, events, cluster initiatives and regional thematic foci will be determined, so that initial points of contact can be identified for interested SMEs. Due to the current COVID-19 crisis, the economic impact of this pandemic on the different industries and cross-cutting topics will also be discussed. There are great opportunities for business partnership especially between the strong industries of both economic regions and the innovative cross-cutting topics that

will be important in the future: these cover some of the key requirements of the future, such as the increased demand for digital solutions (further triggered by the COVID-19 pandemic) or for a more sustainable economy<sup>a</sup>.

The study is divided into the following sections: Chapter 2 presents the methodology of the data collection and analysis, including a presentation of the key questions and the two central pillars of the study (primary and secondary data collection). Chapter 3 presents the respective strengths and challenges of the two economic regions. First, the four industries identified as the most important ones in both BW and the UK are presented one after the other. Then, the three cross-cutting topics, summarised for BW and UK, are presented in detail. This is followed by a brief summary of all findings. In Chapter 4, based on the results of Chapter 3, synergies and complementarities between BW and UK industries are identified. First, synergies within industries are discussed in more detail, followed by synergies across industries and then synergies between industries and cross-cutting topics. Chapter 5 provides concrete recommendations for action for SMEs and for politicians and intermediaries in BW. Chapter 6 summarises the study.

a In this study, the term sustainable economics refers to all economic trends in the field of environmental protection, sustainability or circular economy and thus includes topics such as research and development on alternative energy sources and storage (battery, hydrogen and fuel cell technology), building refurbishment or other measures to save CO<sub>2</sub>.

## 2. Methodology of Data Collection and Analysis

In order to analyse the economic structures of BW and the UK regarding their respective strengths and complementary competences, a comprehensive data collection and analysis of primary and secondary data was carried out. The aim of this was to identify those industries and cross-cutting topics, and thus those future technologies, that promise a high potential for cooperation between BW and the UK after the UK's withdrawal from the EU. Due to its far-reaching economic effects, this study also considers the implications of the COVID-19 crisis on the respective industries and cross-cutting topics.

The methodology of the study is thus based on two pillars: first, a comprehensive research of existing literature (secondary data collection) as well as qualitative interviews with experts from BW and UK (primary data collection) to verify and further supplement the previously collected data. Secondly, a subsequent analysis of all collected results in order to be able to make sound recommendations for action based on findings from theory and practice. In the following, the underlying hypotheses of the study and the method of the data collection and analysis are described in detail.

### 2.1. KEY QUESTIONS

The key questions of this study deal with the identification of industries and cross-cutting topics where the potential for successful cooperation between SMEs from BW and the UK is particularly high in the future. In addition, they refer to current global challenges such as Brexit, the COVID-19 crisis and its implications for the economy of BW and the UK, as well as the trade between the two.

The key questions of the study are:

1. In which industries and cross-cutting topics are BW and the UK currently especially strong, and where do they face challenges?
2. In which industries and cross-cutting topics are there already events, cluster initiatives, networks or partnerships between BW and the UK?
3. Which industries and cross-cutting topics will play an important role in BW and the UK in the future?
4. In which industries and cross-cutting topics does BW and the UK have a high potential for complementing each other, both now and in the future?



5. What will be the impact of the UK's withdrawal from the EU on potential cooperation between BW and UK in the identified industries and cross-cutting topics, and in particular on SMEs in BW?
6. What will be the impact of the economic implications of the COVID-19 crisis on potential cooperation between BW and UK in the identified industries and cross-cutting topics, especially on SMEs in BW?
7. Which measures at political level could be taken to promote and support international business relations between SMEs in BW and the UK?



Figure 1. Key questions

## 2.2. METHODOLOGY AND DATA COLLECTION

In the following, the methodology of the data collection is described in more detail, which can be divided into two areas: secondary data collection (in the form of a desk research) and primary data collection (in the form of qualitative interviews).

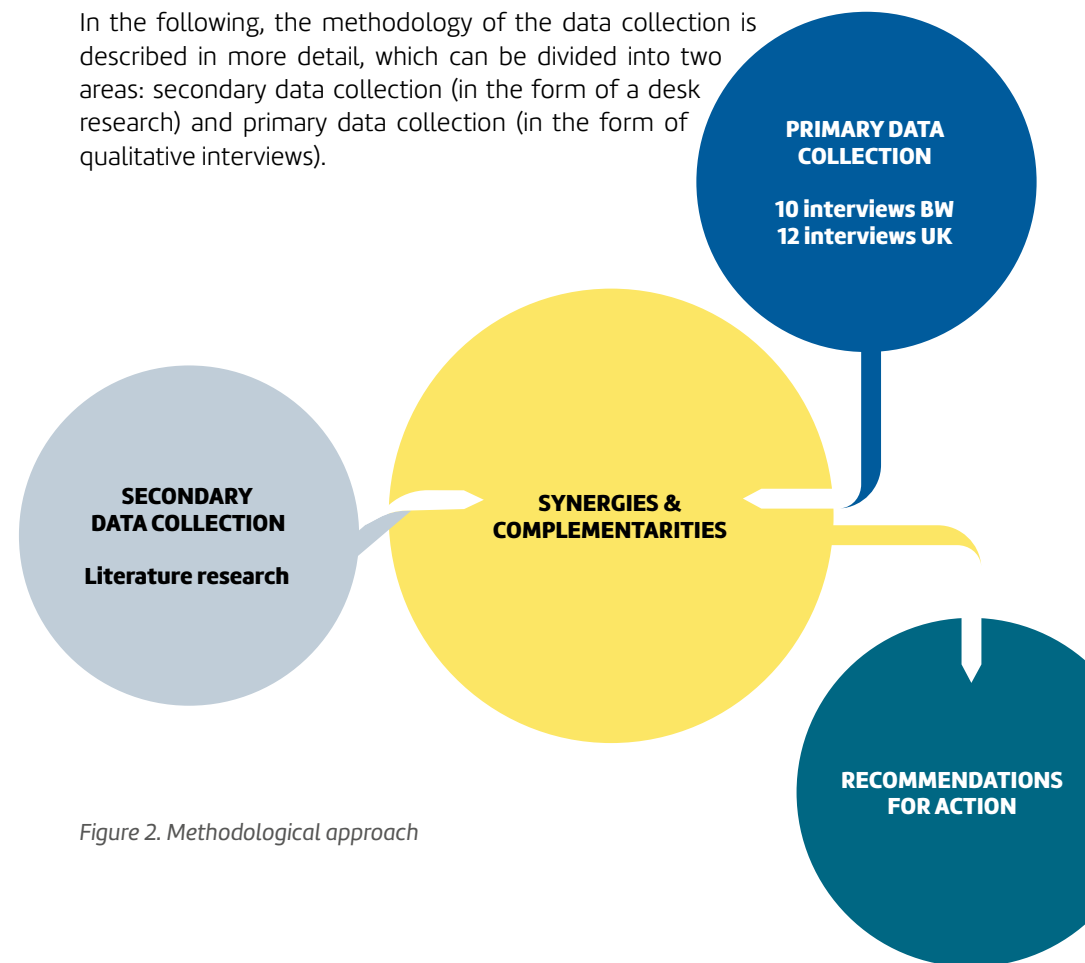


Figure 2. Methodological approach

### 2.2.1. Secondary Data Collection

At the beginning of the study, a secondary data collection was conducted in the form of an in-depth literature research, focusing on the key questions mentioned in Chapter 2.1. The aim was to collect data on which industries and cross-cutting topics exist, which of them are relevant to this study in terms of complementary strengths and challenges of BW and the UK, and which kinds of cooperation, events or cluster initiatives already exist between the two. For this purpose, existing studies, analyses, statistics, strategy and concept papers as well as reports and newspaper articles from both BW and the UK were studied.

In order to obtain an initial overview of relevant industries and cross-cutting topics, the focus was set on the official future strategies of the two economic regions: the Innovation Strategy BW and the UK's Industrial Strategy.

The aim of this preliminary research was to map the current state of research with regard to the topics mentioned in the key questions, to gain an overview of events and cluster initiatives, as well as to uncover potential gaps in knowledge in order to be able to address these in more detail in the subsequent interviews.

Within the individual industries and cross-cutting topics, it is important for various reasons to refer to relevant state agencies and cluster initiatives: on the one hand, BW's cluster initiatives offer valuable information, support and networking opportunities for SMEs in BW. On the other hand, many of these state agencies and cluster initiatives specifically support the internationalisation efforts of regional SMEs. For interested cooperation partners from the UK, BW's state agencies and cluster initiatives can serve as an initial contact point that can then initiate targeted and needs-based contacts and cooperation with interested BW SMEs. In these areas, additional support can also be provided by business organisations such as chambers of industry and commerce. British cluster initiatives and networks also offer support for British SMEs interested in a stronger international orientation. Moreover, they provide interested SMEs in BW with initial points of contact for establishing closer contact with the British market.

### 2.2.2. Primary Data Collection

Within the framework of the primary data collection, a total of 22 telephone interviews were conducted with experts from BW and the UK. The aim of this qualitative data collection was to further supplement the findings collected in the secondary data collection with views from practice and with concrete examples of cooperation, events, cluster initiatives, etc. by means of targeted bilateral discussions, as well as to verify and deepen knowledge already identified. In order to achieve this, the interview partners were selected according to the following criteria:

- Expertise
- Geographic coverage
- Coverage of different types of organisations

### *Expertise*

The selection of technical experts was based on the industries and cross-cutting topics identified in the literature research in order to triangulate data from the previous survey and analysis. In terms of thematic coverage, the following industries were discussed in the interviews based on the results of the previous secondary data collection (in alphabetical order): automotive industry (including battery, hydrogen and fuel cell industry), healthcare industry, cultural and creative industries, food industry and mechanical engineering and manufacturing industry. In addition, interviews were conducted on the following cross-cutting topics: automation and robotics, digitalisation and artificial intelligence as well as sustainable economics.

As the UK is a nation consisting of several states, additional experts on the general economic situation within these regions (England, Scotland, Wales, Northern Ireland) were interviewed without focusing on specific industries or cross-cutting topics. Thus, these interviews provided the necessary general information to achieve adequate coverage.

In addition, all experts were asked about further potentially important synergies regarding industries and cross-cutting topics in order to be able to include any issues that had not been identified in the previous data collection and analysis yet.

### *Geographic coverage*

Since the aim of the study is to identify synergies between BW and the UK, it is necessary to interview experts from both economic regions. It was therefore an important criterion for selection to interview a similar number of experts from BW and the UK. As mentioned above, economic experts from all parts of the country were also interviewed for the UK.

## Coverage of different types of organisations

Interviews with experts from different types of organisations ensured that the different perspectives of important actors were included, which are and will be part of the implementation of the synergies between BW and the UK. Thus, in BW and the UK, representatives of regional associations of industry, government, business, cities, state and cluster initiatives, universities, research institutes, companies and SMEs as well as intermediaries were interviewed.

The specific experts were determined based on the results of the secondary data collection and a list of recommendations from the Ministry for Economic Affairs, Labour and Housing Baden-Württemberg (WM), the British Consulate General, Baden-Württemberg International (bw-i), the Enterprise Europe Network (EEN) and the Vanguard Initiative, as well as Steinbeis 2i GmbH's own contacts and contacts identified by secondary research. The list also included contacts from existing Horizon 2020 cooperations of Steinbeis 2i GmbH and companies identified via the cooperation index InConnect<sup>4</sup>. Based on this list, ten experts from BW and 12 experts from UK were interviewed according to the three criteria mentioned above.

The specific interview partners were selected in such a way that a balance between BW and UK interview partners and different types of organisations as well as an even coverage of the industries and cross-cutting topics previously identified as relevant was ensured

Table 1 gives an overview of the interviews conducted as well as their thematic and regional focus.



	 BW	 UK
<b>INDUSTRIES:</b>		
Automotive industries	x	x
Healthcare industries	x	x
Cultural and creative industries	x	x
Mechanical engineering and manufacturing industry	x	
Other industries		x <sup>b</sup>
<b>CROSS-CUTTING TOPICS:</b>		
Automation and robotics	x	x
Digitalisation and artificial intelligence	x	x
Sustainable economics	x	x
<b>GENERAL:</b>		
England	n.v.	x
Scotland	n.v.	x <sup>c</sup>
Wales	n.v.	x
Northern Ireland	n.v.	x

Table 1. Overview of interviews

- b An interview was conducted with a representative of the food industry with a focus on Scotland.  
 c There was a close written exchange with Scottish economic experts as well as interviews with experts from the cultural and creative industries and the food industry.

## Acquisition and approach

After the list of potential interview partners was completed, the respective contacts were contacted by e-mail and informed about the study and the interviews. Appointments were made for interviews, if interested. The interviews were conducted via the teleconferencing tool *GoToMeeting*<sup>5</sup>.

For the interviews, individualised interview guidelines were created for the respective interviewees and the respective topics of conversation, which were based on a previously designed basic interview guide<sup>d</sup>. The interview guide was divided into six blocks, whereby block I could be repeated as often as desired, depending on the number of topics covered during the interview:

- Welcome
- Block I – Details on researched cross-cutting topics/expertise of the interviewees
- Block II – New industries and cross-cutting topics
- Block III – Cross-cutting Synergies
- Block IV – Impact of UK withdrawal from the EU and/or COVID-19
- Farewell

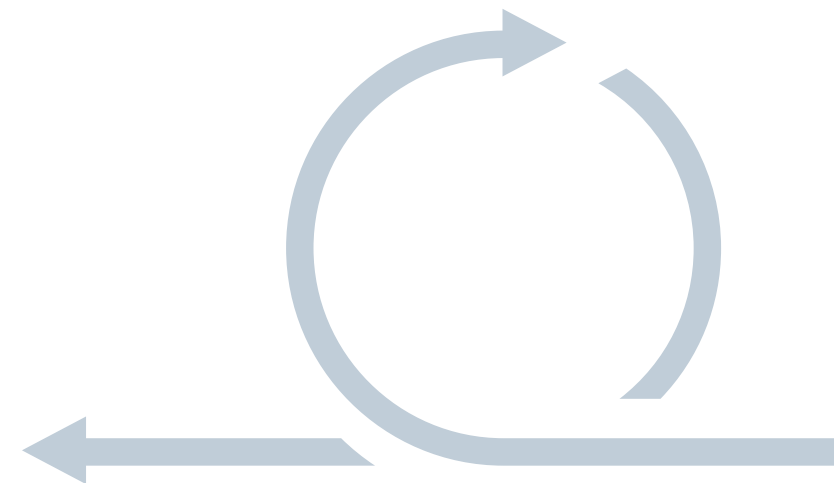
The welcome block introduced the respective interviewers (usually one person who conducted the interview and one person who took notes), as well as the Steinbeis Zi GmbH and the underlying study in brief. In addition, the interviewees were informed that the study is being prepared on behalf of the WM and in cooperation with bw-i. In accordance with the current GDPR guidelines, the interviewees were informed about the length of the interview (maximum one hour) and the anonymisation of their data<sup>e</sup>, and were also asked for permission to record the interview for future reference. Furthermore, the interviewees were informed that they can ask for an interruption of the recording at any time and that they are always free not to answer individual questions or to ask further questions. After a brief check as to whether the interviewee have any further questions, the main part started with the four thematic blocks:

<sup>d</sup> An exemplary interview guide can be found in Appendix 1, Table 5.

<sup>e</sup> At this point, it was also asked whether interviewees would like to be mentioned in the acknowledgements.

- In block I, the interviewee's respective area of expertise was examined in more detail using targeted questions. Some of the central questions in this block were "How do you assess the potential for synergies between BW and the UK in this area", "Do you see any special synergies or complementarities within value chains here?" or "Are there any existing cooperations between BW and the UK in this area, as well as special events, clusters or networks, and how successful do you rate them?" If necessary, special hypotheses from the previous literature research were discussed as well.
- In block II, the interviewees were asked about other industries and topics in which they saw potential for synergies between BW and the UK.
- In block III, the interviewees were asked about cross-clustering between their own area of expertise and other industries or cross-cutting topics.
- In block IV, the expected impact of the UK's withdrawal from the EU and the effects of the COVID-19 crisis on their own field/industry were discussed.

During the farewell block, the interviewee was thanked once again, the opportunity was given to make a final comment and the interviewees were informed that they would be informed about the publication of the study. Depending on the needs of further interviewees, this block also asked for further contact recommendations in BW and/or the UK that might be available for an interview.



### 2.3. METHODOLOGY OF DATA ANALYSIS

The data analysis was focused on the following three points:

1. Which industries and cross-cutting topics are mentioned in the official future strategies of BW<sup>6</sup> and UK<sup>7</sup>? The results of this analysis can be found in Chapter 3.
2. In which industries and cross-cutting topics are BW and the UK currently well positioned? Which industries generate a high turnover, have a high share of exports? What are the respective strengths and challenges of the two economic regions? In which industries and cross-cutting topics do SMEs play a major role? In which areas do concrete events and cluster initiatives already exist? The results of this analysis can also be found in Chapter 3.
3. In which industries and cross-cutting topics do BW and the UK have complementary competencies? In which areas do the two economic regions already cooperate? Which industries and cross-cutting topics therefore promise a high potential for successful cooperation between the two in the future<sup>f</sup>? The results of this analysis can be found in Chapter 4.

The selection of industries and the identification of relevant cross-cutting topics was therefore carried out based on the criteria shown in Figure 3:

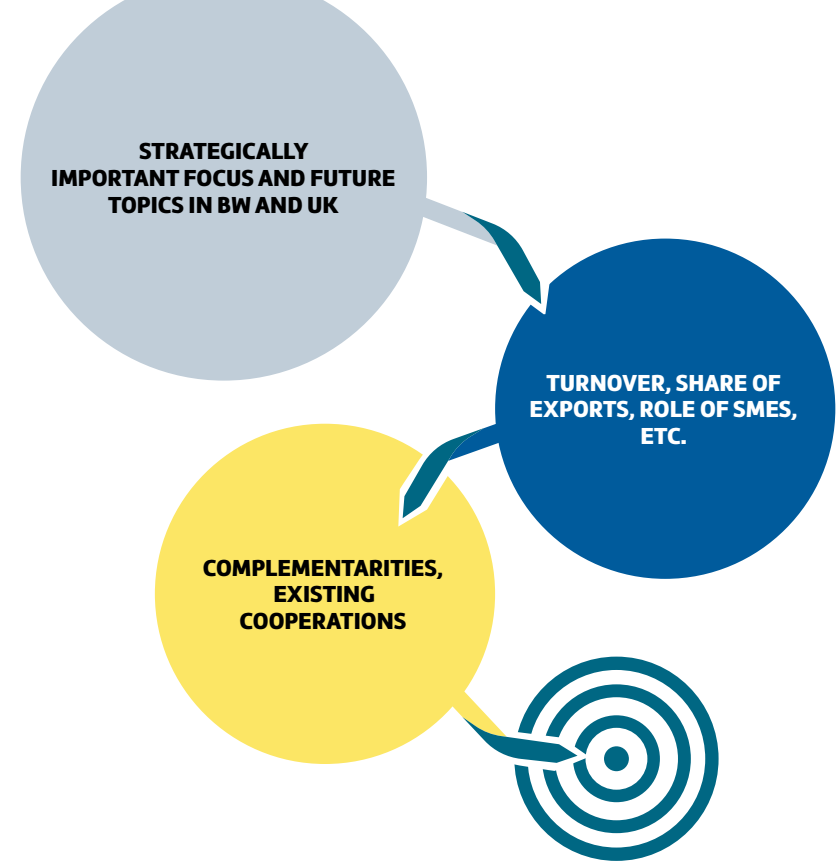


Figure 3. Criteria for selection of industries and cross-cutting topics

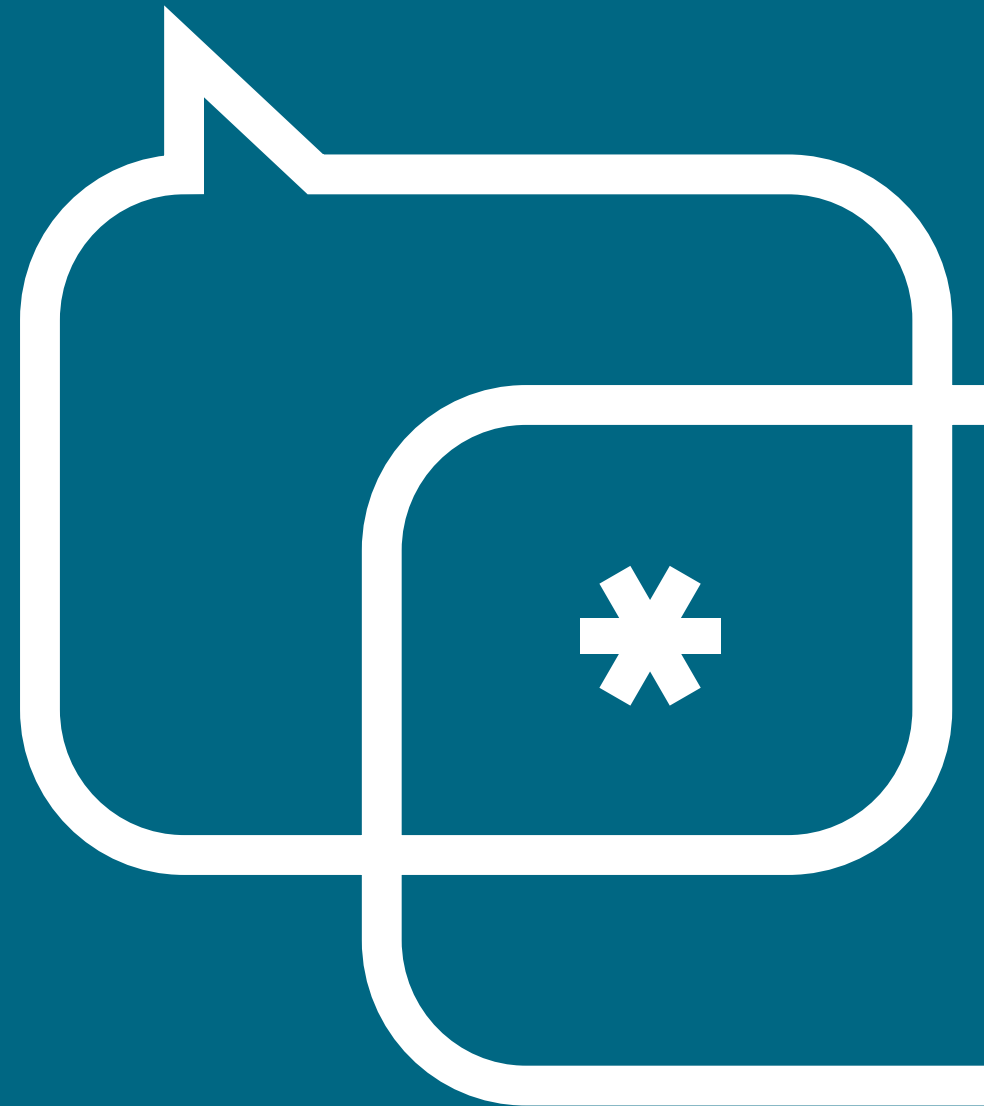
The analysis of the data was performed in two parts: after the secondary data had been collected by the literature research, an analysis was carried out with regard to the relevant industries and cross-cutting topics in the form of a knowledge catalogue (based on the key questions described above). The results of this first part of the analysis served as a basis for selecting the technical experts for the interviews and designing the individual interview guidelines. Thus, additional information on the identified industries and cross-cutting topics could be requested, possible contradictions could be addressed, gaps in the prior data collection could be uncovered and further details could be requested. The collected primary data was also transferred to the knowledge catalogue. The knowledge catalogue thus formed the basis for the second part of the analysis, which was again based on the key questions. Through these two successive phases of data collection and analysis, the triangulation of the data could be performed. This ensured that the results of the secondary data from the literature were completed with the experience of the interview partners, and vice versa.

<sup>f</sup> The term “future” refers primarily to the period after the Brexit. Regarding the current developments, however, “future” now additionally refers to the effects of the COVID-19 crisis.

This multi-stage data analysis has thus revealed that the following industries and cross-cutting topics will be discussed in depth within the scope of this study:

- **Industries:**
  - Automotive industry
  - Healthcare industry
  - Cultural and creative industries
  - Mechanical engineering and manufacturing industry
- **Cross-cutting topics:**
  - Automation and robotics
  - Digitalisation and artificial intelligence
  - Sustainable economics

There are many other industries and cross-cutting topics in both BW and the UK in which the respective economic regions stand out, such as the (financial) services sector in the UK. However, the aim of this study was not to compare all the areas in which BW and the UK are strong, but to focus on those areas where both economic regions are successful and innovative and can therefore benefit from each other's expertise. For this reason, only the above-mentioned industries and cross-cutting topics are discussed in detail. However, other industries or topics will be briefly discussed as required.





### 3. Strengths, Challenges and a Look Into the Future: The Economic Structures of BW and the UK in Detail

BW and the UK are linked by an intensive economic relationship: Germany is the UK's most important trading partner in terms of exports and therefore also plays a central role for BW<sup>1</sup>. Vice versa, the UK is the sixth most important trading partner for BW in terms of exports. It is now important to maintain these good relations and to strengthen them even further in the future.

The UK has left the EU on 31.01.2020. By the end of the agreed transition period on 31.12.2020, the UK and the EU should have negotiated the nature of their future relations. The exact content of these agreements is however not yet clear<sup>g</sup>. For the continuation of the good international trade relations between the EU, including BW, and the UK, future trade agreements and immigration laws are of central concern. Regardless of how exactly these agreements will look, however, both the UK and those EU Member States that are interested in continuing good business relations will have to reorient themselves, approaching and responding to each other in order to remain competitive. For BW, the first step is to analyse the respective strengths and competencies that will continue to be relevant in the future. As a second step, complementary positions should be identified that have a high potential for successful future business partnerships between BW and the UK.



<sup>g</sup> At the time of the finalisation of this study, 31.08.2020.

The economy of both BW and the UK currently focuses on four key areas: automotive, mechanical engineering, information and communication technology (ICT), medical technology and pharmaceuticals<sup>6,7</sup>. Apart from ICT, these are also the areas in which most of the trade between BW and the UK is currently taking place<sup>1</sup>. In the future, however, topics like artificial intelligence, resource efficiency, the future of mobility (sustainable and autonomous driving) and the challenges of the healthcare system will play an important role in both economic regions. Triggered by the COVID-19 pandemic<sup>h</sup>, health topics such as pharmaceuticals or diagnostics will continue to move into focus.

Overall, BW has an excellent university landscape, a high degree of research and development (BW has an above-average international research and development rate of 5.6%<sup>8</sup>) and top companies of all sizes that are operating worldwide: in addition to large companies of worldwide renown (Daimler AG, Robert Bosch GmbH, ZF Friedrichshafen AG, SAP SE, MAHLE GmbH, etc.), a large number of SMEs also contribute to the state's economy: 90% of the companies in BW are SMEs with fewer than 250 employees<sup>6</sup>, which corresponds to more than 450,000 companies<sup>9</sup>. A central challenge of these regional SMEs is the urgently needed stronger integration into the international innovation process<sup>10,11</sup>. All in all, BW is one of the leading economic regions in Germany with the largest export share<sup>12,13</sup>.

The UK has a very strong economy as well: after Germany and ahead of France, it is currently one of the three largest economies in Europe<sup>14</sup>. Almost half of all British exports are currently destined for the EU, with Germany in first place<sup>1</sup>. BW also exports strongly into the UK, with a focus on products from its strongest industries: machinery, pharmaceuticals and automobiles.

The high dependence of BW and the UK on exports, on the other hand, makes them more susceptible to economic and global fluctuations. Traditional industries such as the automotive industry or mechanical engineering in BW are therefore facing several challenges: in addition to Brexit, both industries are currently in the middle of a process of reorientation towards more alternative mobility concepts as well as automation. In addition, there are new requirements in relation to the European Green Deal and, since March 2020, the special burden of the COVID-19 crisis: many employees are on short-time working conditions<sup>15,16</sup>, and the existence of SMEs is particularly endangered as a result of a lack of trade, interrupted value chains and a lack of production<sup>17</sup>.

<sup>h</sup> Since mid-March 2020, outbreak of the pandemic in Europe (<https://www.euro.who.int/de/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov> (accessed on 14.08.2020))

Financial support from the German government and the state of BW is intended to guarantee the survival and competitiveness of BW companies in the future. For this reason, BW set up an emergency aid program at the beginning of the crisis, which supported around 250,000 companies with a total of 2 billion euros<sup>18</sup>. On June 12, 2020, the German government also approved a cross-sectoral bridging aid for SMEs, which will provide support of 25 billion euros over a three-month period from June to August 2020<sup>19</sup>. As in the case of the emergency aid, the state of BW will increase the federal funds for the bridging assistance by a notional entrepreneurial salary of up to 1,180 euros per month from state funds. In order to ensure the economic survival of particularly endangered industries, the state government has also launched further aid programs, for example for the hotel and restaurant industry as well as the event industry. In addition, employees in Germany will receive at least 60 % of their lost net wages as part of the short-time working allowance<sup>20</sup>. It is becoming clear that BW's industry, together with its politicians, must act in order to recognise and implement opportunities for new business models and relationships in addition to all these future challenges.

Despite a wide range of global challenges, both BW and the UK are still among the strongest economic regions in Europe. Both have enjoyed numerous well-functioning trade relations for many decades. It is now a matter of continuing these relationships successfully wherever possible. Wherever the current economic challenges call for new directions, these must be approved, as it is often precisely these new approaches that offer potential for further, even more successful business relationships in the future. Based on a detailed analysis of the respective strengths and challenges of BW and the UK, the following section therefore presents the most economically relevant industries and cross-cutting topics of the two economic regions.

### 3.1. INDUSTRIES BW

In 2019, BW was once again the strongest federal state in Germany with exports worth 205.2 billion euros<sup>21</sup>. Together with the other German states, BW is also the UK's most important trading partner, after the USA<sup>22</sup>. This strong economic position is the result of a large number of industries in which Germany, but especially BW, is very strong. These particularly significant industries of BW are described below. The potential challenges and future prospects of the various industries, particularly regarding trade with the UK, will also be discussed in more detail.

The results of the data collection and analysis based on a literature review and interviews with experts in the field and with economists have shown that the following four industries in BW, presented in alphabetical order, are particularly relevant with regard to future cooperation with the UK:

- Automotive industry
- Healthcare industry
- Cultural and creative industries
- Mechanical engineering and manufacturing industry

Therefore, the focus in this chapter will be on these four industries. First, each industry will be presented according to its strengths. Then the potential challenges of the different industries will be discussed in more detail. This is followed by a brief description of the specific role of SMEs within that sector. Moreover, a look into the future is given, describing both the impact of the UK's withdrawal from the EU and the COVID-19 crisis, and what this means for international business relations. Finally, a selection of relevant events as well as central state and cluster initiatives, which due to their strong network and professional specialisation are good starting points for interested SMEs seeking access to a new market or support in innovation or internationalisation, are presented.

#### 3.1.1. Automotive Industry

##### Brief description

##### Strengths:

With more than 1,250 car manufacturers and suppliers, over 470,000 employees and an annual turnover of around 105 billion euros, the automotive industry is one of the central industries of the BW economy<sup>23</sup>. Over 60 % of this turnover is generated by exports, which makes the automotive industry one of the leading exporters in Germany<sup>23,24</sup>. Nearly 20% of jobs in BW are in the automotive industry<sup>25</sup>. However, BW's automotive industry does not only play a central role within Germany (alongside Bavaria and North Rhine-Westphalia)<sup>26</sup>: in 2012, about one-fifth of the worldwide turnover of the entire automotive industry was generated within BW<sup>27</sup> and in the region of Stuttgart, currently 55 % of the national turnover of the entire industry is being generated<sup>23</sup>. Some of the most notable car manufacturers based in BW are Daimler AG and Porsche AG (both headquartered in the Stuttgart area) as well as Audi AG with an important production and development site in Neckarsulm near Heilbronn.

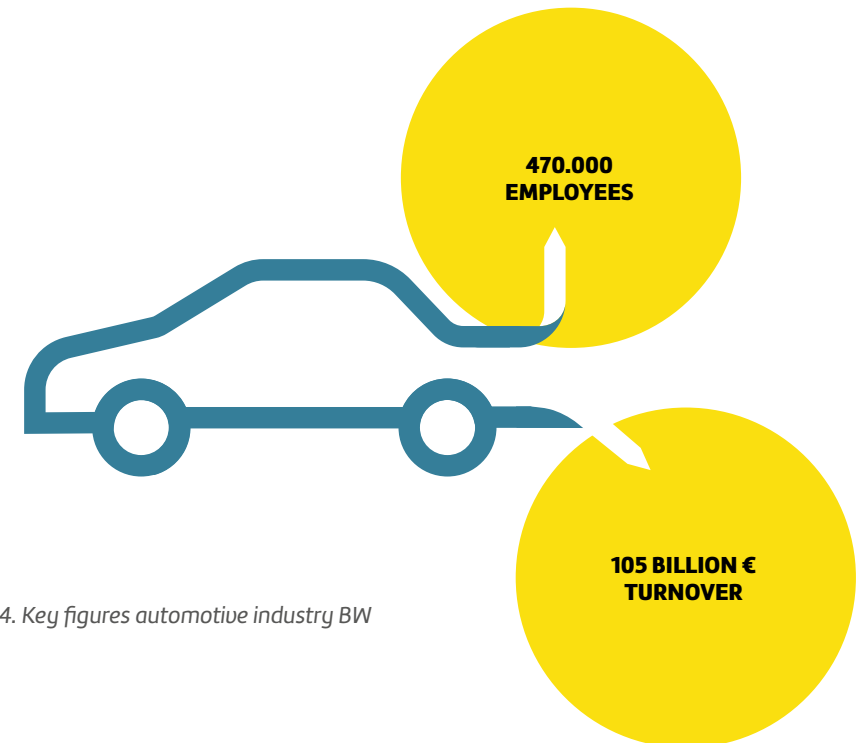


Figure 4. Key figures automotive industry BW

A key feature of the automotive industry is its wide range of suppliers as part of value chains. The economic sectors involved include vehicle construction, electrical engineering, the metal industry, mechanical engineering and the rubber/plastics industry. Like this, in addition to 250 car manufacturers, BW has over 1,000 suppliers in the automotive industry, including numerous well-known large companies such as Robert Bosch GmbH, Mahle Behr GmbH, Eberspächer GmbH or Mann+Hummel GmbH<sup>28</sup>. The majority of those suppliers, however, are SMEs. Many of these companies are located in and around the Stuttgart region, making the city one of the leading centres of the automotive industry, not only within Germany, but also worldwide<sup>25</sup>. According to experts, the Stuttgart region furthermore invests heavily in technology development, making it an important cooperation partner for other countries and regions (according to interview BW01).

The results of the literature research and the interviews have shown that, currently, the topics of fuel cell and hydrogen technology, battery research, autonomous and connected driving and the related competencies in the areas of actuator technology (a sub-area of propulsion technology), sensor technology and software play a major role in the automotive industry: the estimated total turnover of the BW hydrogen and fuel cell industry in 2018 was around 80 million euros, which is a significant proportion of total German turnover<sup>29</sup>. By 2030, sales of up to 9 billion euros are expected<sup>30</sup>. Currently, more than 90 companies and 18 research institutes in BW are active in hydrogen and fuel cell research, employing 840 people in 2019, a large proportion of them in research and development. In addition to many years of experience in research and development, BW has a high level of technological expertise and innovative strength. For example, the German Aerospace Centre (DLR), the Centre for Solar Energy and Hydrogen Research (ZSW) and the Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE) make BW one of the most important European locations for hydrogen research and development today. In order to remain competitive in the international arena in the future, it is important to further build up and expand existing competencies through investments over the next two to five years and to support regional suppliers regarding their participation in international value chains<sup>29</sup>. The first step is already being taken by companies in BW, such as Bosch (which is investing in fuel cell research), the planned construction of the HyFab<sup>31</sup> research factory, and Daimler AG, which has been launching cars with fuel cell technology for several generations of vehicles and is working in the H2 Mobility joint venture to establish a nationwide hydrogen filling station infrastructure in Germany<sup>29</sup>. Daimler AG has also announced its intention to enter large-scale production of fuel cells in a planned joint venture with Volvo Trucks<sup>32</sup>. Furthermore, between 2009 and 2021, BW has provided more than 120 million euros in targeted funding for the development of alternative driving concepts, research into hybrid and electric

vehicles, and the expansion of the hydrogen infrastructure as part of three state initiatives on electromobility<sup>33</sup>. The DLR site in Lampoldshausen also receives direct funding of 16 million euros from BW for hydrogen research<sup>34</sup>. In Europe, Germany is thus one of the most important players in the field of hydrogen and fuel cell technology, alongside France and Norway<sup>29</sup>.

German battery research already generated revenues of 3.9 billion euros in 2019<sup>35</sup>. Additionally, the European Commission (EC) has opened up the possibility to provide state support for innovative high-tech investments in order to remain internationally competitive with grants for Important Projects of Common European Interest (IPCEI). As part of this, BW has committed to the IPCEI battery value chain, providing 155 million euros in support for companies to set up battery cell manufacturing to build competitive capabilities in BW<sup>36,37</sup>. VARTA Microbattery GmbH from Ellwangen is the first participant in this funding measure: the company will use the money for research and development and for initial industrial applications<sup>38</sup>. The cornerstone for this series production was laid at an early stage with the joint research projects that were supported within the framework of the State Initiatives for Electromobility and the Strategy Dialogue Automotive Industry, such as FastStorage<sup>39</sup>, DigiBatPro4.0<sup>40</sup> and the centre for digitalised battery cell production at the Fraunhofer IPA<sup>41</sup>.

Due to its strong position in the automotive industry and within these currently important issues, BW strives to play a leading role in the research and development of alternative mobility in the future as well<sup>42</sup>. However, the state government is aware that already the development towards electric mobility will be an enormous challenge for the automotive industry: not only the large car manufacturers will have to reposition themselves but also the numerous suppliers who will have to react to the changing demand accordingly. The state of BW has therefore initiated the aforementioned Strategy Dialogue Automotive Industry in 2017 and is working closely with the State Agency for Electromobility and Fuel Cell Technology (e-mobil BW) to actively shape this change<sup>j,33</sup>.

i *State initiative Electromobility and Strategy Dialogue Automotive Industry*

j As a state-wide platform, e-mobil BW connects all relevant players within the framework of initiatives, funding activities and projects and involves SMEs in particular even more closely in the current transformation process of the automotive industry and the electromobility innovation process" (<https://wm.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/elektromobilitaet/> (accessed on 14.08.2020)

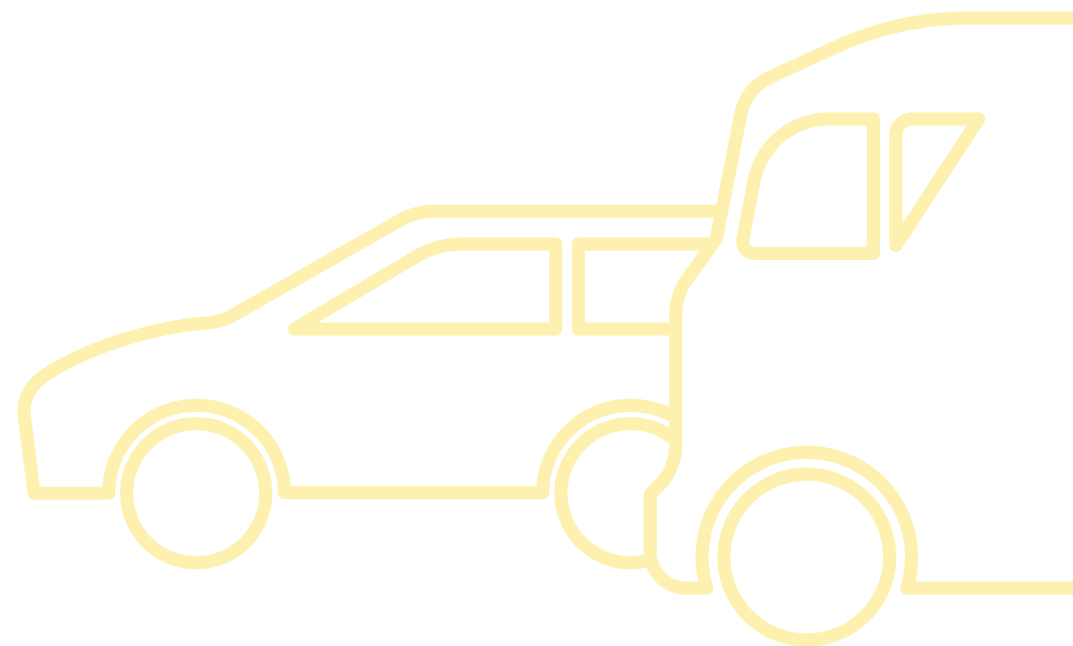
The state of BW has also put together a package of measures to test and promote the digitalisation of various mobility concepts in BW. A core element of this strategy is the 2.5 million euros funding of the Autonomous Driving test field for connected and automated driving in BW, where companies and research institutions have been able to test their technologies and services in everyday traffic since the beginning of 2019<sup>43,44</sup>. The 200 km test field covers selected areas between Karlsruhe, Bruchsal and Heilbronn as well as adjacent state and federal roads and highways. Within this test field, it will be possible to test automated public transport shuttle and bus operations, automated logistics and delivery operations, automated special-purpose vehicles, automated car sharing, automated shuttle operations, individual transport, micro-mobility and mobility apps and services<sup>43</sup>.

### Challenges:

The automotive industry in BW currently faces numerous challenges: increasing digitalisation in almost all sectors of the economy is also playing an increasingly important role in the automotive industry, and its implementation in the coming years is essential for maintaining its current strength.

In recent years, the industry has also been increasingly confronted with the political requirements for combating the effects of climate change and for air pollution control. According to experts, the automotive industry therefore has to deal with the optimisation of gasoline and diesel engines as well as with the development of alternative propulsion systems, such as battery-powered vehicles or the opportunities offered by hydrogen technology, and new mobility solutions in general (according to interview BW01)<sup>33</sup>. In addition, experts say that, although BW is already very active in the field of hydrogen and fuel cell research, the production volumes are still manageable and could be expanded (according to interview BW01). To achieve this, however, the production costs along the entire value chain and in all application areas would first have to be reduced: currently, there are high costs for the use of the required technology as well as for acquisition, investment and operating costs<sup>29</sup>. In addition to the fuel cell, synthetic fuel can also be produced electrically, which does not increase CO<sub>2</sub> emissions as the CO<sub>2</sub> was previously removed from the air<sup>45</sup>. Within the framework of the Strategy Dialogue Automotive Industry, the basis for a subsequent industrialisation of processes and procedures is currently being addressed in the joint research project reFuels of research institutes, the automotive industry, and the mineral oil industry<sup>46</sup>.

