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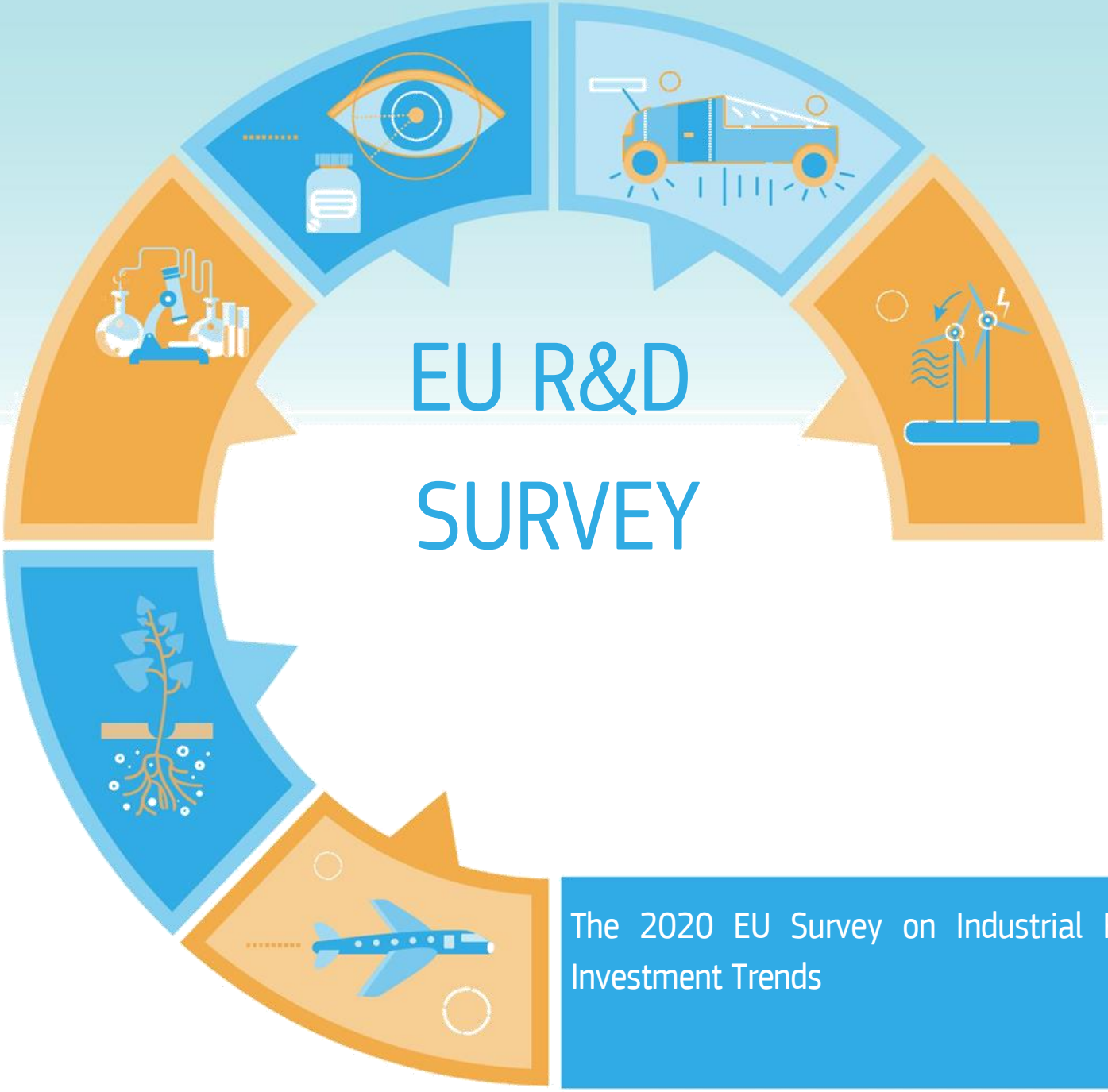

EU R&D SURVEY

The 2020 EU Survey on Industrial R&D Investment Trends

EUR 30518 EN

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Acknowledgements
The "2020 EU Survey on Industrial R&D Investment Trends" within the context of the Global Industrial Research & Innovation Analyses (GLORIA) project that are is jointly carried out by the European Commission's Joint Research Centre, JRC – Directorate Innovation and Growth and the Directorate General for Research and Innovation, R&I- Directorate F, Prosperity. GLORIA has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements No 811163 and 101015509. The main expected impact of GLORIA is the better understanding of corporate Research & Development (R&D) efforts in relation to the green deal and sustainability objectives, starting from the top R&D investors in their global competitiveness perspective. The project was coordinated under the leadership of Alessandro Rainoldi (Head of JRC.B3 Territorial Development Unit) and Doris Schröcker (Head of DG R&I.F1 Industrial R&I Agendas and Business Intelligence Unit). This document was produced by Lesley Potters and Nicola Grassano (JRC.B) as the main authors. Alexander Tübke from JRC B.3 and, Patrick McCutcheon from DG R&I.F1 made contributions to the design and review of the survey.

The JRC.B and DG R&I.F would like to express their thanks to everyone who has contributed to this project.

Contact information
European Commission - Joint Research Centre
Directorate Growth and Innovation - Territorial Development Unit
Edificio Expo; c/ Inca Garcilaso, N° 3
E-41092 Seville (Spain)
Tel.: +34 954488318, Fax: +34 954488300
E-mail: JRC-B3-SECRETARIAT@ec.europa.eu
Any comments can be sent by email to: jrc-b3-iritec@ec.europa.eu
More information, including activities and publications, is available at: http://iri.jrc.ec.europa.eu/ and http://ec.europa.eu/research/

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JRC123333

EUR 30518 EN

PDF	ISBN 978-92-76-27454-4	ISSN 2599-5766	ISSN Collection 1831-9424	doi:10.2760/003388
Print	ISBN 978-92-76-27453-7	ISSN 2599-5758	ISSN Collection 1018-5593	doi:10.2760/144243

Luxembourg: Publications Office of the European Union, 2021

How to cite: Potters, L. and N. Grassano: The 2020 EU Survey on Industrial R&D Investment Trends; EUR 30518 EN; Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-27454-4, doi:10.2760/003388, JRC123333.

Contents

Executive summary

Expectations for R&D investments for the financial year of 2020 vary considerably but is overall flat. From the coronavirus survey, companies expect R&D to increase by 0.6% in 2020. In the R&D Survey, with a different set of respondents, this figure falls to a decrease of -0.7%, although this change is heavily influenced by the largest amongst the respondents specific to the R&D survey only (with more than 50 000 employees) that are the most negative and expect to decrease their R&D investments by 2.8%.

While the impact on employment (both R&D and non-R&D) for the financial year of 2020 is expected to be small, the impact on Capital expenditures and Net Sales show more negative expectations, with foreseen decreases of 4.5% and 5.9%. Almost 40% of the companies applied for at least one type of support, very much related to the firm size: 75% of small firms (up to 1 000 employees) have applied for support, none of the very large firms has done so.

The good news is that a V-shaped recovery with respect to R&D investment is expected for 2021 with an expected increase of 7%. This is the biggest expected increase of R&D investment since the start of the R&D survey. With 72% of the companies expecting growth and only one company expecting a negative change in R&D for 2021, this is a widely supported growth expectation.

More than 80% consider that Sustainable technologies are the most relevant technologies, compared to 74% last year. Software, AI remained similarly relevant between 65% and 70% (62% and 73% last year).

R&D performed within the EU by EUs top R&D performers is not showing any sign of erosion or offshoring to other regions, as we see in earlier editions as well. In fact, the expected growth over the coming two years of R&D invested in the EU (in absolute amounts) is larger than the combined absolute amount invested in China and India together.

The EU's Green Deal is already having an impact on how companies carry out their activities: 82% of the participants change their activities to adopt to the new sustainability regulations and other legal frameworks. Supply and demand of sustainable products and processes follow on a respectable distance (67% and 62% respectively, change their activities for these reasons).

1 Introduction - sample composition

Investment in Research and Development (R&D) is one of the recognise key to fuel the digital and green transitions in Europe. The recent EC communication "A new ERA for Research and Innovation"[1] clearly highlights how private R&D investment in Member States is pivotal for both transformations as for as a fast recovery from the current COVID crisis

The EU Survey on Industrial R&D Investment Trends has provided evidences on the R&D activities of top EU R&D corporate investors identified through the EU R&D Scoreboard for the past 15 years. This is performed via a survey of R&D levels and trends, location strategies, and other activities of these companies, which are responsible for the bulk of private R&D in the EU.

This year it was decided to have two separate surveys. The first one was specifically aimed at getting a better indication on how companies are faring as a result of the COVID-19 pandemic. Compared to the previous surveys, the main difference in data presentation within this edition relates to the EU's new membership composition following the departure of the UK on 31 January 2020.[2] Henceforth, in this report, the EU is understood as EU27 (i.e., without the UK), and whenever the UK is included for comparative purposes, EU28 or EU+UK will be referred to. This survey targeted the top 1000 EU+UK R&D investors from the 2019 EU R&D Scoreboard and remained open online for 6 months.

The questionnaires were sent by post to the top operational level (Chief Executive Officer or similar), or previous year's contact person, at the top 1000 EU+UK companies (EU28 1000) appearing in the 2019 EU Industrial R&D Investment Scoreboard[3].

Only 45 companies responded to the coronavirus questionnaire (response rate of 4.5%), with a total R&D investment of €18.8 bn, or 8.7% of total R&D investments by the EU28 1000. For the R&D survey, 61 responses were received (6.1% response rate), which is well below the response rate of previous exercises 13%-16%. In total 77 firms responded to both surveys, also indicating that not all participants had the time or interest to fill in both surveys. This lower response rate is due to a combination of reasons including remote working and challenges in answering in the timeframe.

However, the responses to the survey are still very valid and key figures are in line with earlier editions. The data provide interesting insight on the impact of the pandemic on companies' R&D and other activities.

1.1 Coronavirus survey

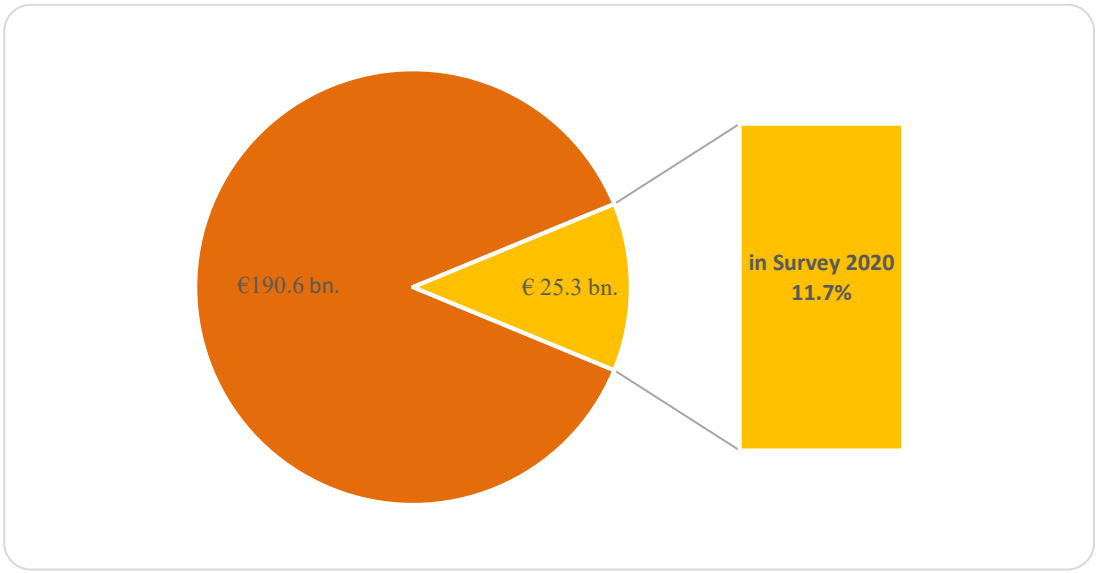
The 45 companies in this survey had an average R&D of €418 million, net sales of €10bn and around 55 000 employees. As shown later, we see that companies responding to the coronavirus survey are very similar in terms of R&D, number of employees and net sales.

1.2 Regular R&D survey

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2020%3A628%3AFIN
[2] https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:European_Union_(EU)
[3] See 2018 EU R&D Scoreboard.

In total, 61 responses were received from EU companies; which invested €25.9 bn. in 2018, accounting for 11.7% of the R&D invested by the EU28 1000 companies (as shown in Figure 1). Last year we collected 131 responses (13.1% response rate) from companies that accounted for a total R&D investment of €64.0 bn. in 2017 (31% of total R&D investment by EU28 1000 firms).

Figure 1: R&D of the 2020 EU Survey participants as share of top EU28 1000 from the 2019 EU R&D Scoreboard



Note: The figure refers to 61 out of the 61 companies in the sample.
Source: European Commission, JRC/DG R&I.

1.3 Company size

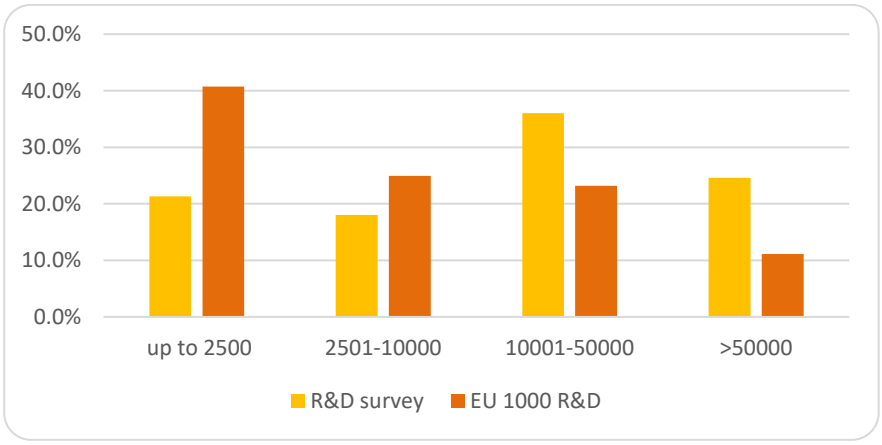
Notwithstanding the drop in number of respondents outlined above, the profile of the "average" company participating in the Survey has not changed substantially compared to last year.

In fact, the average R&D investment of this year's survey respondents is €414.4 million, with average net sales of €13.8 bn. and average employees of around 49 000 in 2018. The correspondent averages for the full EU28 1000 firms were €215.8 million R&D investment, €6.7bn. of net sales and around 22 000 of employees. Thus, the average EU Survey respondent is bigger than the average EU28 1000 firm. This skewedness towards the larger firms is in line with what we have seen in earlier surveys.

The sample contains no SMEs that have 250 or fewer employees. Using the definition of small, medium and large companies,[4] we would classify almost all the sample companies as 'large' companies. In order to increase detail in this report and in line with what we have done last year, we classified companies according to four different size classes: 1) up to 2,500 employees; 2) 2,501 to 10,000 employees; 3) 10,001 to 50,000 employees; and 4) more than 50,000 employees. Figure 2 reports the distribution of the sample according to these four classes compared to the distribution of the full EU28 1000 sample, confirming that we have a disproportional representation of big companies among EU R&D Survey respondents.

[4] Small enterprises (10 to 49 employees); medium-sized enterprises (50 to 249 employees); large enterprises (250 or more employees).

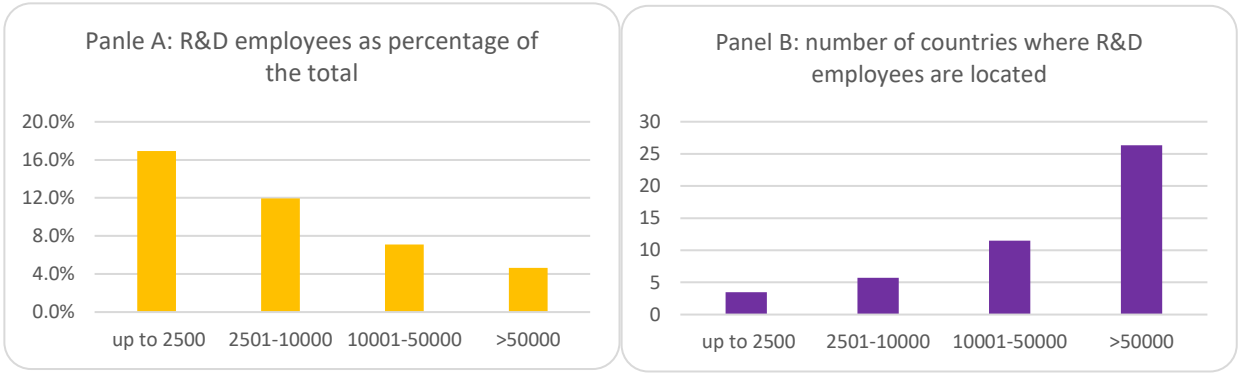
Figure 2: Comparison by size of the 2020 EU Survey participants vs EU28 1000 from the 2019 EU R&D Scoreboard



Note: The figure refers to 61 out of the 61 companies in the sample.
Source: European Commission, JRC/DG R&I.

The respondents to the 2020 EU R&D Survey employs around 3 million people worldwide, of which 5.3 % is R&D personnel, located on average in 12.3 different countries. Figure 3 breaks down these numbers by size. If we look at the R&D personnel as percentage of the total employees of the firm (Figure3, panel A), small companies are those with the highest percentage of R&D employees (16.9%).

Figure 3: R&D employees and countries where they are located



Note: The figure refers to 60 (panel A) and 59 (panel B) out of the 61 companies in the sample for which data are available.
Source: European Commission, JRC/DG R&I.

The contrary is true when considering the number of countries where the R&D personnel is located: The bigger the company the higher the number (up to 26.3 countries for the companies with more than 50000 employees). This picture is consistent with the fact that small companies have higher R&D intensity (defined as the ratio of R&D over Net sales) than big companies. In fact, in the "small" group there are some high tech and pharma and biotech companies, while some big utility companies are in the "large'' group.

1.4 Sector groups

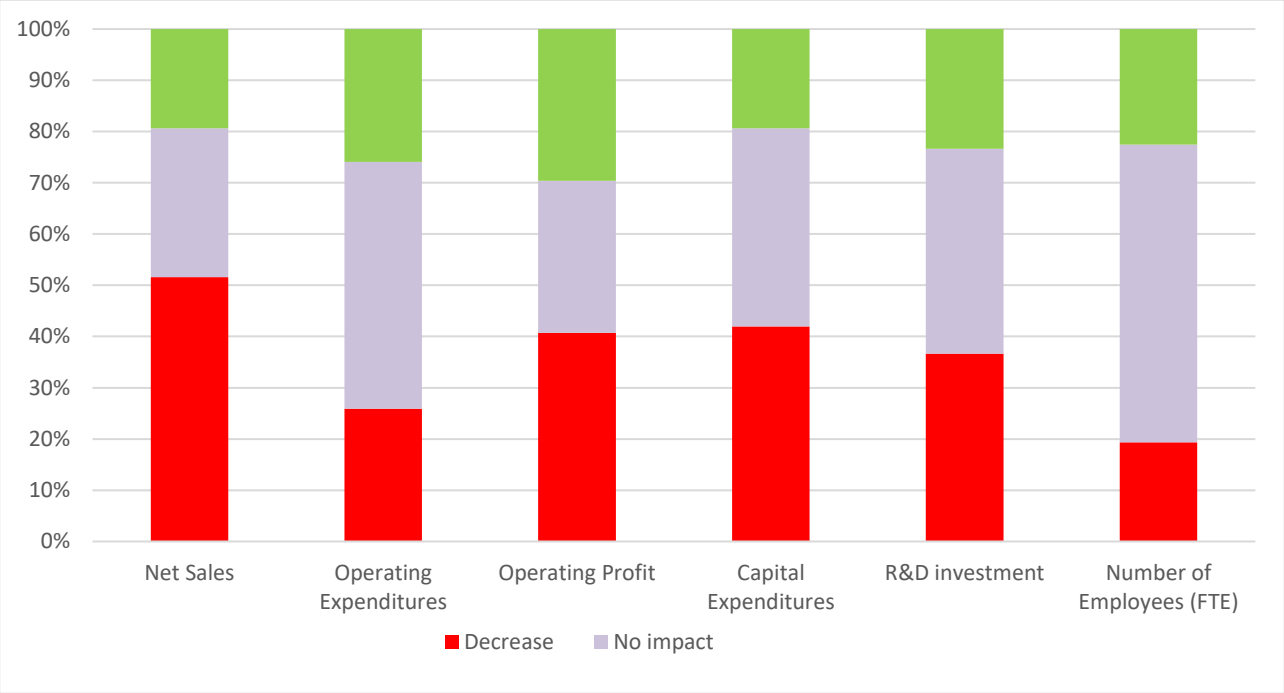
Due to the low response rates for both surveys, it was decided to not analyse the data on sector level since many of the results were not significant. However, when the data allow for it, there have been made some sector groupings, especially to highlight the difference in impact between pharmaceutical and non-pharmaceutical companies.