High costs also play a central role in battery research and development: electric vehicles are currently still significantly more expensive than comparable vehicles with combustion engines. Here, further research and development will play an important role in the future to develop more cost-effective products and production processes. Although governmental support measures, such as rewards or tax reliefs are important short-term measures, experts believe that optimised production processes and cost reductions will be necessary for the successful long-term implementation of electric vehicles (according to interview UK01). Furthermore, the extraction of lithium and cobalt still poses a major challenge, as does the disposal of batteries that are no longer needed<sup>37</sup>. As part of a circular economy, recycling will become more and more important, also in order to extract rare raw materials. As part of the project DeMoBat, the Strategy Dialogue Automotive Industry thus focuses on the topics of battery dismantling and recycling<sup>47</sup>. In addition, the industry has a relatively high wage level, which, combined with a currently insufficient demand, makes it difficult for the industry to keep up with competition from Asia and the USA<sup>48</sup>. In addition, the massive effects of the COVID-19 crisis are currently being felt, which has led to a temporary cessation of production and a decline in the order situation throughout the entire automotive industry worldwide and thus also to a decline in sales.

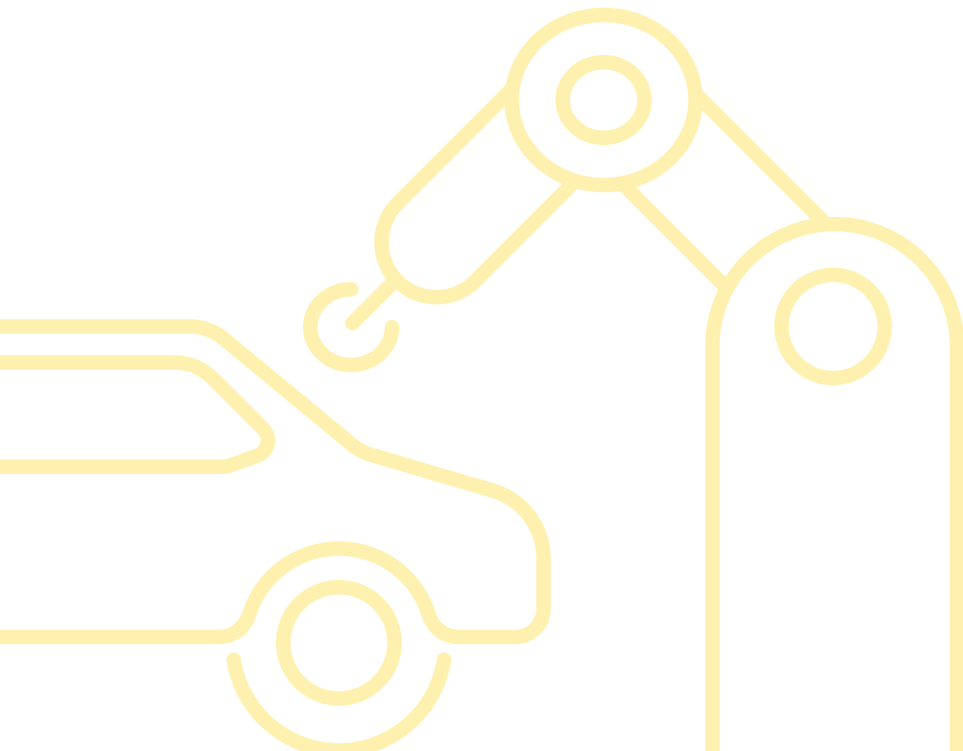


### Role of SMEs:

Especially in the area of the 1,000 suppliers to the automotive industry in BW, numerous SMEs are involved (in addition to the large companies mentioned above), such as Brehm Präzisionstechnik GmbH und Co. KG, EZU-Metallwaren GmbH & Co. KG or the Walter Söhner GmbH & Co. KG<sup>25</sup>. In particular, the competencies in high-precision machining are located regionally in BW in clusters that are characterised by SMEs<sup>49</sup>.

The central players in the hydrogen and fuel cell industry include both SMEs and large international companies. BW companies are active in the production of individual components as well as in all other relevant areas and can therefore cover most components of the value chain. BW's SMEs in this field are also extremely competitive, as they can already offer commercially available products<sup>29</sup>.

Depending on the development of the battery industry, SMEs in this area will also play a greater role as suppliers to the automotive industry, although the number of components here is much smaller than in the internal combustion engine. However, to remain successful in the market, suppliers will have to adapt to the changed requirements of a sustainable, alternative automotive industry<sup>33</sup>.



### A look into the future:

Regarding the withdrawal of the UK from the EU, it is estimated that, within Germany, the automotive industry would potentially experience the strongest changes<sup>k,50</sup>. As concrete examples of these changes, experts cite restrictions on trade relations and higher costs, for example due to new registration procedures or customs duties (of course, all depending upon the exact outcomes of the agreements) (according to interview BW01 and interview BW02). The EU also stands for certain environmental laws and safety regulations, from which the future British requirements could potentially differ. This would then mean that vehicles to be exported from BW to the UK would have to be produced according to different rules than for the rest of the European market, which would mean additional costs for car manufacturers. A major challenge would also arise for SMEs in BW, which currently act as suppliers to British car manufacturers: higher costs could make European suppliers less competitive, which could lead to a reorientation in the UK towards national suppliers. In most cases, however, setting up production sites in the UK would be very cost-intensive for BW SMEs. Consequently, according to experts, there could be a decline in the cooperation between BW and the UK in this area (according to interview BW01 and interview BW02).

Additionally, the automotive industry currently struggles with the economic implications of the COVID-19 crisis as well. Due to the high infectivity of the virus, far-reaching infection protection measures have been taken. Worldwide lockdowns and the accompanying economic slump hit the BW automotive industry that was already under strong pressure to transform beforehand. Together with the worldwide drop in demand for vehicles, the COVID-19 crisis thus caused a sharp drop in activity at the production facilities of automobile manufacturers: according to first estimates, the European average declined by more than 90 % in May 2020, while Germany as a whole saw a 64 % drop<sup>51</sup>. Experts assume that, even if demand for vehicles will rise again in the long term, it may still lead to temporarily higher unemployment or wage cuts and lower production figures for the time being (according to interview BW01 and interview BW02).

The great advantage of battery, hydrogen and fuel cell technology compared to more traditional car production is that research in this area is still relatively new and can therefore react more flexibly to economic challenges such as the uncertainties surrounding the UK's withdrawal from the EU or the COVID-19 crisis. Losses in other industries could even mean a growth for this industry due to reorientation activities or the development of new business models.

<sup>k</sup> Besides mechanical engineering and the pharmaceutical industry<sup>50</sup>.

→ In BW, the following events and cluster initiatives can be used as starting points for future business relations:

## Events

- Automotive Interiors Expo, Stuttgart
- Automotive Lightweight Materials Europe 2020 Exhibition and Conference, Stuttgart
- Automotive Procurement Forum, Ludwigsburg
- Automotive Testing Expo, Stuttgart
- Autonomous Vehicle Interior Design & Technology Symposium, Stuttgart
- Electric & Hybrid Vehicle Technology Expo, Stuttgart
- Electric Drives Production Conference, Ludwigsburg
- f-cell, Stuttgart
- Global Automotive Components and Suppliers Expo, Stuttgart
- i-Mobility, Stuttgart
- International Conference Automotive Wire Harness & Electronic Distribution System, Ludwigsburg
- Internationaler Motorenkongress 2021, Baden-Baden
- Internationales Stuttgarter Symposium Automobil- und Motorentechnik (FKFS), Stuttgart
- M:bility Europe, Stuttgart
- NUFAM - Die Nutzfahrzeugmesse, Karlsruhe
- PIAE - Kunststoffe im Automobilbau, Mannheim
- Retro Classics Stuttgart, Stuttgart
- TECHNORAMA Ulm - Oldtimer Messe, Ulm
- The Battery Show Europe, Stuttgart
- Women Automotive Summit, Stuttgart
- World of Energy Solutions, Stuttgart
- Zulieferertag Automobilwirtschaft BW, Esslingen

## Cluster and state initiatives

### State Agency for New Mobility Solutions and Automotive e-mobil BW GmbH

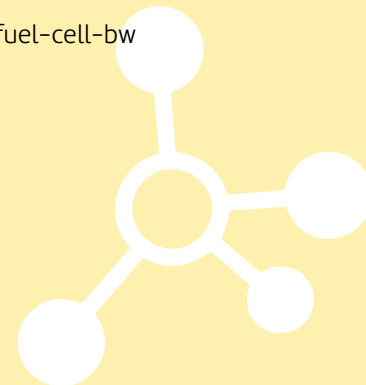
The task of the state agency e-mobil BW GmbH is to be the central point of contact in the state of BW for all matters relating to mobility. It connects companies, SMEs, universities, research institutions, ministries and associations, thereby pooling expert knowledge and connecting relevant players in order to actively shape change in BW. It designs innovation projects, coordinates funding activities and initiates projects. In this way, it supports the industrialisation, market launch and application of sustainable and climate-friendly mobility solutions in order to strengthen BW as a business location. For companies from the UK that are interested in cooperating with SMEs in BW, the state agency thus offers a good first point of contact.

- <https://www.e-mobilbw.de/en/>

### Cluster with the label “Cluster Excellence Baden-Württemberg”

Excellent cluster managers in BW can have their professionalism assessed by an independent review and receive the quality label “Cluster Excellence Baden-Württemberg”. The quality label is also a recognised proof of excellence at European level. For British companies that already have concrete ideas and are looking for clear points of contact, the award-winning cluster initiatives offer a good point of contact.

- **Cluster Elektromobilität Süd-West:**  
<https://www.emobil-sw.de/en/>
- **Virtual Dimension Center Fellbach e. V.:**  
<https://www.vdc-fellbach.de/en/>
- **TechnologyMountains e. V. c/o IHK Schwarzwald-Baar-Heuberg:**  
<https://technologymountains.de/en/>
- **Cluster Fuel Cell BW:**  
<https://www.e-mobilbw.de/en/network/cluster-fuel-cell-bw>



### Further cluster initiatives can be found in the *BW Regional Cluster Atlas*

The *Regional Cluster Atlas Baden-Württemberg* or the Cluster Database is aimed at interested companies (including SMEs) and business development agencies and provides relevant information on BW's cluster initiatives, state-wide networks and state agencies. The cluster atlas also records the cluster-relevant offerings of research, development and transfer institutions in the regions of the state.

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

### Selection of other (cluster) initiatives and networks:

- **German Association of the Automotive Industry:**  
<https://www.vda.de/en>

## 3.1.2. Healthcare Industry

### Brief description

#### Strengths:

The healthcare industry in BW can be divided into medical technology, pharmaceuticals and diagnostic industries<sup>52</sup>. In 2017, a total of 1,078 companies were active in BW with a total of more than 90,500 employees, which together generated revenues of more than 24 billion euros<sup>52</sup>. The healthcare industry is also BW's third largest exporter<sup>53</sup>. In the fields of medical technology and pharmaceuticals, BW has numerous renowned research institutions such as the KIT (Institute for Biomedical Engineering), the German Cancer Research Centre, the European Molecular Biology Laboratory, various Fraunhofer and Max Planck Institutes, numerous university hospitals (Freiburg, Heidelberg, Mannheim, Tübingen or Ulm) and the application-oriented research institutions of the Innovation Alliance BW (Innovationsallianz BW) (such as the Natural and Medical Sciences Institute in Reutlingen), a broad base of SMEs, as well as major companies such as the generics manufacturer Ratiopharm GmbH, Paul Hartmann AG, Boehringer Ingelheim, Aesculap AG, Karl Storz GmbH & Co. KG, Roche Diagnostics GmbH, GlaxoSmithKline Consumer Healthcare GmbH & Co. KG or Reckitt Benckiser Healthcare GmbH<sup>54</sup>.

BW is particularly well positioned in the field of medical technology: with 25% of Germany's sales and more than 600 companies in the state, BW is the leading medical technology location in Germany and Europe<sup>55</sup>. BW's medical technology companies are also highly innovative: over 50 percent of sales are generated with products that have been on the market for less than three years<sup>55</sup>. Moreover, BW is very strong in pharmaceuticals: 138 drug manufacturers make BW Germany's No. 1, and in the field of homeopathy and plant-based active ingredients, BW is even the leading location in all of Europe<sup>56</sup>.



Figure 5. Key figures healthcare industry BW



The results of the data collection and analysis have shown that topics such as digitalisation and artificial intelligence and, in conjunction with these, digital health are playing an increasingly important role in this area. In addition, it is expected that major synergies and new innovations will result primarily from increased cooperation with companies in the medical biotechnology sector<sup>57</sup>. The location factors for this are very good in BW: everything is available, from research, development and production to sales. The state government therefore founded the Healthcare Location BW Forum, which is coordinated by the State Agency BIPORO Baden-Württemberg GmbH. All players are represented in the network and discuss strategies and measures to strengthen the healthcare industry<sup>58</sup>. Numerous spin-offs also emerge from BW universities and research institutions: between 2015 and 2018, 67 start-ups were registered in the BW healthcare industry<sup>52</sup>.

### Challenges:

Digitalisation also poses a challenge for the healthcare industry, especially in terms of necessary investments. At the same time, however, it offers great opportunities.

Furthermore, market access for new pharmaceuticals or medical products is costly<sup>59</sup>, especially for the latter, due to new regulations for medical products and in-vitro diagnostics. This poses a major challenge for all companies, but especially for SMEs, since the new Medical Devices Regulation will lead to resource shortages, longer evaluation procedures and thus possibly to rising prices, and, in the worst case scenario, to insolvencies of small innovative medical technology companies. BW has lobbied for an extension of the transition period, which was to expire on May 26, 2020. With the third corrigendum to the Medical Devices Ordinance, this period was extended by exactly one year to May 26, 2021. Difficulties in implementing the legal requirements, for example due to the lack of a sufficient number of notified bodies, combined with a paradigm shift towards higher classification of the products concerned, are also emerging for the new regulation concerning in-vitro diagnostics.

A further challenge lies in the steadily aging society of Germany, which is a great opportunity for the industry due to the increasing demand for healthcare solutions, but at the same time, combined with the lack of qualified personnel in the medical field, also a great challenge<sup>60</sup>.

A study of the Medical Mountains cluster initiative names between 60 and 70 % losses in turnover in the industry and a 12 % decline in exports due to COVID-19, another major challenge facing the industry<sup>61</sup>. In addition, since the outbreak of the pandemic, there has been a political desire to become more independent of international suppliers in important health issues by strengthening value chains

in Europe. The Healthcare Location Forum BW (*Forum Gesundheitsstandort BW*) is currently working on an interdepartmental strategy paper on this topic, which is to be presented at the end of 2021.

### Role of SMEs:

In addition to numerous universities, research institutions and large companies, there are also many SMEs and start-ups involved in the healthcare sector, whose role, according to experts, is mainly in the translation of research results into the industry (according to interview BW09). Research-intensive SMEs or start-ups do not always find the required funding for their own intensive research or clinical trials and therefore oftentimes offer contract research or services such as laboratory diagnostics to other companies. In medical technology alone, there are about 400 SMEs. Their smaller size is also an advantage for SMEs as that allows for more flexibility and thus the ability to react more quickly to market changes or innovations.

### A look into the future:

It is estimated that the pharmaceutical industry in Germany would be one of the industries that will feel the effects of the Brexit most strongly<sup>62</sup>. Some of the reasons are that, depending on the agreements between the UK and the EU, the potential loss of EU funding on the UK side (such as Horizon 2020<sup>m</sup>, Innovative Medicines Initiative) would also lead to fewer collaborations and international research projects, and thus less trade with BW. However, the potentially higher costs of conducting clinical trials and possible patent law problems would also affect the current trade relations between BW and the UK in the healthcare sector. Under certain circumstances, this could furthermore lead to a reorientation in the area of well-functioning international supply chains<sup>1</sup>. According to experts, this is a major challenge for BW as a strongly export-oriented region, especially in the medical technology and pharmaceutical sectors, and with the UK as the region's sixth most important trading partner in this field (according to Interview BW04).

<sup>l</sup> Besides the automotive industry and mechanical engineering<sup>59</sup>.

<sup>m</sup> There is an agreement between the EU and the UK that all British organisations currently receiving funding under Horizon 2020 will continue to receive funding until the end of Horizon 2020 and until the end of the term of the individual projects (as of January 2020) (<https://www.horizont2020.de/einstieg-teilnahme-brexit.htm> (accessed on 14.08.2020))

In the COVID-19 crisis, the healthcare industry is one of the few industries that is currently facing a number of challenges as well as opportunities, due to the high demand for a vaccine or a drug and equipment for the treatment of COVID-19. An increased demand in the medical technology sector affects both manufacturers of devices and beds for intensive care in hospitals. There are currently more than 78 studies and research groups<sup>n</sup> in Germany working on the development of a vaccine or drug and on innovative treatment methods. In more than 25 of these, universities, research institutes and university hospitals from BW are involved, with a focus on the university hospitals around Tübingen, Freiburg and Heidelberg<sup>62</sup>. According to experts, the COVID-19 pandemic also highlights the importance of international and cross-organisational cooperation for the joint development of solutions for global problems, as it is currently the case with the successful fightCOVID@DKFZ<sup>o</sup> initiative and as it must continue to be possible after the UK has left the EU (according to interview BW09). However, there are also clear challenges that the healthcare industry has to face regarding the COVID-19 crisis: experts note that current funding should not only be used to support or rescue existing SMEs and start-ups, but that investments in higher-risk areas such as start-ups need to be made in order to be able to adequately respond to future diseases (according to interview BW09). In addition, the currently strong focus on COVID-19 problems has also led to declining demand or loss of orders in individual sub-areas that are strongly dominated by SMEs, such as medical technology. A survey conducted by Medical Mountains and Spectaris in June 2020 confirmed the decline in sales: 60% of companies in the medical technology sector expect a double-digit drop in sales compared to 2019, with exports alone down by 12%<sup>63</sup>.

<sup>n</sup> As of July 2020.

<sup>o</sup> DKFZ stands for *German Cancer Research Centre*.

→ In BW, the following events and cluster initiatives can be used as starting points for future business relations:

### Events

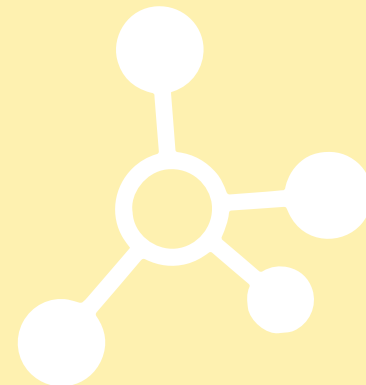
- Diagnostics 4 Future, Konstanz
- ISTN - Interdisziplinärer Stuttgarter Tag der Notfallmedizin, Stuttgart
- Landeskongress Gesundheit Baden-Württemberg, Stuttgart
- Medizinische Woche, Baden-Baden
- Messe Lounges, Karlsruhe
- Messe Technology for Medical Devices T4D, Stuttgart
- Stuttgarter Tag für Infektiologie, Stuttgart

### Cluster and state initiatives

#### State Agency BIOPRO BW GmbH

BIOPRO Baden-Württemberg is the state agency for the topics bioeconomy and biotechnology, pharmaceutical industry and medical technology (healthcare industry). The state agency connects science, industry and politics with each other and contributes to further cross-sectoral networking across the entire value creation chain and thus to innovation. In addition, BIOPRO represents the topics of the healthcare industry and bioeconomy in public and is the central national and international point of contact for BW.

- <https://www.bio-pro.de/en/>



### State Initiative Forum Gesundheitsstandort BW

With the aim of developing the Forum Gesundheitsstandort (health location) BW to the highest possible level, players from all areas of the health industry are to develop and implement appropriate measures with the support of the state government. In this strategic process, specialist working groups on future-oriented topics, such as progressive digitalisation, will come together and develop approaches to solutions, the coordinated implementation of which will be ensured by the establishment of an interministerial working group (IMA).

- <https://www.forum-gesundheitsstandort-bw.de/>

### Cluster with the label “Cluster Excellence Baden-Württemberg”

- **BioLAGO e.V. – the health network:**  
<https://www.biolago.org/en/home/>
- **Mannheim Medical Technology Cluster:**  
<https://medtech-mannheim.de/en>

### Further cluster initiatives can be found in the BW Regional Cluster Atlas

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

### 3.1.3. Cultural and Creative Industries

#### Brief description

#### Strengths:

The cultural and creative industries in BW can be divided into: music industry, book market, art market, film industry, broadcasting industry, performing arts market, design industry, architecture market, press market, advertising market, software and games industry<sup>64,65</sup>. In 2018, the German cultural and creative industries had a turnover of 168.3 billion euros<sup>66</sup>. The software and games sector is particularly strong and dominates the industry with a share of almost 33%, followed by the press market (12.5%) and the advertising market (12.2%)<sup>66</sup>. In BW alone, 22 billion euros in sales were generated by 220,000 employees in about 30,000 companies<sup>67</sup>. Within BW, the Rhine-Neckar region and the Stuttgart region are the centres of the cultural and creative industries: in the Rhine-Neckar region, for example, there are 110 theatres and stages and more than 230 museums and galleries. In terms of the overall economy in BW, seven % of the self-employed persons and companies are employed in the cultural and creative industries<sup>67</sup>. Besides Heidelberg, Mannheim and Karlsruhe are members of the world-wide network Creative Cities of the UNESCO<sup>68</sup>. Stuttgart is the largest market for cultural products and services, thanks to its excellent academic conditions, such as the Hochschule der Medien, and the overall high level of cultural activities<sup>69</sup>.



Figure 6. Key figures cultural and creative industries BW

In an international comparison with other major cities, Stuttgart was ranked fifth for cultural vitality, with particularly good results in cultural vibrancy<sup>70</sup> and enabling environment<sup>70,71</sup>. Other BW cities such as Karlsruhe and Heidelberg also achieved places in the upper ranks<sup>70</sup>. Due to the high innovative power of BW's industry, creative people also have good opportunities to become active in design or media within companies. BW is a member of the international network Districts of Creativity and thus also maintains good contacts with the cultural and creative industries in Scotland.

Overall, the cultural and creative industries is one of the fastest growing industries in the global economy<sup>64</sup>. For this reason, the state government in BW founded the Media and Film Society BW (MFG BW) together with the Südwestrundfunk radio station as early as 1995. MFG acts as a state-wide competence centre, is a public cultural and economic promoter and offers needs-oriented support measures. The focus of the MFG Film Funding division is on the awarding of project funding, while the MFG Creative division focuses on networking and mediation activities for the cultural and creative industries as well as on the competence field of digital culture. Concrete measures include, for example, simplified access to funding for SMEs and freelancers or networking activities and competitions for start-ups. In BW, a special focus of funding is on the successful sub-sectors of the software and games industry as well as film, especially the animated film sector<sup>72</sup>.



The animation and the sound/film score industry in BW is globally successful through its corresponding academies in Ludwigsburg. Game of Thrones is the best-known example: the shooting of single scenes of this TV series was only possible with the help of the high-performance computer at the University of Stuttgart, in cooperation with the BW company Mackevision<sup>73</sup>. Other important actors from BW with worldwide operations in this area include Pixomondo, M.A.R.K.13 or Luxx Studios<sup>74</sup>.

### Challenges:

According to experts, internationalisation and international trade are currently one of the main challenges facing SMEs in BW's cultural and creative industries due to a lack of international funding opportunities (according to interview BW05). In order to enable even more exciting cooperation between regional and, for example, British organisations or associations in the future, it is necessary to overcome these challenges.

In addition, the cultural and creative industries in BW in some sub-sectors depend on the traditionally strong industries of BW such as the automotive industry or mechanical engineering due to direct contracts. However, these are also two of the industries that are highly dependent on the general global economic situation and thus on economic fluctuations. Experts thus say that a broader diversification of the cultural and creative industries would help to become more independent of individual industries and thus more crisis-proof overall (according to Interview BW05).

Since a large part of BW's cultural and creative industries consist of SMEs and self-employed persons, it is a constant challenge to secure one's own existence. In this industry, there is a high dependence on a good order situation and, therefore, an irregular money income. The number of marginally paid employees is higher in this industry than in any other. Women are particularly affected by this<sup>75</sup>. The jobs offered via digital platforms are often seriously underpaid and rarely lead to follow-up orders. Many of the SMEs and self-employed people involved therefore find it difficult to build up reserves, which are urgently needed for important further training, for example in the field of digitalisation: the demand for digital offers is constantly increasing – especially now in the COVID-19 crisis, digital solutions are indispensable. Experts therefore see both opportunities as well as some challenges in the ongoing digitalisation process for the industry, that need to be overcome (according to Interview BW07).

## Role of SMEs

The cultural and creative industries in BW currently employ 220,000 people in approximately 30,000 companies, mainly SMEs<sup>67</sup>. According to experts, a high proportion of national, regional and municipal support measures are available to them (according to interview BW07).

### A look into the future:

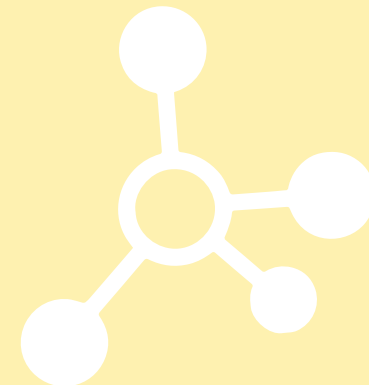
Regarding Brexit, the cultural and creative industries in BW face a number of challenges. Thanks to open borders, there have hardly been any economic restrictions in existence until now. However, depending on how the exact immigration laws of the UK will look like in 2021, there will be new regulations regarding the job opportunities of, for example, BW artists in the UK (and vice versa). Trade of cultural goods, such as musical instruments, may also be restricted<sup>76</sup>. The cultural and creative industries in BW that are interested in the UK will therefore have to focus more on individual contacts and an active search for new, yet untapped cooperation potential in the future.

Due to the high proportion of SMEs and self-employed persons, the cultural and creative industries in BW are also struggling with the challenges of the COVID-19 crisis. In addition to subsidies at the federal level (e.g., short-time work benefits), the state of BW offers numerous financial support measures to compensate for the industry's losses. This includes several emergency aid programs for the self-employed and SMEs or a support program for smaller cultural events in the summer of 2020<sup>77</sup>. The question is, however, what will happen once these support measures expire. For this reason, research is currently being conducted into ways in which new event formats (drive-in movie theatres or digital events) can be successfully continued after the crisis.

→ In BW, the following events and cluster initiatives can be used as starting points for future business relations:

### Events

- Aachen–Dresden–Denkendorf International Textile Conference
- Comic Con Stuttgart, Stuttgart
- Dragon Days – Fantasy Festival, Stuttgart
- Indisches Filmfestival, Stuttgart
- informatica femminile Baden–Württemberg
- Internationales Trickfilmfestival, Stuttgart
- Jazz Open, Stuttgart
- Ludwigsburger Schlossfestspiele, Ludwigsburg
- Open Stage Games Baden–Württemberg
- Sommerfestival der Kulturen, Stuttgart
- Stimmen Festival, Lörrach
- Stuttgarter Filmwinter, Stuttgart
- VR Experience Day, Ludwigsburg
- World Town Festival, Waldshut–Tiengen



## Cluster and state initiatives

### State Agency MFG Baden–Württemberg Media and Film Society

MFG Baden–Württemberg is an institution of the state of BW and the Südwest-rundfunk with the task of promoting film culture, the film industry as well as the cultural and creative industries in the state. It acts as a state-wide competence centre, is a public cultural and business promoter and offers numerous support measures. The focus is on the awarding of project funding, networking and mediation activities for the cultural and creative industries, and on the competence field of digital culture.

- <https://www.mfg.de/en/information-in-english/>

### Further cluster initiatives can be found in the *BW Regional Cluster Atlas*

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

### Selection of other (cluster) initiatives and networks:

- **Kompetenzzentrum Kultur- und Kreativwirtschaft des Bundes:**  
<http://www.kreativ-bund.de>
- **Popbüro Baden–Württemberg:**  
[www.bw.popbuero.de](http://www.bw.popbuero.de)

## 3.1.4. Mechanical Engineering and Manufacturing Industry

### Brief description

#### Strengths:

Overall, BW is considered the leading centre of the German mechanical and engineering industry<sup>78</sup>: in 2018, the industry generated sales of around 85.4 billion euros, 80% of which were exported. Almost 25% of the entire German mechanical engineering and manufacturing industry (in the following, simply manufacturing industry) is based in BW and, with more than 348,000 employees, represents the highest number of jobs in the industry in BW<sup>78,79</sup>: the German Engineering Federation (VDMA) lists 47 different trade associations<sup>80</sup>. The geographical focus of the industry is on the regions around Esslingen, Göppingen, Reutlingen, Ludwigsburg, Biberach, Pforzheim, Karlsruhe, Ortenau and the Rhein-Neckar district<sup>81</sup>. Some notable leading companies in BW are Trumpf GmbH & Co. KG, the Alfred Kärcher SE & Co. KG, Festo SE & Co KG (in the automation/digitalisation sector) or Andreas Stihl AG & Co. KG. The manufacturing industry is also an important partner for numerous other industries when it comes to developing new products and innovative production processes. As a supplier of high-performance production technologies, the manufacturing industry creates the necessary conditions for the rational manufacture of high-quality products. In its importance, the manufacturing industry therefore goes far beyond its measurable economic weight and is, among other things, the key industry for the realisation of ambitious sustainability goals. The industry enables industrial products of all kinds to be manufactured in a customer-oriented, efficient, high-quality and sustainable manner. The manufacturing industry industry is, on the one hand, a user of many new technological developments and, on the other hand, a problem solver of technical tasks as well as a supplier of hardware and system solutions in many future fields<sup>82</sup>. The manufacturing industry in BW is therefore one of the most competitive industries worldwide. One of the main reasons for this is the ability to control complex, geographically distributed industrial processes based on the division of labour and to apply technological innovations in a targeted manner.

85,4 BILLION €  
TURNOVER

348.000  
EMPLOYEES

Figure 7. Key figures manufacturing industry BW

The results of the data collection and analysis have shown that especially the topic of Industry 4.0 will play a central role in the future of the manufacturing industry: with the entry of Industry 4.0 into the manufacturing sector, intelligent systems characterise the digital transformation in the industry. The goal is the Smart Factory, which combines adaptability, resource efficiency and ergonomics as well as the vertical and horizontal integration of customers, suppliers and service partners in business and value-added processes. A characteristic feature of industrial production is the increasing customer orientation and individualisation of products under the economic conditions of highly flexible (large-scale) production, sometimes also to open up new markets. For this, the automation technology is required to become more intelligent through the introduction of AI-supported procedures of self-optimisation, self-configuration, self-diagnosis and cognition, and to better support people in their increasingly complex work. Central topics for this are new forms of work organisation, machine and cyber security, standardisation and open interfaces, and the development of new digital and data-based business models and services<sup>82</sup>.

### **Challenges:**

The manufacturing industry is currently in a difficult phase: in 2019, sales and orders have already fallen due to the challenges of various technological transformation processes, such as Industry 4.0 and digitalisation, as well as global trade disputes<sup>83</sup>. Compared to the previous year, there has been a decrease in sales in 2019 of 2.6 %<sup>84</sup>. The investment volume has also fallen sharply compared to 2018<sup>85</sup>.

The current COVID-19 crisis is causing further burdens: in April 2020, there has been a decrease in sales of 39,5% compared to April 2019<sup>86</sup>. Demand from abroad fell by 48% and domestic demand by 24%<sup>87</sup>. The reasons for this are, among others, the dependence on the automotive industry, which struggles with massive losses due to the COVID-19 crisis as well, but also the limited mobility and the cancellation of numerous trade fairs, which normally result in a large share of new orders. According to experts, the focus of the industry is therefore currently on securing the operative business and on the acquisition of new orders (according to interview BW03).

### **Role of SMEs**

The manufacturing industry has a high proportion of SMEs: around 80 % of the 348,000 employees in BW, or approximately 278,000 people, work in companies with fewer than 250 employees<sup>78</sup>. Many of these companies are world market leaders in their field<sup>79</sup>, such as Arp GmbH & Co. KG with a worldwide sales network for recycling and processing plants, or Binder GmbH, an expert for incubators and climate chambers.

### **A look into the future:**

In addition to the significant demand problems within the industry due to the COVID-19 crisis, experts for the manufacturing industry expects an uncertain future for the value chains between BW and UK companies and producers due to the Brexit (according to interview BW03). Many of the currently existing supply chains are based on long-standing and trust-based business partnerships, whose future existence is not assured due to the uncertain situation and changing framework conditions. The UK is the fifth most important country for Germany in terms of exports of metal products and within the UK, Germany is even the most important supplier of those. It is therefore of particular importance for this industry that the UK and the EU agree on a trade agreement that will enable the continuation of these good and long-standing relations.

Initially triggered by the UK's withdrawal from the EU, and currently intensified by the additional burdens of the COVID-19 crisis<sup>p</sup>, the focus of the manufacturing industry is currently on the development of new business models and a reorientation towards automation and digitalisation processes, according to experts.

<sup>p</sup> Especially during the peak phase of exit restrictions between March and mid-June 2020, many intra-European borders were closed and entry into other countries was not easily possible.

→ In BW, the following events and cluster initiatives can be used as starting points for future business relations:

### Events

- AMB - Internationale Ausstellung für Metallbearbeitung, Stuttgart
- Blechexpo - Internationale Fachmesse für Blechbearbeitung, Stuttgart
- i+e Industriemesse, Freiburg im Breisgau
- Industrieforum Digitaler Mittelstand, Stuttgart
- microTEC Südwest Clusterkonferenz, Freiburg
- MOTeK - Internationale Fachmesse für Produktions- und Montageautomatisierung, Stuttgart
- Virtual Composites Show

## Cluster and state initiatives

### State initiatives

- **Initiative Economy 4.0:**  
<https://www.wirtschaft-digital-bw.de/en/>
- **Allianz Industrie 4.0:**  
<https://www.i40-bw.de/en/>
- **Handwerk International Baden-Württemberg:**  
<https://www.handwerk-international.de/>

### Cluster with the label “Cluster Excellence Baden-Württemberg”

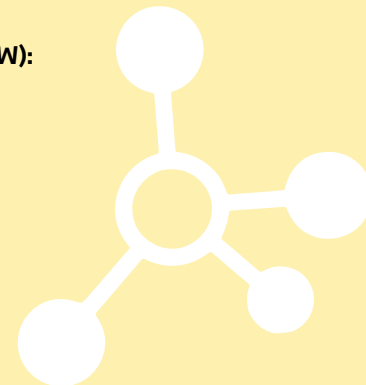
- **Technology Mountains e. V.:**  
<https://technologymountains.de/en/>

### Further cluster initiatives can be found in the *BW Regional Cluster Atlas*

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

### Selection of other (cluster) initiatives and networks:

- **Network for the capital goods industry BW (VDMA):**  
<https://bawue.vdma.org/en/>
- **German Machine Tool Builders’ Association (VDW):**  
<https://vdw.de/en/>





## 3.2. INDUSTRIES UK

The UK has been central to the EU, representing 13% of its population and 17% of its economy<sup>88</sup>. But the EU and its Single Market have also played an important role for the UK's economy: 51% of all UK imports came from the EU<sup>89</sup>.

The results of the data collection and analysis have shown that the following four industries within the UK are particularly relevant with regarding to future cooperation with BW:

- Automotive industry
- Healthcare industry
- Cultural and creative industries
- Mechanical engineering and manufacturing industry

These are presented below in alphabetical order. First, each industry is presented according to its respective strengths. Then the challenges each industry is facing are discussed in more detail. This is followed by a brief description of the special role of SMEs in the respective industries and a look into the future. The effects of both the Brexit and the COVID-19 crisis are described, and what those mean for international cooperation, especially with BW. Finally, a selection of relevant events as well as central state and cluster initiatives, which, due to their strong networking and technical specialisation, are good starting points for interested SMEs seeking access to a new market or support in innovation or internationalisation, are presented.

### 3.2.1. Automotive Industry

#### Brief description

##### Strengths:

The automotive industry is highly regarded in the UK and also enjoys a high reputation worldwide: More than 30 car manufacturers currently produce over 70 different models in the UK, with a geographical focus on the West Midlands and North West of the country<sup>90,91</sup>. In the last decade, the UK automotive industry has recovered strongly compared to previous years, with sales of almost 70 billion euros in 2017<sup>92</sup>. This recovery is partly due to investments from Asia but also

from continental Europe, especially Germany<sup>7</sup>. Some of the previously British car manufacturers are therefore now in foreign hands, such as Mini and Rolls-Royce (now BMW) or Bentley (now Volkswagen Group). In total, more than 1.3 million cars, 78,270 commercial vehicles and 2.5 million engines were built in the UK in 2019<sup>90</sup>. With around 823,000 employees, the British automotive industry thus accounts for 14.4% of total British exports worth 48 billion euros<sup>90</sup>.

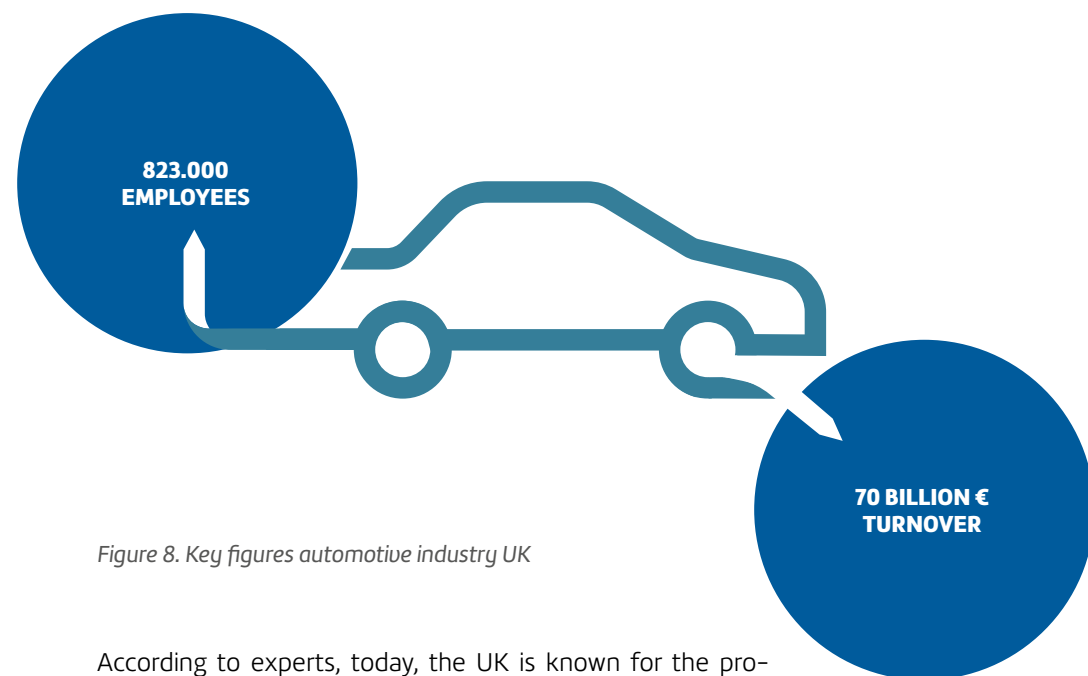


Figure 8. Key figures automotive industry UK

According to experts, today, the UK is known for the production of luxury and sports cars such as Aston Martin, Bentley, Jaguar, Land Rover and Rolls Royce, but also has numerous volume manufacturers such as Honda, Nissan and Toyota as well as commercial vehicle manufacturers such as Ford (according to interview UK01)<sup>93</sup>. In addition, the motor sports industry plays an important role in the UK with around 4,500 companies and a large number of Formula 1 teams headquartered in the UK<sup>94</sup>. As a service-oriented country, one of UK's great strengths is the maintenance and repair of motor vehicles and motorcycles: in 2019, this sector accounted for almost 35% of the British economy<sup>95,96</sup>. According to experts, there is a high demand in the service sector, partly as a result of the strong premium and vintage car market in the UK (according to Interview BW02). Another unique selling point of the British automotive industry is engine production<sup>90</sup>.

Just as in BW, the topics of sustainable mobility concepts and autonomous driving are of particular importance in the UK:

Sustainable mobility is one of the future topics of the UK. In 2018, more than 15,000 people were employed in the sector for alternative mobility solutions in the UK<sup>97</sup>. In the hydrogen and fuel cell technology sector, the turnover was 121.3 million euros in 2019, which is thus currently one of the focal points according to experts (according to interview UK03)<sup>98</sup>. In 2020, the British government plans to invest an additional 98 million euros to reduce pollutant emissions from private households and heavy industry. Part of the investment sum is to be invested in two large hydrogen plants as well as in hydrogen research<sup>99</sup>. With 250,000 tons per year, the UK already produces a large amount of hydrogen<sup>100</sup>. The Scottish Orkney Islands also plays a central role in this regard, producing significantly more sustainable energy than their inhabitants can consume<sup>101</sup>. According to experts, Northern Ireland has a similar unique selling point due to its unique tidal pattern and the resulting strong focus on wind turbine production and repair (according to interview UK13).

The UK is also well positioned for the future in the field of battery research<sup>102</sup>. In addition to a good charging infrastructure, the UK expects an additional 83,000 jobs to be created in the areas of electromobility, battery production and research, and supply chain management<sup>103</sup>. In Wales, experts say that former military sites in Wales offer the opportunity to test e-vehicles (according to interview UK09), and it is estimated that the UK will build the first large-volume lithium-ion factory (so-called giga factories) in 2022 and will need up to 13 more giga factories by 2040 to meet the demand for electric vehicles in the future<sup>102</sup>. The British government is also supporting the purchase of various types of electric vehicles with subsidies or by investing in the research and development of alternative propulsion solutions<sup>104,105</sup>.

With the Centre for Connected and Autonomous Vehicles as part of the Department for Transport and Department for Business, Energy & Industrial Strategy, the UK government is placing further emphasis on the development of autonomous vehicles<sup>106</sup>. Since 2014, the UK has invested 133 million euros in the research and development of connected and autonomous vehicles. Together with a further 75 million euros from the industry, more than 70 projects with more than 200 partners from industry and research have been supported. Wales also has the first Compound Semiconductor Centre cluster initiative for compound semiconductors, a technology that will play a major role in the future of autonomous vehicles and robotics, bringing the research community together with industry and commercial exploitation<sup>107,108</sup>.

In the long term, the UK aims to cover its own demand for alternative mobility technologies through national production. Consequently, clusters will be formed of traditional car manufacturers and manufacturers of alternative mobility technologies to guarantee safe and fast transport from suppliers to producers, thus saving on labour and emissions while at the same time increasing production volumes<sup>102,103</sup>.

### *Challenges:*

The current debate on climate change and the problem of increasing air pollution is also one of the major challenges facing the British automotive industry in the future. In the UK, this has already led to stricter regulations and legislations for car manufacturers, to which the industry must respond in the future<sup>109</sup>.