2 Impact of the COVID-19 pandemic

2.1 Change in main financial indicators

In the questionnaire, we asked to quantify the impact of the pandemic on several of the participants' activities for the 2020 financial year, namely R&D investments, net sales, operating expenditures, operating profit, number of employees (FTE) and capital expenditures. A response rate to this question of about 2/3rd illustrates the difficulties that companies have in estimating the impact of the pandemic.

Figure 4: Expected impact of the pandemic key indicators for the 2020 financial year



Note: The figure refers to 30 out of the 45 companies in the sample for which data are available.
Source: European Commission, JRC/DG R&I.

Expectations for **R&D investments** for the financial year of 2020 vary considerably. Although on average companies expect R&D to increase by 0.6% in 2020 (compared with last year's expectation of an increase of 4.6%). Only 23% of the respondents expect R&D to increase while 37% expect a decrease, without significant sectoral variation.

Capital expenditures for the financial year of 2020 show more negative expectations, with a foreseen decrease of 4.5% and more than 40% of participants indicating negative expectations. **Net sales** are expected to show the greatest decrease of 5.9%, with more than half of the respondents expecting a decrease, and only 19% indicating an increase. Companies that expect an increase in net sales are from the pharmaceutical industry (none of the pharmaceuticals expect a decrease in net sales), chemicals and ICT producers (specifically a company that develops VoIP technology, which has become an important asset in this era of teleworking), typical sectors that might have been able to benefit from the pandemic.

The impact on **employment** (both R&D and non-R&D) for the financial year of 2020 is expected to be small, with equal proportions of respondents with negative and positive expectations (around 20%), translated into no change in number of employees for 2020.

2.2 Impact on companies' global value chains

The questionnaire also asked companies to indicate the effect of the pandemic on several activities within the global value chain. While value chains have become more global and complex over the last few decades, this has become more problematic as a result of global economic uncertainty and limited international transport. In contrast with the expected impact on R&D investments, respondents could only indicate whether an increase, decrease or no change due to the pandemic was expected.

Overall, on all value chains activities that were addressed[5], few participants experience a positive effect of the pandemic on these activities, ranging from to zero to 19%.

A reluctance of companies to introduce new products in this turbulent environment is shown by the impact on **market research, launch advertising, and related marketing activities** for new product introduction, with half of the participants declaring a decrease in this activity. Companies show higher reluctance in Asia and the rest of the world (53% and 55% resp.) than in the EU and US (48% and 50%).

Significant negative impact is also experienced in **in-house production** and **acquisition of new machinery, equipment and software**, where 46% of the participants indicate a decrease in activities, with non-significant differences for the region where these activities are performed. Respectively 60% and 54% of the participants that experience a *positive* impact on these activities do so within the EU.

More innovation related activities, **in-house R&D** and **purchase of IP**, are rather less affected, with only 28% and 21% respectively of the participants indicating a decrease in these activities. There is significant regional difference observed.

2.3 Strategy shift

In addressing potential strategic shifts the survey asked whether these changes were implemented as a response to the pandemic (and – if so – to quantify this change) and if it will be maintained after the pandemic as well. The following table 1 provides an overview of the respondents' views on strategic shifts.

[5] In-house production (EU, US, Asia and Row), in-house R&D (idem), acquisition of new machinery (idem), purchase of IP and other types of knowledge (idem), design and marketing activities (idem), outsourced production (to SMEs and large firms, inside and outside of the EU), and training activities of personnel.

Table 1: Potential strategic shifts

	Implemented	% change	if not, plan to do so	maintain after pandemic
Change to virtual meetings instead of physical meetings	100%	79%	71%	87%
Change in telework/remote work of employees	97%	61%	65%	77%
Preparedness for future crises risks (e.g. cash position, emergency funds)	63%	37%	53%	70%
New restructuring measures	35%	29%	44%	50%
Shift of focus on new services	32%	14%	47%	67%
Accelerating restructuring measures	31%	31%	47%	47%
R&D of 'new to our company' products	28%	17%	48%	65%
R&D of 'new to world' products	24%	-1%	33%	53%
Manufacturing of 'new to our company' products	23%	5%	32%	50%
Manufacturing of 'new to world' products	13%	5%	29%	41%
M&A activity as overtaking part	13%	20%	24%	31%
M&A activity as selling part	10%	13%	12%	25%
Divestment	7%	5%	6%	18%

Note: The figure refers to 34 out of the 45 companies in the sample for which data are available. Source: European Commission, JRC/DG R&I.

As can be seen, the more practical and easier to implement strategic changes are more popular among the participants. In particular, the ways their employees work have been changed as a response to the pandemic and are those most likely to be kept afterwards, with **virtual meetings** and **telework** adopted by (nearly) all participants. Another strategy shift often adopted is to be better **prepared for unforeseen events**, in the form of improved cash positions and emergency funds.

On the other hand, only a small proportion of the companies adopts **M&A activities** and **sales of company parts,** which might be a response to either an opportunity or a threat**,** as a response to the pandemic, although with one out of ten and fourteen companies respectively indicating this strategic shift due to the pandemic might be still considered high.

New **R&D activities**, especially the more daring endeavours for products that are new to the world, are undertaken by only a small proportion of the participants, around 1 out of 4 companies. Since the participants form a subset of the most innovative companies of the EU, this might be considered low. Even if companies implemented a change in R&D strategy, the direction of the response was ambiguous, with companies increasing or decreasing R&D efforts, resulting on an on average negative growth rate for 'new to the world' R&D activities.

2.4 Applied and received government support

Since the onset of the crisis, the EU27 Member States have implemented subsidies to support economic activity. The survey asked if such measures have been requested for and – in case so – received and if they amount received was as requested.

Whereas almost 40% of the companies applied for at least one type of support, the frequency of request correlates with firm size. While 75% of small firms (up to 1 000 employees[6]) have applied for support, none of the very large firms have done so. For medium and large companies, this proportion is around 50%. In fact, respondents that applied for support are on average six times smaller in terms of number of employees and R&D investments and 4 times smaller in terms of net sales than respondents that have not applied.

Of the companies that applied for support, more than 80% received this support, at the time of answering the questionnaire. Of these, 80% also received the exact amount requested.

The participants that have applied for at least one support measure are also, not surprisingly, the companies that are hit hardest. The average expected impact of the pandemic on the net sales and capital expenditures of these companies is a decrease of 12% and 24%, and a decrease of 3% for R&D. This compares with a 2% decrease in net sales, constant capital expenditures and 3% increasing R&D investments for companies that have not applied. The impact on R&D and employment for the former is limited and similar to the latter ones: -1% vs. 0% for R&D and -1% for employment for both groups). Sectoral variation is not significant, but anecdotal evidence shows us that all respondents from the Aerospace & Defence sector and a majority from the Industrial sector have applied for support, while none from the ICT sectors.

Most applied for type of support are direct grants (21% of firms applied), tax advantages (19%) and subsidised public loans (17%). Export credit insurance (8%), state guarantee on loans (5%) and advance payments (3%) were the least interesting for the participants.

[6] According to the Eurostat enterprise size classification, all companies with more than 250 employees are classified as large enterprises. However, due to the fact that we are dealing with a very specific, skewed subsample of the most R&D intensive companies of the EU, all firms with up to 2 500 employees have been identified as small; companies with between 2 501 and 10 000 employees as medium; companies with between 10 001 and 50 000 employees as large; companies with more than 50 000 employees as very large.

3 R&D investment expectations

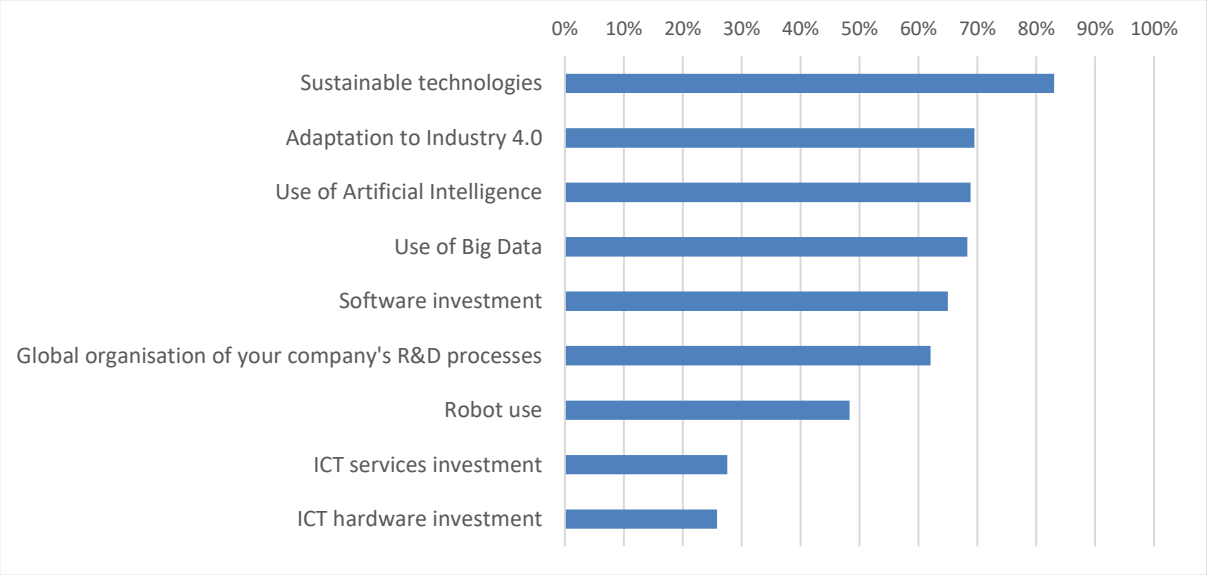
The survey has asks participating companies to indicate the planned R&D investment for the following calendar years. While normally we ask for one expected growth rate for the coming two years, this year, due to the COVID-19 pandemic, we asked specifically for expectations for the current financial year 2020 and the coming year of 2021. In this section, we present these indicators in more detail.