In terms of alternative mobility concepts, the UK currently accounts for just under 1% of the global battery production. In order to keep the automotive industry, and thus jobs in the UK, it needs to expand its local production of battery, hydrogen and fuel cells and link it with its local automotive production industry<sup>103</sup>.

Just as in BW, increasing digitalisation is also playing a major role for the British automotive industry which will require numerous investments and the integration of new business models in the future as well.

### *Role of SMEs*

The British automotive industry currently has more than 2,600 suppliers with over 115,000 employees, 90% of which are SMEs<sup>110</sup>. Due to the increasing demand for alternative mobility concepts, there are many opportunities for SMEs and start-ups in the field of battery, hydrogen and fuel cell technology. Battery production, for example, requires various individual components, for which, according to experts, the technical expertise of suppliers is crucial (according to interview UK01). Various government and private initiatives, such as the Advanced Propulsion Centre UK (APC UK), the Fuel Cells and Hydrogen Joint Undertaking and the Technology Developer Accelerator Programme, are currently supporting SMEs in the development of new driving technologies with funding and consulting services<sup>111</sup>.

### *A look into the future:*

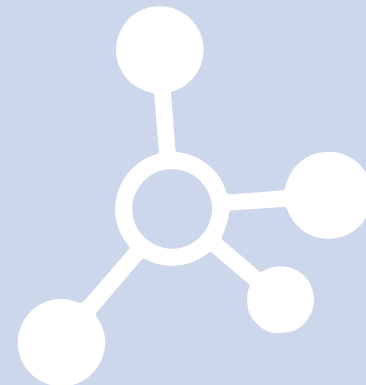
According to experts, the great strength of the automotive industry could also lead to major changes in this industry after the Brexit (according to interview UK03)<sup>12</sup>. A challenge for the UK could be if European car manufacturers were to withdraw from the UK due to potentially higher transfer costs and close their production facilities within the UK. This would also have a direct impact on supply chains: if there are fewer large car manufacturers in the UK, this also means that fewer local suppliers would be needed. However, according to experts, higher customs or import restrictions could benefit British SMEs, as a reorientation towards regionally based suppliers could become necessary if international ones get too expensive (according to Interview BW01 and Interview BW02). But, tariffs would also contribute to making British cars more expensive in the EU single market and thus less attractive for European consumers. If trade restrictions will be imposed, experts hope that the subsequent phase of necessary reorientation will be completed after a few years and that all those involved (both BW and UK car manufacturers and suppliers) will have found new ways to continue the previously established successful trade relations (according to interview UK01).

In addition to these challenges, the British automotive industry has been struggling since 2017 with a decline in demand for traditional vehicles<sup>13</sup>, which is currently being exacerbated by the economic implications of the COVID-19 pandemic. Due to the high level of infectivity, exit restrictions had to be imposed worldwide, which, together with the sharp drop in demand for vehicles, led to a decline in activity at car manufacturers' production facilities. Even if the demand for vehicles will rise again in the long term, especially for electric vehicles, experts expect that lower production figures and thus a temporary increase in unemployment will occur in the meantime (according to interview BW01 and interview BW02). One in six jobs in the British automotive industry is already at risk today<sup>14</sup>. Experts however see a great opportunity for the automotive industry in the research and development of alternative mobility concepts: research in battery, hydrogen and fuel cell technologies are all still relatively young and therefore more flexible with regard to current and future economic challenges (according to interview UK01).

→ In the UK, the following events and cluster initiatives can be used as starting points for future business relations:

### **Events**

- All Energy Exhibition and Conference, Glasgow
- Automechanika Birmingham, Birmingham
- Automotive Quality Management Systems Conference, London
- Battery Cells and Systems Expo, Coventry
- Battery Tech Expo UK, Silverstone
- Battery Technology UK 2021 – Battery Technology Show, Coventry
- CARS – Complete Auto Recycling Show, Stoneleigh, Coventry
- Cenex–Connected Automated Mobility (CAM) und Cenex–Low Carbon Vehicle (LCV), Bedfordshire
- Classic Motor Show, Birmingham
- Energy Storage Summit – Securing the future of Energy Storage in Europe, London
- Ford Fair, Towcester
- Hydrogen and Fuel Cell – Coming of Age, Birmingham
- London Motor Show, London
- Motor Industry Association (MIA) Global Business Growth Conference, Northamptonshire
- North Wales Classic Car & Motorcycle Show, Clwyd – North Wales
- Practical Classics Classic Car & Restoration Show, Birmingham
- Scottish Hydrogen & Fuel Cell Association (SHFCA) Annual Conference, Edinburgh
- SMMT Connected, London
- SMMT International Automotive Summit, London
- The British Motor Show, Farnborough
- The Commercial Vehicle Show, Birmingham



## Cluster initiatives and networks

### Cluster initiatives and networks supported by the UK Government or UK government organisations:

The following is a selection of cluster initiatives and networks supported by the UK government (either directly by the UK government or indirectly through government organisations), such as gov.uk (<https://www.gov.uk/>), gov.scot (<https://www.gov.scot/>), gov.wales (<https://gov.wales/>), Innovate UK (<https://www.gov.uk/government/organisations/innovate-uk>), UK Research and Innovation (<https://www.ukri.org/>), Scottish Enterprise (<http://www.scottish-enterprise.com/>), Scottish Development International (<https://www.sdi.co.uk/>), or The Catapult Network (<https://catapult.org.uk/>).

- **Connected Places Catapult:**  
<https://cp.catapult.org.uk/>
- **Energy Systems Catapult:**  
<https://es.catapult.org.uk/>
- **Faraday Institution:**  
<http://www.faraday.ac.uk>
- **Michelin Scotland Innovation Parc:**  
<http://www.msipdundee.com/>
- **Niche Vehicle Network:**  
<http://www.nichevehiclenetwork.co.uk>

### Excellence clusters<sup>q</sup>:

- **South Wales Industrial Cluster:**  
<https://www.swic.cymru/>
- **Welsh Automotive Forum (WAF):**  
<https://www.welshautomotiveforum.co.uk/>

### Direct contact persons:

In addition, interested BW or UK SMEs can contact the following regional contacts directly:

- **UK in general:**
  - Thomas Schaal (Policy Officer Baden-Württemberg), Consulate General Munich: [thomas.schaal@fco.gov.uk](mailto:thomas.schaal@fco.gov.uk)
- **Northern Ireland:**
  - Markus Rehkopp (Head of Commercial Department Germany), Consulate General Düsseldorf: [markus.rehkopp@investni.com](mailto:markus.rehkopp@investni.com)
- **Scotland:**
  - Dr. Alexandra Stein (Director Germany), British Embassy Berlin: [Alexandra.Stein@gov.scot](mailto:Alexandra.Stein@gov.scot)
- **Wales:**
  - Samantha Dimond (Director Germany), British Embassy Berlin: [Samantha.Dimond@gov.wales](mailto:Samantha.Dimond@gov.wales)
  - Marc Shanker (Senior Business Development Manager), Consulate General Düsseldorf: [Marc.Shanker@gov.wales](mailto:Marc.Shanker@gov.wales)
  - Martha Pawlita (Business Development Executive), British Embassy Berlin: [Martha.Pawlita@gov.wales](mailto:Martha.Pawlita@gov.wales)

<sup>q</sup> “Porter’s definition of clusters encompasses the institutional ties between geographically proximate and functionally integrated companies or between companies and other stakeholders. Some of the UK’s industrial clusters are supported by agencies; for example, Tech City UK was established in 2010 to lead the development of the East London technology cluster. The North East Process Industry Cluster (NEPIC) is a second example of an organisation formed by companies that operate in interrelated sectors (i.e., chemicals, polymers, pharmaceuticals, biotechnology, and renewables) and that are co-located in the North East of England. On the one hand, these formal associations respond to policy inputs such as the UK ministers’ renewed interest in adopting an ‘industrial strategy’ (Nathan and Vandore, 2014); on the other hand they signal the existence of agglomeration economies, the demand for specialised governance bodies, and the need for shared tangible and intangible infrastructures” (see [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/646547/NIESR\\_Clusters\\_Research\\_BEIS\\_Format\\_with\\_summary\\_FINAL.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/646547/NIESR_Clusters_Research_BEIS_Format_with_summary_FINAL.pdf), accessed on 07.09.2020).

### 3.2.2. Healthcare Industry

#### Brief description

##### Strengths:

The healthcare industry can be divided into life sciences, medical technology, pharmaceuticals, digital health and diagnostics<sup>115</sup>. In 2019, the UK healthcare industry had a turnover of 81 billion euros and exports of 33 billion euros<sup>116</sup>. There are currently almost 250,000 jobs in the industry, in around 6,000 companies. Overall, a major strength of the UK is its wide range of research, which, according to experts, has been able to attract a large number of promising talents from all over the world in recent years (according to interview UK02).



Figure 9. Key figures healthcare industry UK

Among the above-mentioned areas of the healthcare industry, the UK is particularly well positioned in the pharmaceutical sector, mainly in and around the so-called Golden Triangle between London, Oxford and Cambridge<sup>117</sup>, with branches of large international companies like Takeda Pharmaceutical and Novartis AG. Also, the regions around Swansea and Cardiff in Wales as well as Northern Ireland (especially in the field of cancer research) have a good research infrastructure according to experts (according to interview UK09 and interview UK13). In Scotland, the industry is growing at an annual rate of 9.6%<sup>118</sup> and benefits from first-class universities and innovation centres as well as a close cooperation with the Scottish NHS<sup>119</sup>. A total of 1,400 companies are active in the pharmaceutical sector throughout the UK. The pharmaceutical industry is also the largest investment sector within the UK: 25% of all investments within the UK go towards this sector<sup>120</sup>. In terms of turnover, the UK ranks fifth in the pharmaceutical industry, behind Switzerland, Germany, France and Italy<sup>1</sup>.

In the medical technology sector, the UK ranks fourth in Europe, behind Germany, Switzerland and Italy, in terms of turnover. In 2015 alone, sales increased by more than 27.5% to 8.1 billion euros. More than 3,000 companies are currently active in the medical technology sector in the UK<sup>1</sup>.

Just as in BW, data collection and analysis has shown that topics such as digitalisation and thus digital health will become increasingly important. The UK has a strong position in the field of digital health, and the e-health sub-sector is rapidly growing, partly due to the new possibilities offered by artificial intelligence<sup>1</sup>. Scotland in particular is home to over 200 companies in the field of e-health. Due to its integration of health and care, its combination of rural and urban areas, its availability of excellent health data and the openness of the Scottish NHS to innovation, Scotland offers ideal testbed conditions for digital health<sup>121</sup>. Wales is also strong in this area due to its high level of expertise in cyber security and the digitalisation of services. Moreover, through the Four Engines for Europe, Wales has had links with BW since the 1990s<sup>121</sup>.

<sup>1</sup> The website [www.digitalhealth.net](http://www.digitalhealth.net) is a resource of topics, studies and field reports from this application area of digitalisation.

## Challenges:

While Northern Ireland is very active in the field of diagnostics (e.g. with the large Northern Irish diagnostics company Randox Laboratories (according to interview UK13), there is, according to experts, still a lot of catching up to do in the UK as a whole in the field of diagnostics, especially in the areas of prevention and examinations<sup>122</sup>. According to experts, this has become evident during the COVID-19 crisis (according to interview UK02).

Just as in BW, a major challenge of the healthcare industry is also posed by an aging society, which is why this is also one of the UK's key future issues<sup>7</sup>.

The already existing shortage of skilled workers in the medical sector also represents a major challenge for the UK.

In addition, as in BW, the new EU Medical Devices Regulation plays a major role for the healthcare industry and poses challenges, especially for SMEs, if companies from the UK want to continue exporting to the EU.

## Role of SMEs

There are currently more than 700 companies in the UK in this sector<sup>123</sup>. Although the British pharmaceutical industry includes some large global players, the largest proportion (73%) is made up of SMEs, 11% of which have fewer than 50 employees. The situation is similar in the medical technology sector: almost 75% of the companies in the medical technology sector are SMEs, of which in turn almost 20% have fewer than 50 employees<sup>1</sup>.

## A look into the future:

According to experts, it is particularly relevant to the healthcare industry that industry, science and healthcare work together and cooperate – also internationally<sup>124,125</sup>. The Brexit could therefore have far-reaching implications for the pharmaceutical industry<sup>1</sup>. The greatest uncertainties for the British healthcare industry are the question of the continuation of EU funding, the potentially higher costs for clinical studies or generally for approvals in EU internal market, as well as potential patent law problems. In addition, the pharmaceutical industry as a whole will be confronted with major changes due to its strong links with the EU on the export side (more than 45 % of exports go to other EU countries). Medical technology is also strongly export-oriented: more than 50 % of exports go to the EU. Here, too, the UK's withdrawal from the EU could possibly lead to a loss of EU subsidies, a shortage of skilled workers and difficulties with CE marking<sup>1</sup>. The British government is therefore already pointing out opportunities for the healthcare industry

to become more competitive in the future and to channel investment into the pharmaceutical and life science industry<sup>126</sup>. In view of the Brexit, the British government has committed to support the healthcare industry with a special Life Sciences Sector Deal<sup>123</sup>. However, to prepare for and remain relevant after the UK's withdrawal from the EU, pharmaceutical and medical device companies will also need to look for new value creation opportunities themselves<sup>127</sup>.

Like BW, experts see the COVID-19 crisis in the UK as presenting the healthcare industry with a number of challenges and opportunities (according to interview BW09)<sup>128</sup>. British universities, research institutes and university hospitals are currently involved in a total of 128 studies<sup>5</sup> to research a vaccine, a drug or innovative treatment methods and equipment within the framework of COVID-19<sup>129</sup>. According to experts, numerous companies were also able to shift their focus during the COVID-19 crisis towards the production of required articles, such as test kits or personal protective equipment, and thus avoid losses (according to interview UK13). Due to the pandemic, however, the healthcare industry also experienced a decline in orders, triggered for example by postponed operations or treatments, which led to significant losses<sup>130,131</sup>.

→ In the UK, the following events and cluster initiatives can be used as starting points for future business relations:

### Events

- Biotech Health Expo UK, Telford
- Cambridge international stem cell symposium 2019, Cambridge
- Digital Health World Congress, London
- International Conference on Research in Life-Sciences and Health, London
- International Nutrition and Food Technology Conference, London
- MedTech Innovation Expo, Birmingham
- The Digital Health and Care Congress, London
- UK Bioscience Forum, London

### Cluster initiatives and networks

#### Supported by the UK Government or UK government organisations:

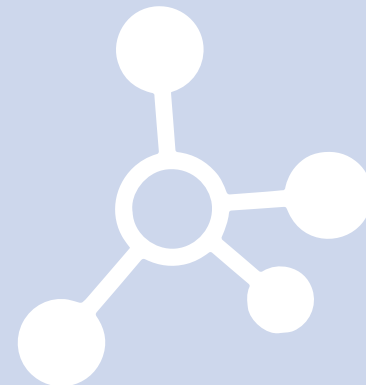
- **BioPartner UK:**  
<http://www.biopartner.co.uk>
- **Bioprocessing Research Industry Club (BRIC):**  
<http://www.bbsrc.ukri.org/innovation/sharing-challenges/bric>
- **Catapult Cell and Gene Therapy:**  
<https://ct.catapult.org.uk/>
- **Catapult Medicines Discovery:**  
<https://md.catapult.org.uk/>
- **Digital Health & Care Institute:**  
<https://www.dhi-scotland.com/>
- **Health and Care Research Wales:**  
<http://www.healthandcareresearch.gov.wales>
- **Industrial Biotechnology Innovation Centre (IBioIC):**  
<http://www.ibioic.com/>

- **Industrial Centre for Artificial Intelligence Research in Digital Diagnostics (ICAIRD):**  
<https://icaird.com/>
- **Life Sciences Hub Wales:**  
<http://www.lshubwales.com>
- **National Institute for Health Research (NIHR):**  
<http://www.nihr.ac.uk>

#### Excellence cluster:

- **Life Sciences Hub Wales:**  
<https://lshubwales.com/>

**Direct contacts:** For a selection of direct contacts in the various regions of the UK, see Chapter 3.2.1.



### 3.2.3. Cultural and Creative Industries

#### Brief description

##### Strengths:

The UK's cultural and creative industries comprise numerous sub-sectors: advertising and marketing, architecture, crafts, design (product, graphics, fashion), film/television/video/animation/visual and special effects, radio and photography, IT, video games, software and computer services (creative tech<sup>t</sup>), museums/galleries/libraries and heritage, music/performing and visual arts and publishing. In the UK, one in eight companies is part of this industry. In 2018, the cultural and creative industries had a turnover of 122 billion euro<sup>u</sup>. This is an increase of 7.4 % over the previous year, which means that this sector is growing five times faster<sup>132</sup> than the entire British economy as a whole and that it is, by far, the fastest growing sector of the UK. Much of the turnover is generated in Scotland (Edinburgh, Glasgow), the West Midlands (including Manchester), the Bristol region and Greater London<sup>133,134</sup>. Currently, over 2 million people are working in the cultural and creative industries (which is three times the UK average) and over 43% of those are in and around the London area. Wales is doing especially well in software and games development, offering excellent university courses and degrees. The cultural and creative industries are also heavily involved in UK's exports: in 2018, 50 billion euros in goods and services were exported from the UK, which represented 12% of total British exports<sup>135</sup>. Currently, the film and television industry as well as the advertising and marketing industry contribute the largest shares to the industry's success: these sub-sectors have been responsible for a quarter of the total growth of the cultural and creative industries since 2017<sup>136</sup>. The British animation industry consists of 469 small independent studios, which, together with the software and games industry, employs about 5,400 people and generates an average annual turnover of almost 829,000 euros. The British animation sector has thus gained international reputation and numerous British animators have received international awards, including the prestigious Oscars and the International Emmy. The games industry, however, is the fastest growing sector of the media and entertainment industry in the UK, with a turnover of 3.2 billion euros in 2017<sup>137</sup>.

t Scotland in particular is very active in the field of creative informatics, a cross-sectional area of cultural and creative industries with informatics, which opens up many new cooperation opportunities (according to interview UK06, <https://creativeinformatics.org/> (accessed on 14.08.2020)).

u Which is more than the UK automotive, aerospace, life sciences and oil and gas industries combined.



Figure 10. Key figures cultural and creative industries UK

According to experts, the UK is thus one of the first places to go for stakeholders interested in the cultural and creative industries, both in Europe and worldwide (according to interview UK06). The UK also offers excellent educational opportunities in the creative industries, with, for example, 50 schools of architecture or the Royal College of Arts, one of the world's best universities for art and design<sup>138,139</sup>. The UK is also an attractive investment market for the cultural and creative industries: there are numerous financial incentives in the creative sector, above all tax breaks, which allow savings of up to 25 % for productions in the film, animation and games<sup>v</sup>. Over the last 10 years, foreign investment has thus contributed 11 billion euros to the UK economy, resulting in some of the most successful productions of the recent years, such as Game of Thrones, which was partly filmed in Northern Ireland<sup>140</sup>. In addition, the new UK Sector Deal for the cultural and creative industries will invest more than 164 million euros over the entire life cycle of cultural and creative businesses<sup>139</sup>. In contrast to many other industries, the cultural and creative industries are a sector where a large proportion of jobs (80% of highly creative jobs) cannot be replaced by automation, for example, via robots<sup>141</sup>.

##### Challenges:

Similar to BW, one of the central challenges of the cultural and creative industries in the UK is the fact that many of the jobs are insecure and often not as well paid as comparable jobs in other industries, partly due to a strong dependence on orders<sup>142</sup>. This leads to a lack of financial reserves for times of crisis or for urgently needed further training, for example in cross-cutting areas like digitalisation<sup>64,143</sup>.

v "Tax relief of up to 25% on up to 80% of development costs for British games, film animation, high-end television, children's television, theatre, games, orchestras and exhibitions". (<https://www.great.gov.uk/international/content/about-uk/industries/creative-industries/> (accessed on 14.08.2020))<sup>139</sup>.



In the UK, there are therefore numerous governmental subsidies, specifically for the creative sector, such as financial grants for start-ups or SMEs in their founding phase, tax breaks, support for training positions or consultancy services<sup>144</sup>.

### **Role of SMEs**

95% of the UK's cultural and creative industries are SMEs with fewer than ten employees. One third of the cultural and creative industries consists of self-employed people or micro-enterprises<sup>135,145,146</sup>.

### **A look into the future:**

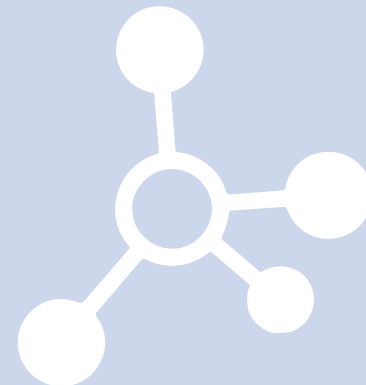
Depending on the exact outcome of the agreements between the UK and the EU, the cultural and creative industries' greatest challenge of the future, according to experts, will be the acquisition of qualified specialists, for example, in film and television (according to interview UK06 and interview UK08). Uncertainty about the future of EU funding also plays a major role<sup>1</sup>. If EU funding will not be available to UK partners anymore, the British cultural and creative industries would have to realign themselves towards other continents, which, according to experts, could also result in opportunities for new cooperation with non-EU countries (according to interview UK08). Other challenges posed by Brexit, according to experts, include potentially higher costs if customs duties were introduced, which would have an impact, for example, on the textile industry (according to interview UK06). Moreover, Brexit could potentially lead to an increase in bureaucracy, which, for example, would mean extra efforts for the music industry in organising tours (according to interview UK06).

Triggered by the COVID-19 crisis, the British cultural and creative industries are facing some further challenges: a study by Oxford Economics on behalf of the Creative Industries Federation shows that 400,000 jobs within this industry are currently at risk. They expect a drop in turnover of 83 billion euro for the year 2020<sup>147</sup>: for example, musicians cannot go on tour, cultural events have to be cancelled, important supply chains are interrupted, or the film industry cannot produce. The British government is trying to soften a large part of these challenges through different support measures: the Arts Councils of England and Wales, for example, award emergency funds for the self-employed and SMEs totalling more than 110 million euro or Creative Scotland, in partnership with Scottish Enterprise and the Scottish Government, offers funding for the arts, film and creative scene<sup>148</sup>.

→ In the UK, the following events and cluster initiatives can be used as starting points for future business relations:

### **Events**

- Belfast Design Week, Belfast
- Birmingham Design Festival, Birmingham
- Camp Digital, Manchester
- Creative North, Manchester
- D&AD Festival, London
- Design It Build It, Edinburgh
- Design Manchester
- Dundee Design Festival, Dundee
- East London Comics & Arts Festival, London
- Goodfest, Cornwall
- Graphic Design Festival Scotland, Glasgow
- Interact, London
- Leeds Digital Festival, Leeds
- London Design Festival, London
- Murmurations, Chester
- OffGrid Sessions, Osea Island
- OFFSET, Dublin
- Pixel Pioneers, Bristol
- Talk UX, Manchester
- Thought Bubble Comic Art Festival, Harrogate
- UX London, London



## Cluster initiatives and networks

### Supported by the UK Government or UK government organisations:

- **Creative Industries Clusters:**  
<https://creativeindustriescusters.com/>
- **Creative Wales:**  
<https://www.wales.com/creative-wales>
- **The Creative Industries:**  
<https://www.thecreativeindustries.co.uk/>
- **UK Research & Innovation Creative Industries Clusters:**  
<https://www.ukri.org/innovation/industrial-strategy-challenge-fund/creative-industries-clusters/>
- **Wales Arts International:**  
<http://wai.org.uk/wales-arts-international/wai-homepage>

### Excellence cluster:

- **Screen R&D Cluster Clwstwr:**  
<http://www.clwstwr.org.uk/>

**Direct contacts:** For a selection of direct contacts in the various regions of the UK, see Chapter 3.2.1.

## 3.2.4. Mechanical Engineering and Manufacturing Industry

### Brief description

#### Strengths:

In 2020, 5.7 million people are working in mechanical engineering and manufacturing in the UK, which represented about 19% of total jobs, thus the most diversified sector in the UK<sup>149,150,151</sup>. In 2018, the turnover of the total British production was 429 billion euro<sup>w,152</sup>, which represented about 10% of the British GDP<sup>x</sup> and 42% of British exports. In Scotland, the mechanical engineering and manufacturing industry (in the following, simply manufacturing industry) accounts for even 55% of international exports<sup>153</sup>. The focus area of this industry is around the London region and the adjacent South East of the country, as well as in the North West and the East Midlands<sup>154</sup>. Partly as a result of automation processes, the value of production output has remained broadly stable over the last 30 years, while the number of people employed in the industry has steadily declined<sup>149</sup>.

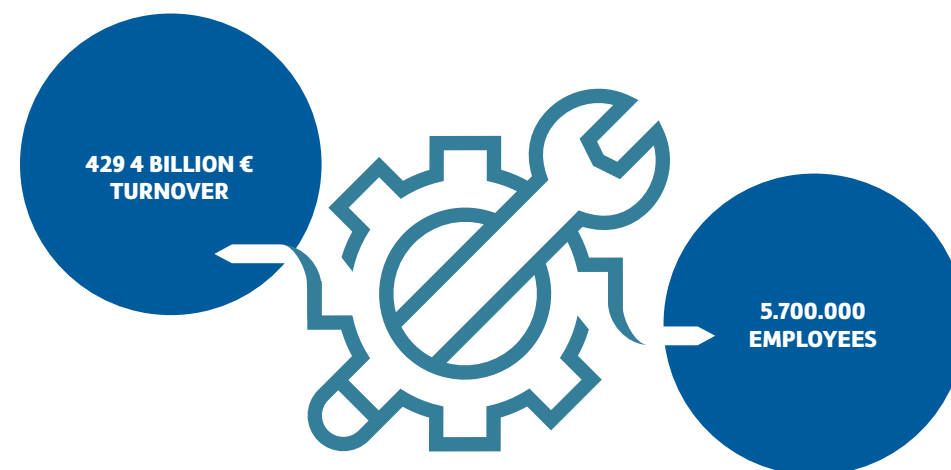


Figure 11. Key figures manufacturing industry UK

w For better comparability, all Pound Sterling currency figures in this study have been converted into Euro (exchange rate June/July 2020).

x By comparison, in Germany manufacturing accounts for 23% of GDP, in France for 11%, in the USA for 12% and in Italy for 17%<sup>149</sup>.

Within the British manufacturing sector, construction and mining equipment, lifting and handling equipment, engines and turbines, among others, make up the largest parts of the industry<sup>155</sup>. Food production and the manufacturing of metal products also make a significant contribution to total production<sup>149</sup>. Wales plays a particularly important role in this respect, where the Japanese company Sony has been manufacturing market-leading professional audio and video products since 1999<sup>156</sup>. Wales is also home to the world's first cluster initiative for components in semiconductor technology, a key technology in robotics and electronics production. Research and industry are working together in this cluster initiative, which is intended to cover the entire value chain, and which already serves 10% of the global market<sup>157</sup>. In Northern Ireland, the focus is on mobile crushing and screening equipment, 40% of the world demand coming from this region<sup>158</sup>. Some generally well-known companies in the British manufacturing industry are Unilever (food, household and personal care), Rio Tinto (mining/metals) or GlaxoSmithKline (pharmaceuticals).

### Challenges:

The share of the manufacturing industry of the UK's total economic output has been declining for many years<sup>y</sup>. However, this is largely due to the strong growth of other industries (particularly the service industry) rather than a decline in outputs itself<sup>z</sup>. Nevertheless, high production costs and the fact that other production centres are located closer to the respectively required raw materials play an important role. Moreover, the consumer markets especially in China and India have grown strongly in recent decades. Finally, within the last two decades, imports of industrial goods have grown faster than exports, resulting in a trade deficit of 100 billion euros for the UK in 2018<sup>149</sup>.

### Role of SMEs

In the UK, about 15,000 companies are part of the manufacturing industry. 98.5% of these are SMEs, which means that only about 225 companies in this industry have more than 250 employees<sup>1</sup>.

y Decline from 27% in 1970 to 10% in 2018<sup>149</sup>.  
z Production in the manufacturing sector was 7% higher in 2018 compared to 1990, but growth in the service sector has increased by 106% in comparison<sup>149</sup>.

### A look into the future:

The British metal industry is one of the strongest industries within the UK. Therefore, this industry will also be most strongly affected by the changes due to the UK's withdrawal from the EU<sup>112</sup>. Currently, almost half of all British exports of finished goods go to the EU, with the majority going to Germany and therefore also to BW. The contents of the UK-EU trade agreements are therefore particularly important for the manufacturing industry<sup>159</sup>. A first decline in foreign direct investment in the UK has already been noted since 2017<sup>149</sup>. As a result, some manufacturers and companies are concerned about the development of future investment, the development of cross-border supply chains and the availability of a skilled workforce. Besides possible burdens due to higher tariffs and import restrictions, a weak pound sterling would lead to higher prices from European suppliers and consequently higher costs for manufacturers in the UK. Furthermore, more than 300,000 non-UK citizens from the EU are currently employed in the industry<sup>9a</sup>. A loss of those skilled workers could lead to a decrease of the UK's competitiveness within the manufacturing industry. Possible measures to counteract such a development could include hiring new workers from non-EU countries, more competitive salaries and an increased training in the MINT subjects. Theoretically, increased automation could also open up opportunities for the industry. However, there are those who claim that the level of automation in production has already reached its zenith and that other manufacturing processes, such as the maintenance of complex machines, rely on low-skilled workers<sup>149</sup>.

The COVID-19 crisis caused a massive drop in orders in the manufacturing industry in the UK as well. Therefore, the industry is currently focusing on the acquisition of new orders and, where possible, on the development of new business models as well as a reorientation towards automation and digitalisation processes. Due to the limited mobility during the pandemic<sup>ab</sup>, but also due to the uncertainties related to the Brexit, experts believe that the best prospects currently lie within those sub-areas overlapping with the cross-cutting topics of automation or digitalisation (according to interview BW03)<sup>9c</sup>.

9a 13% of all employees in the manufacturing industry. By comparison, in the UK economy as a whole, non-UK EU citizens account for 7% of employment<sup>149</sup>.

9b At the time of the exit restrictions between March and mid-June 2020, many intra-European borders were closed and entry to other countries was not easily possible.

9c Further information and examples of synergies can be found in 4.3.

→ In the UK, the following events and cluster initiatives can be used as starting points for future business relations:

### Events

- CRU World Aluminium Conference, London
- Industrial Data Summit UK
- International Conference on Applied Science and Engineering (ICASE), London
- International Conference on Material Science & Smart Materials, London
- Manufacturing & Supply Chain Conference & Exhibition, Milton Keynes
- Northern & Southern Manufacturing & Electronics, Manchester
- SubCon, Birmingham
- The Engineer Expo, Birmingham

### Cluster initiatives and networks

#### Supported by the UK Government or UK government organisations:

- **AMRC Advanced Manufacturing Research Centre:**  
<https://amrc.co.uk>
- **Catapult High Value Manufacturing:**  
<https://hvm.catapult.org.uk/>

#### Excellence cluster:

- **South Wales Industrial Cluster:**  
<https://www.swic.cymru/>

**Direct contacts:** For a selection of direct contacts in the various regions of the UK, see Chapter 3.2.1.



## 3.3. FURTHER INDUSTRIES

In addition to the particularly strong industries of BW and the UK described in 3.1. and 3.2, there are further industries in both economic regions that might offer potential for synergies as well, namely the food industry and the aerospace industry. However, as a result of the data collection and analysis, these two industries include less potential for future cooperation between BW and the UK than the other industries and are therefore presented in abbreviated form below.

### 3.3.1. Food Industry

In BW, 90 companies, mainly SMEs, have joined the Support Association for Quality Products from BW (*Fördergemeinschaft für Qualitätsprodukte aus Baden-Württemberg e.V.*, FBW), thus supporting regional added value as well as the preservation and promotion of jobs and training positions within BW. Well-known members of the FBW include the *Maultaschen*<sup>ad</sup> manufacturer Bürger GmbH & Co. KG, the sparkling wine producer Kessler Sekt GmbH & Co. KG or the worldwide known chocolate manufacturer Alfred Ritter GmbH & Co. KG<sup>160</sup>. Furthermore, the strengthening of organic farming and the further development of the BW quality label (*Qualitätszeichens Baden-Württemberg*, QZBW) as well as the introduction of the standard “without genetic technology” play an important role in BW<sup>161</sup>. In addition, the BW discount supermarket chain Lidl is currently expanding strongly into the British market (according to Interview BW07, Interview BW08 and Interview UK11): Lidl committed to invest more than 1.5 billion euros to create 1000 stores within the UK by 2023<sup>162</sup>. Together with the Aldi stores, the two discounters will thus account for more than 15% of total retail sales in the UK<sup>163</sup>. Lidl and Aldi stand for reasonably priced products of high quality, which is particularly welcome in times of rising living costs in the UK<sup>ae,af</sup>.

In 2018, the UK food industry contributed 74 billion euros to the UK economy with 430,000 people working in this industry, mostly within SMEs<sup>164</sup>. In 2019, goods worth 26 billion euros were exported, almost 60% of which to the EU<sup>165</sup>. According to experts, Scotland and Wales in particular have many food production and retail companies that account for a large share of these exports (according to interview UK09 and interview UK11). In Scotland, the whisky industry plays a major role, with

ad A special type of dumplings, typical for BW.

ae According to experts, a key difference between German and British discounters is the fact that discounters in the UK not only stand for lower-priced goods, but also for regional and high-quality products (according to interview UK11).

af Higher living costs triggered by the 2008 financial crisis and the UK’s subsequent austerity policy and now the UK’s exit from the EU<sup>163</sup>.

sales of 5 billion euros in 2019, both for international trade and for securing jobs in the country<sup>166</sup>. Other important industries within the British food production industry are, according to experts, fishing and aquaculture, the livestock/meat industry and the production of high-quality regional foods such as shortbread, chutneys or sauces (according to interview UK11). In terms of sustainability and healthy eating, veganism and the development of meat alternatives is playing an increasingly important role throughout the UK, as in Germany. According to experts, there are many start-ups in this area that are working together with universities on vegan alternatives (according to interview UK11). In the last five years, sales of meat substitutes in the UK have already grown by 40% and are expected to reach the billion mark by 2024<sup>165</sup>.

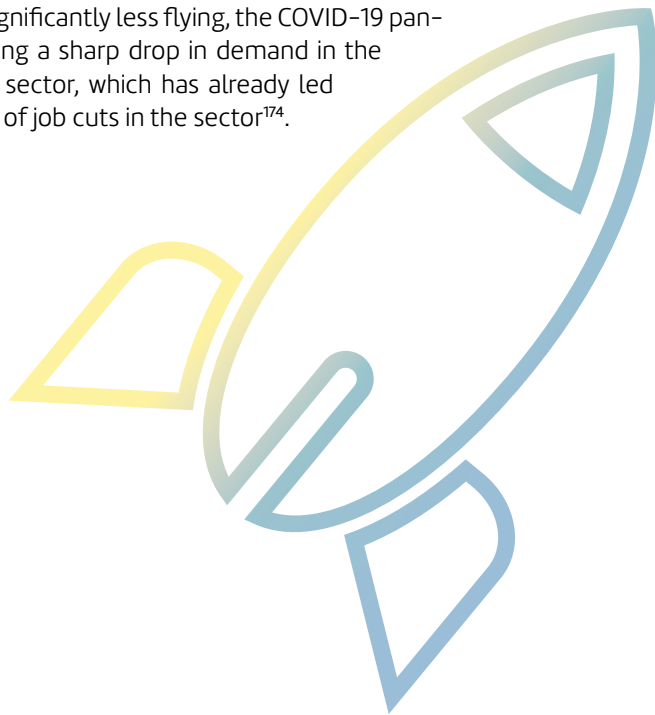
Thanks to an increasing shift from international to regional suppliers, the British discount segment of the food industry is well positioned in terms of Brexit: in 2006, only 35% of products were produced within the UK, in 2016, it were already 65%<sup>163</sup>. However, according to experts, this also means that fewer local products will be available for export, thus decreasing trade relations (according to interview UK11). Moreover, this increases the competition for British food retailers outside the discount segment that will continue to rely on imports from EU countries: British SMEs in the food industry in particular fear non-tariff trade barriers, differing standards or documentation requirements, as well as longer delivery times due to border controls and higher customs duties. This could also affect business relationships between British partners and BW suppliers. In addition, 33% of employees in food production within the UK are currently non-UK citizens from the EU, whose further whereabouts after the UK's withdrawal from the EU cannot be clarified yet<sup>149</sup>. The current draft of the new Immigration Act 2021 envisages that visas will no longer be issued for low-skilled workers from abroad<sup>167</sup>, which would lead to a massive shortage of temporary workers in the food industry, who would be employed primarily in the sale of bakery and meat products, but also in the production of cheese, pasta or sausages<sup>165</sup>.

The COVID-19 crisis has had a strong impact on both BW's and UK's food industry, especially the wholesale trade in the service sector. Due to strict worldwide exit restrictions in the second quarter of 2020, many orders had to be cancelled and production had to be stopped throughout the entire industry (according to interview UK11): food producers could no longer comply with the required distance and hygiene regulations in their production facilities and therefore had to temporarily close down. The entire restaurant and hotel industry had to temporarily close as well, thus decreasing demand for products from wholesale traders. As a result, new offers for take-away services were created worldwide. The only really benefiting sector within the food industry, both in BW and the UK, were supermarkets and food retailers, as those were at times the only stores that were allowed to remain open.

### 3.3.2. Aviation and Aerospace Industry

Thanks to its excellent research infrastructure, a highly specialised equipment industry and a close network of manufacturers and suppliers, the aviation and aerospace industry is a significant branch of the economy in BW. The University of Stuttgart has the largest aerospace faculty in Europe and, together with seven institutes of the German Aerospace Centre (Deutsches Zentrum für Luft- und Raumfahrt, DLR) as well as institutes of the Fraunhofer-Gesellschaft and the Innovation Alliance BW offers ideal conditions for training future aerospace experts. Already today, 15,000 people, that is 40% of the German aviation and aerospace industry workforce, are working in BW, making the state one of Germany's most important aerospace locations. In addition to the automotive industry and manufacturing industry, the fields of electrical engineering, metrology and plastics processing as well as ICT play an important role in this industry. The main focus is on equipment, components, construction of satellites, remote sensing and life-support systems, and satellite communications. Apart from numerous SMEs, world market leaders such as EADS, Recaro Aircraft Seating, Airbus Defense Space GmbH or Diehl Aerospace and Diehl Air Cabin have their headquarters or locations in BW. From 2016 to 2021, BW promotes the topic of autonomous flying with the project E-Flying and the topic of aviation and aerospace in general with the project Integrated Research Platform for Affordable Satellites (IRAS)<sup>168,169</sup>.

The British aviation and aerospace industry is the second largest in Europe and the third largest in the world. The UK specialises in the production of aircraft and individual aircraft components, engines, systems and aircraft interiors. In Scotland, the focus is also on small satellite production (according to interview UK12). In 2017, the industry generated annual sales of 38.6 billion euros, of which 33.1 billion euros were exported<sup>170,171</sup>. Some world-famous British companies are Britten-Norman, Cobham or Hybrid Air Vehicles, but also SMEs such as Aeromet, which has received orders from Airbus and Boeing thanks to governmental support<sup>172</sup>. Wales in particular is home to some of the world's leading companies such as BAE Systems, British Airways, GE Aviation and General Dynamics<sup>172</sup> while Scotland is home to one-fifth of all jobs in the British aerospace industry, according to experts (according to interview UK12). Furthermore, numerous international companies have production facilities in the UK, such as Boeing, Bombardier or Airbus. Especially the latter stands out: Airbus produces wings for civil aircraft in North Wales and employs 6,500 people at this plant<sup>173</sup>. In addition, the defence and space activities of Airbus are based in South Wales. Northern Ireland is well positioned with Bombardier. The British government, together with the industry, will spend 4.3 billion euros on aerospace research and development until 2026, supporting the more than 3,000 companies employing over 120,000 people within the UK<sup>170</sup>. The government is also investing up to 138 million euros into the Future Flight program, which focuses on clean growth. Another program is supporting supply chain competitiveness to help British SMEs improve their productivity<sup>172</sup>. However, with significantly less flying, the COVID-19 pandemic is currently causing a sharp drop in demand in the aviation and aerospace sector, which has already led to first announcements of job cuts in the sector<sup>174</sup>.



### 3.4. CROSS-CUTTING TOPICS RELEVANT TO THE FUTURE

In addition to clearly defined industries such as the automotive industry or the cultural and creative industries, numerous so-called cross-cutting topics or technologies also play a central role regarding the potential for cooperation between BW and the UK. These cross-cutting topics relate to topics that have certain overlaps with the more traditional industries or that play an important role within those. A typical cross-cutting issue, for example, is sustainable economy: in light of the impending climate change, BW and UK policymakers have already reacted and adopted various climate targets for the near future. However, now it is also up to the industry and the individual citizen to act as well. Therefore, topics such as sustainability or circular economy are playing an increasingly important role in almost all industries.

The results of the literature research and the interviews with the experts have shown that especially the following three cross-cutting topics will play a central role in the future regarding synergies between BW and the UK:

- **Automation and robotics**
- **Digitalisation and artificial intelligence**
- **Sustainable economics**

In the following, these cross-cutting topics are therefore presented in detail, in alphabetical order. First, each one is characterised by its respective strengths. Then the corresponding challenges are discussed in more detail. This is followed by a look into the future, focusing on the effects of the UK's withdrawal from the EU and the COVID-19 crisis, and their significance for international cooperation. Finally, a selection of relevant events and central state and cluster initiatives will be presented as initial points of contact for interested SMEs.

Due to the strong overlap of these cross-cutting topics in BW and the UK, they will be presented jointly for both economic regions. Where relevant, special features of BW or the UK will be discussed in more detail.

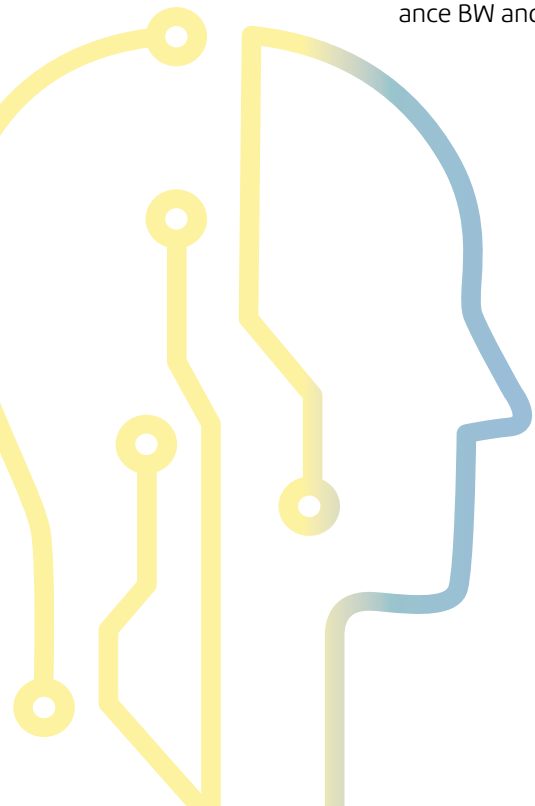
### 3.4.1. Automation and Robotics

#### Brief description

##### Strengths:

Automation and robotics are central components of the Industry 4.0. However, they are also playing an increasingly important role in many other areas of the entire economy and personal life, such as the service sector. This cross-cutting topic is therefore also one of the central future topics for BW and the UK<sup>67</sup>. Both economic regions are very well positioned to play a key role in automation and robotics in the future.

BW benefits from its high level of expertise and its high outputs in the production industry (manufacturing industry as well as automotive industry), which is highly relevant for the application of automated processes. In 2018, the German automation and robotics industry has already achieved sales of 15 billion euros<sup>175</sup>. However, according to experts, the actual potential production volume is far from being exhausted (according to interview BW03). The services offered by applied research, for example through the Innovation Alliance BW and the Fraunhofer Institutes in BW, stand for



a functioning knowledge and technology transfer of the key technologies required for modern and future production, especially to SMEs. ROS-Industrial, for example, is an open source project, coordinated by Fraunhofer IPA in Stuttgart, that extends the advanced functions of ROS software (Robot Operating System) to robotics applications in industrial production environments<sup>176</sup>.

According to experts, the UK has a strong research in the field of automation (according to interview UK07)<sup>177</sup>: at the Imperial College London and the University of Cambridge, for example, work is being done on small robots that can move through tiny cavities or even penetrate cells, which would revolutionise medical technology<sup>178,179</sup>. At the University of Oxford, research is being conducted on autonomous vehicles that can interact with each other<sup>180</sup>, and at the University of Bristol and the BrisSynBio research centre, robots are being developed that are able to scan the Atlantic seabed for bacteria<sup>181</sup>. Moreover, in the UK, a large proportion of the more than 100,000 manufacturing companies are already active in the field of automation<sup>182</sup>. Because of this excellent basis, the UK therefore expects to take a leading role in the fourth industrial revolution<sup>182</sup>.

For both BW and the UK, progress in the cross-cutting topic of automation and robotics is also relevant in view of the increasing shortage of skilled workers. Automation is repeatedly cited by experts as the answer to this problem, since automation processes and robots can be used to replace skilled personnel in certain processes (according to interview BW03)<sup>183</sup>. For this reason, both economic regions have already invested more heavily in this cross-cutting topic in the recent years. In BW, for example, the Baden-Württemberg Foundation (Baden-Württemberg Stiftung) has funded eight projects as part of their research program Robotics – Man, Machine, Interaction with a total of 3.5 million euros<sup>184</sup>. In addition, in 2019, Freiburg hosted the renowned international conference Robotics: Science and Systems<sup>185</sup>. In 2019, the British government has invested 37.5 million euros in research into autonomous technologies, with a focus on care robots<sup>186,187</sup>. Currently, the Robots for a safer world funding program is underway, with more than 111 million euros being made available to industry and research to minimise risks in the field of advanced robotics<sup>188</sup>.

### Challenges:

There are great opportunities for both BW and the UK in the field of automation and robotics. However, both economic regions are still facing certain challenges. According to experts, the greatest challenge in BW is to be able to make appropriate use of the country's great potential within the manufacturing and automotive industries by further expanding the required competencies in its software sector (according to interview BW10 and interview UK07).

The biggest challenge for the UK is still the reluctance from both companies and the government in terms of application<sup>ag</sup>. Despite its academic strength in the field of automation, the actual production output in the UK is still significantly lower than in other regions, including Germany<sup>183</sup>. This could lead to a migration of companies, investments and thus jobs to other regions, such as the USA or Japan<sup>189</sup>. In order to stop this trend, the British government is trying to support companies and research institutes by increasing funding and investment incentives and by facilitating access to international research projects<sup>190</sup>.

### A look into the future:

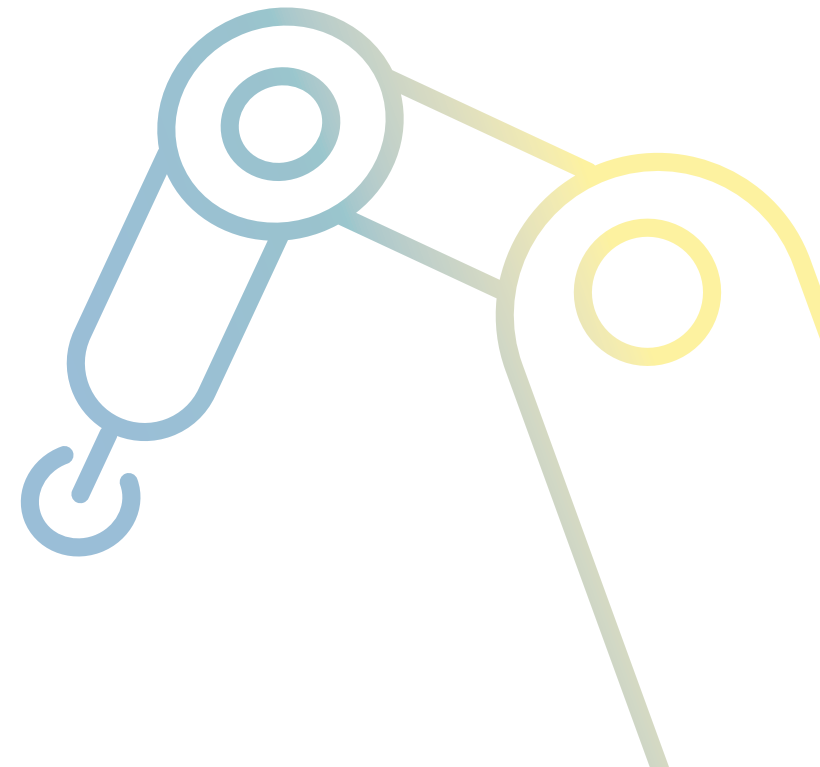
Regarding Brexit, it is expected that the automation and robotics industries will be less affected by it than other industries. Nevertheless, according to experts, much will depend on the exact agreements between the UK and the EU, especially on important issues such as standardisation or certification, but also on issues such as the 2021 immigration laws in the UK (according to interview BW03)<sup>183</sup>. In contrast though, experts state that the cross-cutting topic of automation and robotics will be able to offer solutions to many future challenges, such as the expected shortage of skilled workers in various industries (according to interview BW03)<sup>183</sup>. To ensure the successful development of this topic in Europe and around the world, experts consider it important to facilitate a lively exchange of knowledge across national borders, because solutions to global challenges must be tackled jointly in order to achieve the best possible results (according to interview UK07).

<sup>ag</sup> Press release of the British Department of Trade and Industry BEIS: UK R&D Roadmap of July 1, 2020, including far-reaching government measures to promote the research landscape and the attractiveness of Great Britain as a future location (<https://www.gov.uk/government/news/government-fires-up-rd-across-the-country-to-cement-the-uk-as-science-superpower> (accessed on 14.08.2020)), <https://www.gov.uk/government/publications/uk-research-and-development-roadmap/uk-research-and-development-roadmap#being-honest-about-where-we-need-to-improve> (accessed on 14.08.2020).

The COVID-19 pandemic has also led to fewer losses in the automation and robotics industry in both BW and the UK than in other areas. According to experts, the order situation even increased in the first quarters of 2020, in some cases because various innovative robot systems were used for the first time during this period, for example for disinfecting hospitals or in the field of diagnostics (according to interview BW06). A major challenge, however, is that previous cooperation partners from industries that are currently suffering from the implications of the COVID-19 crisis will now have to focus on saving their own day-to-day business instead of on the implementation of new technologies.

### Conclusion:

In automation and robotics, there is plenty of scope for joint efforts from BW and the UK, both in direct B2B (business-to-business) and in knowledge and technology transfer. In particular, there are numerous synergies resulting from BW's great expertise in the manufacturing industry and the technical competence in the field of digitalisation and artificial intelligence in both economic regions. An overview of the industries in which this cross-cutting topic is of particular importance can be found in Chapter 4.





→ In BW and the UK, the following events and cluster initiatives can be used as starting points for future business relations:

## Events

### BW:

- All About Automation, Friedrichshafen
- Fachtag Robotik, Friedrichshafen
- Fraunhofer Robot Operating System (ROS) Industrial Conference, Stuttgart
- Robotics for the Smart Factory, Baden-Baden

### UK:

- ConTech, London
- Digital Manufacturing Week, Liverpool
- Global Pharma R&D AI, Data Science and Informatics Summit, London
- Industry 4.0 Summit & Expo, Manchester
- International Conference On Robotics and Artificial Intelligence, London
- Robotics and Automation Exhibition, Coventry
- The IoT and Industry 4.0 Expo, Milton Keynes
- UK Robotics Week

## Cluster and state initiatives

### BW:

#### State initiatives

- **Initiative Economy 4.0:**  
<https://www.wirtschaft-digital-bw.de/en/>
- **Allianz Industrie 4.0:**  
<https://www.i40-bw.de/en/>
- **Cyber Valley:**  
<https://cyber-valley.de/en>

## Further cluster initiatives can be found in the *BW Regional Cluster Atlas*

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

## Selection of other (cluster) initiatives and networks:

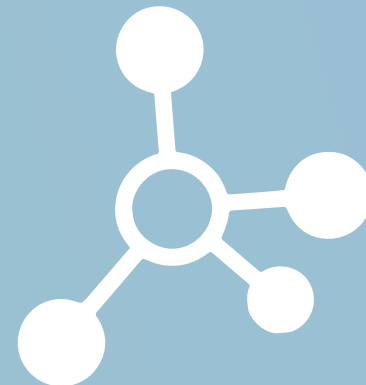
- **Robotics and Mechatronics Center (RMC):**  
<https://www.dlr.de/rmc/en/>

### UK:

## Supported by the UK Government or UK government organisations:

- **Alan Turing Institute:**  
<https://www.turing.ac.uk/>
- **High Value Manufacturing Catapult:**  
<https://hvm.catapult.org.uk>
- **Remote Applications in Challenging Environments:**  
<http://www.race.ukaea.uk/>
- **UK-RAS Network Robotics & Autonomous Systems:**  
<https://www.ukras.org/>

**Direct contacts:** For a selection of direct contacts in the various regions of the UK, see Chapter 3.2.1.



### 3.4.2. Digitalisation and Artificial Intelligence

#### Brief description

##### Strengths:

Digitalisation and artificial intelligence (AI) are among the most important future topics for BW and the UK<sup>67</sup>. Digitalisation refers to the use of digital technologies, for example, to develop a business model or to create new revenue and opportunities for added value<sup>191</sup>. It is not just a matter of making information readable via a digital device, but also, for example, of creating faster, more secure or more controllable processes by connecting data from different sources, and thus (further) developing products, services or business models. With respect to AI, there is no generally accepted definition. AI is a branch of computer science that tries to use algorithms to realise cognitive abilities such as learning, planning or problem solving in computer systems. AI thus stands for systems that exhibit behaviour that is generally assumed to be human intelligence. The goal of modern AI is to enable machines, robots and software systems to independently process and solve abstractly described tasks and problems. In doing so, the systems should also be able to adapt to changing conditions and to their environment<sup>192,193</sup>. Digitalisation and especially AI thus enable new business models and insights that can be used for new products and services.

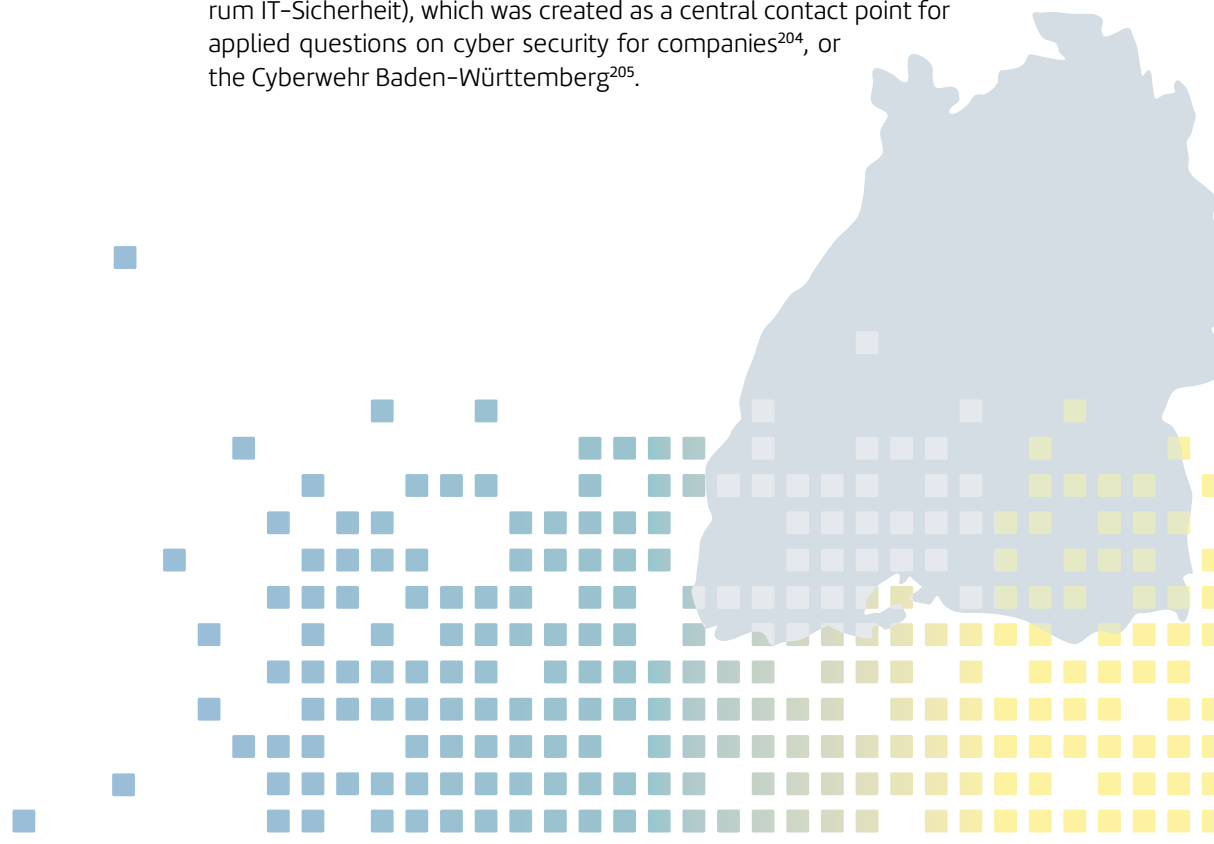
##### Baden-Württemberg

With digital@bw, the first nationwide and interdepartmental digitalisation strategy for BW was launched in 2017, and the cross-cutting topic of digitalisation and AI continues to be one of the focal points of the innovation funding of the WM<sup>194</sup>. Also in 2017, the WM launched Initiative Wirtschaft 4.0<sup>194</sup> as a key component of this interdepartmental digitalisation strategy. Together with 36 partners from business, business organisations, chambers of commerce, associations and science, the WM is working to make digitalisation measures and initiatives as practice-oriented as possible and to thus promote digitalisation, especially within SMEs. In addition, industry-specific initiatives such as Allianz Industrie 4.0<sup>195</sup>, Handel 2030<sup>196</sup> (for trade), Handwerk 2025<sup>197</sup> (for crafts), Dienstleistungswirtschaft 4.0<sup>198</sup> (for service industries) and Kultur- und Kreativwirtschaft 4.0<sup>199</sup> (for culture and creative industries) address the requirements and topics of individual industries. The various support measures are differentiated according to the respective degree of digitalisation within the companies. One example of the support offered are the ten regional digitalisation centres (Digital Hubs), which provide companies,

start-ups, researchers and other actors in the digitalisation context with local access to technical infrastructure and space for ideas and experiments that would otherwise not be accessible to many. Together with the three thematic de:hubs in BW – “Future Industries” (Stuttgart), “Applied Artificial Intelligence” (Karlsruhe) and “5-HT Digital Hub Chemistry & Health” (Mannheim/Ludwigshafen) – they form the powerful Digital Hub Network BW, where the hubs can learn from each other and thus drive digital innovations<sup>200</sup>.

With the Digital Innovation Centre (Digitales Innovationszentrum, DIZ), the corporate network CyberForum e.V. and the Research Centre for Information Technology (Forschungszentrum Informatik) have created a platform for bringing together scientific and economic players, thus providing sustainable support for the economy of the state of BW, especially SMEs, in the area of digitalisation and thus also advancing the digital transformation in the state<sup>201</sup>.

The topic of cyber security is also playing an increasingly important role<sup>202,203</sup>, triggered by the increasing connection (the so-called Internet of Things) and the associated growing possibilities for cyber attacks, and should therefore be promoted even more strongly in BW in the future<sup>6</sup>. BW is already supporting this topic with initiatives such as the Cyber Security Competence Centre (Kompetenzzentrum IT-Sicherheit), which was created as a central contact point for applied questions on cyber security for companies<sup>204</sup>, or the Cyberwehr Baden-Württemberg<sup>205</sup>.



BW will invest a total of around 1 billion euros by 2021 to make the state the leading digital region in Germany, half of which will be used to expand the digital infrastructure. In 2019, BW has also adopted a strategy to strengthen the research, development and commercialisation of AI in BW<sup>206</sup>. This includes, among other things, the implementation of a business-oriented research program to improve the transfer of knowledge between science and industry, and the rapid, cross-sectoral promotion of the AI action program for SMEs to promote the application and commercialisation of AI in SMEs<sup>207</sup>. A comprehensive package of measures, which will be further expanded in 2020 and 2021, is intended to tap additional value-added potential of AI at the BW location. On the one hand, the two programmes aim to further develop and expand the traditional strengths of the BW economy, for example in the fields of industry, mobility or medical technology, with the help of AI technologies. On the other hand, they are also intended in providing targeted support for the development of new strengths for the business location, for example in the service sector. To this end, the package of measures includes both initiatives to support the use of AI technologies in the state's territory, for example through a network of 19 regional AI labs as first contact points for SMEs, and the promotion of competence centres and projects of superregional importance, such as the Competence Centre for AI-Engineering in Karlsruhe (Kompetenzzentrum für KI-Engineering), which focuses on AI in the engineering sciences. In addition, the state government is conducting a feasibility study to examine the establishment of a large AI Innovation Park in BW with international appeal as an innovation and value creation centre for AI-based products and services. The AI Innovation Park would be the largest innovation project with public participation in BW for decades and, if realised, would make a substantial contribution to the commercialisation of AI from BW. The feasibility study has been running since January 2020 and is expected to be completed by the end of 2020. The official website of the state's digitalisation strategy, <https://www.digital-bw.de/>, and the WM's Wirtschaft digital BW portal, <https://www.wirtschaft-digital-bw.de/>, offer a comprehensive overview of all measures and initiatives in BW.

ICT as one of the central sectors of digitalisation, is one of BW's key strengths, with approximately 164,000 employees in around 16,000 companies and sales of 46 billion euros<sup>208</sup>. Important BW universities and research centres in the field of digitalisation and AI are the Fraunhofer Institutes IOSB, IPA and IAO, the learning laboratory for cyber security of the Fraunhofer Academy (Lernlabor für Cybersicherheit), the KIT and the research centre informatics (Forschungszentrum Informatik, FZI) in Karlsruhe, the University of Freiburg, the University of Tübingen, the University of Mannheim, the Max-Planck-Institute for Intelligent Systems Stuttgart or the University of Stuttgart, which offer not only strong research but also numerous study programs in the fields of AI, machine learning or computer

science. The two most important centres of ICT in BW are the Karlsruhe region (with the KIT, FZI, and Cyberforum e.V., the de:hub for applied AI, the KASTEL research centre<sup>209</sup> and the start-up accelerator for cyber security PreLab<sup>210</sup>) and the Stuttgart region (including, for example, the University of Stuttgart and the High-Performance Computing Centre Stuttgart (HLRS), the Fraunhofer Institutes and the IT cluster initiatives), which stand out with their great strength in the areas of software development, IT services and IT consulting as well as with a high number of start-ups<sup>211</sup>.

With the creation of the Cyber Valley<sup>ah</sup>, BW has also strengthened its position as one of the world's leading centres for AI: the Cyber Valley is currently Europe's largest research consortium in the field of AI, with partners from science and industry, and is also a European leader in the field of relevant top publications in the scientific field<sup>212</sup>. On the joint initiative of the WM and the Fraunhofer Gesellschaft, the AI Progress Centre Learning Systems was established in 2019 as a central contact point for SMEs in Cyber Valley, thus building a bridge between excellent fundamental research and commercial application in companies and SMEs<sup>213, 214</sup>.

In addition to renowned research institutions, companies and cluster initiatives, BW also has an active start-up scene: 15 start-ups are currently part of the Cyber Valley Start-up Network alone, almost all of them from the Tübingen-Stuttgart region<sup>215</sup>. Some very successful larger companies in this area are Robert Bosch GmbH, which, following Alphabet Inc., has most patents in the field of machine learning worldwide<sup>216</sup>, and international world market leaders such as SAP Deutschland SE & Co. KG or the International Business Machines Corporation (IBM) Germany. According to experts, BW has a highly innovative mid-sized sector in the central application areas of AI, such as mechanical and plant engineering, the automotive industry, the healthcare industry, and software development (according to interview BW04). Experts also state that SMEs and start-ups in particular are quite flexible due to short decision-making paths and can therefore react quickly to new trends and thus drive innovation (according to interview UK07). This was recently highlighted at the "AI Champions Baden-Württemberg" awards ceremony, where five of the nine prize-winning companies had fewer than 500 employees<sup>217</sup>.

ah <http://www.cyber-valley.de/en> (accessed on 14.08.2020)

## United Kingdom

Already in 2015 nearly 165,000 companies in the British ICT sector employed more than 850,000 people and exported goods worth almost 130 billion euros. Almost 95% of these companies were micro-enterprises with fewer than 10 employees, and only 0.1% had more than 250 employees<sup>1</sup>. The UK's centres of digitalisation and AI is located in and around London. But other major cities such as Manchester, Bristol, Oxford or Edinburgh are also of great importance. These cities also have the highest level of digitalisation in the country, while the more rural regions of the UK still have some catching up to do in terms of digitalisation measures, according to experts (see interview UK05, interview UK10 and interview BW10).

The University of Edinburgh, one of the world's best universities for AI, is located in the UK<sup>218</sup>. Numerous other British universities also offer excellent AI research, such as the University of Cambridge, the University of Oxford, Imperial College London and University College London. The UK is thus represented in the majority of the world's AI publications as well as at international conferences<sup>219</sup>. Some well-known British companies

in the field of digitalisation and AI include the telecommunications company Vodafone Group Plc, the software company Sage Group or the cyber security expert Darktrace. The UK's success in this area is also due to its agile start-up scene: for example, one of the first British start-ups in AI, DeepMind, was founded in London in 2010 and was bought by Google subsidiary Alphabet Inc. in 2014<sup>220</sup>. 90% of the AI ecosystem in the UK is based on start-ups, which are primarily responsible for the continuous growth. There are currently more than 120 companies active in AI in the UK, more than in any other European country, and almost 90% of these are SMEs with 50 or fewer employees<sup>221,222</sup>. In terms of investment in AI, the UK ranks third in the world behind the US and China<sup>222</sup>. In 2018, AI scale-ups in the UK received twice as much investment as all AI scale-ups in Europe combined<sup>223</sup>.

The UK itself has also made significant investments in AI, for example with the AI Sector Deal 2018, where 1.1 billion euros have been invested in research and development, including the creation of new PhD positions<sup>223</sup>. This has resulted, among other things, in a strong AI strategy in the UK, strong research activities and many AI start-ups<sup>224</sup>. In Wales, the government specifically supports the move towards Industry 4.0 in the form of specialisation strategies and support measures for companies and research institutes. Scotland is also planning to develop a regional AI strategy for 2021 to demonstrate what needs to be done over the next five years to reach its full potential in AI, according to experts (according to interview UK12). With the Bayes Centre at the University of Edinburgh, the city already has a large AI centre. Moreover, their School of Informatics is the largest in the UK and one of the best in the world<sup>225</sup>. With plans to make Edinburgh the data capital of Europe, the UK is investing in further AI facilities focusing on specific topics such as health. In addition, the Research Council for Engineering and Physical Sciences (EPSRC) is currently funding robotics and AI in the UK with 273 million euros.

Moreover, the UK is the European leader in the provision and use of data (the so-called data economy): the EC currently estimates the UK's share of the total European data economy at 20.4% and its share of the European data market at 22.4%<sup>226</sup>.

According to experts, however, two additional topics will be of particular importance in the context of digitalisation and AI in the near future: cyber security and 5G<sup>ai</sup> (according to interview UK09 and interview UK10). The regions around the Golden Triangle (London, Oxford, Cambridge) and the cities of Glasgow, Belfast and Cardiff are particularly active in the field of cyber security: in 2019, there were already 123 British start-ups<sup>7,227,228</sup> in this area and 77 of these start-ups currently have a value of more than 1 billion, which makes them so-called technical unicorns and thus some of the most successful start-ups in the world<sup>229</sup>. With Cyber Wales<sup>aj</sup>, Wales is also home to UK's largest cluster initiative of innovative cyber security companies<sup>230,231</sup>. Scotland's Cyber Cluster also connects over 100 companies and benefits from a strong financial sector and talented university graduates<sup>232</sup>. In 5G, the UK is currently investing 66 million euros into the construction of a 5G Innovation Centre with around 100 researchers, 26 large companies and a strong SME network to enable them to access the market and collaborate between the various players in the sector<sup>233</sup>. In addition, the UK is currently investing more than 320 million euros into fibre and 5G through the National Productivity Investment Fund<sup>234</sup>. Furthermore, the University of Surrey, King's College London and the University of Bristol are collaborating to support 5G research to the tune of 17.6 million euros<sup>235</sup>.

### Challenges:

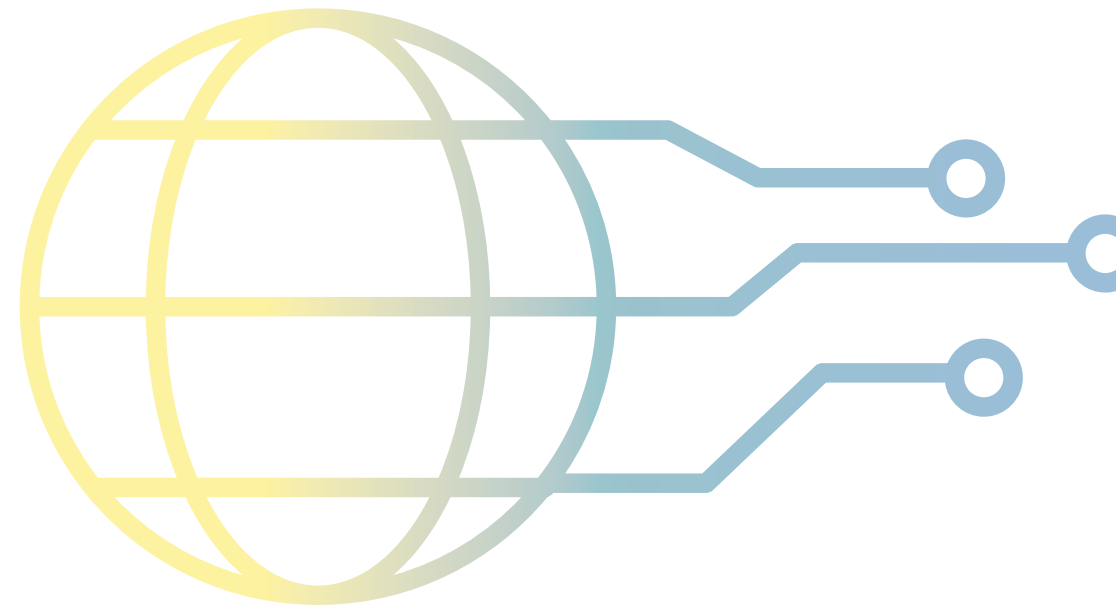
The power of the five tech giants Apple Inc, Alphabet Inc, Amazon.com Inc, Facebook Inc, Google LLC and Microsoft Corporation is, above all, a power over and by means of data. The challenge for BW and the UK is therefore to reverse this one-way flow of data from Europe to the central storage facilities of these five major companies and to use the data of Europe or European companies for new European business models and products. As part of this, the German Federal Government, in cooperation with industry and science, has, for example, launched the GAIA-X project, whose goal it is to establish a European data infrastructure in order to reduce dependencies on international providers<sup>236</sup>.

ai 5G stands for the fifth generation of mobile communications. The 5G technology is up to 100 times faster than LTE and thus enables transmissions in real time (<https://www.telekom.de/unterwegs/was-ist-5g> (accessed on 14.08.2020)).

aj Throughout Wales, several centres have been established through partnerships between government, academia and industry to reinforce the strength of this ecosystem, such as the National Cyber Security Academy, Centre for Cyber Security Research, Cyber Threats Research Centre, Information Security Research Group, National Digital Exploitation Centre, Airbus Endeavr Wales<sup>231</sup>.

Likewise, many SMEs and start-ups in BW and the UK, especially in the field of AI, but also in digitalisation, share the difficulty of finding concrete application areas for their developed solutions as well as qualified personnel<sup>237</sup>. On average, 25% of large companies, but so far only 15% of SMEs, say that they are already using AI technologies<sup>238</sup>. A possible solution can be found in the field of universities and research institutes, since this is where the skilled personnel of the future is trained, who in turn can offer concrete application examples in the context of academic theses. Furthermore, universities stand for a high level of expertise, especially in the fields of new technologies. Moreover, universities have large networks with numerous contacts to people working in the industry and are often part of international cooperation projects, such as Horizon 2020<sup>239</sup>, from which SMEs can benefit as well.

According to experts, the problem of insufficient network coverage in rural areas represents a major challenge for BW and the UK. In BW, for example, well-known companies are oftentimes located in more rural regions that urgently need a better and, above all, faster infrastructure in order to competitively implement digitalisation processes (according to interview BW10 and interview UK10).



### *A look into the future:*

As a result of Brexit, it is currently unclear how the acquisition of suitably skilled workers will continue in the UK in the future, as currently around 15% of newly recruited skilled workers come from the EU. There is also uncertainty in the UK regarding the continuation of financial support for start-ups, which, so far, benefited from numerous foreign investments. However, in contrast to other industrialised countries, British start-ups benefit from an overall easier access to venture capital and a favourable tax law. The UK's future relationship with the EU may also have an impact on the conditions under which British partners (can) participate, for example in the new EU research and innovation framework programme Horizon Europe. Depending on the exact agreements, there could be a negative impact on cooperations between the UK and the EU, and thus also BW partners, in the field of digitalisation and AI, especially in the academic field. Since digital solutions generally depend less on physical transport routes and physical borders, experts expect that the effects of the Brexit will have less of an impact on digitalisation and AI and on international trade between the UK and the EU within this cross-cutting topic (according to interview UK05, interview UK07 and interview UK10). Nevertheless, there will still be restrictions on the exchange of digital products with respect to new approval procedures or standards. Thanks to the UK's overall strength in the area of digitalisation and AI, however, it is expected that the country will continue to play a major role in these issues, no matter the circumstances. The UK will find suitable solutions to these challenges and will thus be able to continue to maintain successful business relations with international partners in the future<sup>240</sup>.

Due to the COVID-19 crisis, there is a short-term risk that the currently high level of governmental support in other areas (such as SME support) could lead to shortages in the support for digitalisation and AI measures. This can already be seen in the example of Horizon Europa, which had been cut in the course of EU budget negotiations<sup>ak, 241</sup>. However, this programme is of great importance in the area of SME support for applied research and innovation in the field of digitalisation and AI<sup>242</sup>. Experts from industry and science expect a considerable boost for this cross-cutting topic, especially in the areas of education and the economy, triggered by the COVID-19 crisis<sup>243</sup>. According to experts, the COVID-19 pandemic has also led to a sudden increase in demand for functioning digital infrastructures and solutions, both in the professional and in the private sectors, which has rapidly improved the general acceptance and dissemination of these technologies (according to interview BW06, interview UK03 and interview UK07). As a result, the potential for the economy and in particular the many providers of AI and compa-

ak As of July 2020.

nies in the field of digitalisation services is also growing and new business opportunities are being created. According to experts, digital solutions and technologies, such as cloud computing and 5G in particular, are urgently needed in order to process and commercially exploit the high volume of data that is currently being produced and will continue to be produced in the future (according to interview UK10). Cyber security will also play an increasingly important role, for example, in conducting digital conferences and in securing the respective data (according to interview UK05). The COVID-19 pandemic is also contributing to the development of digitalisation and the spread and use of new digital solutions and technologies, despite the considerable losses for the economy (according to interview BW10, interview UK05, interview UK07 and interview UK10).

### *Conclusion:*

According to a study on the impact of AI on the world economy, this cross-cutting topic could add 11 trillion euros in global value by 2030<sup>244</sup>. For Horizon Europe, the EC has proposed to invest 15 billion euros in the digital, industrial and aviation and aerospace industries, where AI will be one of the main areas to be promoted. In addition, the Digital Europe programme will invest around 2.5 billion euros in the introduction of data platforms and AI applications<sup>245</sup>. With their major investments and ambitious efforts in digitalisation and AI, BW and the UK are on the right track: close cooperation in the field of applied research and also in direct innovation support for SMEs is therefore a great opportunity for cooperation between the two economic regions and thus for even stronger development for each in this area. Both are continuing to work on upgrading research and application of data from all relevant industries, such as mobility or health. It is precisely this strong focus on AI and the investments in this area in BW and the UK that could make a difference for them, compared to other European players. An overview of the industries in which this topic is of particular importance can be found in Chapter 4.

→ In BW and the UK, the following events and cluster initiatives can be used as starting points for future business relations:

## Events

### BW:

- Digital Festival, Stuttgart
- Digital Summit, Stuttgart
- IndustrieForum Digitaler Mittelstand, Stuttgart
- InnovationForum Smart Technologies & Systems, Donaueschingen
- Iodata BI Symposium, Karlsruhe
- Smart Data & AI Day, Karlsruhe
- UX Day Conference, Mannheim

### UK:

- AI in Retail Summit, London
- AI Summit London, London
- Deep Learning Summit, London
- International Conference On Robotics and Artificial Intelligence (AI), London

## Cluster and state initiatives

### BW:

#### State initiatives

- **Initiative Economy 4.0:**  
<https://www.wirtschaft-digital-bw.de/en/>
- **Allianz Industrie 4.0:**  
<https://www.i40-bw.de/en/>
- **Cyber Valley:**  
<https://cyber-valley.de/en>

#### Cluster with the label “Cluster Excellence Baden-Württemberg”

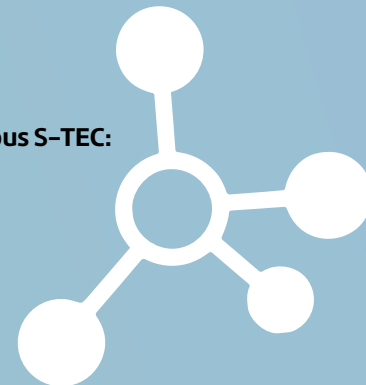
- **Virtual Dimension Center:**  
<https://www.vdc-fellbach.de/en/>

#### Further cluster initiatives can be found in the *BW Regional Cluster Atlas*

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

#### Selection of other (cluster) initiatives and networks:

- **BitKom e.V. Baden-Württemberg:**  
<https://www.bitkom.org/EN>
- **Nationaler Digital Hub für Angewandte KI:**  
<https://digitalhub-ai.de/>
- **Stuttgarter Technologie- und Innovationscampus S-TEC:**  
<https://s-tec.de/>



**UK:****Supported by the UK Government or UK government organisations:**

- **Alan Turing Institute Artificial Intelligence:**  
<https://www.turing.ac.uk/research/research-programmes/artificial-intelligence-ai>
- **Digital Catapult:**  
<https://www.digicatapult.org.uk/>
- **Digital Catapult AI:**  
<https://www.digicatapult.org.uk/technologies/artificial-intelligence>
- **Innovate UK Artificial Intelligence:**  
<https://innovateuk.blog.gov.uk/tag/artificial-intelligence/>
- **UK5G:**  
<https://uk5g.org/>

**Excellence clusters:**

- **Airbus Centre of Excellence in Cyber Security Analytics:**  
<https://www.cardiff.ac.uk/research/explore/research-units/airbus-centre-of-excellence-in-cyber-security-analytics>
- **Cyber Wales:**  
<https://cyberwales.net/>
- **ScotlandIS:**  
<https://www.scotlandis.com/our-clusters/>

**Direct contacts:** For a selection of direct contacts in the various regions of the UK, see Chapter 3.2.1.

**3.4.3. Sustainable Economics****Brief description***Strengths:*

According to the World Economic Forum, the consequences of climate change have been among the top five global risks since 2011<sup>246</sup>. The topic of sustainable economics therefore already plays an important role in many different industries, and its role will continue to grow in the future, making it a central cross-cutting topic for BW and the UK: according to the BW Innovation Strategy, sustainable mobility, resource efficiency, energy transition, and sustainable bioeconomy play a particularly important role in BW<sup>6</sup>, while the UK Industrial Strategy focuses on the topic of clean growth<sup>7</sup>. Moreover, Scotland, together with New Zealand and Iceland, has set itself the goal of driving forward the so-called well-being economy, which includes global sustainability goals<sup>247</sup>.

BW is very well positioned in the field of sustainable economics thanks to its activities in the fields of renewable energies, environmentally friendly production techniques and innovative technologies for resource efficiency. The region is particularly innovative in the area of new production technologies, which can, for example, save resources through digital applications, and thus enable a circular economy and new value-added chains. The BW university landscape is actively involved in research into alternative energy sources (such as photovoltaics, battery or fuel cell technology) and renewable energy technologies and offers numerous academic programmes in these areas<sup>248</sup>. The region also has numerous cluster initiatives in which renowned research and educational institutions connect with companies. Further information on battery or fuel cell technology can be found in Chapter 3.1.1. The topic of sustainable construction is also of particular importance in BW: for example, the KIT has a department dedicated to sustainable construction as part of the Faculty of Architecture. In addition, the BW WM supports various projects in the field of housing construction. Since 2019, for example, the BW Innovative Housing Initiative has been providing a pool of ideas for affordable living and living of the future, where sustainability is one of the central aspects<sup>249</sup>. The remedy of urban planning deficits as well as monument protection and thus the sustainable development of cities and communities are also of central concern to BW<sup>250,251</sup>.



In the UK, too, the issue of sustainable economics is of great importance. Scotland is currently the world leader in offshore wind power generation<sup>252</sup>. Between 2010 and 2019, the UK invested 193 billion euros in renewable energy generation projects<sup>252</sup>. This means that by 2019, more than 50% of the electricity generated in the UK could already be generated from low-carbon sources. The UK's target is to stop the emission of new greenhouse gases by 2050<sup>52</sup>. Some cities, such as Manchester, have even more ambitious targets: the city plans to become carbon-free by 2038 (according to the UK08 interview)<sup>253</sup>. In 2015, sustainable development in the UK accounted for 3% of its GDP, an increase of almost 40% compared to the previous year<sup>a1</sup>. Currently, more than 220,000 people are employed in more than 132,000 companies in this sector, with a focus on the London area and Scotland. However, the sector is very limited to the local market and is not particularly involved in the import or export market. Nevertheless, there is a close relationship with the EU in the field of renewable energy technology transfer<sup>1</sup>. For example, Scottish Enterprise is leading a pilot in the international Vanguard Initiative on new production methods for off-shore and underwater energy production<sup>254</sup>.

### Challenges:

BW has set itself ambitious goals in the fields of energy and climate policy. BW's goal is that 80 % of the country's energy will come from renewable sources by 2050. A key challenge for both, BW and the UK, is therefore to make energy available and affordable for consumers and the industry<sup>255,256</sup>.

In addition to energy supply and energy savings in buildings, energy production also plays a major role, especially with respect to saving and reusing resources, for example via a circular economy, recycling or upcycling efforts. The European industry must adapt to the targets set by the EC, also with regard to the entire value chain. Raw materials such as rare earths are particularly important for new digital processes or the production of batteries. Research networks in BW are therefore already working on the recycling of these materials, while others are working on doing without these rare earths from China or Africa<sup>257,258</sup>. The COVID-19 pandemic has shown that dependencies on raw materials or components, whether in the field of pharmaceuticals or energy storage, can have grave implications for the economy and society.

a1 As defined by the Office for National Statistics, the figures given here refer to the following sub-areas of sustainable economic activity: production of low carbon energy, production of low carbon heat, production of energy from waste/biomass, production of energy efficient products, low carbon services<sup>1</sup>.

In the UK, sustainable construction or the retrofitting of old buildings in particular still poses a challenge. As the government is not directly involved in the real estate market, experts say that there is no comprehensive strategy or support measures in this area (according to interview UK04 and interview UK08)<sup>259</sup>. However, a support package was recently passed by the UK government to reduce CO<sub>2</sub> emissions within buildings<sup>260</sup>.

### A look into the future:

There is a close relationship between the UK and the EU regarding the technology transfer of renewable energies<sup>1</sup>. According to experts, international cooperation with European universities or companies will therefore continue to play an important role in the future, regardless of the UK's withdrawal from the EU (according to interview UK04). Currently, the UK is still participating in numerous European subsidies, but their continued existence from 2021 on is currently no longer assured. However, the British government has already announced that it will use national subsidies to make up for any potential losses. Should the Brexit nevertheless create financing gaps in the area of sustainable economics, some British companies might leave the UK. Areas such as energy and heat production, however, will continue to be tied to the UK due to their dependence on the local infrastructure, raw materials or certain weather conditions within the UK<sup>1</sup>. In addition, the UK is less dependent on the EU for energy imports than other countries because, in addition to a strong domestic energy production (for example through the offshore wind energy mentioned above), it can cover a large part of its additional oil and gas needs through imports from Norway and Russia<sup>261</sup>. There is also no concern on the BW side with regard to the energy market after the Brexit, as it obtains a large part of its electricity from imports from neighbouring states and countries such as France, and not from the UK<sup>262</sup>.

With regard to the COVID-19 crisis, both opportunities and challenges arise for the cross-cutting topic of sustainable economics in BW and the UK: it is assumed that the energy sector will play a central role in the future as part of a sustainable recovery after the pandemic. The topic of sustainable economics equally supports and benefits from the situation, for example, through the acceleration of alternative mobility solutions, regional industrial clusters or local supply chains<sup>263</sup>. However, the COVID-19 crisis also leads to delays in renewable energy projects that are currently under construction, as interrupted supply chains and travel as well as exit restrictions led to temporary shutdowns, which resulted in higher costs and construction delays<sup>264</sup>.