3.1 Technologies for future competitiveness

For second year in a row, the survey asked the participants about the technologies that they deem relevant to remain competitive in the future. **More than 80% consider that Sustainable technologies are the most relevant technologies**, compared to 74% last year**.** As can be seen in Figure 5, Software, AI remained similarly relevant between 65% and 70% (62% and 73% last year).

ICT-related technologies are considered much less important for future competitiveness, similar to last year. This sounds surprising, however we have to take into account that several other categories do already represent ICT service and hardware related investments, such as robot use, Industry 4.0, software, AI and Big Data.

Figure 5: Proportion of firms identifying different technologies as (highly) relevant to future competitiveness



Note: The figure refers to 60 out of the 61 companies in the sample.
Source: European Commission, JRC/DG R&I.

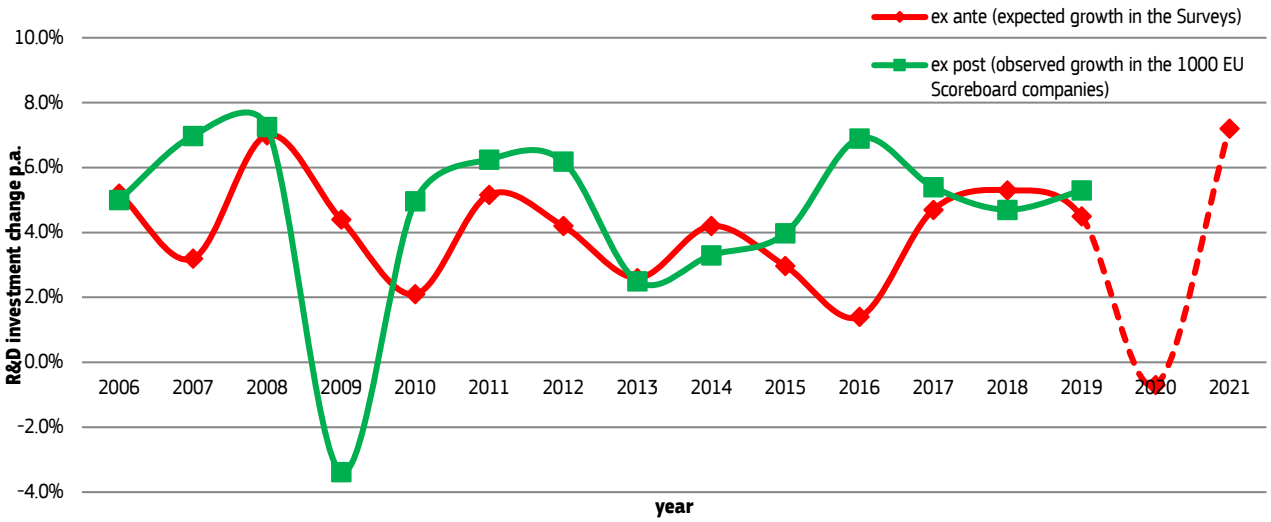
3.2 R&D forecasts

For 2020, companies in our sample forecast a decrease of 0.7% in R&D. This is of course heavily influenced by the COVID-19 pandemic. Only 58% of the 50 companies that replied to this question indicated growth in their R&D investment for this year, whereas last year 85% did. Interestingly, only 18% of the companies foresee an actual decrease, but the companies that do so have highly negative expectations to decrease R&D by 9%. This contrasts with the more negative expectations on the other indicators.

The good news is that a V-shaped recovery with respect to R&D investment is expected for 2021 with an expected increase of 7%[7]. With 72% of the companies expecting growth and only one company expecting negative change in R&D, this is widely supported under the survey participants. Figure 6 combines this year's survey data R&D forecasts with past editions' R&D forecasts, and compares these to ex post growth rates as observed in the EU R&D Scoreboard the year after. As such, we can check the reliability of the R&D expenditure changes reported by the surveyed companies.

For this specific subsample of large R&D investors, we see that **the largest amongst these companies (with more than 50 000 employees) are the most negative and expect to decrease their R&D investments by 2.8%.** This drives the change of 0.7%. In all other groups (up to 2 500, 2 501-10 000 and 10 001-50 000 employees), companies expect to increase their R&D investments in 2020. For companies up to 2 500 employees, the expected growth is 0.7%, companies with 2 501-10 000 employees expect R&D to increase by 5.5% and companies with 10 001-50 000 employees expect a 3.7% increase. This indicates that it is only the biggest companies that cut R&D on average. However, since the number of participants is low, it is difficult to extrapolate this.

Figure 6: Expected (surveys) versus observed (scoreboards) R&D investment changes



Note: The ex ante series refers to the whole sample in each of the 13 surveys (2006-2019). The ex post series refers to the top 1 000 EU companies as published in the R&D Scoreboard for each of the years. This year, 51 companies replied to the R&D forecast question.
Source: European Commission, JRC/DG R&I.

[7] With respect to 2020

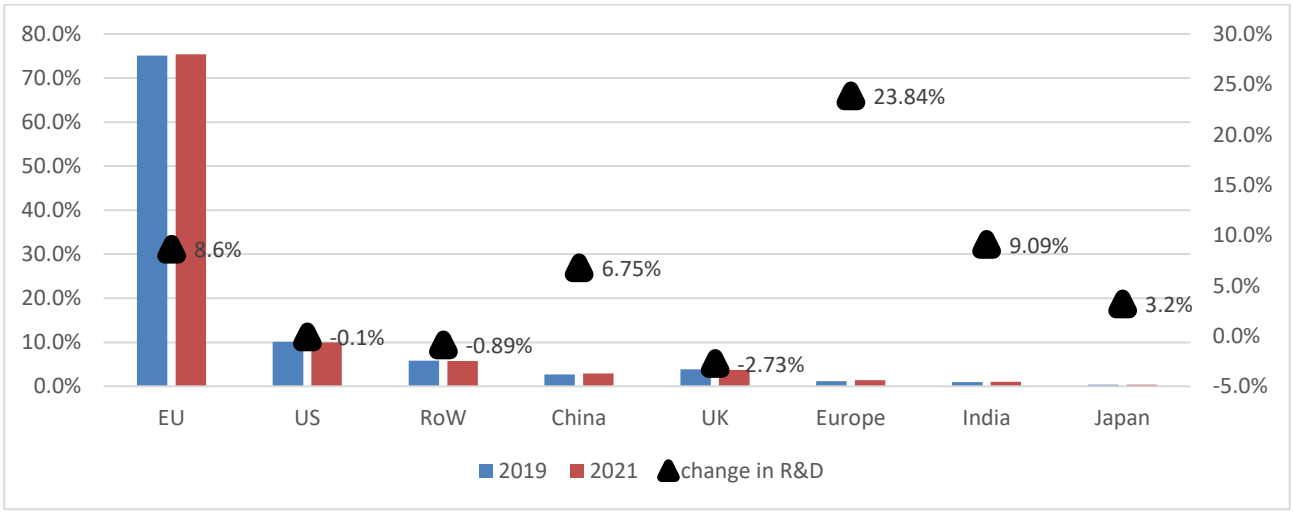
The expected R&D change as asked for in the survey has proven to have predictive value, as can be seen in Figure 6, Only in three out of 14 years, the forecast and actual R&D change were going in opposite directions. In 10 out of 14 years, the predictions went in the same direction, although2009 it was the magnitude. We must take into account here that the *ex ante* and *ex post* expectations refer to different samples: the *ex post* observed growth refers to the top EU28 1000 in each Scoreboard, while the *ex ante* refers to the survey participants. Moreover, *ex ante* R&D change expectations are declared in the survey almost 1.5 years before we can compare them with the *ex post* figures published in the annual reports (and consequently in our Scoreboard). .

3.3 Expected global distribution of R&D investment

75% of R&D by the responding firms is performed within the EU, similar to earlier editions. This proportion has been stable for many years and is not showing any sign of erosion or offshoring to other regions. In fact, while China's and India's expected R&D growth has been often double digit, only 2.7% and 1.0% of the EU firms' R&D is performed in these countries. To put this in perspective, the expected absolute growth of R&D performed within the EU is much higher than the absolute amounts of R&D spent in these countries together.

Respondents expect to increase their R&D activities per the most in India, similar to last year, by 9.1%. R&D performed in China shows again a lower, although still considerable, expected increase in R&D performed by the top EU performers of 6.8% -- the last two years this expected increase were 21.3% and 8.1%. Data for non-EU Europe are not significant due to the low amount of companies providing growth indications for 2020 and 2021– the number of 23.8% is heavily influenced by one company.