### Conclusion:

To ensure competitiveness and to strengthen the economy's ability to adapt to the challenges of sustainable development, its capacity for innovation is particularly important. For this, it is important to address all the affected areas, such as housing construction, resource efficiency or savings, and research into alternative energy sources. An overview of the industries in which this topic is of particular importance can be found in Chapter 4.



→ In BW and the UK, the following events and cluster initiatives can be used as starting points for future business relations:

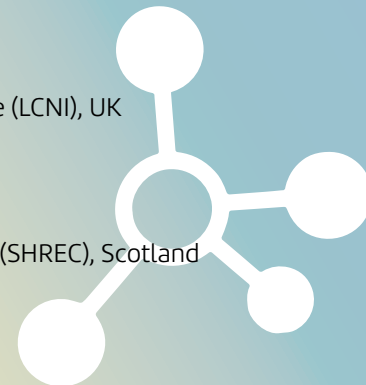
### Events

#### BW:

- C/sells Regional Conference BW, Karlsruhe
- Energy Transition Days BW
- Congress Climate Neutral Communities, Freiburg
- Sustainability Days BW
- Smart Grids-Congress, Stuttgart
- Solarbranchentag 2020, Stuttgart
- STOREENERGY congress, Offenburg

#### UK:

- All Energy, Glasgow
- Annual Energy Trading Operations and Technology Summit, London
- Corporate Renewables, UK
- Energy Risk Europe, London
- Energy Trading Week, London
- Energy Transition Summit, London
- Future of Utilities: Smart Energy, London
- International Conference on Offshore Renewable Energy (CORE), Glasgow
- International Conference on Structural Integrity for Offshore Energy Industry, Aberdeen
- London Energy Summit, London
- Low Carbon Networks And Innovation Conference (LCNI), UK
- Marine Energy Wales Conference, Llandudno
- Road to Zero Conference, UK
- Scottish Highland Renewable Energy Conference (SHREC), Scotland



- Scottish Renewables Conference, Edinburgh
- Smart Energy Northern Ireland, Belfast
- UBS Global Renewables Conference, London
- UK National Heat Transfer Conference, UK
- Wind & Aviation, UK

## Cluster and state initiatives

### BW:

#### State agencies

The tasks of the cross-cutting topic sustainable economics are covered by the following three state agencies of BW:

- **Umwelttechnik BW GmbH:**  
<https://umwelttechnik-bw.de/de>
- **BIOPRO Baden-Württemberg GmbH:**  
<https://www.bio-pro.de/en>
- **E-Mobil BW GmbH:**  
<https://www.e-mobilbw.de/en/>

#### Cluster with the label “Cluster Excellence Baden-Württemberg”

- **Electric Mobility Cluster South-West:**  
<https://www.emobil-sw.de/en/>
- **Cluster Fuel Cell BW:**  
<https://www.e-mobilbw.de/en/network/cluster-fuel-cell-bw>

### Further cluster initiatives can be found in the *BW Regional Cluster Atlas*

- **Cluster-Atlas:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-atlas-baden-wuerttemberg/>
- **Cluster-Database:**  
<https://www.clusterportal-bw.de/en/cluster-data/cluster-database/clusterdb/Cluster/list/>

### UK:

#### Supported by the UK Government or UK government organisations:

- **Energy Systems Catapult:**  
<https://es.catapult.org.uk/>
- **Catapult Offshore Renewable Energy:**  
<https://ore.catapult.org.uk/>
- **Marine Energy Wales:**  
[www.marineenergywales.co.uk/](http://www.marineenergywales.co.uk/)

#### Excellence cluster:

- **Offshore Wind Scotland:**  
<https://www.offshorewindscotland.org.uk/deepwind-cluster/>

**Direct contacts:** For a selection of direct contacts in the various regions of the UK, see Chapter 3.2.1.



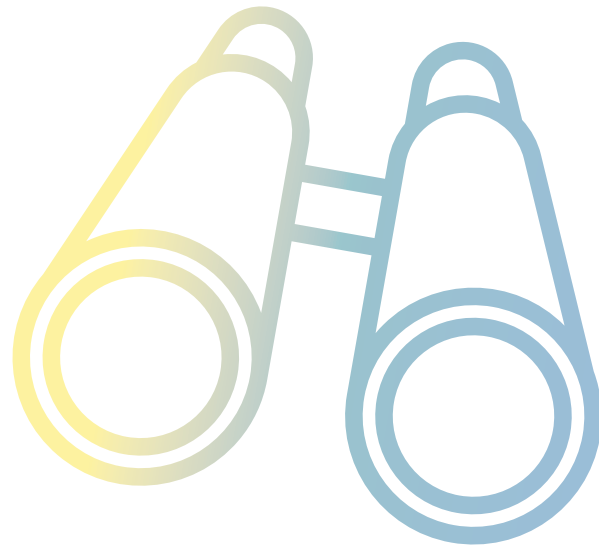
### 3.5. SUMMARY: ECONOMICALLY IMPORTANT INDUSTRIES AND CROSS-CUTTING TOPICS

The presentation of the different strengths and challenges of the BW and UK economies in Chapter 3 offers a good insight into the current situation of the various industries, but also into the relevant cross-cutting topics in the two economic regions. The main results of the sector analysis are summarised again in the following paragraphs on the basis of the four categories “strengths”, “challenges”, “role of SMEs” and a “look into the future”. The cross-cutting topics play a highly relevant role in BW and the UK and are therefore taken up again in Chapter 4, in the identification of suitable starting points for economic cooperation.

Based on the findings of the primary and secondary data collection presented in Chapter 3, the following assessments of the BW and UK economies emerge:

In BW, the automotive industry, healthcare industry and manufacturing industry are the three strongest industries in terms of annual sales and exports. In fourth place come the cultural and creative industries, which with 220,000 jobs are one of the fastest growing industries, but are not yet as strong in exports (with the exception of the film industry).

In the UK, the manufacturing industry and the cultural and creative industries are the two economically strongest industries in terms of annual sales and exports. In third place comes the healthcare industry, which (besides the cultural and creative industries) has the highest proportion of SMEs. The automotive industry comes fourth in place.



However, these assessments may change in the future due to the COVID-19 pandemic and its economic implications: all four of the above-mentioned industries in BW and the UK are experiencing heavy losses due to, for example, declines in production and demand nationally and internationally. Especially in the automotive and the manufacturing industries, the digital transformation and the development towards more sustainability will add to this, leading to losses on the one hand but also necessary investments on the other. In the UK, the manufacturing industry has also suffered a slight decline and a negative trade balance in recent years due to high production costs and the lack of proximity to important raw materials. The UK's withdrawal from the EU could potentially worsen these effects. Moreover, the British healthcare industry needs to grow in the field of diagnostics, especially regarding innovations, in order to be better prepared for future health challenges. Here, the focus should be on the transfer of results from research to application. Digitalisation plays an increasingly important role here too, both in BW and the UK.

#### 3.5.1. Opportunities

The reorientation of the creative and cultural industries towards digital concepts and new event and presentation formats offers a great opportunity for both BW and UK partners.

In the same way, the healthcare industry has great potential due to the overall increasing interest, for example, in healthy lifestyles or preventive measures.

In the automotive industry, there is great potential in the expansion of alternative mobility concepts and a stronger focus on battery, hydrogen and fuel cell technologies, with great opportunities emerging from applications that have already been successfully tested in BW. The resulting increase in demand for alternative energy sources and storage is also a great opportunity for Scotland, Northern Ireland and Wales with their excellent climatic conditions.

In order to compensate for previous losses in the manufacturing industry in both BW and the UK and to reposition itself well in the future, it will also be essential for this industry to reorient itself towards greater resource efficiency, automation and digitalisation processes, for example, as part of the Industry 4.0. or the Internet of Things.

### 3.5.2. Challenges

With regards to Brexit, there are both opportunities and challenges for the various industries in the near future. Thanks to the strong international trade relations with the UK, the automotive, health and manufacturing industries of BWs are looking with great interest at the exact contents of the trade agreement and hope that there will be no barriers to international cooperation.

The cultural and creative industries of BW fear a decline in existing international cooperations with the UK and estimate potential trade barriers and increasing bureaucratic efforts as a major challenge, for example, for international events. Trade barriers also play an important role for the British cultural and creative industries, but the industry is known far beyond the UK's borders and will therefore continue to find solutions for international cooperations.

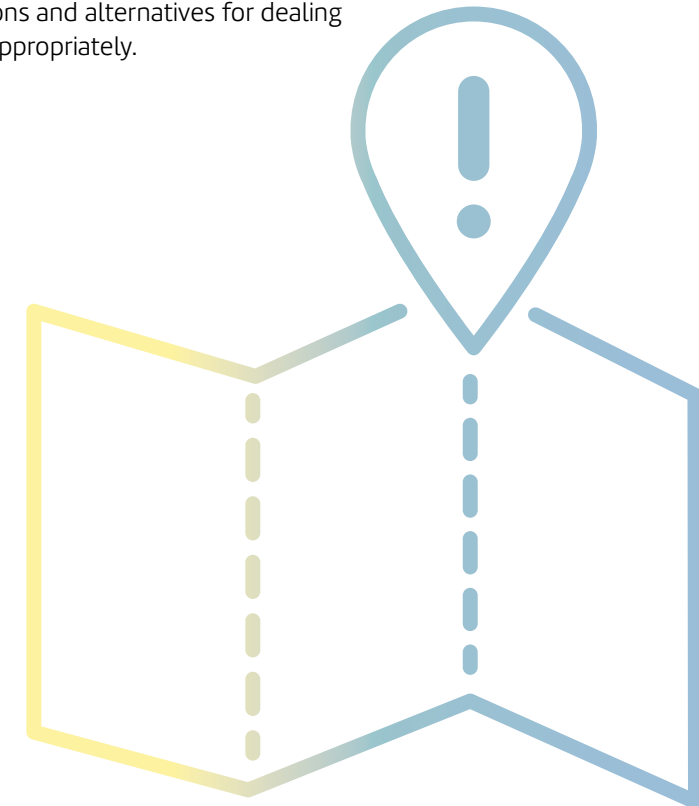
The manufacturing as well as the healthcare industry in the UK in particular depend on functioning trade relations to maintain their high export shares. The manufacturing industry at the same time has to deal with automation concepts as part of its important development towards an Industry 4.0. However, this also offers great opportunities for new business relations and models. The healthcare industry in the UK (but also in BW) is also dependent on the continuation of international cooperation in order to jointly develop solutions, for example, for global health challenges.

Regarding the individual regions of the UK, there are different challenges: while Wales, Scotland and England belong to the island of Great Britain and therefore do not share any direct national borders with the EU, the situation is quite different for Northern Ireland. Northern Ireland shares a direct border with the Republic of Ireland, which will remain part of the EU. Because of this direct border and the resulting proximity to the EU, Northern Ireland faces many opportunities but also various challenges regarding its trade relations with the EU. The outcome of the current negotiations between the UK and the EU will therefore be of great interest to Northern Ireland, especially regarding the trade agreements.

### 3.5.3. Summary

The economy of BW consists of numerous strong industries, which will be affected quite differently by the various opportunities and challenges of the present and future. However, this is also one of the key strengths of the automotive industry within BW and the manufacturing industry in BW and the UK: while traditional industries and industries strong in export such as those two continue to generate the highest sales and the highest number of jobs, those are also the industries that are usually most affected by economic changes and which therefore have to make the greatest efforts to remain competitive. Although less strong BW export industries such as the cultural and creative industries currently have a lower turnover, they exhibit strong potentials for the future, especially regarding digitalisation efforts. Similarly, the healthcare industry of BW offers great potential for the future due to the current increase in demand, despite certain challenges.

The second strongest industry within the UK is the cultural and creative industries, which is well positioned for the future thanks to good governmental support (as well as numerous investments from outside), a very high educational level and a broadly based and excellent industry. The healthcare industry in the UK also has potential, similar to BW: despite certain setbacks, the industry provides solutions and alternatives for dealing with future challenges appropriately.





## 4. Synergies and Complementarities: Success through Economic Cooperations

As described in Chapter 3, BW and the UK have numerous strong industries and cross-cutting topics that continue to play an important role in the future for the respective economies, companies and trade relations with each other. The strengths and challenges of the two economic regions described above give rise to a large number of complementary competences that offer a high potential for synergies and thus for further successful business relations between BW and the UK. The following section presents those industries and cross-cutting topics within and between which the greatest synergy effects for BW and the UK are expected.

### 4.1. SYNERGIES WITHIN INDIVIDUAL INDUSTRIES

In the following, the four industries within which the data analysis has indicated the greatest potential for future cooperation between BW and the UK are presented in detail in descending order. These industries are the automotive industry, the manufacturing industry, the healthcare industry and the cultural and creative industries. In all four industries, BW and the UK have a strong and innovative market in their own economic region as well as existing trade relations between each other. Both factors are also great prerequisites for close and profitable future business relations.

### 4.1.1. Automotive Industry

The automotive industry is one of the strongest industries in both BW and the UK. In both, there is a very high number of SMEs involved. While in BW, the focus is on the production of premium brands such as Daimler or Porsche and a correspondingly large network of suppliers, the UK focuses more on engine development, the trade with classic cars, the production of luxury brands such as Bentley or Jaguar and volume manufacturers such as Nissan or Toyota, as well as the service sector (maintenance and repair). As a result, the supply of individual components by SMEs in BW and the UK results in different and thus complementary expertise.



**Production of engines and luxury brands,  
trade with classic cars and service sector**

**Production of premium brands, numerous suppliers**

Figure 12. Complementarities automotive industry BW–UK

In the field of future technologies, sustainable mobility solutions and the opportunities offered by digitalisation play a major role, in production and application. Both BW and the UK are very active in the areas of battery research and production as well as fuel cell and hydrogen technology. Both try to establish value-added chains within Europe and both aim to be proactively involved in the development and implementation as a country or region respectively.

An analysis of the existing cooperation between BW and the UK in the European research and innovation program Horizon 2020 for the keyword hydrogen showed that mainly research institutions are involved, while the number of companies is rather low. Figure 13 gives an overview of the geographical distribution of the 61 institutions cooperating in 28 projects within Horizon 2020 in the field of hydrogen. Some project partners are involved in several projects at the same time. In BW, the focus lies on the Stuttgart and Karlsruhe area, while project



participation in the UK is mainly concentrated around London and Cambridge. Among BW companies, Sphera Solutions GmbH is involved in four projects, followed by Daimler AG with three projects and ElringKlinger AG with two projects. On the academic side, KIT is involved in nine projects. EIFER European Institute for Energy Research (EDF KIT EWIV) should also be mentioned here with four project participations. In the UK, the company Element Energy Ltd. in Cambridge stands out with nine project participations, but also ITM POWER (trading) Ltd. with five project participations is quite involved. Among academics, the University of Birmingham and the University of Ulster are particularly actively cooperating with BW in three projects each. Due to the high level of existing activity in this research area, there are good opportunities for cooperation for interested SMEs.

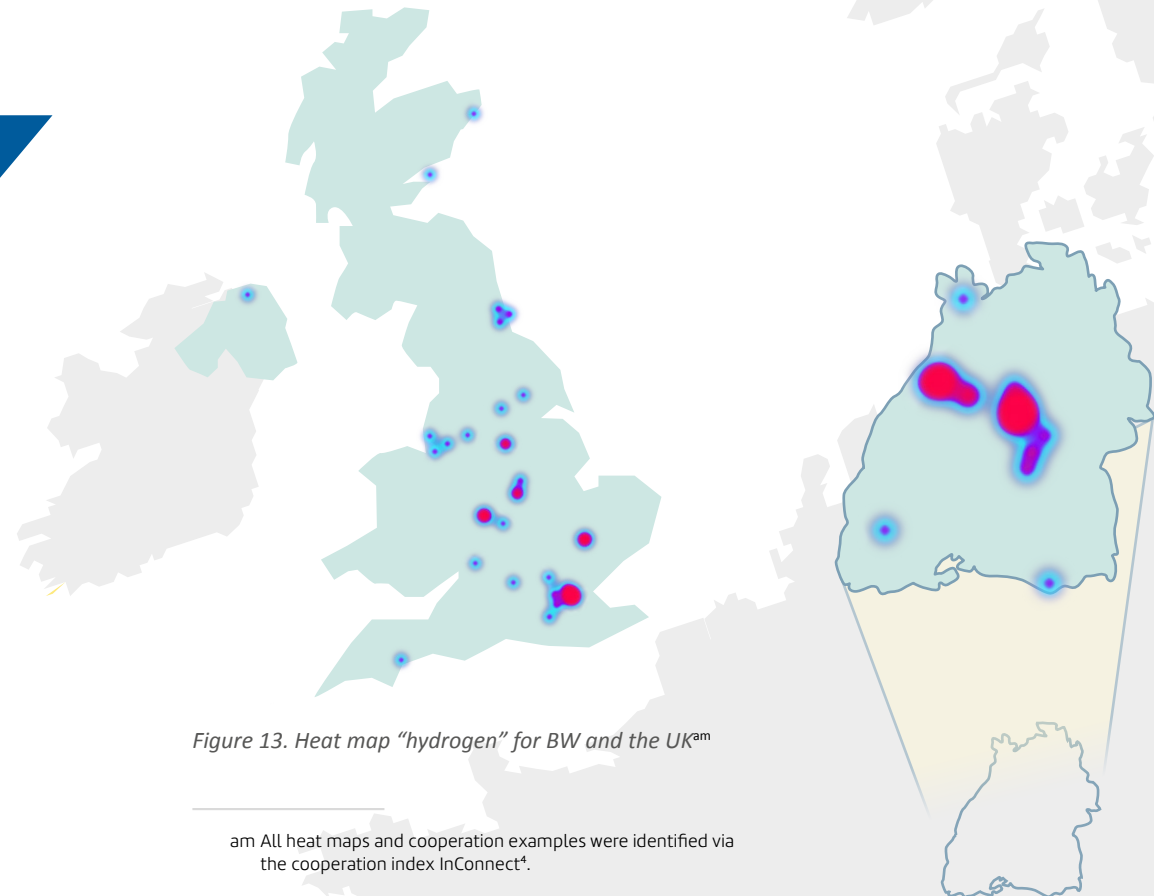


Figure 13. Heat map "hydrogen" for BW and the UK<sup>am</sup>

<sup>am</sup> All heat maps and cooperation examples were identified via the cooperation index InConnect<sup>4</sup>.

In the field of battery research, existing cooperation between BW and the UK in Horizon 2020 shows that companies from BW, such as VARTA Microbattery GmbH, have already entered numerous projects with the UK. In detail, the analysis has shown that mainly universities and research institutions as well as large companies are involved, while the number of SMEs is still manageable. Figure 14 gives an overview of the geographical distribution of the 60 institutions in BW and the UK in 19 projects in the field of battery technology. In BW, partners are mainly active in the Ellwangen, Karlsruhe, Stuttgart, and Heidelberg areas, while project participation in the UK is mainly concentrated around the London and Oxford areas. Among the companies from BW, VARTA Microbattery GmbH is involved in six projects, followed by Robert Bosch GmbH with three projects, EURA AG and Daimler AG with two projects each. From the academic side, the Ruprecht-Karls-University of Heidelberg is involved in two projects, while all other universities and research institutions in BW are only involved in one project each. In the UK, the KMU OXIS Energy Ltd. is involved in two projects. From the academic side, the University of Warwick is involved in three projects and Cranfield University in two. All other organisations are involved in one project.

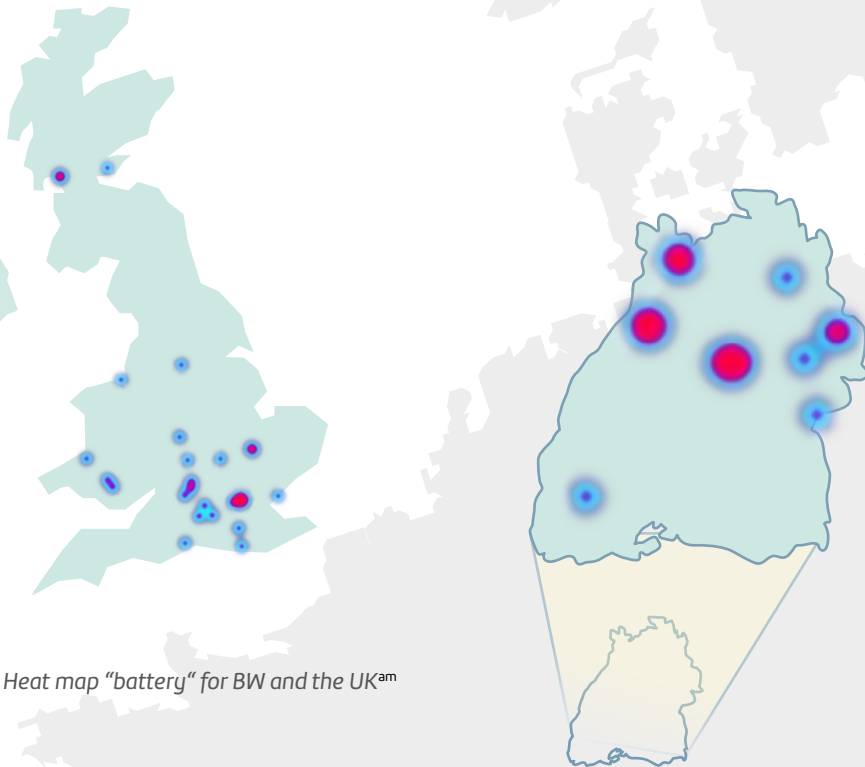


Figure 14. Heat map "battery" for BW and the UK<sup>am</sup>

Regarding the automotive industry as a whole, the following are concrete examples of research and innovation cooperation between BW and the UK:

- Daimler AG from Stuttgart and European Thermodynamics Ltd. from Leicestershire in the field of thermoelectrics (EU project ECOCHAMPS)
- Evobus GmbH from Stuttgart and London Bus Services Ltd. from Kent in the field of transport and mobility (EU project NewBusFuel)
- BIGA Energy GmbH & Co. KG from Engstingen and Green Fuels Research Ltd. from London in the field of fuel cell technology, specifically in the conversion of organic waste into sustainable aviation fuel (EU project flex-JET)
- Nucellsys GmbH from Kirchheim unter Teck and Element Energy Ltd. from Cambridge in the field of fuel cell and hydrogen technologies (EU project HY4ALL)

The automotive industry thus reveals numerous complementary competencies between BW and the UK, which are already being actively used by BW and British companies. In particular, the research and development of alternative mobility systems will offer numerous opportunities for new markets and a new positioning of their own strengths in the future. Some concrete examples of potential synergies are:

- Joint further development of alternative mobility solutions, components or technologies
- Targeted cooperation initiations for market access (B2B, inclusion of start-ups)
- Mutual complementarity between BW premium brand manufacturers and the British service sector



### 4.1.2. Mechanical Engineering and Manufacturing Industry

The manufacturing industry represent one of the strongest industries especially in BW, but also in the UK. In both economic regions, there are world-renowned large companies and a high number of SMEs. The mutual potential between BW and the UK is already being actively exploited by both sides. Existing exemplary cooperations in the field of research and innovation are (with the exception of Bosch Rexroth Ltd. all SMEs):

- AP Sensing GmbH from Böblingen and Fike Safety Technology Ltd. from Wales in the field of mechanical and plant engineering, specifically shipbuilding (EU project Lash Fire)

- Hohenloher Spezial-Maschinenbau GmbH from Kupferzell and Bosch Rexroth Ltd. from Cambridgeshire in the field of mechanical and plant engineering (EU project Forwarder2020)

BW's strength lies in its high level of competence and innovation, as evidenced by the number of world market leaders and its high production volume. Even though production in the UK has declined significantly in recent years, it has been experiencing an upward trend, primarily through the application of automation and digitalisation processes, especially in the areas of e-commerce and digital business models. Increased use of these already existing complementary skills can generate synergy effects, both for SMEs in BW and in the UK. Concrete cooperations thus arise in the field of automation with the aim of knowledge transfer, joint international market development or the purchase of know-how.



**Application of automation and digitalisation processes**



**High production volume, expertise and innovative**

Figure 15. Complementarities manufacturing industry BW-UK

Due to the strong overlap in content with the topic of automation and robotics, further information on concrete synergies in the area of manufacturing can be found in Chapter 4.3.1..

### 4.1.3. Healthcare Industry

The healthcare industry is strong in both economic regions, with a high proportion of SMEs, which are of central importance for the translation of research results into industry, among other things. While both BW and the UK are strong in medical technology and pharmaceuticals, BW also stands out in diagnostics, while the UK's focus lies on digital health. Overall, both have excellent medical universities. Existing exemplary cooperations are (with the exception of BioRegioSTERN Management GmbH, Geistlich Biomaterials Vertriebsgesellschaft mbH, HITS gGmbH Heidelberger Institut für Theoretische Studien, University of Ulm and University of Ulster all SMEs):

- BEITER GmbH & Co. KG from Sigmaringendorf and Jenson+ Ltd. from Barnstaple in the field of pharmacy, specifically delivery of antibodies/multifunctional biomaterials for the treatment of multiple sclerosis (EU project N2B Patch)
- BioRegioSTERN Management GmbH from Stuttgart and Mirada Medical Ltd. from Oxford in the field of biotechnology/personalised medicine (EU project HYBRID)
- Geistlich Biomaterials Vertriebsgesellschaft mbH from Baden-Baden and Tissue Click Ltd. from Brighton in the field of pharmaceuticals, specifically development of bioactive functionalised materials to prevent the occurrence of osteoarthritis after meniscus loss (EU project MEFISTO)
- Research company HITS gGmbH Heidelberg Institute for Theoretical Studies from Heidelberg and Icen Diagnostics from Norwich in the field of pharmacy and diagnostics, treatment of metabolic diseases (EU project PoLiMeR)
- Karl Storz GmbH & Co. KG from Tuttlingen and M-Squared Lasers Ltd. from Glasgow in the field of photonic endoscopy for early detection of colorectal cancer (EU project Piccolo)

BW and the UK exhibit numerous synergies in the healthcare industry, as a result of complementary skills as well as similar challenges, such as an aging society with a declining number of health professionals. Here, SMEs in BW can play an important role, for example in future areas of therapy and diagnostics, especially

endoscopy, imaging procedures or minimally invasive therapies. The UK has invested massively in digital health in recent years, creating favourable conditions for a growing, innovative ecosystem for start-ups and SMEs. Topics such as the hospital of the future, digital therapy methods and novel simulation processes based on new high-performance computers can benefit both economic regions.



Figure 16. Complementarities healthcare industry BW-UK

Especially in the field of digital health, there are thus already numerous existing business relations between BW and the UK. An analysis of the existing collaborations in Horizon 2020 for the keyword digital health, shows that a total of 32 BW and UK institutions are active in nine projects in this area. On the BW side, most activities take place in the Stuttgart and Heidelberg areas (as illustrated in Figure 17): here, the European Molecular Biology Laboratory, Steinbeis 2i GmbH and Steinbeis Innovation gGmbH are active in two projects each. Three further companies, three SMEs and a research institute are each active in one project. The regional focus of activities in the field of digital health in the UK is around the Greater London area, Cambridge, Sheffield, Manchester and Edinburgh. The SME Ian Harrow Consulting Ltd. is active in two projects, as are the two universities University of Manchester and University of Edinburgh. Seven other universities and 12 companies or SMEs are active in one project each.

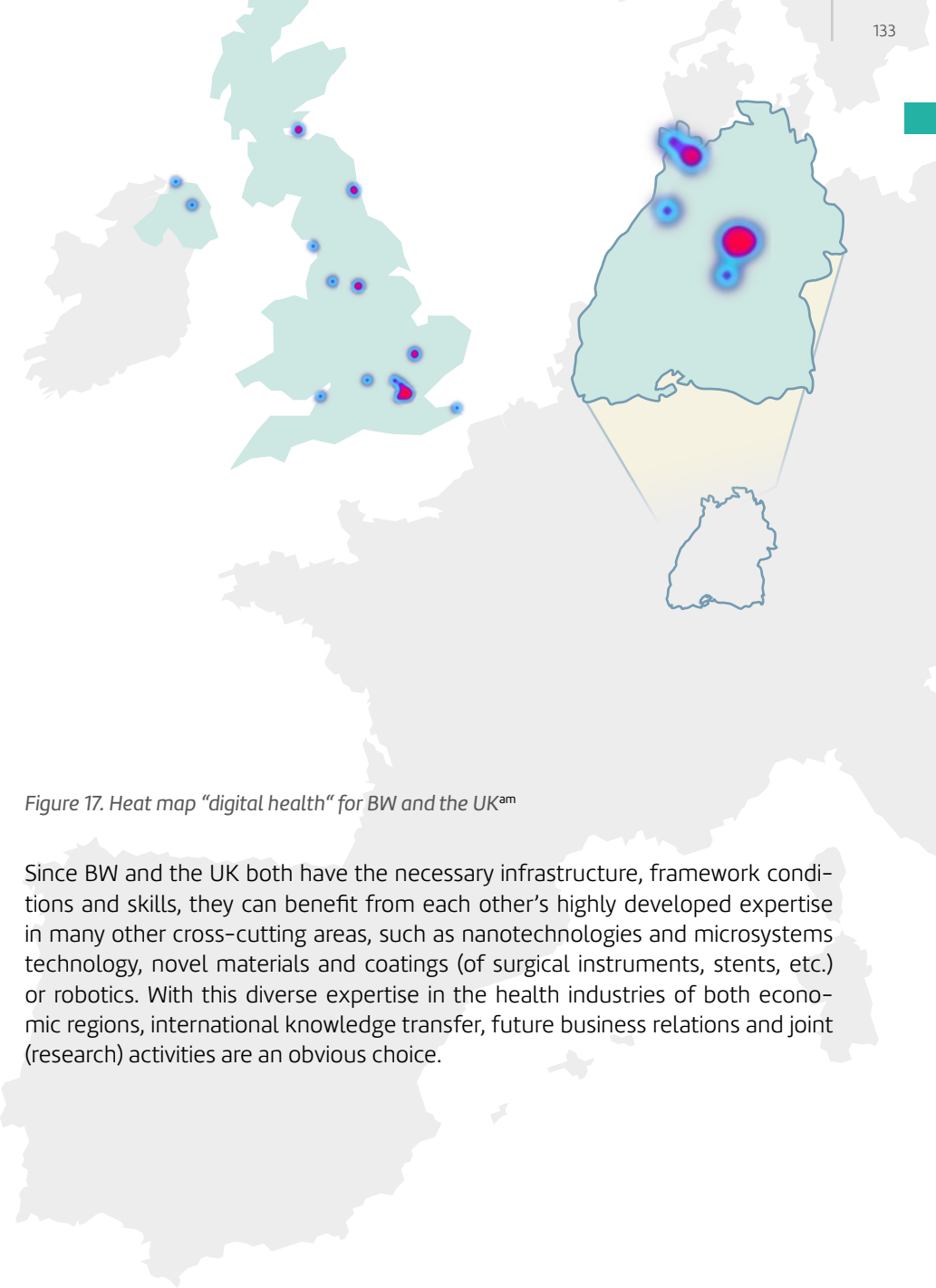


Figure 17. Heat map "digital health" for BW and the UK<sup>am</sup>

Since BW and the UK both have the necessary infrastructure, framework conditions and skills, they can benefit from each other's highly developed expertise in many other cross-cutting areas, such as nanotechnologies and microsystems technology, novel materials and coatings (of surgical instruments, stents, etc.) or robotics. With this diverse expertise in the health industries of both economic regions, international knowledge transfer, future business relations and joint (research) activities are an obvious choice.

#### 4.1.4. Cultural and Creative Industries

There is also potential for synergies in the cultural and creative industries as both economic regions are very strong in this sector. Synergies lie, for example, in an exchange of knowledge between BW and UK institutions regarding internationalisation opportunities and, building on this, increased joint activities. The analyses of the primary and secondary data collection have shown that the British cultural and creative industries are very internationally oriented. In addition, the two economic regions have set partly similar and partly complementary thematic priorities (BW: software and games industry, animated films, advertising industry; UK: film and television industry, advertising and marketing industry), resulting in numerous opportunities for creative exchange, business relationships and joint activities.

There is also great potential for synergies through BW's and Scotland's membership in the Districts of Creativity network, founded in 2004, which links countries and regions around the world to promote interdisciplinary creativity and innovation<sup>265</sup>. Some exemplary activities are the annual study visits Reverse Mission, which took place in BW in 2019 and in Scotland in 2015<sup>266</sup>, and the Creativity World Forum, which is organised by a different member of the network each year<sup>267</sup>. The study "Growing the UK's Creative Industries" has already identified areas where an exchange of best practices between BW and the UK could be useful, including<sup>268</sup>:

- **Funding and support:** BW has a well-positioned regional and state funding structure and its own state agency (MFG, see 3.1.3), which offers, as needed, support measures specifically for the creative sector. The UK also offers numerous funding opportunities for the cultural and creative industries.
- **Promoting talent:** An exchange in the area of education and training in the cultural and creative industries could give impulses to both economic regions.

#### 4.2. SYNERGIES BETWEEN INDUSTRIES

In the following, examples of possible cross-sectoral synergies between BW and the UK are presented, which seem most promising in terms of their respective complementarities and the resulting future synergy effects. Figure 18 gives an overview of identified exemplary synergies.

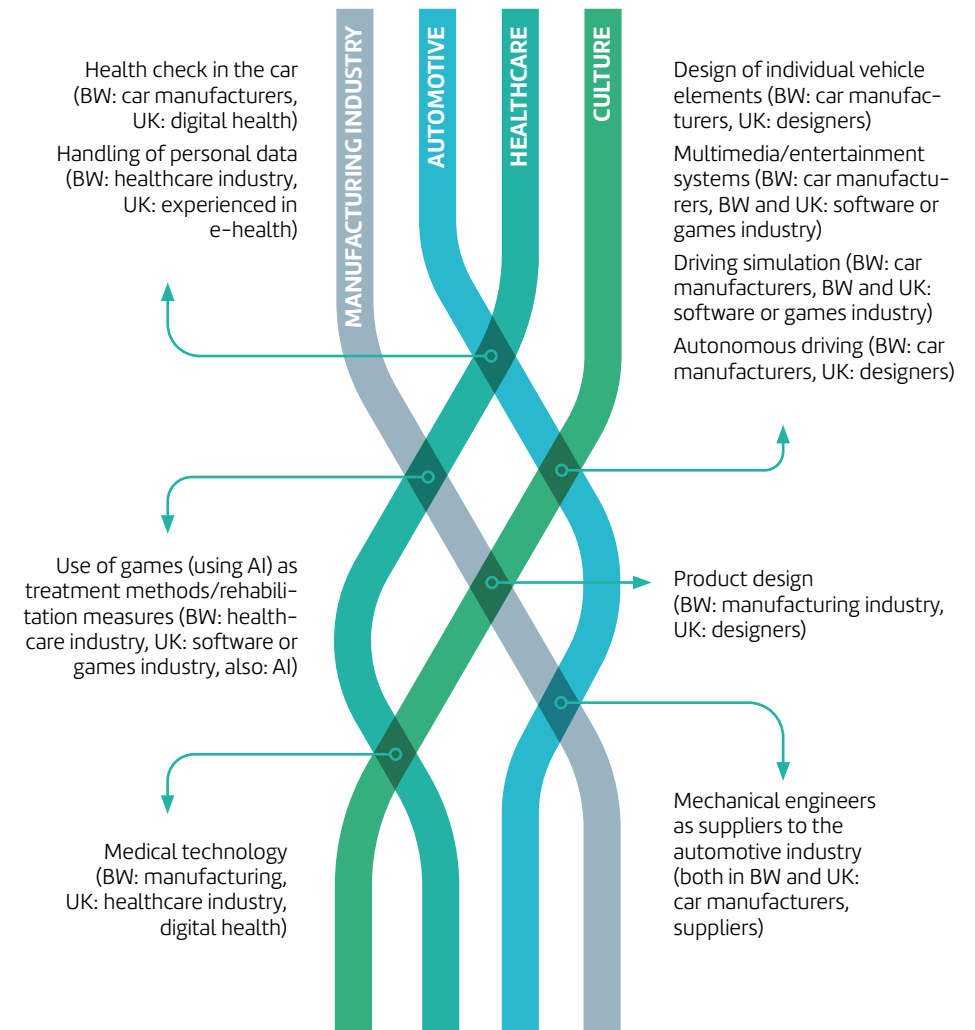


Figure 18. Matrix of cross-sectoral synergies

### 4.2.1. Automotive and Healthcare Industry

Due to the high number of complementarities (see Chapter 4.1.1 and Chapter 4.1.3) and the continuous advancement in both areas, there are great synergies between the automotive industry and the healthcare industry. In most cases, these cross-thematic synergies necessarily involve numerous other players, especially from the cross-cutting topics of automation and robotics as well as digitalisation and AI. BW and the UK have their respective expertise and competencies, which complement each other well to the benefit of all and can thus lead to jointly developed new products, processes and market accesses.

The mobility of the future, for example, already includes a wealth of digital and smart components, such as driver assistance systems. The further integration of health data, for example for monitoring or diagnostics, is already being tested in some cases. Linking the strong BW automotive industry with digital expertise from the field of digital health in the UK could therefore be very beneficial for both economic regions.

Both industries can furthermore benefit from a general transfer of knowledge, for example regarding the handling of personal data, which has long been tested and implemented in the e-healthcare industry, but where mobility is only just beginning.

All in all, there is a great deal of potential arising from BW's strong hardware expertise in the automotive industry and the UK's great strength in the (digital) service sector, which could lead to the development of a wide range of application areas or even new markets in the future.

### 4.2.2. Automotive and Cultural and Creative Industries

In the automotive industry, there are numerous individual components as well as end products where various design aspects have to be considered: from the seats, the steering wheel, the controls, the rims and the display to the bodywork, design and thus the overall impression of the product plays a central role. In the future, due to digital innovations, numerous other components that have to be integrated into the design of the car will be added. Therefore, the expertise of various sub-sectors of the cultural and creative industries, especially the design industry (where the UK in particular is very good), plays a key role. From this results good potential for complementing the strong automotive producers of BW.

Furthermore, the cultural and creative industries, especially the film, television, video and animation industries, as well as the software and games industry, have

great opportunities in the area of producing target group-specific content for, for example, children who are looking for entertainment during long car journeys. Special touchpads for rear seats can be equipped with exclusive software specifically for children or film content, which, combined with the respective software expertise, is one of the UK's areas of expertise.

There is also an overlap between the automotive industry and the cultural and creative industries in the field of driving simulation, specifically addressing the games industry, which already has highly advanced software and hardware in this area. Both BW and the UK are very active in this area and can therefore benefit greatly from mutual knowledge exchange.

Finally, the trend towards connected driving, which describes the communication between vehicles and infrastructures, and the intelligent car, also has many links. Here, in addition to strong expertise in the field of autonomous driving, designer knowledge is required, for example from the (British) cultural and creative industries.

The strength of the creative industry in BW is thus complementary to that of the UK: joint activities and offers to the automotive industry, which operates internationally, can lead to a new strength in the cooperation between the two economic regions in this sector. In addition, cooperations also benefit from the strong complementarity between BW and the UK in the area of hardware and services.

### 4.2.3. Healthcare Industry and Cultural and Creative Industries

Due to the complementarities (see Chapter 4.1.3. and Chapter 4.1.4.) and the great interest in international cooperation in both industries and economic regions, there is a high potential for cross-thematic synergies between BW and the UK.

In the healthcare sector, there is great interest in research into new successful diagnostic and therapeutic methods, for example in the areas of nutrition, fitness or rehabilitation, in order to achieve treatment success or behavioural changes. For this purpose, the search is on for solutions from other fields, which can be found, for example, in cooperation with the software and games industry<sup>269</sup>. The combination of these different industries offers a high potential for cross-thematic synergies for better diagnosis and treatment of different conditions or diseases with the help of gaming apps or software. Further cooperation with experts from the fields of digitalisation and AI in particular will open up innovative possibilities for collecting and analysing patient data in order to better motivate and interact with patients. The first examples that are already moving in this direction are fitness tracking apps, health apps, augmented reality games or specific games

for stroke rehabilitation therapy<sup>an.270</sup>. Based on these cross-thematic cooperations between the healthcare industry and the cultural and creative industries (in further cooperation with AI), numerous further synergies could arise in the future, which the respective industries in BW and the UK could use.

#### 4.2.4. Mechanical Engineering and Manufacturing Industry: Cross-thematic Synergies

In the field of manufacturing, there are numerous synergies with various of the other industries that are worth exploring. Those are therefore summarised here jointly for this industry.

Within the healthcare industry, the sub-sector of medical technology in particular offers great potential for cooperation with the manufacturing industry, as this sector is concerned with the development of technical devices and processes for use in medicine (prevention, diagnosis, therapy). There are already numerous examples of successful cooperation between the healthcare industry and the manufacturing industry, such as the products of the BW company Aesculap (surgical instruments for open or minimally invasive access, implants or products for cardiology)<sup>271</sup>. There is also great potential for international synergies in the field of medical technology. Here, cooperation with the fields of robotics and AI is becoming increasingly important in order to develop systems that can independently respond to the condition of the patient and thus relieve the burden on doctors and nursing staff<sup>272</sup>. Consequently, there is an ideal potential for complementing the very strong health and manufacturing industry in BW with the expertise in the healthcare industry and AI available in the UK.

There are further synergies between the manufacturing and automotive industries in that the manufacturing industry companies act as suppliers of individual components or production machines for the automotive industries while at the same time managing maintenance and repair.

In the cultural and creative sector, synergies with the manufacturing industry also arise, for example in the area of product design.

<sup>an</sup> For example Freeletics (<https://www.freeletics.com/de> (accessed on 14.08.2020)), Fabulous (<https://www.thefabulous.co/> (accessed on 14.08.2020)), Pokémon Go (<https://www.pokemongo.com/de-de/> (accessed on 14.08.2020)).

### 4.3. SYNERGIES WITH CROSS-CUTTING TOPICS

The three cross-cutting topics of automation and robotics, digitalisation and AI, and sustainable economics comprise central technologies of the future and thus offer a multitude of possible points of contact between BW and the UK. The cross-cutting topics are characterised by numerous overlaps with the different industries, which will be discussed in more detail as well.

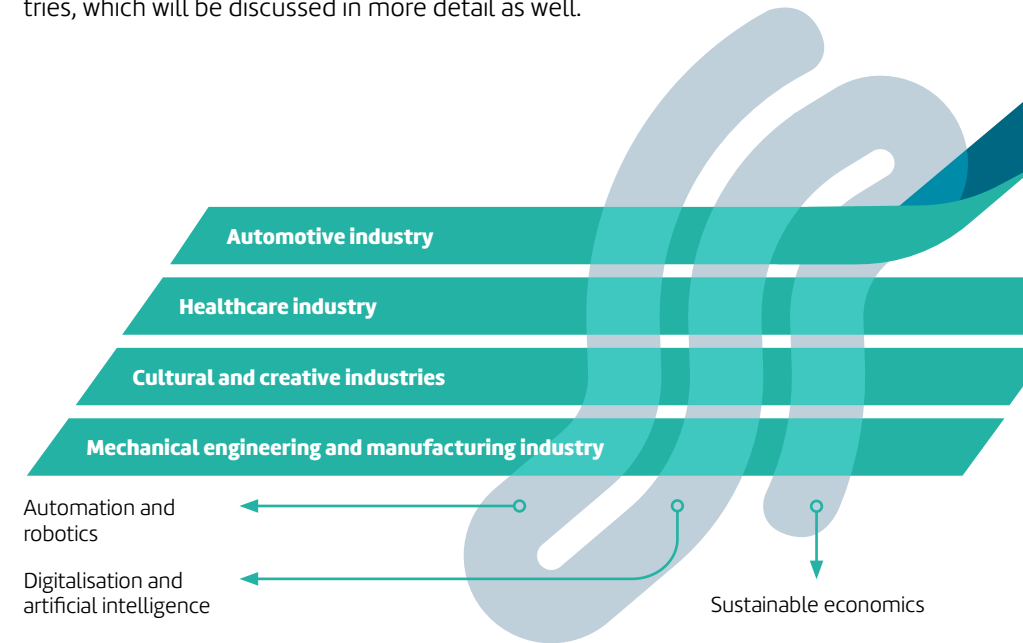


Figure 19. Synergies between industries and cross-cutting topics

#### 4.3.1. Automation and Robotics

The cross-cutting topic of automation and robotics plays a central role, especially in view of the developments of the Industry 4.0, both in BW and the UK. Besides a strong software competence, BW's great strength lies in its high level of expertise and its high production volume in the application areas that are most important for automation processes, such as the manufacturing industry or the automotive industry. The UK is especially well positioned on the software side, also thanks to its excellent research in this field. In the field of automation and robotics, BW and the UK therefore have numerous complementary competencies, which in turn offer great potential for future synergies. In some areas, these complementarities are

already being exploited today, which in recent years has led to a number of collaborations between BW and the UK within the framework of Horizon 2020 (all SMEs with the exception of NEC Europe Ltd., ESI SOFTWARE GERMANY and Festo AG)<sup>14</sup>:

- DYNAmore FEM Ingenieurdienstleistungen GmbH from Stuttgart and NEC Europe Ltd. from South Ruislip in the field of Industry 4.0/AI, specifically machine learning, to meet new challenges that arise in the industry due to the increasing complexity of products, product development and production processes (EU project ECOLE)
- ESI SOFTWARE GERMANY GmbH Stuttgart and LimitState Ltd. from Sheffield in the area of Industry 4.0 (EU project Integradde)
- Festo AG from Esslingen with Ththink Wireless Technologies Ltd. from Sheffield in the area of Industry 4.0 (EU project Platforms4CPS)

An analysis of the already existing cooperation between BW and the UK in Horizon 2020 for the cross-cutting topic of automation and robotics revealed a very high number of activities: BW and UK institutions cooperate in 36 projects in the field of automation and robotics, with numerous institutions active in several projects. A total of eight SMEs, 14 large companies, two cities and ten universities/research institutions are involved in BW. As shown in Figure 20, the regional focus here is on the Stuttgart area and the cities of Ulm, Karlsruhe and Heidelberg. In the UK, 22 SMEs, 11 large companies, one city and 23 universities/research institutions are active. The regional focus here is on the London area, near Bristol, the Birmingham area and Glasgow. On the BW side, Robert Bosch GmbH dominates among the large companies with activities in seven projects, followed by Thales Transportation Systems GmbH with two projects. All other companies are active in one project. Of the SMEs, all are active in a maximum of one project. The research institutions and universities are again increasingly involved in different projects: the KIT and the University of Ulm are active in four projects each, followed by the University of Stuttgart and NEC Laboratories Europe GmbH in three projects each. All other academic representatives are involved in one project each. Of the British large companies, the British Telecommunications Public Ltd. company, NEC Europe Ltd. and Network Rail Infrastructure Ltd. are each active in two projects, all other large companies in one project each. As in BW, the SMEs are also active in one project each. Among the universities and research institutions, Imperial College London is active in four projects, while the University of Cambridge, the University of Edinburgh, the University of Glasgow, University College London and the University of Strathclyde are each active in two projects. All others are active in one project each. Thanks to the high proportion of SMEs in already existing projects and the overall above-average activity within this area, the cross-cutting topic of automation and robotics thus offers interested SMEs particularly good opportunities for international cooperation with the UK.

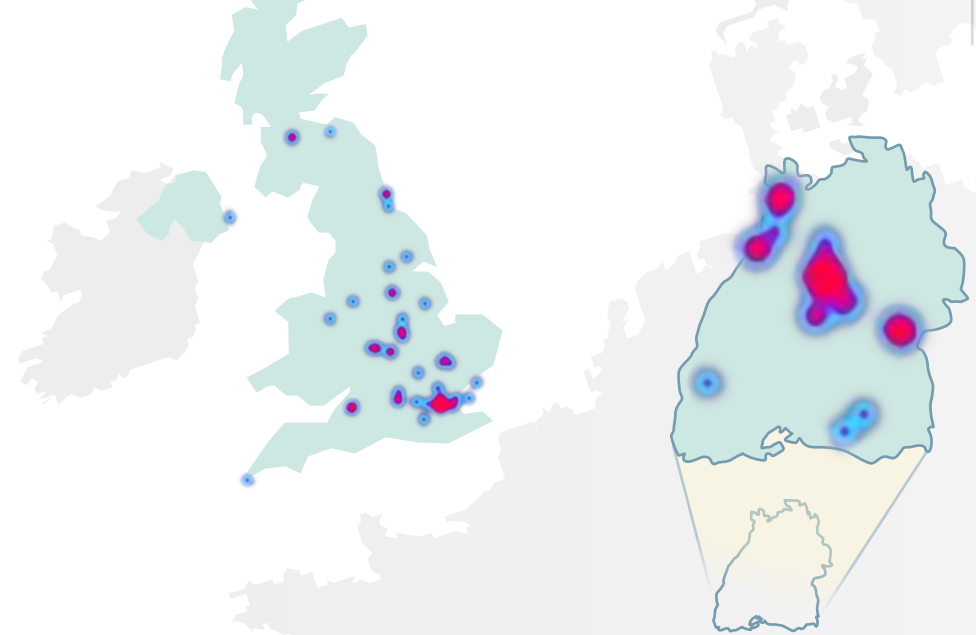


Figure 20. Heat Map "automation and robotics" for BW and UK<sup>am</sup>

As a cross-cutting topic, automation and robotics offer numerous complementarities and thus points of contact for mutually rewarding synergies with various industries, both in BW and in the UK. Some examples of such potential thematic synergies are shown in Table 2.

INDUSTRIES	SYNERGIES IN AUTOMATION AND ROBOTICS
Automotive industry	<ul style="list-style-type: none"> <li>• autonomous driving</li> <li>• optimised production processes</li> </ul>
Healthcare industry	<ul style="list-style-type: none"> <li>• medical equipment, surgical techniques (for example remote-controlled surgery)</li> <li>• Ambient Assisted Living</li> </ul>
Cultural and creative industries	<ul style="list-style-type: none"> <li>• automation processes in the fields of film, television, video, animation, radio or photography</li> <li>• automation processes in publishing</li> </ul>
Mechanical engineering and manufacturing industry	<ul style="list-style-type: none"> <li>• Industry 4.0.</li> </ul>

Table 2. Synergies between automation and robotics and other industries

The greatest impact of automation and robotics is expected in the automotive industry, the engineering and manufacturing industry and the healthcare industry, due to the developments of autonomous driving, the Industry 4.0 and the high demands on the healthcare industry.

Together with the vehicle component, automation technology for autonomous driving is the central aspect needed in the **automotive industry** to produce self-driving cars in the future. Here, BW with its outstanding automotive industry could take on a leading role in the future and successfully cooperate with British software manufacturers. Both BW and the UK are already active in this area and are cooperating with each other in initial partnerships, for example as part of the EU projects AUTOPILOT, PASCAL, ULTRACEPT or VI-DAS. The respective regional foci of activities in the field of autonomous driving is shown in Figure 21: in BW, work is concentrating around the Karlsruhe region and in the UK, around the city of London. In BW, three research institutes or universities (NEC Laboratories Europe GmbH, the University of Mannheim, and KIT), one start-up (Dino Robotics GmbH), and one company (Valeo Schalter und Sensoren GmbH) are active in the field in one project each. In the UK, the University of Leeds is active in two projects. Two other universities (University of Lincoln and University of Newcastle upon Tyne) and three other companies (NEC Europe Ltd., RDS Driving Services Ltd., XL Insurance Company SE) and an SME/start-up (Visomorphic Technology Ltd.) are each active in one project. In total, 12 institutions from BW and the UK are thus cooperating in four projects in the field of autonomous driving.

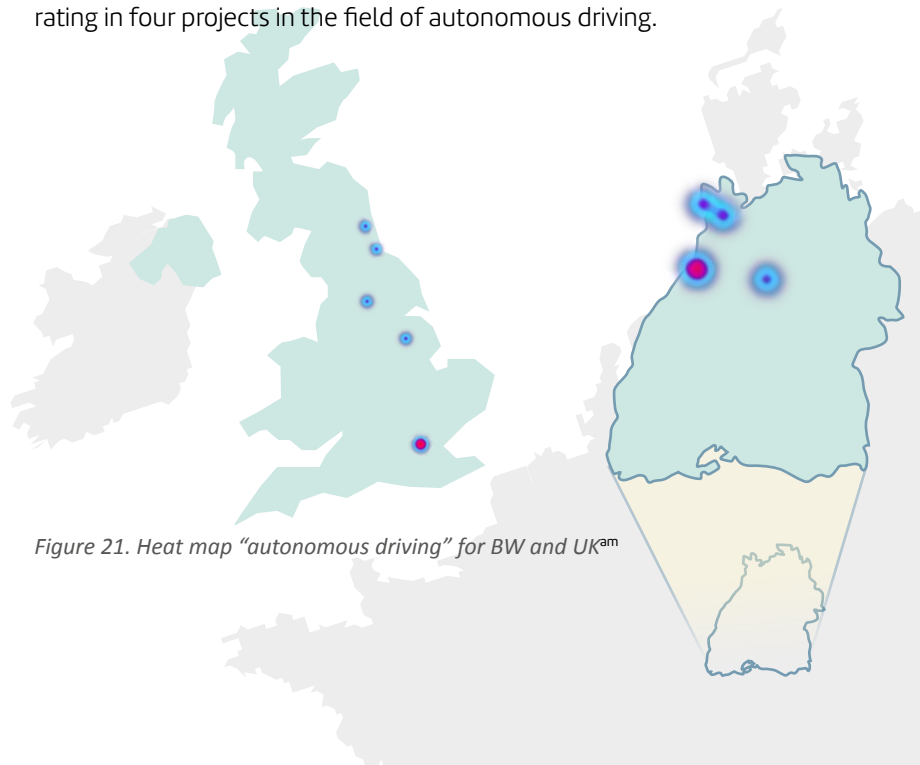


Figure 21. Heat map "autonomous driving" for BW and UK<sup>am</sup>

In the **manufacturing industry**, automation is already playing a major role with respect to the efforts of Industry 4.0., which will continue to play an increasingly important role in the future. Numerous machines and tools will become more efficient, safer and thus significantly more productive through automation processes. The manufacturing industry in BW, which is largely made up of SMEs, can also benefit greatly from the automation expertise of British experts in this field. Vice versa, British automation specialists benefit by working with a wide variety of BW manufacturing industry companies to find specific areas of application for their software.

An analysis of existing cooperation between BW and the UK in Horizon 2020 for the term Industry 4.0. showed that 22 BW institutions cooperate with 26 UK institutions in this area. In total, 48 partners are active in 15 projects. Figure 22 gives an overview of the regional priorities: in BW, the focus is on Karlsruhe, Stuttgart and Freiburg. In the UK, the focus is on London and Cambridge. A total of six large companies, four SMEs and six universities and research institutes are active in BW. KIT stands out with five projects, while Robert Bosch GmbH is the only company in two projects. All other institutions are active in one project each. In the UK, there are six large companies, five SMEs, and 15 universities or research institutes. Here, only two universities are active in two projects each (Brunel University London and University of Southampton), while all other institutions are active in one project each.

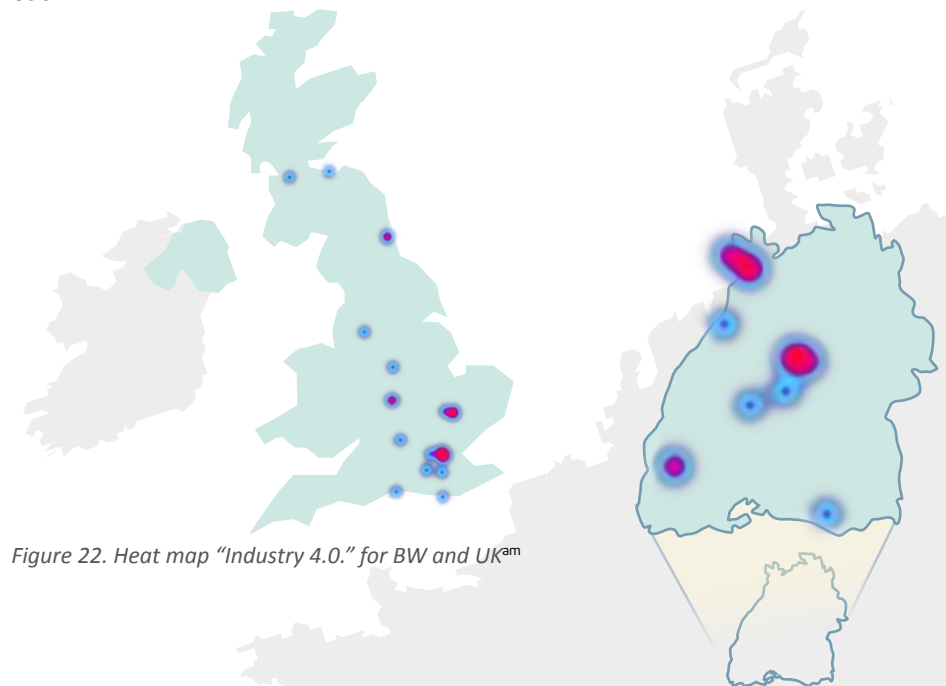


Figure 22. Heat map "Industry 4.0." for BW and UK<sup>am</sup>

The **healthcare industry** also offers numerous areas of application for automation processes. In the field of medical technology there are various opportunities, for example in the automation of various treatment devices. At the University of Tübingen, for example, doctors are currently working together on the automation of respirators for the treatment of COVID-19 patients with a company for gripping systems, Schunk GmbH & Co. KG<sup>273</sup>. Thus, there is also a high potential for cooperation between UK and BW companies and/or universities in the healthcare sector.

Further synergies also result from automation processes in the **cultural and creative industries**, such as within the film and television or publishing sub-sectors.

### 4.3.2. Digitalisation and Artificial Intelligence

Like automation and robotics, digitalisation and AI play a central role in both economic regions with regard to future developments, such as Industry 4.0. In addition, digitalisation and AI, further intensified by the COVID-19 crisis, are central future topics that are of great importance for a change towards more digital activities in almost all industries, but also in the private sector.

BW's great strength in this cross-cutting topic lies, on the one hand, in the Industry 4.0 development, which BW owes to its strong manufacturing and automotive sector, its strong research landscape as well as numerous investments, support measures and initiatives by the state of BW. On the other hand, BW also has great expertise in the areas of digitalisation and AI, for example, through its strong software industry.

In the UK, the focus is clearly on AI and data economy, but also on digitalisation issues such as cyber security or 5G.

This results in numerous complementary competencies and potentials for knowledge and experience exchange between BW and the UK, which results in a high potential for future cooperation: for example, BW with its strong industry offers numerous areas of application for digitalisation and AI measures from which the UK can benefit. Both BW and the UK have great expertise in digitalisation and AI as well as the necessary excellent research and development resources. The UK is at the forefront of the data economy and is already investing heavily in upgrading research and application of data from all relevant industries such as mobility or health. The UK is thus an important partner for BW in order to advance these topics even further in the BW SME sector. The UK also leads Europe in the area of public procurement, the so-called GovTech (AI for the public sector), with annual

investments of around 45 million euros<sup>274,275</sup>. There is therefore great potential to advance the topic of data economy in BW in cooperation with the UK. There are also major synergies between BW and the UK in the area of cyber security, as this is an important future topic in both economic regions. BW is very active in this area, particularly on the academic and political sides. In the UK, there is a high level of activity in the area of start-ups and cluster initiatives, which means that there are great complementarities between BW and the UK.

In numerous areas of digitalisation and AI, the great complementarities between BW and the UK are already being exploited today, which has led to several collaborations between the two economic regions in this cross-cutting topic in recent years (all SMEs with the exception of Silvaco Europe Ltd. and Carl Zeiss AG)<sup>li</sup>:

- NEC Laboratories Europe GmbH from Heidelberg with CommAgility from Leicestershire and CyberLens Ltd. from London in the area of 5G, specifically in the introduction of 5G in the automotive industry for the purpose of providing safer, more environmentally friendly and intelligent means of transport (EU project 5G CARMEN)
- Admos GmbH Advanced Modeling Solutions from Frickenhausen and Silvaco Europe Ltd. from Saint Yves in the field of IT and telecommunications, specifically in connecting households for the purpose of mutual learning of energy-efficient behaviour (EU project DOMINO)
- Carl Zeiss AG from Oberkochen with ISD Solutions from Gloucester in the field of digital twins (Project DigitalTWIN)

A special analysis of the already existing cooperations between BW and the UK in Horizon 2020 for the keyword AI showed that, although more universities and research institutions are involved in cooperations in this area, numerous companies, museums and a few SMEs are involved as well. Figure 23 gives an overview of the geographical distribution of the 42 institutions in BW and the UK, which are involved in ten projects with each other in the field of AI. As before, some project partners are involved in several projects, such as KIT or the University of Sussex. In BW, the regional focus is on the cities of Heidelberg, Karlsruhe and Freiburg. In the UK, activities are focused around the London area, Cambridge and Edinburgh. Two major companies from BW, SAP SE and ZF Friedrichshafen AG, are each involved in one project, as is the State Museum of Natural History Stuttgart. On the scientific side, KIT is involved in three projects, followed by the European Molecular Biology Laboratory in two projects and eight further universities or research institutions in one project each. On the British side, University College London is most active with four projects, followed by the University of Sussex with a participation in three projects. This is followed by the University of Manchester and



the University of Leeds in two projects each. A further 15 universities and research institutes are active in one project each. On the business side, seven companies, museums and gardens (including the Natural History Museum London and the Royal Botanic Gardens Edinburgh and Kew) and two SMEs (Digirati Ltd. and LOUPE 16 Ltd.) are involved in one project each.

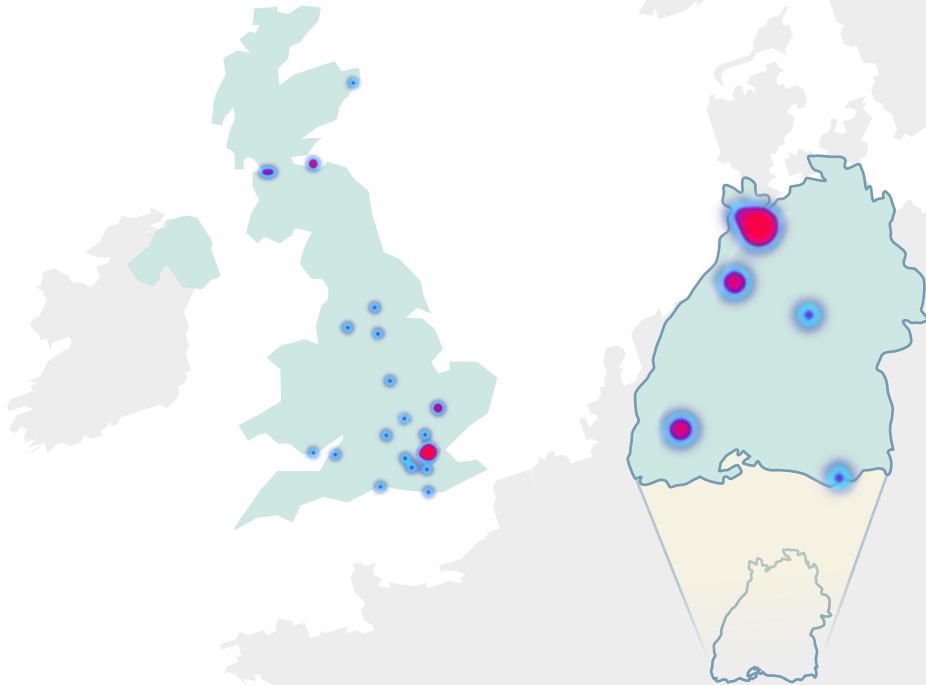


Figure 23. Heat map “artificial intelligence” for BW and UK<sup>am</sup>

As a cross-cutting topic, digitalisation and AI will offer numerous complementarities in the future and thus points of contact for mutually rewarding synergies with various industries, both in BW and in the UK. Some examples of such potential synergies are shown in Table 3.

INDUSTRIES	SYNERGIES IN DIGITALISATION AND AI
Automotive industry	<ul style="list-style-type: none"> <li>• autonomous driving, including topics such as cyber security, 5G</li> <li>• connected cars/hardware</li> <li>• digital/smart factory, for example predictive maintenance</li> <li>• process optimisation</li> <li>• digital traffic management</li> <li>• AI in battery development, for example recognition of battery life or fuel cell power</li> <li>• knowledge management</li> <li>• more efficient fuel cells</li> <li>• digitalisation in value chains / at suppliers</li> </ul>
Healthcare industry	<ul style="list-style-type: none"> <li>• application of games in the healthcare industry, for example for rehabilitation after strokes (further industry involved: creative industries)</li> <li>• Ambient Assisted Living</li> <li>• digital health apps</li> <li>• digital health / telemedicine</li> <li>• digital diagnostics, for example ICAIRD<sup>ao</sup></li> </ul>
Cultural and creative industries	<ul style="list-style-type: none"> <li>• advertising/marketing (analysis of customer data to evaluate purchasing behaviour)</li> <li>• augmented or virtual reality games</li> <li>• live streams of concerts and festivals</li> <li>• digital museum tours</li> <li>• digital fairs</li> </ul>
Mechanical engineering and manufacturing industry	<ul style="list-style-type: none"> <li>• Industry 4.0</li> <li>• digital business models (for example digital twins, platform economy)</li> <li>• digital factory, for example predictive maintenance</li> <li>• process optimisation</li> <li>• knowledge management</li> <li>• digitalisation in value chains / at suppliers</li> </ul>

Table 3. Synergies between digitalisation and artificial intelligence and other industries

<sup>ao</sup> According to experts, the Industrial Centre for Artificial Intelligence Research in Digital Diagnostics (ICAIRD) in Scotland has set itself the goal of becoming a centre of excellence focusing on the application of artificial intelligence in digital diagnostics (according to interview UK12).

Digitalisation and AI will be equally important in all industries, due to the high demand for alternative mobility concepts and treatment methods, digital leisure activities or production optimisation:

In the **automotive industry**, digitalisation and AI technologies are urgently needed to drive forward the development of autonomous and connected vehicles. Topics such as cyber security and 5G or aspects of AI will play a major role in order to be able to offer secure self-driving mobility concepts in the future. This area of development is also of central importance for the future competitiveness of the automotive industry in BW and the UK.

In the **healthcare industry**, the further development of digital diagnosis and treatment methods is currently playing a major role: Innovative solutions such as telemedicine help to reduce the risk of infection between doctors and patients, but also between patients themselves, by using digital media for diagnosis and treatment where possible. A current pilot project in this direction is DocDirekt<sup>276</sup>. The aim should be to be able to digitally diagnose an even wider range of diseases in the future, which will require further developments in the field of digitalisation and AI. A further advantage of telemedicine is that patients with rare diseases can be treated remotely by specialised physicians that are located farther away.

In the **cultural and creative industries**, the COVID-19 crisis shows very clearly how the need for digitalisation and AI solutions can immensely increase overnight in certain sub-sectors of an industry. While there has been a rather low demand for virtual fairs or live concert broadcasts in the past, these concepts have now become a necessity in order to enable artists to work and people to continue to enjoy cultural experiences. Since the further course of the COVID-19 crisis is currently not foreseeable and people are beginning to recognise the advantages of digital activities, further innovative solutions will be developed in the future to meet the demand for digital, international exchange, but above all, for a continuation of cultural experiences. AI applications are also playing an increasingly important role in film productions, especially in the field of animated film, as was the case, for example, in the production of Game of Thrones.

In the **manufacturing industry**, process and production optimisation will play an increasingly important role in the context of Industry 4.0, for which a well-functioning industry as an application area on the one hand and innovative digital solutions and AI on the other hand are of central relevance. For example, the implementation of 5G in production facilities is an important factor (example Worcester Bosch<sup>277</sup>), as is the connection of processes along the value chain with the help of digital twins (example DigitalTWIN<sup>278</sup>).

### 4.3.3. Sustainable Economics

Due to the effects of climate change and CO<sub>2</sub> emissions, the cross-cutting topic of sustainable economics is playing an increasingly important role worldwide, not only within the economy but also in many other areas of life. It is therefore of central concern to the strong industries of BW and the UK to exploit the potential for sustainable processes or products wherever possible and economically reasonable. BW has excellent research in the field of sustainable economics, which has been and continues to be strongly supported by the state of BW. Thanks to its great strength in the automotive sector, BW also offers a good starting position for the development of sustainable mobility solutions and resource-efficient production.

The UK is also investing heavily in the area of sustainable economics and, for example, has a good starting position in the area of wind power generation with Scotland's Orkney Islands.

However, the fight against climate change requires collaborative solutions, supported by cooperative approaches across borders. In the area of housing, for example, BW can score points with its extensive experience in sustainable and energy-efficient construction and like this, can make a targeted contribution in the UK.

An analysis of the existing collaborations between BW and the UK in Horizon 2020 for the term sustainable building revealed that 15 partners from BW are cooperating with 25 partners from the UK in this area. In BW, most activities are focused around the cities of Stuttgart, Heidelberg and Karlsruhe. In the UK, the focus lies on Swindon and London, as shown in Figure 24. In BW, two large companies, three SMEs and four universities or research institutes are involved. In the UK, a total of six large companies, six SMEs and ten universities or research institutes are active. In total, 31 BW and UK institutions are cooperating in 11 projects. In BW, the KIT particularly stands out with activities in four projects. Two projects also involve a major BW corporation, the Tecnar Gesellschaft zur industriellen Anwendung nachwachsender Rohstoffe mbH. On the British side, the two research institutes, the United Kingdom Research and Innovation and the Science and Technology Facilities Council, and the large corporation Building Research Establishment Ltd. are involved in two projects. All other partners are active in one project each. From these results it is clear that British partners are already actively benefiting from BW's expertise in the field of sustainable housing and that there is a mutual exchange of knowledge and a large potential for further cooperation in the future.

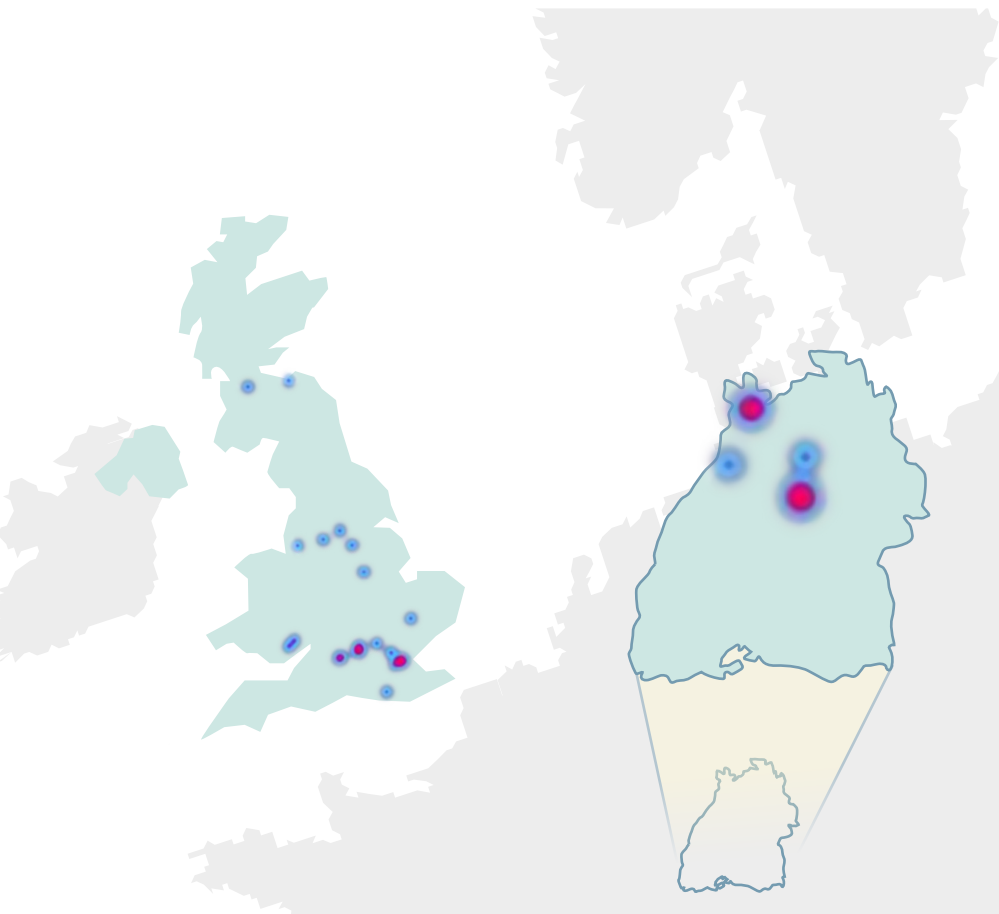


Figure 24. Heat map "sustainable construction" for BW and UK<sup>am</sup>

BW is also strong in the areas of resource efficiency, circular economy and energy saving. The analysis of existing cooperations in Horizon 2020 on the keyword circular economy showed that 13 institutions from BW cooperate with 33 institutions from the UK in 15 projects. The regional focuses are shown in Figure 25: it can be clearly seen that in BW, the focus is on Freiburg and Stuttgart and in the UK on Coventry, London and Manchester. In BW, mainly large corporations (six) and SMEs (six) and only one university are active. In the UK, also large corporations (eight), SMEs (12) and universities (13) are active. In both BW and the UK, only SMEs are

active in several projects: the ICLEI European Secretariat GmbH from BW is active in three projects, followed by iPoint-systems GmbH from BW, Exergy Ltd. from the UK and Information Catalyst for Enterprise Ltd. from the UK in two projects each. All others are active in one project each. This shows that numerous SMEs are involved in the field of circular economy and that there is already a large exchange between BW and the UK taking place, which can be built on in the future.

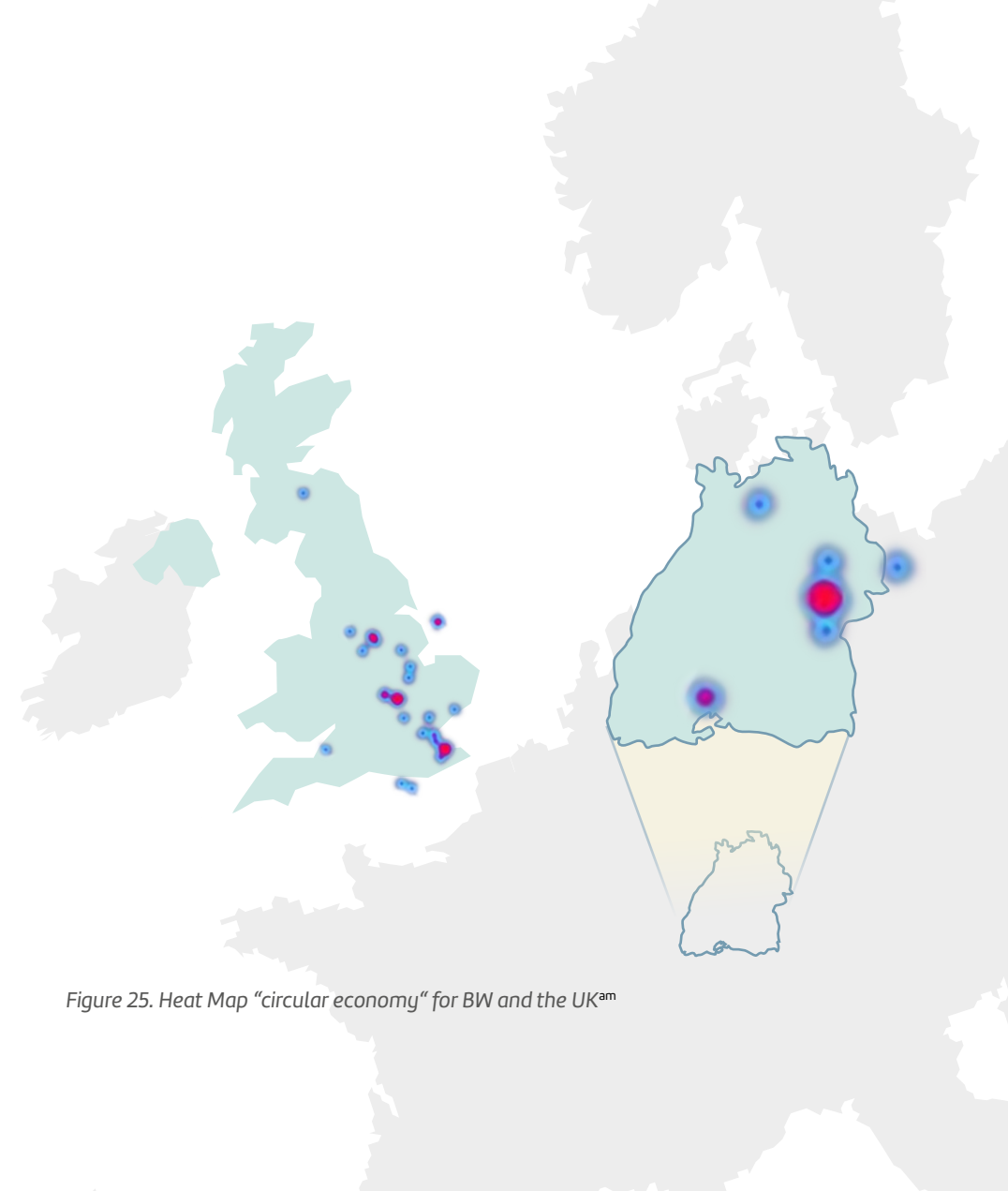


Figure 25. Heat Map "circular economy" for BW and the UK<sup>am</sup>

In the field of sustainable economics, BW and the UK thus have numerous complementary competencies, which in turn offer a high potential for future synergies. In some areas, these complementarities are already being exploited today, which has led to a number of cooperation agreements between BW and the UK in recent years (with the exception of Freudenberg Performance Materials SE & Co. KG, Johnson Matthey Fuel Cells Ltd., Integrated Environmental Solutions Ltd. and Johnson Matthey plc all SMEs):

- FUMATECH BWT GmbH from Bietigheim-Bissingen and ITM Power from Sheffield in the field of Efficient Transport/Smart Cities (EU project CREATE)
- Freudenberg Performance Materials SE & Co. KG from Weinheim and Johnson Matthey Fuel Cells Ltd. from London in the field of energy efficiency (EU project GAIA – Green Awareness in Action)
- Geothermal Engineering GmbH from Karlsruhe and TWI Ltd. from Cambridge in the field of sustainable economics, geo-energy technologies (EU project Science for Clean Energy)
- Dr. Jakob energy research GmbH & Co. KG from Weinstadt and Integrated Environmental Solutions Ltd. from Glasgow in the field of sustainable economics, specifically building physics, building performance and climate engineering (EU project NewTREND)
- INERATEC GmbH from Karlsruhe and Johnson Matthey plc from London in the field of sustainable economics, specifically in the production of electricity, heat and fuels from renewable energies (EU project FLEXCHX)

As a cross-cutting topic, the area of sustainable economics will continue to offer numerous complementarities in the future and thus points of contact for mutually rewarding synergies with various industries, both in BW and in the UK. In addition, BW and Scotland, for example, are members of the Under2 Coalition<sup>279</sup>, a group of state and regional governments that have committed themselves to ambitious climate protection measures in line with the Paris Agreement and to limiting the global temperature increase to well below 2°C. Scotland will also take over the European co-chair of this group from BW in September 2020, which means that there is great potential for synergies between BW and the UK in the area of sustainable economics. Some examples of specific potential synergies are shown in Table 4.

INDUSTRIES	SYNERGIES IN SUSTAINABLE ECONOMICS
Automotive industry	<ul style="list-style-type: none"> <li>• sustainable/alternative mobility, for example e-vehicles, hybrids</li> <li>• batteries or fuel cells as energy-efficient energy producers and storage devices</li> <li>• resource-efficient production</li> </ul>
Healthcare industry	<ul style="list-style-type: none"> <li>• sustainable pharmacy</li> <li>• energy-efficient hospitals</li> </ul>
Cultural and creative industries	<ul style="list-style-type: none"> <li>• sustainable innovations</li> <li>• sustainable film production</li> <li>• sustainable architecture</li> <li>• sustainability at festivals</li> <li>• sustainability in the textile industry</li> </ul>
Mechanical engineering and manufacturing industry	<ul style="list-style-type: none"> <li>• resource efficiency</li> <li>• use of renewable energies</li> <li>• use of sustainable raw materials</li> <li>• CO<sub>2</sub> savings in supply chains</li> <li>• eco manufacturing</li> <li>• production of components for renewable energy sources such as wind turbines, photovoltaic systems, etc.</li> </ul>

Table 4. Synergies between sustainable economics and other industries

Table 4 shows that the cross-cutting topic of sustainable economics will be of particular importance in all major industries.

A great deal of research and development is currently taking place in the field of sustainable mobility solutions, which represents a classic area of overlap between a traditional sector, the **automotive industry**, and the cross-cutting topic of sustainable economics. Besides the optimisation of combustion engines, alternative mobility concepts using batteries or fuel cells as well as synthetic fuels are playing an increasingly important role. Experts estimate that as early as 2030, only a quarter of newly registered vehicles will have a conventional combustion engine, while another quarter will be hybrid vehicles and half of all newly registered vehicles will be electric ones<sup>33</sup>. This opens up numerous opportunities for cooperation between BW and UK car manufacturers and suppliers of alternative mobility concepts.

Further synergies will arise in the **healthcare industry**, for example in the sustainable production and subsequent disposal of pharmaceutical products or in energy efficiency measures for hospitals.

In the **cultural and creative industries**, the concept of sustainability is a common theme throughout all sub-sectors, ranging from sustainable film production and architecture to more sustainable materials in the textile industry and far beyond.

In the **manufacturing industry**, more work is being done to achieve greater resource efficiency by using renewable energies and sustainable raw materials wherever possible and economically reasonable. Also, the reduction of CO<sub>2</sub> in the supply chain plays a major role, due to its large scale. The large overlap between the manufacturing industry and sustainable economics is also due to the fact that the manufacturing industry is responsible for the production of crucial components for renewable energy sources, such as wind turbines.

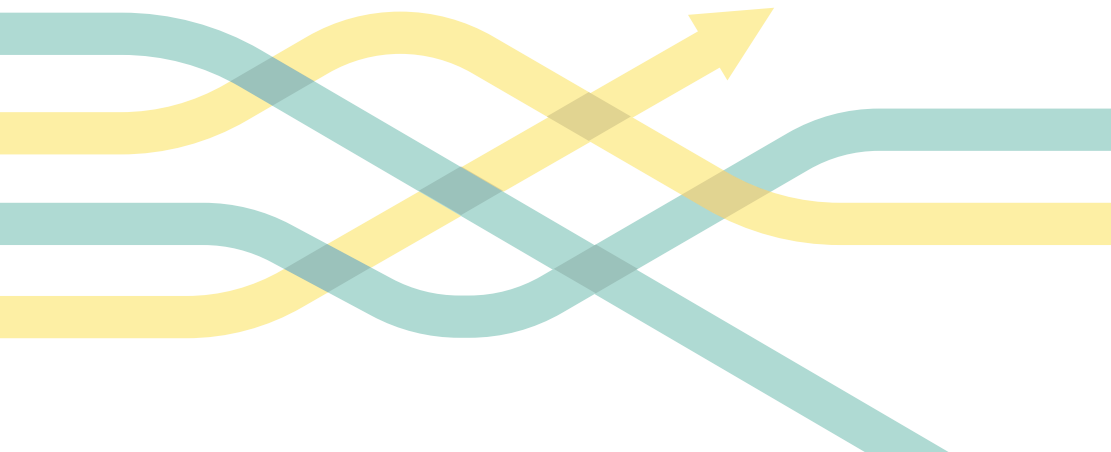
## SYNERGIES IN THE AREA OF START-UP FINANCING

Both BW and the UK have dedicated measures to support start-ups through appropriate ecosystems and financing opportunities to help them get started and grow.

It is important to BW to support innovative start-ups in order to strengthen the country's economy and to remain competitive. For this reason, the WM has launched the state campaign Start-up BW (see <https://www.startupbw.de/en/>), whose task it is to strengthen the regional start-up landscape and provide (even) greater international visibility<sup>280</sup>. Through the Start-up BW Accelerators Program<sup>281</sup>, start-ups receive support in the early phases of business model development, financing acquisition and market entry. A new feature is the pre-seed instrument<sup>282</sup>, which supports financial support to start-ups in an early phase, where investors are not yet involved, through corresponding subsidies from the state. Start-up BW also offers special consulting and innovation vouchers<sup>283</sup> as well as support in the area of internationalisation<sup>284</sup>. In addition, start-ups in BW can obtain financing through private loans, investors (including venture capitalists), crowd funding or business angels.

According to the consumer research company NimbleFin, the UK is the second best country in Europe for start-ups<sup>285</sup>. London ranked second among the world's top locations for start-ups in 2020, along with New York and only behind Silicon Valley. In the FinTech sector, London is even the world's top financial centre with 420 start-ups compared to 320 in New York<sup>286</sup>. In addition to an attractive ecosystem with attractive framework conditions (such as tax breaks) for start-ups<sup>287</sup>, the UK also offers numerous financing options for start-ups: there are a wide range of government support measures designed to make it easier for start-ups to enter the business world. Since 2012 there is the possibility of a state-supported loan available to anyone who wants to start up or expand a start-up or an SME<sup>288</sup>. There are numerous government grants administered by the Department for Business, Energy & Industrial Strategy<sup>289</sup>. With Innovate UK, the country offers independent advice on innovation, cooperation and financing support<sup>290</sup>, as well as tenders for innovation support<sup>291</sup>. As in BW, private loans, investors (including venture capitalists), crowd funding and business angels are also available.