Figure 7: Expected annual changes in R&D investment in the next two years



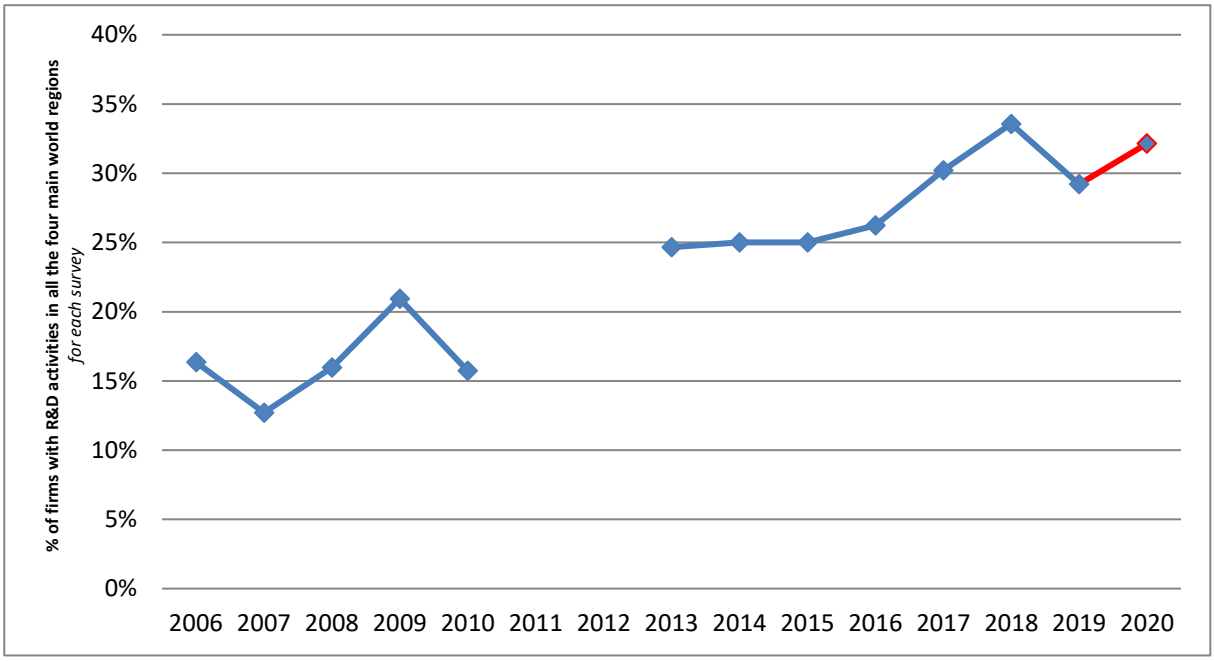
Note: The figure refers to 41 out of the 62 companies in the sample. RoW refers to Rest of the World: all countries that are not captured by EU, US or Asia – mainly Norway, Switzerland, countries from South America, Oceania and Russia.
Source: European Commission, JRC/DG R&I.

3.4 R&D location

One in seven companies in this year's survey performs its R&D in only one country, while one third of the firms do so in 10 or more countries – similar to last years .

One in three companies perform R&D in all four main economic regions[8] – this is slightly higher than last year, but somewhat less than in 2018, indicating early signs of a stabilisation of this proportion after years of uninterrupted increase, as shown in Figure 8**Error! Reference source not found.**, which will need to be confirmed in future surveys.

Figure 8: Global presence of top EU R&D performers, percentage of companies with R&D in all four main regions



Note: The figure refers to 56 out of the 61 companies in the sample. This question was not asked in 2011 and 2012.
Source: European Commission, JRC/DG R&I.

[8] EU, North America, Asia and Rest of the World

4 Sustainability

4.1 Corporate sustainability policies

As climate change is a top EU priority as elaborated in the European Green Deal, a part of the questions is dedicated to sustainability and the role this plays for Europe's most innovative companies. **A large majority (93%) of the respondents have environmental and social sustainability policies in place, or are planning to introduce them within the next five years.** Only 7% of the companies do not have either of these policies in place – similar to last year (8%), but are planning to introduce one in the next five years. As the sample of respondents is not the same, this does not necessarily indicate a trend or lack of trend.

Table 2: Corporate sustainability policies in place

Environmental\Social	Environmental policy	Social policy
Policy in place	93%	93%
Planning to implement within 5 years	7%	7%

Note: The figure refers to 55 out of the 61 companies in the sample.
Source: European Commission, JRC/DG R&I.

4.2 Investments for improving environmental performance

Besides the sustainability policies that companies have in place, participants were asked to estimate the amount of capital investments in 2019 in physical assets such as plant and equipment aimed at improving environmental performance in terms of energy and material use, improving waste management and reducing emissions). This question is similar to last year's question, but not comparable, because then the question was broader and asked about "the investment in environmental sustainability, not limited to R&D investments"[9].

While the average R&D intensity for all participants in the survey is 3.0%[10], this environmental sustainability intensity[11] is 1.7%. This figure should be treated with some caution because as last year. Several companies indicated that they found it difficult to answer question which resulted in a response rate of only 50%. Smaller companies in the subsample invest a larger proportion of their net sales in assets for improving environmental performance than larger firms. This proportion steadily decreases with firm size: 1.7% for the subset of the smallest firms and thereafter 1.5% (between 2 501 and 10 000 employees), 0.9% (between 10 001 and 50 000 employees) and 0.4% (more than 50 000 employees) for the other firm size groups.

Around one third of R&D investment is specifically aimed at sustainability. This figure is the same as last year's sustainability share of R&D spend. The data do not permit a sector comparison, but

[9] "If your company has a policy in place to ensure the environmental sustainability of its activities, could you provide an estimation of the companies' investments in "environmental sustainability" (not limited to R&D)?"
2020 question: "If your company has a policy in place to ensure the environmental sustainability of its activities, could you provide an estimation of the companies' capital investments (excluding depreciation costs) in 2019 *in physical assets such as plant and equipment aimed at improving environmental performance in terms of energy and material use, improving waste management and reducing emissions)*?"
[10] This is calculated from 2019 R&D investments by 2018 net sales from the 2019 R&D Scoreboard.
[11] The total environmental sustainability investments calculated as a percentage of net sales of 2018.

considering firm size, larger firms (the two subsets of firms with more than 10 000 employees) report an average proportion of 38%, while for the two groups of smaller firms (less than 10 000 employees), report a proportion of only 10%, which is the inverse trend of the environmental sustainable intensity

4.3 The impact of the Green Deal on companies' activities

The survey indicates that the EU's Green Deal has influenced companies' activities, **82% of the participants change their activities to adopt to the new sustainability regulations and other legal frameworks.** Supply and demand of sustainable products and processes follow on a respectable distance (67%[12] and 62%[13], respectively, change their activities for these reasons). This indicates that companies adjust their strategies to respond to both societal concerns expressed in public policy and to supply and demand.

Reduction of greenhouse gas (GHG) emissions, Circular economy and Energy and resource efficient construction would be the most often financed projects with Sustainable Finance[14] as developed by the EU, indicated by 77%, 69% and 60% of the respondents respectively. Sustainable food projects are reported as less likely be to fund. This is most likely due to its sector focus of the repondents. Companies were also offered to indicate other types of projects not listed in the questionnaire that could be financed with Sustainable Finance. Responses included: Sustainable Air Mobility, Water Treatment, Waste reduction & Recycling, Energy efficient production, Material efficient production, Efficient Logistics.

Smaller companies show much less interest in these Sustainable Finance possibilities. For all types of projects that were presented to the respondents, less than half of the smaller companies would be interested in funding this with Sustainable Finance tools, the lowest of all size sub classes. Take into account that this size group is also the uses the least external finance methods (see Chapter 6). This might be related to more difficult access to capital that these firm encounter.

4.4 EU Taxonomy for sustainable finance

In the near future, the EU taxonomy for sustainable activities will require a set of large companies to disclose the proportion of activities aligned with the sustainability taxonomy. These activities include activities making a substantial contribution to climate change mitigation, climate change adaption, preservation of water and marine resources, circular economy, pollution prevention and control and/or preservation of biodiversity and healthy ecosystems, and not harming any of the others. While the actual EU Taxonomy is under development, the Technical Expert Group on Sustainable Finance (TEG) has published on 9 March 2020 its recommendations, to the European Commission, on the list of sustainable activities. We asked companies on their awareness of this taxonomy.

Just above half of the companies is "somewhat aware" of this new taxonomy, while 31% is fully aware. The remaining 17% is not aware at all. No clear firm size effect can be detected. **However, when asked for an estimate of the proportions of taxonomy-aligned activities for some indicators[15],**

[12] Main markets demanding sustainable products
[13] Availability of sustainable products and processes from suppliers
[14] Sustainable finance at EU level aims at supporting the delivery on the objectives of the European Green Deal by channelling private investment into the transition to a climate-neutral, climate-resilient, resource-efficient and just economy, as a complement to public money.
[15] As the EU taxonomy is not yet available, companies can provisionally refer to the TEG recommendations (reports published in March 2020).