With its particular strength and expertise in the financial services sector, the UK is thus an ideal cooperation partner for interested BW start-ups or SMEs, offering a high potential for future synergies.



## 5. Recommendations for Action

BW and the UK focus on economic policy in numerous similar industries and cross-cutting topics and can therefore strengthen and benefit from each other. Accordingly, there are already many links and collaborations both in applied research and within the industry and SME sector. In the European research and innovation program Horizon 2020 alone, 736 organisations from the UK and 348 organisations from BW are working together in joint projects<sup>ap,292</sup>.

### 5.1. FUTURE FIELDS FOR STRATEGIC COOPERATION

The study provides many indications of industries and cross-cutting topics where BW and the UK can be stronger together. Finally, the three promising cross-cutting topics are discussed in more detail, as well as the most promising synergies between these cross-cutting topics and different industries, where a high potential can be identified for cooperations between BW and the UK, primarily for SMEs.

#### 5.1.1. Digitalisation and Artificial Intelligence

BW and the UK are among the world's leading economic regions in the field of digitalisation and AI. No other European country has as many AI start-ups as the UK, and the country is also a world leader in terms of AI investment. This also applies to the area of data economy, that is, the use of data for new economic sectors or business models. BW's great strength in the area of AI lies with large and medium-sized companies, and their development and implementation of AI<sup>221</sup>. In both economic regions, the respective (state) governments are heavily involved and support the development of AI with far-reaching governmental measures. Furthermore, both BW and the UK have an excellent research landscape in the field of AI.

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<sup>ap</sup> With the withdrawal of the UK from the EU, it is not clear at this stage (30.07.2020) how the future of UK participation in European programmes will look.

## Overall

In addition to numerous cross-thematic cooperations with individual industries (such as the automotive industry or the healthcare industry), there is also targeted potential for synergies within this cross-cutting topic itself. In particular, the following topics can be of interest for mutual exchange and learning as well as for the joint development or marketing of new products and business models:

- **Data economy:** The use of data not only for process optimisation but also for intelligent services and products, based on the analysis of data and leading to learning systems and machines is an interesting cooperation topic. The connection of possibilities and competences by existing industries (especially in BW) and AI service providers (not only, but more strongly in the UK) can be of benefit to all. The basis for this is the high number of AI companies in the UK and the quantity of researchers and innovation developers, for example in Scotland, as well as the great potential regarding the available data, for example in the automotive industry in BW.
- **New digital business models:** Within Europe, the UK is a forerunner and still the leader in e-commerce. The digital economy by means of platform models and service offerings is far from being exhausted in Europe. New business models are also creating new value chains on the European market, which, as a digital market, will continue to be of interest to the UK as well. For BW companies, this is not just about knowledge transfer, but also about working with partners from the UK to integrate the opportunities offered by digital commerce and digital services into their own business models and value and supply chains.
- **Cyber security:** Due to increasing digitalisation, especially in the wake of the COVID-19 pandemic, the topic of cyber security is playing an increasingly important role in society and in the economy. In BW and the UK (especially in Scotland and Wales) there is a large expertise and various cluster initiatives that can be used together to accelerate the development in this area and to thus offer support, especially to SMEs, in both economic regions.

## Automotive industry

The topic of autonomous and connected driving is playing an increasingly important role in the automotive industry. This industry is working with digitalisation and AI experts to develop the car of the future. Besides digitalisation and AI, the technologies of the cross-cutting topic automation and robotics also play an important role here.

- **Autonomous driving:** The use of AI, for example in the field of assistance systems or autonomous driving, is a major topic in both BW and the UK. Complementarities and new value chains can arise if the respective research and development competencies, but also different experiences (premium brands such as Daimler in BW vs. luxury brands or motor sports in the UK) are used and, where appropriate, shared. The heat maps in Chapter 4 show a strong network of companies and research and development facilities in BW and the UK. It makes sense to continue this network and to create value chains with market access.
- **Software and infrastructure:** In connection with the increasing connectivity and automation of vehicles, the software architecture in vehicles and the respective infrastructure are also changing. The operating system in the vehicle and the software platform are becoming more and more important, also regarding value chains. This also offers opportunities for future cooperation between the participating industries in BW and the UK.

## Healthcare industry

For the healthcare industry, the cross-cutting topics with their future technologies in the fields of digitalisation and AI open up many opportunities that are far from being exhausted. Closer cooperation in the following fields could be particularly interesting:

- **Digital health:** The field of digital health covers a broad range of topics. The UK looks back on extensive experience in this area, which means that BW companies can benefit from their proven good practices through cooperation with British partners<sup>293</sup>. In return, British partners can learn from the high level of expertise of BW SMEs in the field of diagnostics and together, they can jointly expand the field of digital prevention or examination measures.
- **E-health and data analysis:** All health data from the UK are centrally collected. This means that the healthcare industry can already successfully use the analysis of patient data to generate findings for future treatments. In the case of the COVID-19 virus, there are several starting points: first, the structure of this novel virus can be investigated with the aid of simulation and supercomputers, enabling the development of precisely tailored therapeutic approaches. Second, data and technologies can be used to improve public safety. Access to high-performance computers and data analytics is essential for this<sup>294</sup>. Here, too, there is great potential for BW and UK companies and research institutions to exchange information and to thus benefit from each other<sup>295</sup>.

## Cultural and creative industries

The cultural and creative industries are a fast-growing sector, especially for the media, which are being given entirely new opportunities through digitalisation and the use of high-performance computers and AI. A closer exchange of knowledge and joint developments or market launches within these topics, especially since both economic regions have their strengths here, can be very interesting, especially in the following areas:

- **Animation:** international award winners and leading companies are located both in the UK and in BW.
- **Software and games industry:** this is a very fast growing sector, especially regarding learning programs or other digital media.
- **Virtual Realities:** the applications in the market are still cautious here, although the technology could already do much more than what is currently being implemented. A cooperation between BW and the UK could close this gap.
- **Use of AI in the production of films:** the use of AI in film production can unleash high savings potentials.

Applications of the above-mentioned creative topics could also open up new markets, for example in the automotive and health industries: 3D solutions or the use of virtual reality (VR), augmented reality (AR) and mixed reality (MR) in film production could be used to a large extent in these industries in BW and the UK. For example, 3D/VR/AR/MR approaches could be used when doing online purchases of vehicles (but also for real estate or other luxury products) or when doing virtual product presentations to improve the user experience and to avoid physical journeys. Moreover, such solutions could also be used extensively in the preparation of complex operations in the healthcare sector.

## Mechanical engineering and manufacturing industry

The influence of digitalisation and AI also plays a central role in the manufacturing industry. For more information, see Chapter 5.1.2.

## 5.1.2. Automation and Robotics

Both BW and the UK are very well positioned in the field of automation and robotics. The heat map in Chapter 4 has shown that there is thus already a high amount of cooperation going on in this cross-cutting topic between BW and the UK. A high potential for future synergies between these two economic regions lies in the following industries:

### Automotive industry

The influence of automation and robotics also plays a central role in the automotive industry. For more information, see chapter 5.1.1.

### Healthcare industry

The technologies of the cross-cutting topic automation and robotics are also of particular importance in the healthcare industry. Closer cooperation could be of particular interest in the following field:

- **Robotics:** Both BW and the UK have their strengths here, but their complementarity could lead to even greater effects on the market. Robotics has great potential in the healthcare industry, including support for nursing care (nursing carts, personal lifts, etc.), but also for surgery or rehabilitation<sup>296</sup>.

### Mechanical engineering and manufacturing industry

Thanks to automation processes, the manufacturing industry will change fundamentally in the future towards the development of an Industry 4.0. and thus become more efficient, more digital and more connected. BW has an excellent starting position here, which, for example, coupled with the software expertise from the UK, can lead to far-reaching improvements within overall production:

- **Automation:** One of BW's great strengths lies in the Industry 4.0, especially in the areas of process optimisation, predictive error detection, automation processes, etc., in other words, the Internet of Things of production. This also applies to the planning of a smart factory that is currently taking place<sup>297</sup>. The UK also has strengths in the topics important for this, such as automation and robotics, but especially in the application of AI and in machine learning.



### 5.1.3. Sustainable Economics

Due to the challenges of the impending climate change, both BW and the UK started to implement more and more sustainable measures into their different industries. Due to a great number of complementarities, a high potential for synergies arises in the following fields:

#### Automotive industry

The topic of sustainable mobility is one of the central future issues for BW and the UK. The industries of both economic regions are thus already doing great efforts in this regard and have been proactively supported with numerous investments and measures from both state governments. In order to make even more progress, it is now necessary to exploit complementarities and synergy effects through international cooperation:

- **Hydrogen:** With BW's claim to be one of the most innovative regions in Europe in terms of hydrogen technology, this topic lends itself to closer cooperation with the UK. The experience gained there in the field of application and rapid market implementation will result in numerous synergies. BW companies, especially SMEs, could gain initial market experience in the UK or, in cooperation with companies from the UK, could offer joint solutions to the European market, but also to the UK (and to countries with which the UK will have trade agreements).
- **Battery:** Battery research and production also lends itself to closer cooperation between BW and the UK. The heat map in Chapter 4 has shown that there is a large number of existing research and innovation collaborations between BW and the UK. These synergies in innovation could be used even more intensively in the future to create value chains.
- **New ideas and projects for the future:** An economic and entrepreneurial exchange between BW and the UK with regard to alternative mobility systems, initial prototypes or test runs can be beneficial in that the automotive industry in BW and the UK has different characteristics that are helpful in the development and test phases. For example, what is being tested in motor sports in the UK may be transferred to vehicles and the mobility of tomorrow in the UK and beyond. In the field of synthetic fuels cooperation possibilities arise as well, such as between car manufacturers and suppliers or even the petroleum and chemical industries.

### Mechanical engineering and manufacturing industry

In addition to important automation processes, numerous sustainability aspects as well as clean production play an important role in connection with Industry 4.0. Here, too, BW has an excellent starting position, which can be combined with the UK's high level of expertise in automation.

- **Industry 4.0:** When planning a smart factory, the goals of sustainability, circular economy, cost optimisation, etc. are of particular importance<sup>298</sup>. More efficient measures in operation can save unnecessary CO<sub>2</sub> emissions and thus lead to cleaner production. Automation, for example of tiring or very repetitive processes can help to prevent accidents at work and thus increase employee satisfaction, resulting in less fluctuation in the company and thus more sustainable work processes.



## 5.2. POLITICAL RECOMMENDATIONS FOR ACTION

### 5.2.1. Overview

**Regular economic policy exchange between BW and the UK, particularly on current innovation topics, to enable the timely initiation of joint activities:** this exchange could be strengthened both through regular contacts of the WM with the responsible Consulate General of the UK and through direct contacts with the countries Wales, Scotland, England and Northern Ireland. The already regular bi-lateral talks between the Commissioner for Europe of the Minister for Economic Affairs, Labour and Housing of the state of Baden-Württemberg and the respective representations in Brussels (Wales, Scotland and Northern Ireland) and in other European networks and initiatives can be further expanded.

#### Focusing of industries and topics:

- **Targeted use of regular specialised and interdisciplinary expert meetings to continuously concretise the topics** of the most promising industries and future technologies and value chains (as described in the previous chapters) that are to be included for targeted initiation of cooperation. The state agencies and experts from cluster initiatives, trade associations, chambers of commerce, etc. could be involved in this process. Furthermore, the topics could be fed back, updated and adapted to the existing nationwide strategies of the automotive or health industries.

*Example: Data analysis/AI in the healthcare industry is successfully used in the UK. The strategy dialogue of the healthcare industry in BW confirms the importance of this topic and puts further focus onto it in order to enter an exchange with successful users in the UK.*

- **Targeted use of existing players, networks and their measures** in the connection of companies and research institutions with the UK, such as the partners of EEN and bw-i, but also the state agencies and cluster initiatives. Inclusion of stakeholders that have successfully implemented digital formats for cooperation exchanges, working groups or the like in 2020.

- **Use of the Vanguard Initiative (VI)** with the partners Scotland and Wales for joint initiatives and pilot projects within and outside VI and in strategic economic policy areas, such as AI.
- **Use of events, trade fairs, delegation trips and cooperation exchanges** in BW, the UK and other EU countries.

*Example 1: Suppliers and potential customers from BW and the UK meet at the bw-i stand at the Hannover Messe in 2021 to get to know each other.*

*Example 2: The Start-up Summit in 2021 invites start-up ecosystems from the UK and creates spaces for political and economic exchange.*

*Example 3: The medical cluster Medical Mountains with 400 SMEs invites a British cluster initiative from the software and games industry to get inspired and to get to know providers for digital learning and marketing formats.*

- **Establishment of a central digital platform** for networking activities between BW and the UK. In addition, the existing offers for initiating cooperation for SMEs (for example, the EEN homepage <https://een-deutschland.de/>) could also be used specifically for British activities.

*Example: A BW provider in the AI industry is looking for a cooperation partner from the UK to jointly serve a customer. The EEN platform can be activated and used. It shows not only potential partners from the UK, but from all over the world.*

#### Financing:

- **Utilisation of state, federal and European funding measures** to initiate and implement cooperation as well as export and import support between BW and the UK.
- **Examination of the need for new promotional measures** to be developed, for example:
  - for networking start-up ecosystems between DE and the UK,
  - for joint financing of infrastructures (for example in the planned Innovation Park AI in BW),
  - for business cooperations.

As the Heat Maps in Chapter 4 have shown, there are already many co-operations in the fields of, for example, hydrogen, battery, automation and robotics or AI in the context of H2020 projects between BW and the UK. These projects will continue after the UK has left the EU. However, it is currently unclear how the UK's participation in the following research framework program Horizon Europe will look. Should there be no or reduced participation, government measures could be useful to continue supporting such collaborations.

#### Evaluation:

Results-oriented, anonymised data collection for measures such as co-operation exchanges or delegation trips to assess the effectiveness of the respective stakeholders involved, their needs and challenges.

#### Market access for innovations:

- Examine the extent to which **support measures** could be mutually opened up or, for example, how more targeted growth financing for start-ups and scale-ups in selected industries, such as AI or hydrogen, could provide new impulses.

*Example: A start-up from BW has provided evidence of a new drive system in the field of mobility (fictitious example) that could be installed without pollutants and that could fully replace combustion engines. Financing from BW alone would not be enough, but the London financial market might be interested. If corresponding agreements between BW and the UK would already exist at that time, a financing round could be implemented quickly.*

- Examine to what extent public procurement in BW and the UK can also be made accessible or easier to use for innovative joint providers from BW and the UK.

*Example: Hospitals in the UK need intensive care beds, but these must comply with certain UK guidelines. An SME in BW with a lot of experience, including from the COVID-19 era, joins forces with a British provider that can implement the upgrade in line with the UK standard, and they jointly bid for the contract.*

## 5.2.2. Proposal for an Implementation Process

### Screening and focusing

The aim for BW and UK stakeholders (primarily SMEs) is to exchange information and to specify the thematic blocks that could be given priority in the selected industries. Ideally, these are the areas in which both have already set priorities and provided or are planning to provide funding.

### Networking

Networking can have different objectives. In case of doubt, the different goals can also be linked together.

- **Promotion of knowledge exchange and technology transfer**

Companies and applied research can be brought together via cooperation exchanges. Ideally, such events are linked with an introduction to important new results from research or five-minute pitches, for example by research institutes, which demonstrate the benefits for SMEs and thus arouse their interest.

Since BW already has a strong landscape of applied research, it is the task of experts to bring that kind of applied research from the UK to BW that is still missing.

Companies can get to know each other through appropriate (digital) formats such as speed dating or brokerage events, as well as through targeted trade fair visits or working groups on specific topics. The integration of the experiences from the EEN are helpful in this respect. Delegation trips, which are offered for example via bw-i, already planned brokerage events of the EEN network or project-related financing possibilities of the Steinbeis-Europa-Zentrum could be used for this as well.

- **B2B connections and market access**

SMEs and especially start-ups need customers in order to demonstrate the value of their new products or technologies and to generate income. The first customers are decisive for innovations. Similar network activities are conceivable here, such as cooperation exchanges, coupled with pitches from the providers. Of interest in this context is the involvement of the public sector as a contractor for innovative solutions, for example targeted supplier exchanges for hospitals and care facilities in the UK (with suppliers from BW) or supplier exchanges for innovative digital solutions by British suppliers for users in BW.

- **Linking ecosystems for start-ups and future technologies (hydrogen, AI)**

Especially in the areas of digitalisation and AI, the UK offers a large number of technical unicorn companies that have been created with appropriate capital and support in the ecosystems around London, Cambridge or Edinburgh. BW's start-up ecosystems are also successful, but the number of technology-driven innovative start-ups is lower than in the UK. The targeted networking of these systems can be beneficial for both sides, not least because it gives UK start-ups access to new, strong customers and, conversely, because start-ups from BW can learn about growth and financing approaches from the UK.

### Activation and mobilisation through existing instruments

- **Financial instruments for companies:** If the networking opportunities listed above are not yet sufficient, further offers through financial instruments for companies could be considered.
- **Innovation vouchers:** Approximately 15 % of innovation vouchers<sup>aq</sup> are already being used by SMEs in BW to use service providers from abroad. These vouchers can be used to develop and finance prototypes, initial samples or other services such as software development for AI applications.
- **EU Cascading Funding Projects,** located at the Steinbeis-Europa-Zentrum.

### Networking instruments:

- **Enterprise Europe Network:** With partners in BW and EEN consortia in the UK, there is a good basis for jointly planned business trips or suitable parallel events at large exhibitions or cooperation exchanges, which are usually not only organised bilaterally between two countries.
- **Bw-i**
- **Vanguard Initiative**
- etc.

### Monitoring

- Monitor measures regularly, for example, by sending out follow-up questionnaires to participants asking about the networking and cooperation results as well as what kind of an influence the measures had on the results of the company.
- Evaluate individual measures in relation to the results.
- Apply learning effects from the measures to future measures.

<sup>aq</sup> More information on innovation vouchers is available at <https://wm.baden-wuerttemberg.de/de/innovation/innovationsgutscheine/> (accessed on 03.09.2020).

### 5.3. STARTING POINTS FOR SMES: DISCOVERING SYNERGIES AND STIMULATING COOPERATION AS WELL AS MARKETS

#### Stronger together:

As part of the strategy for closer cooperation between BW and the UK, regular event and cooperation initiation formats will be offered from autumn 2020 to the end of 2021, which will be particularly geared to the participation of SMEs. Information on these will be made available through the participating organisations such as bw-i (<https://www.bw-i.de/en/start-page.html>), Steinbeis 2i GmbH (<https://www.steinbeis-europa.de/en/>) and the WM (<https://wm.baden-wuerttemberg.de/>). The main focus will be on the selected cross-cutting topics and industries with the highest potential for synergies, as proposed here in the study.

#### Cluster initiatives:

The interdisciplinarity of competences plays an increasingly important role in the development of innovative products and services. SMEs cannot always cover this interdisciplinarity internally and therefore depend on the support of business promoters such as cluster initiatives. A cross-clustering approach between BW and the UK could promote cooperation between SMEs and research and development institutions and would enable SMEs in both economic regions to carry out interdisciplinary product development as well as open up new market access.

#### State agencies for impulses and in-depth information:

BW has established state agencies in important future fields to give SMEs access to new technologically important developments that can be applied across all industries. Whether it's about saving materials (example: Leichtbau BW, <https://www.leichtbau-bw.de/en/home.html>), circular economy and sustainable production (example: Umwelt BW, <https://umwelttechnik-bw.de/>), new drive and storage systems (example: e-Mobil BW, <https://www.e-mobilbw.de/en>), biodegradable materials (example: BIOPRO BW, <https://www.bio-pro.de/en>) or digital and virtual worlds for marketing, sales or simulations (example MFG, <https://www.mfg.de/>) – in these and many other topics, the state agencies are on the road internationally, and of course also in the UK, to provide support in cooperation projects.

#### Getting impulses – finding synergies: Proposals for procedures

1. Use existing contacts to cluster initiatives, business developers, etc.
2. Use specialist events and initiation formats offered by the WM for cooperation.
3. Maintain contacts with relevant state agencies and cluster initiatives and networks.
4. Identify and visit suitable trade fairs and professional events.

Possible points of contact can be found in the table of resources in the appendix, Table 6, as well as in Chapter 3.



## 6. Conclusion: Gemeinsam Stärker – Stronger Together!

As one of the most innovative regions in Europe, the federal state of BW wants to further expand its opportunities and possibilities for a closer cooperation with the UK.

The aim of this study was therefore to determine the economic strengths and the respective challenges of BW and the UK in order to identify those industries and cross-cutting topics with the greatest potential for successful business relationships in the future. The aim was not to compare a region (BW) with a nation (UK), but to identify synergies for mutual benefit for an innovative and competitive economy.

Based on an in-depth literature research and 22 interviews with technical and economic experts from BW and the UK, four industries and three cross-cutting topics were identified as being particularly relevant for future business relations. Of course, there are also other industries and cross-cutting topics that offer points of contact and exciting (niche) markets as well. The following **industries**, however, were identified as being of central importance for successful future cooperation between BW SMEs and the UK:

- Automotive industry
- Healthcare industry
- Cultural and creative industries
- Mechanical engineering and manufacturing industry

In addition, the following three identified **cross-cutting topics** play a central role as well:

- Automation and robotics
- Digitalisation and artificial intelligence
- Sustainable economics



Within all of these industries and cross-cutting topics, there is a high potential for **synergies within the different industries** (for example, a BW car manufacturer with a UK automotive supplier) and **across the different industries** (for example, a BW medical technology company with a UK game software company) as well as for **synergies between individual industries and the cross-cutting topics** (for example, a BW manufacturing company with a UK digitalisation expert). There is great potential for future synergies, especially in the cross-cutting topics, as these address areas where there will be a great need for innovations and further developments in the future in order to combat global challenges such as climate change, the spreading shortage of skilled workers or future pandemics, while at the same time being as well and strategically positioned as possible for global competition.

**Based on the results of this study, concrete recommendations for action** could thus be derived: **SMEs** in BW could focus their efforts on the industries and cross-cutting topics mentioned here. In addition, it is important for SMEs interested in international exchange and future business relationships to contact regional focal points, cluster initiatives and networks, both of their own industries and potential industries outside their own field and use them as initial points of contact. In addition, events offer numerous opportunities to identify future business partners, ideas or models, both within one's own industries and across industry boundaries.

At the economic policy level, the aim is to show **political decision-makers** the concrete added value of close cooperation, which could be promoted by various instruments such as joint promotional measures and closer connection of important ecosystems in the field of trade and innovation. Concrete proposals have been made for the design of support measures to strengthen economic cooperation with the UK in order to exploit synergies and under-utilised potentials.

Thus, entrepreneurial scientific institutions and those promoting transfer of research, business-related intermediaries and promoters as well as chambers of commerce and industry also benefit from this study. Particularly in the area of cross-cutting topics, support from the political side would be helpful in bringing together the mutual exchange and networking between experts from different industries and cross-cutting topics and, for example, in initiating expert discussions. This is particularly relevant if one is interested in international cooperation in the area of cross-cutting topics, since the already existing good contacts between BW and UK political representatives and intermediaries can be of great value here.

For both BW and the UK, good future business relations with each other will continue to be important in order to build a strong foundation for the future and to maintain the prosperity created. The current challenges of the COVID-19 pandemic once again illustrate that international relations and cooperation are of the

highest relevance to solve global tasks. For BW and the UK to continue to benefit from each other's particular strengths and to support each other in potential challenges, it is important that the business relations, joint activities and research cooperations that have functioned so well in the past continue to be equally successful in the future. In addition to the concrete synergies within or between industries and cross-cutting topics mentioned here, other country- or region-specific factors are also of particular importance when it comes to future cooperation and, above all, knowledge exchange between BW and UK companies.

The important and strong financial and service sector in the UK is also an advantage for SMEs in BW, for example when financing issues arise in the context of cooperation. The strong manufacturing industry of BW also offers many advantages for cooperation with the UK. The shaping of future relations with the UK is therefore of great importance to BW's economy, especially for the 980,000 SMEs located there, which provide nearly 5 million jobs in the region and thus employ 65% of all employees. It is clear that business relations between BW and the UK continue to exist in the future. It is also against this background that the WM has set up a dedicated Brexit contact point in 2017 to offer BW companies assistance and support in all matters relating to the UK's withdrawal from the EU.

BW and the UK are connected by more than just mutual trade and cooperation in various areas. In addition to the ease of communication with British business partners, there is also a cultural proximity between Germany and the UK, which has already led to numerous cooperation projects in the past. Moreover, mutual complementarities lead again and again to a productive exchange of knowledge between the two economic regions.

In summary, it can therefore be said that the UK will continue to be an important economic (trade) partner for BW due to the numerous synergies and especially due to its particular strengths.

## References

- 1 Expert talk about chances of Brexit for Baden-Württemberg, Stuttgart 2017.
- 2 <https://wm.baden-wuerttemberg.de/de/service/presse-und-oeffentlichkeitsarbeit/pressemitteilung/pid/hoffmeister-kraut-echte-planungssicherheit-gibt-es-erst-mit-ambitioniertem-freihandelsabkommen> (accessed on 14.08.2020)
- 3 Draft Exposé: Economic Partnership Initiative UK-Baden-Württemberg 2020/21 (Stand: January 2020, Ref. 62)
- 4 Blessing, V., Loeffler, J. & Liedl, P. (2019). InConnect - Internationaler Kooperationsindex, White Paper for Max Syrbe-Symposium on 25.06.2019.
- 5 <https://www.gotomeeting.com/de-de> (accessed on 14.08.2020)
- 6 Innovationsstrategie Baden-Württemberg (Fortschreibung 2020) (2020). Stuttgart, Germany: Ministry for Economic Affairs, Labour and Housing Baden-Württemberg.
- 7 Industrial Strategy. Building a Britain fit for the future (2017). London, United Kingdom: Her Majesty's Government.
- 8 <https://www.statistik-bw.de/Presse/Pressemitteilungen/2019166> (accessed on 14.08.2020)
- 9 <https://www.statistik-bw.de/GesamtwBranchen/UnternehmBetriebe/040230xx.tab?R=LA> (accessed on 14.08.2020)
- 10 Abel-Koch, J., Acevedo, M.F. et al. (2018) Internationalisation of European SMEs – Taking Stock and Moving Ahead. Maisons-Alfort, France: Bpi France.
- 11 <https://www.clusterportal-bw.de/aktuelles/thema-des-monats/internationalisierung-von-kmu-eine-grosse-herausforderung-fuer-cluster-initiativen/> (accessed on 14.08.2020)
- 12 <https://www.statistik-bw.de/Presse/Pressemitteilungen/2019070> (accessed on 14.08.2020)
- 13 [https://www.statistik-bw.de/HandelDienstl/Aussenhandel/AH-XP\\_exportquote.jsp](https://www.statistik-bw.de/HandelDienstl/Aussenhandel/AH-XP_exportquote.jsp) (accessed on 24.08.2020)
- 14 <https://de.statista.com/statistik/daten/studie/188776/umfrage/bruttoinlandsprodukt-bip-in-den-eu-laendern/> (accessed on 14.08.2020)
- 15 <https://www.daimler.com/konzern/news/covid-19-voruebergehende-kurzarbeit.html> (accessed on 14.08.2020)
- 16 <https://www.stuttgarter-zeitung.de/inhalt.bosch-mahle-zf-zulieferer-planen-mit-kurzarbeit-bis-en-de-2020.377dc245-427e-4434-9b57-fa897c973b46.html?reduced=true> (accessed on 14.08.2020)
- 17 <https://www.ulm.ihk24.de/blueprint/servlet/dynamic/action/sihk24/system/rsscategories/rssactions/667552/rssfeedstandortpolitik-konjunktur> (accessed on 22.07.2020)
- 18 <https://wm.baden-wuerttemberg.de/de/service/foerderprogramme-und-aufrufe/liste-foerderprogramme/soforthilfe-corona/> (accessed on 14.08.2020)
- 19 <https://wm.baden-wuerttemberg.de/de/service/foerderprogramme-und-aufrufe/liste-foerderprogramme/ueberbrueckungshilfe-corona/> (accessed on 14.08.2020)
- 20 <https://wrs.region-stuttgart.de/informationen-zu-corona.html#c1843> (accessed on 14.08.2020)
- 21 <https://www.statistik-bw.de/Presse/Pressemitteilungen/2020040> (accessed on 14.08.2020)
- 22 <https://www.uktradeinfo.com/Statistics/Pages/Monthly-Tables.aspx> (accessed on 14.08.2020)
- 23 Frieske, B., van den Adel, B. (Deutsches Zentrum für Luft- und Raumfahrt e. V. – Institut für Fahrzeugkonzepte), Schwarz-Kocher, M., Stieler, S. (IMU Institut GmbH), Schnabel, A. & Tözün, R. (BridgingIT GmbH) (2019). Strukturstudie BWe mobil 2019. Transformation durch Elektromobilität und Perspektiven der Digitalisierung. Stuttgart, Germany: e-mobil BW GmbH.
- 24 <https://www.bw-invest.de/standort/branchen-cluster/automobilwirtschaft> (accessed on 14.08.2020)
- 25 <https://cars.region-stuttgart.de/> (accessed on 14.08.2020)
- 26 [https://www.e-mobilbw.de/fileadmin/media/e-mobilbw/Publikationen/Broschueren/Datenmonitor\\_Juli\\_2019\\_e-mobil.pdf](https://www.e-mobilbw.de/fileadmin/media/e-mobilbw/Publikationen/Broschueren/Datenmonitor_Juli_2019_e-mobil.pdf) (accessed on 14.08.2020)
- 27 <http://www.automotive-bw.de/de/unternehmen/GrusswortMinister.php> (accessed on 14.08.2020)



- 28 <https://www.clusterportal-bw.de/clusterdaten/technologiefelder/technologiefelder-detailseite/automotive/clusterdb/Innovationsfeld/show/> (accessed on 14.08.2020)
- 29 Weichenhain, U., Lange, S., Koolen, J., Benz, A., Hartmann, S., Heilert, D., Henninger, S. & Kallenbach, T. (2020). Potenziale der Wasserstoff- und Brennstoffzellen-Industrie in Baden-Württemberg. Study commissioned by the Ministry for the Environment, Climate and Energy of Baden-Württemberg. Munich, Germany: Roland Berger GmbH.
- 30 <https://www.bw.igm.de/news/meldung.html?id=94455> (accessed on 14.08.2020)
- 31 Staatsministerium Baden-Württemberg (2018). Baden-Württemberg wird Vorreiter für Künstliche Intelligenz. Strategy paper. (see also <https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/vorreiter-fuer-kuenstliche-intelligenz/> (accessed on 31.08.2020)).
- 32 <https://www.heise.de/news/Daimler-buendelt-Brennstoffzellen-Entwicklung-4777211.html> (accessed on 26.08.2020)
- 33 <https://wm.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/elektromobilitaet/> (accessed on 14.08.2020)
- 34 <https://wm.baden-wuerttemberg.de/de/service/presse-und-oeffentlichkeitsarbeit/pressemitteilung/pid/wirtschaftsministerium-foerdert-wasserstoffforschung-am-dlr-standort-lampoldshausen-mit-rund-16-milli/> (accessed on 24.08.2020)
- 35 <https://de.statista.com/statistik/daten/studie/373212/umfrage/umsatz-der-deutschen-batteriebranche/> (accessed on 14.08.2020)
- 36 [https://ec.europa.eu/commission/presscorner/detail/de/ip\\_19\\_6705](https://ec.europa.eu/commission/presscorner/detail/de/ip_19_6705) (accessed on 14.08.2020)
- 37 <https://wm.baden-wuerttemberg.de/de/service/presse-und-oeffentlichkeitsarbeit/pressemitteilung/pid/landesregierung-beschliesst-unterstuetzung-fuer-europaeische-batterie-projekte-ipcei/> (accessed on 24.08.2020)
- 38 <https://www.electrive.net/2020/04/01/baden-wuerttemberg-beschliesst-millionen-foerderung-fuer-batterie-projekte/> (accessed on 14.08.2020)
- 39 <https://www.ipa.fraunhofer.de/de/referenzprojekte/Fast-Storage-BW-II.htm> (accessed on 26.08.2020)
- 40 <https://www.ipa.fraunhofer.de/de/referenzprojekte/digibattpro-4-0---bw--digitalisierte-batterieproduktion-4-0.html> (accessed on 26.08.2020)
- 41 [https://www.ipa.fraunhofer.de/de/zusammenarbeit/industry-on-campus/s-tec/zentrum\\_fuer\\_digitalisierte\\_batteriezellenproduktion.html](https://www.ipa.fraunhofer.de/de/zusammenarbeit/industry-on-campus/s-tec/zentrum_fuer_digitalisierte_batteriezellenproduktion.html) (accessed on 26.08.2020)
- 42 <https://www.baden-wuerttemberg.de/de/bw-gestalten/nachhaltiges-baden-wuerttemberg/verkehr/> (accessed on 14.08.2020)
- 43 <https://taf-bw.de/> (accessed on 14.08.2020)
- 44 <https://vm.baden-wuerttemberg.de/de/politik-zukunft/zukunftskonzepte/autonomes-fahren/> (20.08.2020)
- 45 <https://www.bmbf.de/de/synthetische-kraftstoffe-5040.html> (18.08.2020)
- 46 <https://www.refuels.de/index.php> (accessed on 26.08.2020)
- 47 <https://www.e-mobilbw.de/service/meldungen-detail/13-millionen-euro-fuer-batterierecycling> (accessed on 26.08.2020)
- 48 Laabidi, S. (2016). Wertschöpfungs- und Beschäftigungsauswirkungen der Elektromobilität auf die Zulieferindustrie in Baden-Württemberg. Academic thesis. Stuttgart, Germany: University of Stuttgart.
- 49 Expert discussion with automotive experts of the WM 2020.
- 50 Felbermayr, G., Gröschl, J., Heiland, I., Braml, M. & Steininger, M. (2017). Ökonomische Effekte eines Brexit auf die deutsche und europäische Wirtschaft. ifo Forschungsberichte 85. Munich, Germany: ifo Institut.
- 51 <http://www.vda.de/en/services/facts-and-figures/share.html?src=en/infographics/0.html> (25.08.2020)
- 52 <https://www.gesundheitsindustrie-bw.de/standort/fakten> (accessed on 14.08.2020)
- 53 <https://www.bw-invest.de/standort/branchen-cluster/gesundheitsindustrie/> (accessed on 14.08.2020)
- 54 <https://www.clusterportal-bw.de/clusterdaten/technologiefelder/technologiefelder-detailseite/pharmaindustrie/clusterdb/Innovationsfeld/show/> (accessed on 14.08.2020)
- 55 <https://wm.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/medizintechnik/> (accessed on 14.08.2020)
- 56 <https://wm.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/chemie-und-pharmazie/> (accessed on 14.08.2020)
- 57 <https://www.clusterportal-bw.de/clusterdaten/technologiefelder/technologiefelder-detailseite/pharmaindustrie/clusterdb/Innovationsfeld/show/> (accessed on 18.08.2020)
- 58 [www.forum-gesundheitsstandort-bw.de](http://www.forum-gesundheitsstandort-bw.de) (accessed on 14.08.2020)
- 59 <https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/pharmadiolog-diskutiert-herausforderungen-der-pharmaindustrie/> (accessed on 14.08.2020)
- 60 <https://www.aerztekammer-bw.de/news/2019/2019-03/arztzahlstatistik/index.html> (accessed on 14.08.2020)
- 61 <https://medicalmountains.de/umfrage-von-medicalmountains-und-spectaris-umsatzminus-deutscher-medizintechnikindustrie-durch-corona-bestaetigt-sich/#more=5373> (accessed on 21.08.2020)
- 62 <https://clinicaltrials.gov/ct2/results/map/click?map.x=943&map.y=936&cond=COVID&cntry=DE&dist=100&map=EU&mapw=1669> (accessed on 14.08.2020)
- 63 <https://medicalmountains.de/umfrage-von-medicalmountains-und-spectaris-umsatzminus-deutscher-medizintechnikindustrie-durch-corona-bestaetigt-sich/#more=5373> (accessed on 26.07.2020)
- 64 Engstler, M., Mörgenthaler, L. & Nohr, H. (2015). Trendbarometer Kreativwirtschaft Baden-Württemberg 2015. Reale und virtuelle Orte der Kooperation von Kreativschaffenden in Baden-Württemberg. Hochschule der Medien, Institute for creative industries. GRIN Verlag.
- 65 <https://www.clusterportal-bw.de/clusterdaten/technologiefelder/technologiefelder-detailseite/medienkultur-und-kreativwirtschaft/clusterdb/Innovationsfeld/show> (accessed on 14.08.2020)
- 66 [https://www.bmwi.de/Redaktion/EN/Publikationen/Wirtschaft/cultural-and-creative-industries-monitoring-report-2019-summary.pdf?\\_\\_blob=publicationFile&v=4](https://www.bmwi.de/Redaktion/EN/Publikationen/Wirtschaft/cultural-and-creative-industries-monitoring-report-2019-summary.pdf?__blob=publicationFile&v=4) (accessed on 14.08.2020)
- 67 <https://www.clusterportal-bw.de/clusterdaten/technologiefelder/technologiefelder-detailseite/medienkultur-und-kreativwirtschaft/clusterdb/Innovationsfeld/show/> (accessed on 14.08.2020)
- 68 <https://www.m-r-n.com/presse/pressemitteilung-details/803/> (accessed on 24.08.2020)
- 69 Wirtschaftsförderung Region Stuttgart GmbH (WRS) (2017). Kreativwirtschaft in der Region Stuttgart.
- 70 Montalto, V., Tacao Moura, C. J., Alberti, V., Panella, F. & Saisana, M. (2019). The Cultural and Creative Cities Monitor. 2019 edition. Luxembourg: Publications Office of the European Union.
- 71 Andres, R., Erdsiek, D., Ohnemus, J., Rammer, C. & Viete, S. (2020). Monitoringbericht Kultur- und Kreativwirtschaft 2019. Berlin, Germany: Federal Ministry of Economics and Energy (BMWi).
- 72 <https://kreativ.mfg.de> (accessed on 14.08.2020)
- 73 <https://www.stuttgarter-nachrichten.de/inhalt.neue-staffel-von-game-of-thrones-so-viel-stuttgart-steckt-in-der-fantasy-serie.c14b5437-a3b4-417f-a841-ce97d0282c0b.html> (accessed on 26.08.2020)
- 74 <https://wm.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/kultur-und-kreativwirtschaft/> (accessed on 24.08.2020)
- 75 <http://www.institut-kreativwirtschaft.de/wp-content/uploads/2016/06/Trendbarometer-Kreativwirtschaft-BW-2015.pdf> (accessed on 14.08.2020)
- 76 [http://www.kulturgutschutz-deutschland.de/DE/Staateninformation/Europa/Grossbritannien/grossbritannien\\_staateninfo.html](http://www.kulturgutschutz-deutschland.de/DE/Staateninformation/Europa/Grossbritannien/grossbritannien_staateninfo.html) (accessed on 14.08.2020)
- 77 <https://kreativ.mfg.de/service/corona-krise/> (accessed on 14.08.2020)
- 78 <https://wm.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/maschinenbau/> (accessed on 14.08.2020)
- 79 <https://www.bw-invest.de/standort/branchen-cluster/maschinenbau> (accessed on 14.08.2020)
- 80 <https://www.vdma.org/> (accessed on 14.08.2020)
- 81 <https://www.stuttgarter-zeitung.de/inhalt.maschinenbau-in-baden-wuerttemberg-branche-mit-langfristiger-perspektive.f115b5b7-5142-44b7-b220-3f9caa49082c.html> (accessed on 14.08.2020)
- 82 Expert discussion with Department 33 of the WM 2020.
- 83 <https://bawue.vdma.org/viewer/-/v2article/render/48880388> (accessed on 14.08.2020)
- 84 <https://www.statistik-bw.de/Presse/Pressemitteilungen/2020087> (accessed on 14.08.2020)
- 85 <https://www.swr.de/swraktuell/baden-wuerttemberg/maschinenbau-vdma-100.html> (14.08.2020)

- 86 <https://www.statistik-bw.de/Presse/Pressemitteilungen/2020125> (accessed on 14.08.2020)
- 87 <https://bawue.vdma.org/viewer/-/v2article/render/49060796> (accessed on 14.08.2020)
- 88 <https://www.tagesschau.de/wirtschaft/brexit-folgen-103.html> (accessed on 14.08.2020)
- 89 <https://de.statista.com/statistik/daten/studie/567817/umfrage/grossbritannien-importe-aus-der-eu/> (accessed on 14.08.2020)
- 90 <https://www.smmmt.co.uk/industry-topics/uk-automotive/> (accessed on 14.08.2020)
- 91 <https://www.statista.com/statistics/299312/number-of-people-employed-in-the-motor-industry-in-the-united-kingdom/> (accessed on 14.08.2020)
- 92 <https://www.statista.com/topics/1982/the-uk-automotive-industry/> (accessed on 14.08.2020)
- 93 <https://www.smmmt.co.uk/wp-content/uploads/sites/2/SMMT-Motor-Industry-Facts-May-2019-V2.pdf> (accessed on 14.08.2020)
- 94 <https://www.great.gov.uk/international/content/about-uk/industries/automotive/> (accessed on 14.08.2020)
- 95 <https://www.ibisworld.com/united-kingdom/market-research-reports/motor-vehicle-maintenance-repair-industry/> (accessed on 14.08.2020)
- 96 <https://www.gov.uk/government/publications/business-population-estimates-2019/business-population-estimates-for-the-uk-and-regions-2019-statistical-release-html> (accessed on 14.08.2020)
- 97 Her Majesty's Government (HMG) (2018). The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy. London, United Kingdom.
- 98 <https://www2.staffingindustry.com/eng/Editorial/Daily-News/UK-Hydrogen-Group-revenue-and-profits-sink-due-to-weak-EMEA-and-APAC-performances-53390> (accessed on 14.08.2020)
- 99 <https://www.gov.uk/government/news/90-million-uk-drive-to-reduce-carbon-emissions> (accessed on 14.08.2020)
- 100 <https://matthey.com/en/inspiring-science/expert-insights/supporting-the-hydrogen-economy> (accessed on 14.08.2020)
- 101 <https://www.bbc.com/future/article/20190327-the-tiny-islands-leading-the-way-in-hydrogen-power> (accessed on 14.08.2020)
- 102 <https://www.ft.com/content/b28e7aba-c4f2-11e9-a8e9-296ca66511c9> (accessed on 14.08.2020)
- 103 Gifford, S. (2019). The Gigafactory Boom: the Demand for Battery Manufacturing in the UK. The Faraday Institution. Faraday Insights – Issue 2: August 2019.
- 104 <https://www.gov.uk/plug-in-car-van-grants> (accessed on 24.08.2020)
- 105 <https://www.electrive.net/2020/03/12/grossbritannien-e-foerderung-verlaengert-aber-zu-geringeren-saetzen/> (accessed on 24.08.2020)
- 106 <https://www.gov.uk/government/organisations/centre-for-connected-and-autonomous-vehicles> (accessed on 20.08.2020)
- 107 <https://tradeandinvest.wales/tech/compound-semiconductors> (accessed on 18.08.2020)
- 108 <https://tradeandinvest.wales/compound-semiconductor-infrastructure> (accessed on 18.08.2020)
- 109 Jenkins, K.E.H. & Hopkins, D. (2019). Transitions in Energy Efficiency and Demand. The Emergence, Diffusion and Impact of Low-Carbon Innovation. London, United Kingdom: Routledge.
- 110 <http://smestrategies.co.uk/smes-in-the-automotive-supply-chain-facing-downturn-in-global-car-market/> (accessed on 14.08.2020)
- 111 <https://www.fch.europa.eu/sites/default/files/Big%20results%20for%20SMEs.pdf> (accessed on 14.08.2020)
- 112 Weishäupl, E. & Nothnagel, I. (2017). The Impact of Brexit on German Businesses. Results of the IHK Business Survey "Going International 2017". Berlin, Germany: Association of German Chambers of Industry and Commerce (DIHK).
- 113 <https://www.smmmt.co.uk/2020/01/uk-car-output-falls-as-industry-targets-world-class-fta-that-keeps-auto-building-for-britain/#:~:text=UK%20car%20production%20fell%20%2D14.2,a%20third%20year%20of%20decline.&text=Last%20year%20saw%20a%20welcome,publicly%20announced%20for%20the%20UK> (accessed on 14.08.2020)
- 114 [autoindustrie-jeder-sechste-job-in-gefahr?utm\\_source=mailchimp&utm\\_medium=newsletter&utm\\_campaign=nachrichten \(accessed on 14.08.2020\)

115 <https://www.gov.uk/government/publications/life-sciences-industrial-strategy-update> \(accessed on 18.08.2020\)

116 <https://www.great.gov.uk/international/content/about-uk/industries/health-and-life-sciences/> \(accessed on 14.08.2020\)

117 <https://blog.ttcp.com/the-uks-golden-triangle/> \(accessed on 14.08.2020\)

118 <https://www.lifesciencesscotland.com/> \(accessed on 18.08.2020\)

119 <https://www.timeshighereducation.com/world-university-rankings> \(accessed on 18.08.2020\)

120 <https://www.abpi.org.uk/media-centre/news/2019/january/government-set-to-invest-100-million-in-research-and-tech/> \(accessed on 14.08.2020\)

121 Written exchange with British Consulate on 14.08.2020.

122 <https://www.med-technews.com/features/a-new-dawn-for-diagnostics-in-a-post-covid-world/> \(accessed on 26.08.2020\)

123 <https://www.beauhurst.com/blog/uk-fast-growing-life-sciences-companies/> \(accessed on 14.08.2020\)

124 Varnai, P., Rentel, M., Davé, A., De Scalzi, M., Timmerman, W., Rosemberg, C. and Simmonds, P. \(2017\). The Impact of Collaboration: the value of UK medical research to EU science and health. \(see also <https://www.cancerresearchuk.org/about-us/we-develop-policy/we-work-with-government/exiting-the-eu/uk-and-eu-research> \(accessed on 26.08.2020\)\)

125 <https://www.ukri.org/innovation/industrial-strategy-challenge-fund/healthy-ageing/#pagecontentid=0> \(accessed on 24.08.2020\)

126 <https://www.pwc.co.uk/industries/pharmaceuticals-life-sciences.html> \(accessed on 14.08.2020\)

127 <https://www2.deloitte.com/uk/en/pages/life-sciences-and-healthcare/articles/global-life-sciences-sector-outlook.html> \(accessed on 14.08.2020\)

128 <https://www.bakermckenzie.com/en/insight/publications/2020/03/making-medical-devices-tackle-covid19> \(accessed on 14.08.2020\)

129 <https://clinicaltrials.gov/ct2/results?cond=COVID&term=&cntry=GB&state=&city=&dist=&Search=Search> \(accessed on 14.08.2020\)

130 <https://www.england.nhs.uk/2020/05/nhs-roadmap/> \(accessed on 26.08.2020\)

131 <https://www.nytimes.com/2020/07/18/world/europe/nhs-waiting-times-coronavirus.html> \(accessed on 26.08.2020\)

132 \[https://www.thecreativeindustries.co.uk/media/551640/ci\\\_value-revise-2\\\_2020.png\]\(https://www.thecreativeindustries.co.uk/media/551640/ci\_value-revise-2\_2020.png\) \(accessed on 29.07.2020\)

133 <https://www.creativeindustriesfederation.com/statistics> \(accessed on 14.08.2020\)

134 <https://www.nesta.org.uk/press-release/first-mapping-of-uks-creative-and-high-tech-economies-reveals-role-for-government-in-addressing-regional-imbalance/> \(accessed on 14.08.2020\)

135 <https://www.creativeindustriesfederation.com/statistics> \(accessed on 14.08.2020\)

136 <https://www.gov.uk/government/news/uks-creative-industries-contributes-almost-13-million-to-the-uk-economy-every-hour> \(accessed on 14.08.2020\)

137 <https://www.globenewswire.com/news-release/2019/04/15/1803764/0/en/United-Kingdom-Animation-VFX-Games-Industry-Strategies-Trends-Opportunities-Report-2019.html> \(accessed on 18.08.2020\)

138 <https://www.topuniversities.com/university-rankings/world-university-rankings/2019> \(accessed on 14.08.2020\)

139 <https://www.great.gov.uk/international/content/about-uk/industries/creative-industries/> \(accessed on 14.08.2020\)

140 <https://www.thecreativeindustries.co.uk/uk-creative-overview/why-the-uk> \(accessed on 14.08.2020\)

141 <https://creativeeconomy.britishcouncil.org/guide/what-creative-economy/> \(accessed on 29.7.2020\)

142 <https://creativeeconomy.britishcouncil.org/guide/three-stages-life-creative-economy/> \(accessed on 14.08.2020\)

143 <https://ahrc.ukri.org/documents/publications/bop-ahrc-report/> \(accessed on 14.08.2020\)](https://www.automobilwoche.de/article/20200623/AGENTURMELDUNGEN/306239946/1344/britische-</a></p>
</div>
<div data-bbox=)

- 144 <https://creativeconomy.britishcouncil.org/guide/new-funding-and-business-models/> (accessed on 14.08.2020)
- 145 <https://www.thecreativeindustries.co.uk/uk-creative-overview/facts-and-figures/employment-figures> (accessed on 14.08.2020)
- 146 <https://www.prospects.ac.uk/jobs-and-work-experience/job-sectors/creative-arts-and-design/overview-of-the-creative-arts-sector-in-the-uk> (accessed on 14.08.2020)
- 147 <https://www.dezeen.com/2020/06/18/creative-industries-federation-coronavirus-uk/> (accessed on 26.7.2020)
- 148 <https://www.smia.org.uk/development/coronavirus-resources/audio-and-radio-emergency-fund-open-for-applications/> (accessed on 14.08.2020)
- 149 Rhodes, C. (2020). Manufacturing: Statistics and Policy. Briefing Paper. House of Commons Library. Number 01942, 10 January 2020.
- 150 <https://www.prospects.ac.uk/jobs-and-work-experience/job-sectors/engineering-and-manufacturing/overview-of-the-engineering-and-manufacturing-sector-in-the-uk> (accessed on 14.08.2020)
- 151 <https://www.engineeringuk.com> (accessed on 14.08.2020)
- 152 <https://www.ons.gov.uk/businessindustryandtrade/manufacturingandproductionindustry/bulletins/ukmanufacturerssalesbyproductprodcom/2018https://www.ons.gov.uk/businessindustryandtrade/manufacturingandproductionindustry/bulletins/ukmanufacturerssalesbyproductprodcom/2018> (accessed on 14.08.2020)
- 153 <https://www.gov.scot/publications/export-stats-scotland-2018/> (accessed on 26.08.2020)
- 154 <https://www.makeuk.org/news-and-events/news/make-ukbdo-report-industry-warns-of-damaging-double-whammy-hit-to-regions-from-no-deal> (accessed on 14.08.2020)
- 155 <https://www.industryforum.co.uk/resources/articles/the-competitiveness-of-european-mechanical-engineering-industry/> (accessed on 14.08.2020)
- 156 <https://www.sonypencoed.co.uk/> (accessed on 26.08.2020)
- 157 <https://www.ft.com/content/328f6170-c5bb-11e9-a8e9-296ca66511c9> (accessed on 27.7.2020)
- 158 <https://www.tesab.com/> (accessed on 14.08.2020)
- 159 <https://www.telegraph.co.uk/business/tips-for-the-future/future-of-manufacturing/> (accessed on 14.08.2020)
- 160 <https://www.schmeck-den-sueden.de/starke-marken/> (accessed on 14.08.2020)
- 161 <https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/regionale-lebensmittel-werden-immer-beliebter/> (accessed on 14.08.2020)
- 162 <https://www.retailgazette.co.uk/blog/2020/02/lidl-opens-800th-store-amidst-1-3bn-investment-announcement/> (accessed on 01.09.2020)
- 163 <https://www.zeit.de/zustimmung?url=https%3A%2F%2Fwww.zeit.de%2Fwirtschaft%2F2019-11%2Faldi-lidl-discounter-grossbritannien-brexit-preise-wachstum%2Fkomplettansicht> (accessed on 14.08.2020)
- 164 <https://www.fdf.org.uk/statsataglance.aspx> (accessed on 14.08.2020)
- 165 <https://www.gov.uk/government/publications/food-statistics-pocketbook/food-statistics-in-your-pocket-summary> (accessed on 24.08.2020)
- 166 <https://www.scotch-whisky.org.uk/newsroom/scotch-whisky-exports-surge-amidst-backdrop-of-tariff-uncertainty/> (accessed on 14.08.2020)
- 167 <https://www.gtai.de/gtai-de/trade/recht/rechtsmeldung/vereinigtes-koenigreich/entwurf-fuer-neues-britisches-einwanderungsrecht-vorgelegt-220090> (accessed on 14.08.2020)
- 168 <https://www.baden-wuerttemberg.de/de/innovation/ausgewaehlte-branchen/luft-und-raumfahrt> (accessed on 14.08.2020)
- 169 <https://www.clusterportal-bw.de/clusterdaten/technologiefelder/technologiefelder-detailseite/luft-und-raumfahrt/clusterdb/innovationsfeld/show/> (accessed on 14.08.2020)
- 170 <https://www.great.gov.uk/international/content/about-uk/industries/aerospace/> (accessed on 14.08.2020)
- 171 <https://www.gov.uk/government/publications/aerospace-sector-deal/aerospace-sector-deal> (accessed on 28.08.2020)
- 172 <https://tradeandinvest.wales/advanced-materials-manufacturing/aerospace> (accessed on 14.08.2020)

- 173 <https://www.aerospacewalesforum.com> (accessed on 14.08.2020)
- 174 <https://www.bbc.com/news/uk-northern-ireland-53036530> (accessed on 14.08.2020)
- 175 <https://rua.vdma.org/> (accessed on 14.08.2020)
- 176 <https://rosindustrial.org/ric-eu> (accessed on 18.08.2020)
- 177 <https://epsrc.ukri.org/newsevents/news/ukairobotics/> (accessed on 14.08.2020)
- 178 <https://www.imperial.ac.uk/news/185135/experts-outline-robotic-devices-transform-surgical/> (accessed on 14.08.2020)
- 179 <https://epsrc.ukri.org/newsevents/news/tinyenginefromgold/> (accessed on 14.08.2020)
- 180 <https://www.oxbotica.com/> (accessed on 14.08.2020)
- 181 <https://epsrc.ukri.org/blog/antibiotic-discovery-in-the-abbyss/> (accessed on 14.08.2020)
- 182 <https://www.great.gov.uk/international/content/about-uk/industries/engineering-and-manufacturing/> (accessed on 14.08.2020)
- 183 <https://ifr.org/news/brexit-uk-falling-back-in-global-automation-race-robot-sales-down-3/> (accessed on 14.08.2020)
- 184 <https://www.bwstiftung.de/forschung/programme/neue-technologien/robotik/#c2925> (accessed on 14.08.2020)
- 185 <http://rss2019.informatik.uni-freiburg.de/> (accessed on 14.08.2020)
- 186 <https://www.gov.uk/government/news/care-robots-could-revolutionise-uk-care-system-and-provide-staff-extra-support> (accessed on 14.08.2020)
- 187 <https://www.telegraph.co.uk/politics/2019/10/26/robot-carers-funded-government-scheme/> (accessed on 14.08.2020)
- 188 <https://www.ukri.org/innovation/industrial-strategy-challenge-fund/robots-for-a-safer-world/> (accessed on 14.08.2020)
- 189 <https://ifr.org/ifr-press-releases/news/robot-investment-reaches-record-16.5-billion-usd> (accessed on 26.08.2020)
- 190 House of Commons (2019). Automation and the future of work. Twenty-third Report of Session 2017- 19, ordered by the House of Commons, Business, Energy and Industrial Strategy Committee.
- 191 <https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/#686921212f2c> (accessed on 18.08.2020)
- 192 <https://www.plattform-lernende-systeme.de/glossar.html> (accessed on 03.09.2020)
- 193 <https://www.digital-bw.de/> (accessed on 14.08.2020)
- 194 <https://www.wirtschaft-digital-bw.de/initiative-wirtschaft-40/initiative-wirtschaft-im-ueberblick/> (accessed on 19.08.2020)
- 195 <https://www.i40-bw.de/de/> (accessed on 20.08.2020)
- 196 <https://www.baden-wuerttemberg.de/de/wirtschaft/wirtschaftsfoerderung/handel-2030/> (accessed on 27.08.2020)
- 197 <https://handwerk2025.de/> (accessed on 27.08.2020)
- 198 <https://www.bmw.de/Redaktion/DE/Artikel/Mittelstand/dienstleistungswirtschaft-03-innovation-technologie-forschungspolitik.html> (accessed on 27.08.2020)
- 199 <https://www.kultur-kreativ-wirtschaft.de/KUK/Redaktion/DE/Top-Themen/2017-05-11-toptHEMA-wirtschaft-4-0.html> (accessed on 27.08.2020)
- 200 <https://www.wirtschaft-digital-bw.de/digital-hubs/digital-hubs/> (accessed on 21.08.2020)
- 201 <https://www.diz-bw.de/das-diz/> (accessed on 19.08.2020)
- 202 [https://www.bsi.bund.de/DE/Themen/Cyber-Sicherheit/Gefaehrdungslage/Lageberichte/cs\\_Lageberichte\\_node.html](https://www.bsi.bund.de/DE/Themen/Cyber-Sicherheit/Gefaehrdungslage/Lageberichte/cs_Lageberichte_node.html) (accessed on 17.08.2020)
- 203 <https://www.security-insider.de/grundlagen-der-iot-sicherheit-a-712510/> (accessed on 17.08.2020)
- 204 <https://www.fzi.de/de/forschung/kompetenzzentrum-it-sicherheit/> (accessed on 14.08.2020)
- 205 <https://www.digital-bw.de/-/cyberwehr-baden-wuerttemberg> (accessed on 14.08.2020)
- 206 <https://www.baden-wuerttemberg.de/de/service/presse-und-oeffentlichkeitsarbeit/pressemitteilung/pid/>

- landesregierung-beschliesst-massnahmenpaket-zur-staerkung-ki-standort-baden-wuerttemberg-und-investiert/ (accessed on 14.08.2020)
- 207 <https://www.wirtschaft-digital-bw.de/service/ki-made-in-bw/> (20.08.2020)
- 208 <https://www.bw-invest.de/standort/branchen-cluster/informations-und-kommunikationstechnologie> (accessed on 14.08.2020)
- 209 <https://www.kastel.kit.edu/index.php> (accessed on 17.08.2020)
- 210 <https://www.cyberlab-karlsruhe.de/it-security-lab/> (accessed on 17.08.2020)
- 211 <https://www.stuttgarter-zeitung.de/inhalt.it-branche-in-der-region-stuttgart-das-unterschaetzte-potenzial-der-it.8215c023-c1f4-4f50-b25a-e582f3e82a2d.html> (accessed on 14.08.2020)
- 212 <https://cyber-valley.de/de/news/cyber-valley-ends-third-year-on-a-high-note-at-leading-global-machine-learning-conference> (accessed on 21.08.2020)
- 213 <https://www.iao.fraunhofer.de/lang-de/presse-und-medien/aktuelles/2211-fraunhofer-gesellschaft-tritt-cyber-valley-bei.html>
- 214 [www.ki-fortschrittszentrum.de](http://www.ki-fortschrittszentrum.de) (accessed on 17.08.2020)
- 215 <https://cyber-valley.de/start-up-network> (accessed on 21.09.2020)
- 216 <https://t3n.de/news/kuenstliche-intelligenz-diese-1141799> (accessed on 21.08.2020)
- 217 <https://www.wirtschaft-digital-bw.de/service/ki-made-in-bw/wettbewerb-ki-champions-baden-wuerttemberg/> (accessed on 20.08.2020)
- 218 <https://www.analyticsinsight.net/top-universities-in-the-world-to-study-artificial-intelligence/> (accessed on 28.08.2020)
- 219 <https://medium.com/@chuvpilo/ai-research-rankings-2019-insights-from-neurips-and-icml-leading-ai-conferences-ee6953152c1a> (accessed on 27.08.2020)
- 220 <https://www.theguardian.com/technology/2014/jan/27/google-acquires-uk-artificial-intelligence-startup-deepmind> (accessed on 26.08.2020)
- 221 <https://www.analyticsinsight.net/top-10-countries-leading-the-artificial-intelligence-race> (accessed on 21.08.2020)
- 222 <https://www.computerweekly.com/news/252470371/UK-artificial-intelligence-investment-reaches-record-levels> (accessed on 21.08.2020)
- 223 <https://www.gov.uk/government/publications/artificial-intelligence-sector-deal> (accessed on 28.08.2020)
- 224 <https://www.forbes.com/sites/cognitiveworld/2020/04/12/the-united-kingdoms-role-in-the-future-of-ai/#33cdfed1768d> (accessed on 14.08.2020)
- 225 <https://www.ed.ac.uk/bayes> (accessed on 18.08.2020)
- 226 [https://assets.ctfassets.net/nubxhjwc091/58bVZcHRq0aK80SWscia6C/694799a92bccf0eebaad-6447b7e10414/UKDataEconomyReport\\_DigitalVersion.pdf](https://assets.ctfassets.net/nubxhjwc091/58bVZcHRq0aK80SWscia6C/694799a92bccf0eebaad-6447b7e10414/UKDataEconomyReport_DigitalVersion.pdf) (accessed on 21.08.2020)
- 227 <https://www.wavestone.com/en/insight/2019-uk-cybersecurity-start-up-radar/> (accessed on 14.08.2020)
- 228 <https://technation.io/best-of-british-cybersecurity/#the-uk-cyber-landscape> (accessed on 14.08.2020)
- 229 <https://technation.io/report2020/#key-statistics> (accessed on 14.08.2020)
- 230 <https://cyberwales.net/clusters/south/> (accessed on 14.08.2020)
- 231 Written exchange with British Consulate on 18.08.2020.
- 232 <https://www.scotlandis.com/scotlandis-cyber/> (accessed on 18.08.2020)
- 233 <https://re.ukri.org/funding/our-funds-overview/uk-research-partnership-initiative-fund/case-studies/5g-innovation-centre-5gic-university-of-surrey/> (accessed on 26.08.2020)
- 234 <https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016#productivity-1> (accessed on 27.08.2020)
- 235 <https://www.bristol.ac.uk/engineering/research/csn/projects/5g> (accessed on 26.08.2020)
- 236 <https://www.data-infrastructure.eu> (accessed on 19.08.2020)
- 237 [https://www.destatis.de/DE/Presse/Pressemitteilungen/2019/12/PD19\\_459\\_52911.html](https://www.destatis.de/DE/Presse/Pressemitteilungen/2019/12/PD19_459_52911.html) (accessed on 14.08.2020)
- 238 Federal Ministry of Economics and Energy (BMWi) (2020) Studie im Rahmen der Begleitforschung zum

Technologieprogramm PAiCE – Platforms | Additive Manufacturing | Imaging | Communication | Engineering (2019), presented at Cloud Mall webinar on 30.09.2020.

- 239 <https://cordis.europa.eu/projects/de> (accessed on 26.08.2020)
- 240 <https://www.forbes.com/sites/kasiaborowska/2018/12/21/brexit-causing-anarch-ai-in-the-uk/#700f03d97034> (accessed on 14.08.2020)
- 241 <https://www.forschung-und-lehre.de/politik/kritik-an-eu-haushalt-starke-kuerzungen-bei-forschung-2962/> (accessed on 28.08.2020)
- 242 <https://sciencebusiness.net/framework-programmes/news/budget-deal-shrinks-eu-ambitions-technology-and-innovation-programmes> (accessed on 14.08.2020)
- 243 <https://www.wienerzeitung.at/nachrichten/wissen/technologie/2065292-Corona-Krise-treibt-Kuenstliche-Intelligenz-voran.html> (accessed on 14.08.2020)
- 244 <https://www.mckinsey.de/news/presse/2018-09-05-ki-studie-mgi-dampfmaschine#> (accessed on 27.08.2020)
- 245 [https://ec.europa.eu/germany/news/20200219digitale-zukunft-europas-eu-kommission-stellt-strategien-fuer-daten-und-kuenstliche-intelligenz\\_de](https://ec.europa.eu/germany/news/20200219digitale-zukunft-europas-eu-kommission-stellt-strategien-fuer-daten-und-kuenstliche-intelligenz_de) (accessed on 27.08.2020)
- 246 <https://www.telegraph.co.uk/business/tips-for-the-future/future-of-sustainability/> (accessed on 14.08.2020)
- 247 <https://wellbeingeconomy.org/wego> (accessed on 21.08.2020)
- 248 <https://www.bw-invest.de/standort/branchen-cluster/energie-und-umwelttechnik> (accessed on 14.08.2020)
- 249 <https://wm.baden-wuerttemberg.de/de/bauen/wohnraumoffensive-baden-wuerttemberg/innovativ-wohnen-bw/> (accessed on 24.08.2020)
- 250 <https://wm.baden-wuerttemberg.de/de/bauen/staedtebauforderung/foerderschwerpunkte-und-programme/> (accessed on 24.08.2020)
- 251 <https://wm.baden-wuerttemberg.de/de/bauen/denkmalchutz-und-pflege/ueberblick/> (accessed on 24.08.2020)
- 252 <https://www.great.gov.uk/international/content/about-uk/industries/energy/> (accessed on 28.08.2020)
- 253 [https://secure.manchester.gov.uk/info/500002/council\\_policies\\_and\\_strategies/3833/climate\\_change/2](https://secure.manchester.gov.uk/info/500002/council_policies_and_strategies/3833/climate_change/2) (accessed on 26.08.2020)
- 254 <https://www.s3vanguardinitiative.eu/cooperations/advanced-manufacturing-energy-related-applications-harsh-environments-adma-energy> (accessed on 14.08.2020)
- 255 <https://um.baden-wuerttemberg.de/de/energie/energiewende/unsere-kernziele/> (accessed on 14.08.2020)
- 256 <https://publications.parliament.uk/pa/cm201617/cmselect/cmenergy/705/705.pdf> (accessed on 14.08.2020)
- 257 <https://blog.energiedienst.de/recycling-seltener-erden/> (accessed on 26.08.2020)
- 258 <https://www.stimme.de/suedwesten/nachrichten/pl/Rohstoffe-Baden-Wuerttemberg-muss-unabhaengeriger-werden;art19070,4344959> (accessed on 27.08.2020)
- 259 [https://www.green-alliance.org.uk/resources/reinventing\\_retrofit.pdf](https://www.green-alliance.org.uk/resources/reinventing_retrofit.pdf) (accessed on 14.08.2020)
- 260 <https://www.gov.uk/government/news/quality-assurance-at-heart-of-new-2-billion-green-homes-grants> (accessed on 18.08.2020)
- 261 <https://www.ons.gov.uk/economy/environmentalaccounts/articles/ukenergyhowmuchwhattypeandwherefrom/> (accessed on 15.08.2016)
- 262 <https://www.baden-wuerttemberg.de/de/service/alle-meldungen/meldung/pid/der-stromimport-nimmt-zu-1/> (accessed on 14.08.2020)
- 263 <https://www.energy-uk.org.uk/our-work/covid-19-information-hub/7563-rebuilding-the-uk-economy.html> (accessed on 14.08.2020)
- 264 <https://www.nortonrosefulbright.com/de-de/wissen/publications/be467bc7/the-impact-of-covid-19-on-the-power-and-renewables-industry> (accessed on 14.08.2020)
- 265 <https://districtsofcreativity.org/members/> (accessed on 14.08.2020)
- 266 <https://districtsofcreativity.org/projects/reverse-missions/> (accessed on 20.08.2020)

- 267 <https://districtsofcreativity.org/projects/creativity-world-forum/> (accessed on 20.08.2020)
- 268 <https://www.creativeindustriesfederation.com/sites/default/files/2018-12/Creative%20Industries%20Federation%20-%20Growing%20the%20UK's%20Creative%20Industries.pdf> (accessed on 14.08.2020)
- 269 <https://www.gamesforhealthurope.org/> (accessed on 14.08.2020)
- 270 [https://link.springer.com/chapter/10.1007/978-3-319-49879-9\\_8](https://link.springer.com/chapter/10.1007/978-3-319-49879-9_8) (accessed on 14.08.2020)
- 271 <http://www.bbraun.de/de/unternehmen/organisation-zahlen-und-fakten/aesculap-partner-der-chirurgie.html> (accessed on 14.08.2020)
- 272 <https://medizin-und-technik.industrie.de/medizintechnik-studium/faszination-medizintechnik/beatmungsgeraete-und-mehr-was-menschen-beim-atmen-unterstuetzt/> (accessed on 14.08.2020)
- 273 <https://automationspraxis.industrie.de/news/medizintechnik-schunk-greifer-fuer-corona-beatmungsgeraete/> (accessed on 14.08.2020)
- 274 [https://www.accenture.com/\\_acnmedia/PDF-110/Accenture-Govtech-POV.pdf#zoom=50](https://www.accenture.com/_acnmedia/PDF-110/Accenture-Govtech-POV.pdf#zoom=50) (accessed on 21.08.2020)
- 275 <http://www.datalandscape.eu> (accessed on 21.08.2020)
- 276 <https://www.docdirekt.de/start> (accessed on 14.08.2020)
- 277 <https://www.bosch.co.uk/internet-of-things/leading-in-5g-technology/> (accessed on 14.08.2020)
- 278 <https://d-twin.eu/forschungsprojekt> (accessed on 14.08.2020)
- 279 <https://www.under2coalition.org/> (accessed on 14.08.2020)
- 280 <https://www.Start-upbw.de/finanzierung-foerderung/> (accessed on 20.08.2020)
- 281 <https://www.Start-upbw.de/finanzierung-foerderung/accelerators/> (accessed on 21.08.2020)
- 282 <https://www.Start-upbw.de/finanzierung-foerderung/finance/pre-seed/> (accessed on 21.09.2020)
- 283 <https://www.Start-upbw.de/finanzierung-foerderung/vouchers/> (accessed on 21.08.2020)
- 284 <https://www.Start-upbw.de/finanzierung-foerderung/international/> (accessed on 21.08.2020)
- 285 <https://www.computerworld.com/article/3557898/how-the-uk-government-supports-technology-Start-ups.html> (accessed on 20.08.2020)
- 286 [www.finanzen.net/nachricht/geld-karriere-lifestyle/Start-up-report-2020-silicon-valley-new-york-london-das-sind-die-Start-up-hochburgen-der-welt-9081591](http://www.finanzen.net/nachricht/geld-karriere-lifestyle/Start-up-report-2020-silicon-valley-new-york-london-das-sind-die-Start-up-hochburgen-der-welt-9081591) (accessed on 21.08.2020)
- 287 <https://www.wiwo.de/erfolg/gruender/start-up-oekosysteme-der-beste-ort-zum-gruenden-ist-immer-noch-england/19897464.html> (accessed on 20.08.2020)
- 288 <https://www.Start-uploans.co.uk> (accessed on 20.08.2020)
- 289 <https://www.gov.uk/business-finance-support> (accessed on 20.08.2020)
- 290 <https://www.gov.uk/government/organisations/innovate-uk/about> (accessed on 20.08.2020)
- 291 <https://apply-for-innovation-funding.service.gov.uk/competition/search> (accessed on 20.08.2020)
- 292 <https://ec.europa.eu/programmes/horizon2020/en/h2020-sections-projects> (accessed on 21.08.2020)
- 293 <https://www.digitale-gesundheit-bw.de/news/digitale-gesundheit-360-medizin-im-digitalen-zeitalter-transformation-durch-technologien-und-menschen> (accessed on 21.08.2020)
- 294 <https://www.gesundheitsindustrie-bw.de/fachbeitrag/aktuell/mit-hochstleistungsrechnern-und-data-analytics-gegen-das-coronavirus> (accessed on 21.08.2020)
- 295 [https://www.bitkom.org/sites/default/files/2020-05/2020-05-15\\_verbandeallianz\\_gesundheitsdaten-retten-leben-2.pdf](https://www.bitkom.org/sites/default/files/2020-05/2020-05-15_verbandeallianz_gesundheitsdaten-retten-leben-2.pdf) (accessed on 21.08.2020)
- 296 <https://www.healthtechdigital.com/technology/robotics/> (accessed on 21.08.2020)
- 297 <https://media.daimler.com/marsMediaSite/de/instance/ko/Die-Smart-Factory-Die-komplett-vernetzte-Wertschoepfungskette.xhtml?oid=9905147> (accessed on 21.08.2020)
- 298 <https://www2.deloitte.com/us/en/insights/focus/industry-4-0/smart-factory-connected-manufacturing.html> (accessed on 04.09.2020)

# Annex

## 1. Exemplary interview guide

BLOCK	TOPICS	#	QUESTIONS
Introduction	Introduction		Greetings and thanks Personal introductions Introduction Steinbeis 2i GmbH
	Information on the study and procedure of the interview		Presentation study Information on interview length and anonymisation process Information about recording Further questions
Block I – Details on Sector/ Cross-cutting topic	Synergies incl. value chains	<b>I.1</b>	How do you assess the potential for synergies between BW and the UK in sector/cross-cutting topic X? In which thematic area are there synergies/potential for cooperation? Are there complementarities within value chains?
	Existing cooperations & events	<b>I.2</b>	Are there existing cooperations between BW and the UK? Events? Cluster initiatives/networks? How successful do you consider them to be?
	Hypotheses from research	<b>I.3</b>	Review of 1-3 hypotheses previously identified through literature research (such as special opportunities or challenges of the industry, role of SMEs)
Block II – New / further topics	Topics	<b>II.1</b>	Are there any other topics where you see potential for cooperation between BW and the UK? What are these topics? What do you base this assumption on?
	Synergies incl. value chains	<b>II.2</b>	How do you estimate the potential for synergies between BW and the UK? Are there complementarities within value chains?

BLOCK	TOPICS	#	QUESTIONS
Block III – Cross-thematic synergies	Cross-thematic synergies	<b>III.1</b>	Which cross-clustering synergies do you see between BW and the UK?
	Changes of synergies	<b>IV.1</b>	As strong synergies you mentioned x, y, z, how do you expect these to change in the future: through the Brexit and through COVID-19? Which will be stronger, which weaker?
Block IV – influence of the Brexit and COVID-19	Other effects e.g. of Brexit or COVID-19	<b>IV.2</b>	Do you see any other influences of Brexit and COVID-19 that would be important in this context?
	Closing questions		Is there anything else important in this context that we have not discussed? Would you like to add anything else? Would it be okay if we contact you again for shorter follow-up questions? May we mention you in the acknowledgements? Can you think of any other suitable contacts that might be available for an interview?
Block X – end	Thanks and goodbye		

Table 5. Exemplary interview guide

## 2. Ressourcensammlung

ORGANISATION/ WEBSITE	LINK (where available, the English version is linked)	FOCUS
<b>BREXIT INFORMATION AND ADVICE</b>		
Federal Foreign Office Germany: Brexit	<a href="https://www.auswaertiges-amt.de/en/aussenpolitik/europa/brexit-where-are-we-now-what-next/2204138">https://www.auswaertiges-amt.de/en/aussenpolitik/europa/brexit-where-are-we-now-what-next/2204138</a>	The negotiations at a glance.
British Chamber of Commerce in Germany: Brexit	<a href="https://www.bccg.de/brexit">https://www.bccg.de/brexit</a>	Free Brexit advice for companies.
WM BW Brexit Questions & Answers	<a href="https://wm.baden-wuerttemberg.de/de/wirtschaft/wirtschaftsstandort/brexit/fragen-und-antworten/">https://wm.baden-wuerttemberg.de/de/wirtschaft/wirtschaftsstandort/brexit/fragen-und-antworten/</a>	Answers to the most important / most frequent
WM BW: Contact point Brexit	<a href="https://wm.baden-wuerttemberg.de/de/wirtschaft/wirtschaftsstandort/brexit/kontaktstelle-brexit/">https://wm.baden-wuerttemberg.de/de/wirtschaft/wirtschaftsstandort/brexit/kontaktstelle-brexit/</a>	For all questions, information and concerns regarding Brexit, for companies, associations and institutions, information on all economic policy aspects of the ongoing negotiations and their implications.
<b>UK IN GENERAL</b>		
British Chamber of Commerce in Germany	<a href="https://www.bccg.de/">https://www.bccg.de/</a>	First contact point for businesses and professionals seeking advice on British-German business and trade.
British Department for International Trade	<a href="https://www.gov.uk/government/organisations/department-for-international-trade">https://www.gov.uk/government/organisations/department-for-international-trade</a>	Supports UK companies to export and grow in global markets. Support for international companies to locate in the UK.

## WALES

Trade & Invest Wales	<a href="https://tradeandinvest.wales/">https://tradeandinvest.wales/</a>	Welsh Assembly Government initiative for Foreign Direct Investment in Wales. Promotes Wales as a location for business and supports those who wish to locate there.
Welsh Government International Offices	<a href="https://gov.wales/international-offices">https://gov.wales/international-offices</a>	Responsible for trade and investment, government relations, tourism, culture and education. The main focus of the Brussels office is on EU affairs.

## SCOTLAND

Scottish Government International Trade & Investment	<a href="https://www.gov.scot/policies/international-trade-and-investment/">https://www.gov.scot/policies/international-trade-and-investment/</a>	Support for the export and acquisition of foreign investment.
Scotland in Germany - Scottish Govern- ment Hub	<a href="https://www.gov.scot/publications/international-offices-strategic-objectives/pages/germany-berlin-office/">https://www.gov.scot/publications/international-offices-strategic-objectives/pages/germany-berlin-office/</a>	Scottish Government Representation in Germany. Responsible for governmental and economic relations and the priorities energy, innovation, climate protection, higher education and research, culture, tourism
Scotland in Germany - Scottish Develop- ment International	<a href="https://www.sdi.co.uk/about-us/global-offices/europe-middle-east-and-africa/germany-duesseldorf">https://www.sdi.co.uk/about-us/global-offices/europe-middle-east-and-africa/germany-duesseldorf</a>	Scotland's Agency for International Trade and Investment. Promotes Scotland as a business location and supports Scottish companies in export.
Scottish Enterprise / Highlands and Is- lands Enterprise	<a href="https://www.scottish-enterprise.com/">https://www.scottish-enterprise.com/</a> <a href="https://www.hie.co.uk/">https://www.hie.co.uk/</a>	Scotland's national agencies for economic development.

Table 6. Table of resources for SMEs (Status: 31.08.2020)

ORGANISATION/ WEBSITE	LINK (where available, the English version is linked)	FOCUS
<b>NORDIRLAND</b>		
Business Information Center NI	<a href="https://www.nibusinessinfo.co.uk/business-support/business-information-centre">https://www.nibusinessinfo.co.uk/business-support/business-information-centre</a>	Free service from Invest NI, the official online channel for business advice and guidance in Northern Ireland. Key information, support and services for businesses and the self-employed.
Chamber of Industry and Commerce Northern Ireland	<a href="https://www.northernirelandchamber.com/">https://www.northernirelandchamber.com/</a>	Supports companies in local and international growth.
InterTradeIreland	<a href="https://intertradeireland.com/">https://intertradeireland.com/</a>	Assists small businesses in Ireland and Northern Ireland to enter new markets, develop new products, processes and services and become ready to invest.
Invest Northern Ireland	<a href="https://www.investni.com/">https://www.investni.com/</a>	Promotes local economies, helps to become internationally competitive, attracts new investment to Northern Ireland.
Invest NI Office Düsseldorf	<a href="https://www.investni.com/about-us/where-we-are">https://www.investni.com/about-us/where-we-are</a>	Direct contact in Germany for German companies with interest in Northern Ireland.

## GENERAL INFORMATION, CONSULTING & SUPPORT

### UK

Catapult	<a href="https://catapult.org.uk/">https://catapult.org.uk/</a>	Network of world-leading technology centres designed to transform the UK's innovation capacity in specific areas and help drive future economic growth.
Great Britain & Northern Ireland Industries	<a href="https://www.great.gov.uk/international/content/about-uk/industries/">https://www.great.gov.uk/international/content/about-uk/industries/</a>	Information on UK industries, sectors, horizontal issues

### BW

BW Invest	<a href="https://www.bw-invest.de/en/location/industries-clusters/information-and-communication-technology">https://www.bw-invest.de/en/location/industries-clusters/information-and-communication-technology</a>	Information on BW's branches, sectors, cross-cutting topics and cluster initiatives
Clusterportal BW technology fields	<a href="https://www.clusterportal-bw.de/en/cluster-data/technology-fields/">https://www.clusterportal-bw.de/en/cluster-data/technology-fields/</a>	Information on BW's industries, sectors, cross-cutting topics
Enterprise Europe Network	<a href="https://een.ec.europa.eu/">https://een.ec.europa.eu/</a>	Supporting companies in innovation and international growth
Thematic cluster initiatives	See chapter 3, sorted by industry and cross-cutting topics	An overview of important clusters and networks can be found within the industry and cross-cutting topics descriptions in Chapter 3

### EVENTS

Tradefairdates	<a href="https://www.tradefairdates.com/">https://www.tradefairdates.com/</a>	Database/search engine with events sorted by country, region, industry and date
Thematic events	See chapter 3, sorted by industry and cross-cutting topics	An overview of important events can be found within the industry and cross-cutting topics descriptions in Chapter 3

### GERMAN CONTACT POINTS

Chamber of Industry and Commerce BW	<a href="https://www.bw.ihk.de/">https://www.bw.ihk.de/</a>	Political mouthpiece for companies in the country as well as a constructive and critical companion of national politics.
Baden-Württemberg International	<a href="https://www.bw-i.de/en/start-page.html">https://www.bw-i.de/en/start-page.html</a>	Support for domestic and foreign companies, research institutions and universities as a central contact point for all questions concerning internationalisation.



ORGANISATION/ WEBSITE	LINK (where available, the English version is linked)	FOCUS
<b>GERMAN CONTACT POINTS</b>		
Chamber of Industry and Commerce BW	<a href="https://www.bw.ihk.de/">https://www.bw.ihk.de/</a>	Political mouthpiece for companies in the country as well as a cons- tructive and critical companion of national politics.
Baden-Württemberg International	<a href="https://www.bw-i.de/en/start-page.html">https://www.bw-i.de/en/ start-page.html</a>	Support for domestic and foreign companies, research institutions and universities as a central contact point for all questions concerning internationalisation.
Clusterportal BW	<a href="https://www.clusterportal-bw.de/en/">https://www.clusterportal- bw.de/en/</a>	Information on cluster-related news, events and current informa- tion from Baden-Württemberg. On the BW cluster portal, Baden- Württemberg cluster players can find out everything about current developments and events in the world of clusters.
German Chamber of Foreign Trade	<a href="https://www.ahk.de/en/">https://www.ahk.de/en/</a>	Support in establishing new con- tacts, exchange of information, etc.
German-British Chamber of Industry and Commerce / Chamber of Foreign Trade United King- dom	<a href="https://grossbritannien.ahk.de/en/">https://grossbritannien. ahk.de/en/</a>	B2B organisation with about 750 German and British member com- panies. Offers business contacts, information and advice and thus helps companies to open up new markets and expand their export activities.
Germany Trade & Invest	<a href="https://www.gtai.de/gtai-en">https://www.gtai.de/ gtai-en</a>	Economic Development Agency of the Federal Republic of Germany. With over 50 locations worldwide and a strong partner network, GTAI supports German companies on their way abroad, promotes Germa- ny as a business location and assists foreign companies in establishing themselves in Germany.
Steinbeis Europa Zentrum/ Steinbeis 2 i GmbH	<a href="https://www.steinbeis-europa.de/en/">https://www.steinbeis- europa.de/en/</a>	In cooperation with the Enterprise Europe Network, it forms the bridge to Europe for companies, research institutions, universities, administra- tion and politics.  EU advice centre for SMEs in BW.

As two strong economic regions, Baden-Württemberg (BW) and the United Kingdom (UK) look back on a long tradition of mutually successful trade relations and business partnerships with each other. This positive exchange should continue in the future under the changing conditions. In addition to the UK's withdrawal from the European Union, the global economic consequences of the COVID-19 pandemic are now of particular importance. The aim of this study is to identify the economic strengths and the respective challenges of BW and the UK in order to recommend to small and medium sized enterprises (SMEs) in BW and the UK which industries and cross-cutting topics have the greatest potential for synergies in the future.

A data analysis, based on a literature review and interviews, showed that four sectors (automotive industry, health care industry, cultural and creative industries, mechanical engineering and manufacturing industry) and three cross-cutting topics (automation and robotics, digitalisation and artificial intelligence, sustainable economics) are of particular relevance. There is a high potential for synergies between BW and the UK both within and between the industries, as well as in overlaps with the cross-cutting topics.

The results of this study have led to concrete recommendations for action for SMEs as well as for BW's policymakers and economic intermediaries. The central recommendations consist of a thematic focus on innovative future technologies such as autonomous driving, battery and hydrogen research, digital health, digital event formats, or Industry 4.0, increased use of the services of existing state or cluster initiatives, and the proactive initiation of regular international and interdisciplinary exchange (expert workshops, delegation trips, events), both at the political and economic level.