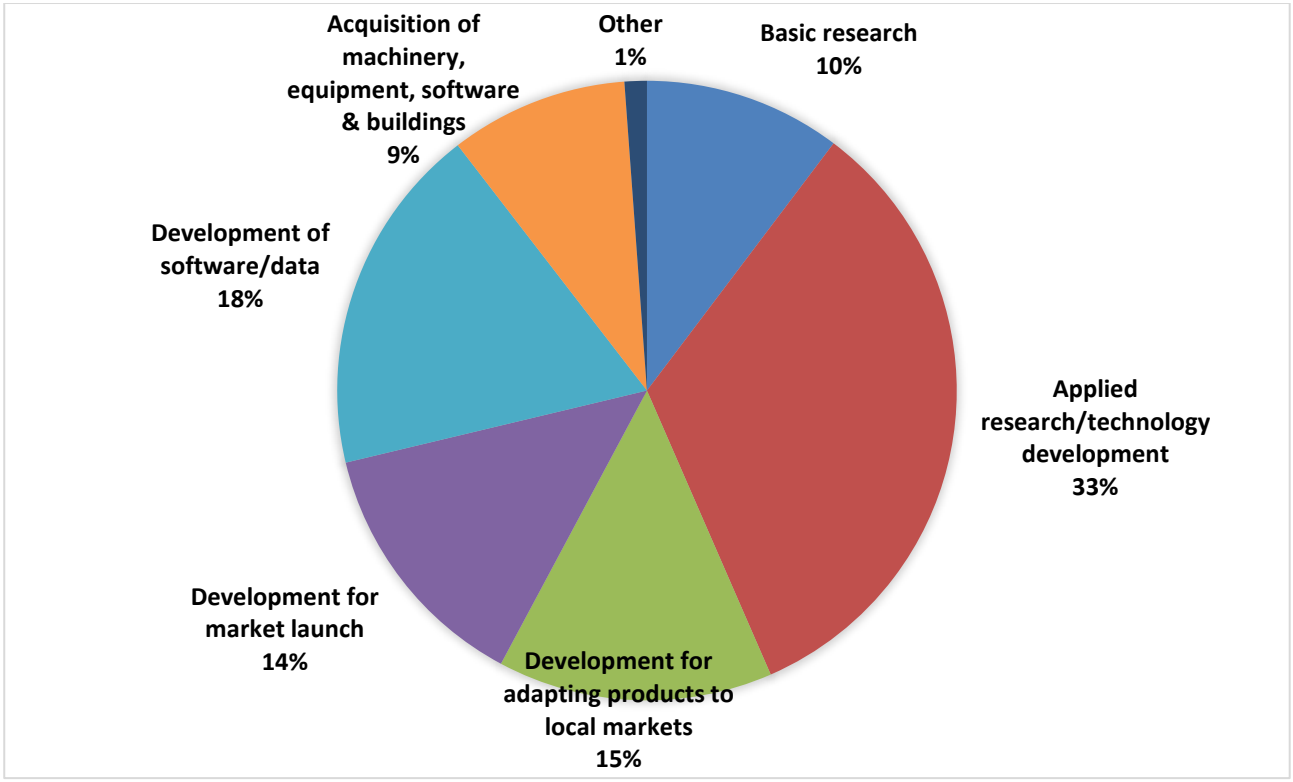
perhaps not surprisingly, only 8% of the companies provided an estimation – insufficient to do any analysis.

5 Type of R&D undertaken

The participants were asked to break down their R&D investment among the different R&D activities they carried out in 2019. As in previous editions of the survey, the majority of the R&D effort is dedicated to development activities, as reported in Figure , the four development categories account for 80% of total R&D investment. Only about 10% of the total R&D investment is dedicated to 'Basic research'.[16]

Development of software/data has seen a significant increase. This can be attributed to the increasing importance of Big Data and Artificial Intelligence. This is consistent with the previous question on the most relevant technologies for future competitiveness.

Figure 9: Proportion of R&D investment, by type of investment

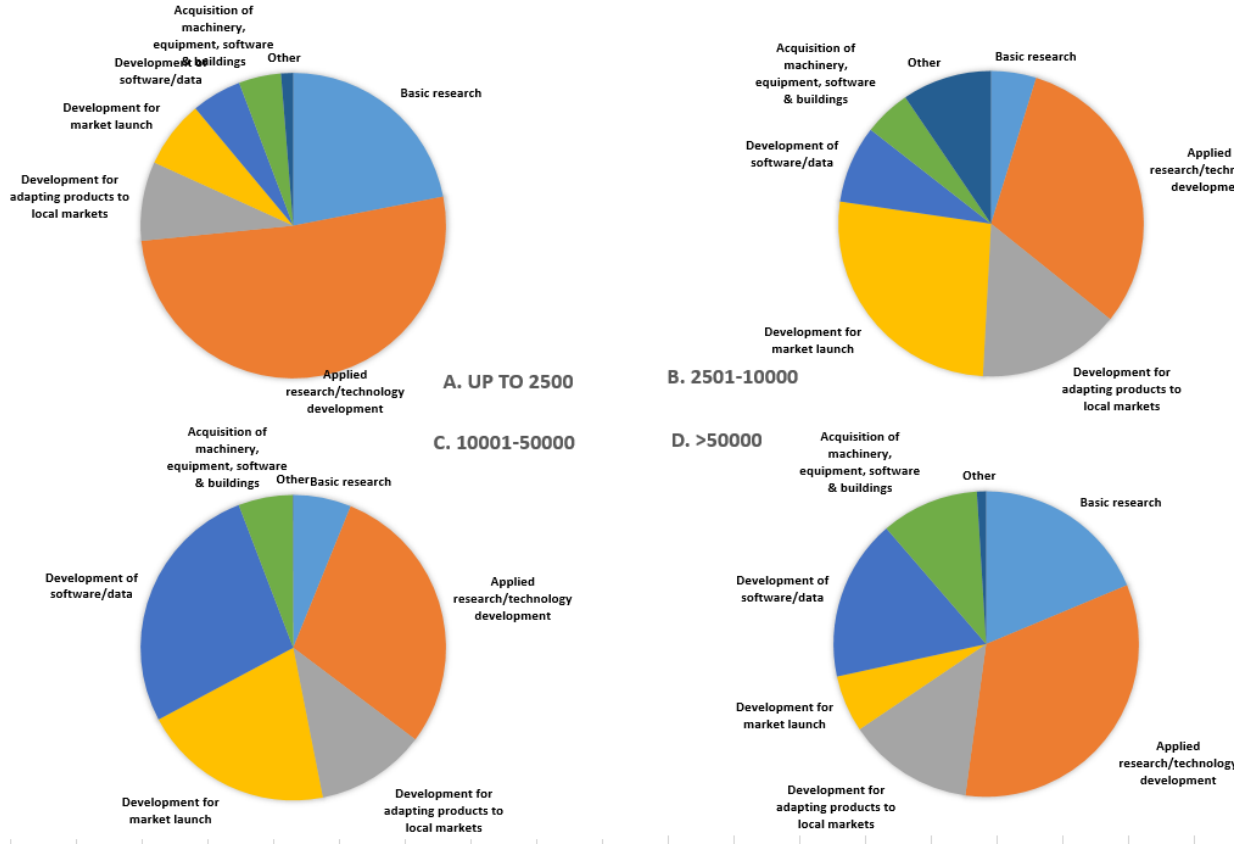


Note: The figure refers to 111out of the 131 companies in the sample.
Source: European Commission, JRC/DG R&I.

Looking at the size of the companies (see Figure 10: Type of R&D investment, by company size) we see that smaller companies spend around 3/4th of their R&D on the more initial phases of the innovation process in particular applied research and much less on development in the later stages. The two middle sized groups (between 2 500 and 50 000 employees) spend more than half of their R&D on the later stages of development (typically starting at adaption to local markets), while the largest firms spend a higher proportion on basic research.

[16] Based on the OECD's Frascati Manual (OECD)

Figure 10: Type of R&D investment, by company size

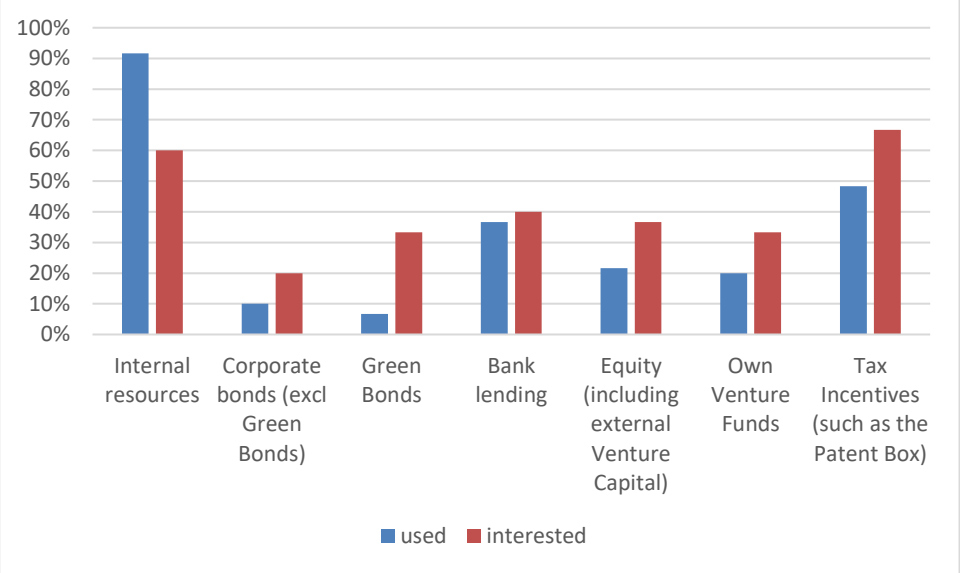


Note: The figure refers to 54 out of the 61 companies in the sample.
Source: European Commission, JRC/DG R&I.

6 Sources for financing R&D

Internal sources for financing R&D projects are used by 92% of all participants. The responding companies are mostly largest R&D performers of the EU and not representative all companies within the EU and seem to have a capacity to finance these more risky undertakings. Nevertheless, they also utilise other sources of finance of which tax incentives are the most commonly used. The difference with the second most used source of financing – tax incentives – is large, with just less than half of the participants indicating its use.

Figure 11: Use of different sources of financing of R&D projects



Note: The figure refers to 60 out of the 61 companies in the sample.
Source: European Commission, JRC/DG R&I.

Tax incentives, internal sources and bank lending are the sources of funding that are most widely used and that have the widest interest from the participants. With 60-70% indicating interest in these instruments for future R&D&I investments, these instruments seem to be the default option for many companies. Green Bonds and Tax incentives have the largest imbalance between the proportion of companies that is interested and that has access to these instruments.

Green bonds are the least used source of financing for R&D&I investments and only used by companies larger than 10 000 employees and especially by those with over 50 000 employees. Since sustainable technologies are seen as most important for future competitiveness, these results can be considered surprising. It might be because of the novelty and unfamiliarity with this instrument, which makes participants – especially the smaller ones – reluctant, although the low level of current access is in stark contrast with the high level of interest shown. Further investigation might be worth, so that investment in these widely considered as important technologies can take off.

The subclass of the smallest firms (<2 500 employees) make use of the fewest sources of (external) R&D financing: only 4 out of 7 (no use of Green Bonds, equity and own venture funds) – while the other groups use all sources of financing. The proportion of small firms using internal resources is the lowest amongst all groups (83% vs an average of 93% for the other groups) and they seem to rely more heavily on bonds (excluding green bonds).

7 Competition rules

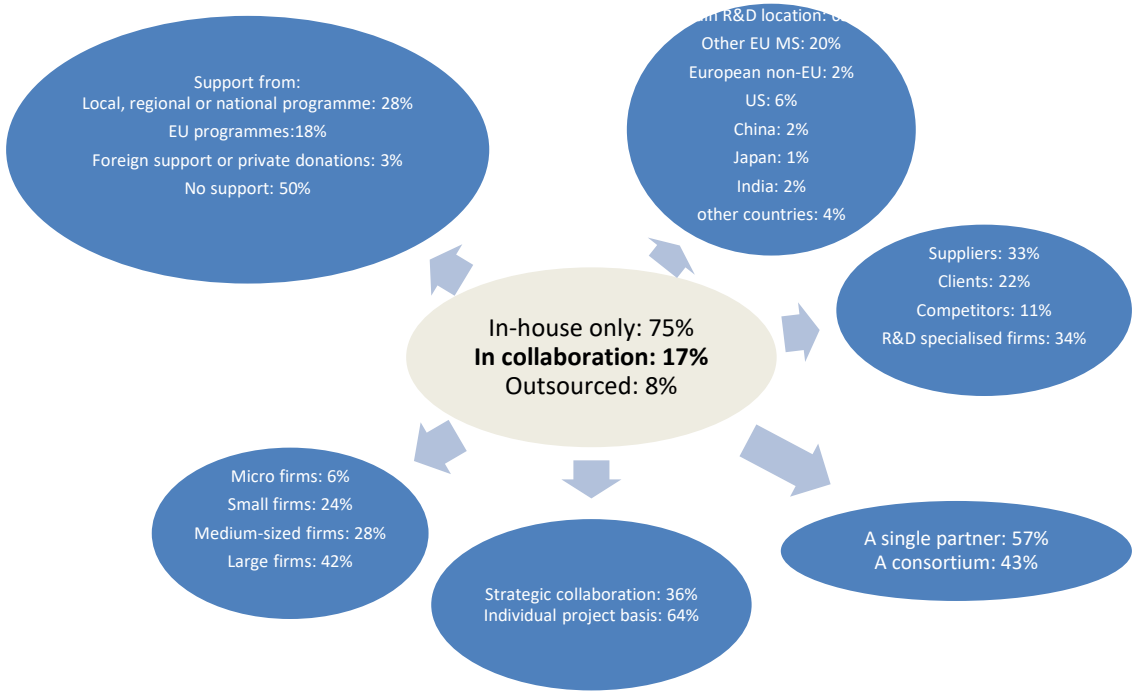
Commission policy to support innovation collaboration involves not just direct financial support but also other policies. As the European Commission is currently reviewing two sets of competition rules concerning RD&I, the survey addressed how the companies collaborate in with the aim of identifying issues that could be addressed in these review. These rules comprise:

- Antitrust rules:
    - guidelines on horizontal cooperation agreements that, amongst other, address R&D collaboration and standardisation;
    - the two block exemption regulation on R&D agreements and specialisation (production) agreements and
- State aid rules:
    - State aid framework for research, development and innovation (RD&I.)
    - General Block Exemption Regulation (GBER)

7.1 R&D collaboration

The figure 12 below starts in the centre and characterises how **R&D collaborations** are undertaken: 17% of R&D activity is performed in collaboration. Of these collaboations, participants were asked on the type of partners (suppliers, clients, competitors, specialized R&D firms), number of partners, type of contract, size of partners, financing and location of partners.

Figure 12: R&D collaboration characteristics



Source: European Commission, JRC/DG R&I.

On average, the participants perform 75% of their R&D in-house, while 17% is done in collaboration and 8% is outsourced to third parties. Firm size is an important determinant for how external R&D is organised. The largest companies (>50 000 employees) make very little use of R&D outsourcing (5%) and prefer to do R&D in collaboration as a way of internalizing new knowledge[17], while for the other size subclasses, these proportions favour outsourcing (13-28%) rather than collaboration (10%-11%), likely due to less capacity to collaborate.

Looking more in detail at the R&D collaborations, we see that in **more than half of these collaborations are vertical in nature, performed with either suppliers (33%) or clients (22%)**. Specialized R&D firms act as R&D collaborator in one third of the time, while - as expected - competitors are least searched for partner for R&D collaboration (11%). Firm size effects were unobservable due to the limited number of participants per size subclass. R&D collaborations are pretty even split between single partners (57%) and consortiums (43%). This difference is more pronounced for small firms (82% and 18%, respectively).

The largest firms of our subset (>50 000 employees) tend to collaborate with large firms[18] (60%), while the smallest firms of our subset (>2 500 employees) collaborate more often with small firms[19] (49%). R&D collaborations are not often undertaken with micro-firms (<10 employees), only in 6% of the cases – although this is quite stable amongst all size subclasses and still a significant proportion, taking into account that the participants are amongst the top EU R&D performers.

Half of all R&D collaborations are performed without external support[20]. This is more so for smaller firms that do not receive external support in 80% of their R&D collaborations. This raises the question whether they have more difficult access to these support measures. Local, regional and national support programmes were received most (28%), followed by EU programmes such as Horizon framework programs (18%). Although this percentage is low, it has to be taken into account that our specific subset does not contain small companies that are often targeted by public intervention.

7.2 Antitrust – horizontal cooperation agreements

The aim of the Antitrust rules[21] is to provide clarity on how companies can collaborate with other companies and other entities on R&D projects while at the same time complying with antitrust rules. These questions aim at understanding to what degree companies are aware of these block exemption regulations on R&I agreements and specialisation agreements and how helpful these are.

78% of the respondents are aware of the EU antitrust rules relating to horizontal cooperation agreements. When a respondent answered confirmative, they were asked if there are any specific provisions in the block exemption ruling that hinder R&D collaboration. An anonymized version of these comments is presented here, combining and summarizing the opinions of several companies:

[17] See eg. Amoroso and Vannucci (2019) on collaborations in publicly funded research ("Teaming up with Large R&D Investors: Good or Bad for Knowledge Production and Diffusion?", JRC Working paper No. 05/2019)
[18] According to the Eurostat definition, >250 employees.
[19] According to the Eurostat definition, <50 employees
[20] Support from local, regional, national, EU, foreign and private R&D support programmes
[21] You can find the horizontal guidelines here and the R&D Block Exemption Regulation here.

- It was stressed that *"the definition of paid-for R&D in Art. 1(a) (iv/vi) is overly broad and should be limited to horizontal cases to cover the example in Recital 17. According to these companies, it is not clear why paid-for R&D should be put under the restrictive conditions of the Block Exemption Regulation (BER) rather than being exempt because the overwhelming majority of paid-for R&D takes place in non-horizontal cases. Between industry players and private or public research institutes, the industry player paying for the R&D should be entitled to have full and unlimited ownership of the results.*

- *Having to grant access to the joint final results and access to the pre-existing know-how for an unlimited period of time creates a major risk of leakage of know-how and trade secrets. This significantly limits the willingness of undertakings to engage in such co-operation especially when engaging with players from outside the EU. Research institutes do regularly exploit results by licensing out results of own R&D to third parties. Accordingly. Art. 3 should not apply to any non-horizontal R&D cooperation. At the same time in non-horizontal R&D scenarios, the granting of rights does not lead to the benefits which they are intended to lead to in horizontal scenarios – namely to ensure competition between the players after the end of the joint R&D. The partners in these non-horizontal scenarios will usually not have the possibility or the interest to make use of these rights and compete against each other. The BER should therefore be amended to exempt non-horizontal R&D without further requirements. This would be more in line with para. 130/131 of the HGL and recital 18 BER which state that these types of cooperation are regularly not restrictive of competition.*

- *There are particular kinds of R&D agreements for which it is not easy to understand exactly under what block exemption regulations they may fall."*

The survey addressed the relevance, clarity and comprehensiveness of the EU antitrust rules relating to horizontal cooperation agreements - and in particular the block exemption regulations on R&D agreements and specialisation agreements. **More companies see the rules and guidelines as relevant than clear and comprehensive**: 59% of respondents indicated that the rules and guidelines are quite or very relevant, while less respondents found these provisions clear (37%) and comprehensive (38%). The proportions of companies indicating that the ruling is not clear (16%) or comprehensive (3%) remain low.

91% of the of respondents advise that the given examples of R&D cooperation and business models are adequate. Companies were given the possibility to indicate on the types of R&D cooperation and business models on which further guidance could be provided to incentivise innovative activity. A summary of the responses is presented here:

- *"Non-horizontal R&D agreements should be per se exempted for practical reasons. Currently, the 25%-threshold will apply even to non-competing undertakings after seven years. This means the safe harbour for vertical R&D co-operation is smaller than for other vertical agreements, as the market share threshold in the Vertical BER is 30%. Further, having to assess market shares can unduly limit pro-competitive co-operation. The delineation of markets is burdensome and complicated and often does not produce a clear black and white result whether a market is EEA-wide or worldwide, can in many cases lead to seismic shifts in market shares. While this is difficult enough for "normal" product and geographic markets, regarding technology markets this becomes neigh impossible. For technologies, information on income from royalties (suggested as a measurement in para. 125 HGL) is usually not accessible to market players. Regarding the duration of the exemption, the HGL should clarify that for determining the point in time in which the contract products are first put on the market, the sale of products from pilot plants, pre-series*

models, or in ramp-up phases for test and market preparation purposes are not relevant; Placing on the market should be defined from the start of fully-fledged sales from ramped-up serial production. It is also currently unclear, is how restrictions are to be treated and which consequences arise in cases where the parties have agreed on joint exploitation but later fail to come to a commercial agreement on such joint exploitation."

- *"Definitions in the block exemption regulations are quite clear. The guidelines, on the other hand, are rather obscure, and seems to be addressed only to high tech industries, and use a jargon that is too specialized."*
- *"The regulation does not include all possible cooperation and business models, however it may be better to avoid trying to regulate all such possibilities if the EU wants R&D to flourish and to make business sense common tech platforms"*

74% of the companies indicate that they participate in standard development in standard development organisations. 95% of the respondents do not see any provisions in the current regulations that hinder competition enhancing standard developments.

7.3 State Aid

The Commission is reviewing the State aid framework for RD&I, the aim of which is to clarify the conditions under which direct or indirect support of companies' RD&I efforts are compatible with State aid rules. The aim of these questions is to understand how helpful companies find this guidance.

72% of the respondents are aware of the EU State aid rules relating to direct or indirect State aid. Only 24% of the respondents valued the relevance, clarity and comprehensiveness of these State aid rules. Participants were given the possibility to comment on parts that are not relevant, clear and/or comprehensive, presented here:

- *"The indirect state aid contributions in collaborations of companies with research institutes (with basic state funding) are sometimes unclear."*
- *"On what concerns R&D, also here we believe that too much regulation is not positive and maybe the States should be allowed more room to support specific developments."*
- *"In most cases an obvious market price for IPR resulting from research activities does not exist but should nevertheless be made clear before entering into collaboration. The price finding procedure is either not feasible or time consuming."*
- *"Member states are making different interpretations on the meaning of the state aid framework for R&D."*
- *"Frascati classification is outdated as R&D&I and tech development is overlapping in real life."*

Companies could also comment on provisions that hinder the performance of R&D:

- *"Nothing in particular in the EU state aid rules, but their use requires rather high administrative effort in practical implementation of provisions*
- *"The rules are too strict for indirect "state aid", as they apply also to joint R&D activities with universities and other research institutions. We feel that the current situation hinders research agreements"*
- *"The power given to Commission to "stop the clock", delaying the deadline of a decision, by making questions or asking for information is not reasonable and should be replaced by a more effective and less time consuming mechanism."*

- *"Given the long lasting and time consuming discussions between research institutes and enterprises, many enterprises refrain from agreements negotiations and R&D collaboration activities stop."*

Asked for the reason why applied funding was not received, **in only 1 (2.5%) case funding was denied because the funding was not permitted under EU State aid rules and in 4 (10%) cases funding was denied because it was not permitted under national state aid rules** – a clear minority of only 13% in total. In 43% the reason for not receiving the funding was unknown. In the remaining cases, 45% no funding was provided because it concerned competitive funding and the project was not awarded.

The companies were asked about the consequences for a project when public support (not from the EU but from a Member State authority) for an R&D&I-project was requested, but no support was received, or considerably less than requested. Since only 55% of the respondents answered this question, the other 45% consists of companies that have not encountered problems related to requested public support, did not ask for funding or just did not answer this particular question.

In only 36% of the cases the project nevertheless went ahead as planned. If no or less public support was received, 83% of the companies indicate that the project went ahead in a restricted or different manner without the public support, but only 44% would go ahead with an alternative project that could be financed without public support. 40% of the companies indicate that the project was cancelled if the no or considerably less support was received.

Annex: Methodology

Background and Approach

The European Commission's Global Research and Innovation Analysis (GLORIA)[22] initiative serves to better understand industrial R&D and innovation in the EU and to identify medium and long-term policy implications. GLORIA is carried out by the European Commission's Joint Research Centre (JRC) Directorate B, Growth & Innovation, and the Directorate General for Research Directorate A, Policy Development & Coordination.

The objective of this project is to generate science-based evidence to support policy making in the light of the Europe 2020 strategy and the Investment Plan for Europe initiative by monitoring, analysing and benchmarking the global industrial players in R&D, following the mandate given by Member States of actions to be implemented by the European Commission since 2003. These companies are responsible for very large shares of Europe's total business R&D investments and their global flows.

The present GLORIA surveys tackles the lack of comparable information on business R&D investment trends at the European level by gathering qualitative information on factors and issues surrounding and influencing companies' current and prospective R&D investment strategies. The survey complements other R&D investment related surveys and data collection exercises (e.g. Innobarometer, Eurostat data collection and other on-going surveys).

Link to the R&D Investment Scoreboards

The EU R&D surveys complement the *EU Industrial R&D Investment Scoreboard*[23], which is the main publication of the GLORIA project. The Scoreboard helps the European Commission to monitor and analyse company R&D investment trends and to benchmark, inform and communicate developments in R&D investment patterns.

The Scoreboard and the Survey take different perspectives on the industrial R&D dynamics in companies. The Scoreboard looks at trends ex-post based on the audited annual accounts of companies, whereas the Survey improves the understanding of the Scoreboard companies by collecting ex-ante information. The survey also addresses location strategies, drivers and barriers to research and innovation activities, or perception of policy support measures with a questionnaire agreed between JRC B.3 and DG R&I. This questionnaire is printed and mailed by post together with the Scoreboard analysis report and the previous Survey analysis report to the 1 000 European companies. Also, a web-interface and email contacts are made available to allow for paperless participation. The Survey makes efficient use of the direct contacts established with the European Scoreboard companies by adding-on to the Scoreboard mailing when the reports are officially released.

For the 2020 Survey, the response period ran for 5 months: from 30 March 2020 (first emailing of the questionnaires) to 28 August 2020.

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[22] See: http://iri.jrc.ec.europa.eu/.

[23] The Scoreboard is published annually and provides data and analysis on the largest R&D investing companies in the EU and abroad (see: http://iri.jrc.ec.europa.eu/research/scoreboard.htm).

Methodology

To improve response rates, the following measures were taken during the survey cycle:

1. The questionnaire was revised and streamlined with a view towards keeping it as short and concise as possible and minimise the burden for the respondent.
2. The questionnaire was sent together with the Scoreboard report to take advantage of this occasion as a door-opener.
3. The cover-letter presented full colour figures and tables with a benchmarking analysis of the company addressed compared to its peers in the same sector.
4. As well as physically sending the questionnaire to each company, an online site was provided to facilitate data entry via the European Commission's EU Survey tool,[24] where a pdf version of the questionnaire was downloadable for offline information input.
5. The questionnaire was emailed to the respondents of previous surveys, together with a link to the electronic copy of the latest analysis.
6. The contact database was continuously improved. Respondents who had already participated in previous surveys, or their substitutes in cases where they had left their position, were priority contacts. Returned questionnaires and reminder mailings were resent using the latest contact information on the internet or by contacting the company directly via email or phone.
7. The response rate is closely followed on a regular basis during the implementation. If necessary, measures for improving the response rate are applied, e.g. by adjusting the number of reminders, allowing more time for questionnaire reception, following up selected candidates by e-mail and phone or searching support from former survey participants
8. Personal contact by phone or email was made with several dozen companies when the deadlines were close, especially for those which had participated in the past.

The response rate has been steadily high over the past five years, taking full advantage of the familiarity of the EU Scoreboard companies with the exercise and their mature approach.[25]

Outliers were detected by analysing the distribution of the dataset in scatter and boxplots and defining upper and lower quartiles ranges around the median, according to the variable(s) analysed. To maintain the maximum information in the data, outliers were eliminated only in extreme cases and after assessing the impact on the result.[26]

One-year growth is simple growth over the previous year, expressed as a percentage: 1yr growth = 100*((C/B)-1); where C = current year amount and B = previous year amount. 1yr growth is calculated only if data exist for both the current and previous year. At the aggregate level, 1yr growth is calculated only by aggregating those companies for which data exist for both the current and previous year.

Two-year growth is the compound annual growth over the two years, expressed as a percentage: 2yr growth = 100*(((C/B)^(1/t))-1); where C = current year amount, B = base year amount (where base year = current year - 2), and t = number of time periods (= 2). 2yr growth is calculated only if data exist for the

[24] See: https://ec.europa.eu/eusurvey/

[25] The response rate of the present survey is 16.2%. This is slightly lower compared to the 18.5% of last year due to a two-week shorter response period. The responsiveness per day has been very steady over the past five surveys.

[26] For the systematic detection of outliers, an adjusted methodology from the NIST/SEMATECH e-Handbook of Statistical Methods was applied, see: http://www.itl.nist.gov/div898/handbook/prc/section1/prc16.htm

current and base years. At the aggregate level, 2yr growth is calculated only by aggregating those companies for which data exist for the current and base years.

Unless otherwise stated, the **weighted figures** presented in this report are weighted by R&D investment.

R&D Investment Definition

To make the survey as easy to complete as possible and to maximise the response rate, only a short definition of R&D investment is provided in the survey.[27] The definition refers mainly to R&D as reported in the company's most recent accounts. The definition used in the survey is thus closely related to the International Accounting Standard (IAS) 38 "Intangible Assets",[28] based on the OECD "Frascati" manual,[29] and the definition used in the EU Industrial R&D Investment Scoreboards.

Composition of the Responses

The 45 responses for the COVID-19 survey and the 62 responses for the R&D survey were classified according to the ICB classification.[30] Sector classifications of individual companies were cross-checked with the Scoreboards. The sectors were grouped as shown in the following. Table , which includes the distribution of the responses among the sectors

Table 3 Distribution of the responses by sectors

Sector group	# responses COVID-19 survey	# responses R&D survey	# top 1000 EU+UK Scoreboard companies
Aerospace & Defence	2	2	24
Automobiles & other transport	2	5	66
Chemicals	4	6	41
Health Industries	9	9	191
ICT producers	4	6	108
ICT services	3	5	124
Industrials	8	12	141
Others	13	16	305

Source: European Commission, JRC/DG R&I.

The number of responses by home country is shown in Table below. According to the Scoreboard methodology, the home country is the country of registered office of the company.

[27] See Annex B

[28] See http://www.iasplus.com/standard/ias38.htm

[29] See "Proposed Standard Practice for Surveys on Research and Experimental Development: Frascati Manual", OECD, Paris, 2002, http://www1.oecd.org/publications/e-book/9202081E.PDF

[30] ICB, or the Industry Classification Benchmark, as owned and published by FTSE International (see: http://www.icbenchmark.com/docs/ICB_StructureSheet_120104.pdf)

Table 4: Distribution of the responses by home country of the company

Country	# responses COVID-19 Survey	# responses R&D Survey
Germany	11	15
Spain	8	11
Italy	4	7
Finland	2	5
UK	4	5
Sweden	3	4
Austria	2	3
Portugal	1	2
France	2	2
Netherlands	3	2
Poland	-	2
Denmark	1	1
Belgium	3	1
Ireland	-	1
Slovenia	1	1

Source: European Commission, JRC/DG R&I.

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doi:10.2760/003388
ISBN 978-92-76-27454-4