DataBench

Evidence Based Big Data Benchmarking to Improve Business Performance

D2.2 Preliminary benchmarks of Industrial Significance of Big Data Technologies Performance Parameters

Abstract

One of the DataBench project's central goals is to design, develop and validate in industrial Case Studies a benchmarking process based on highly relevant business metrics to help European organizations evaluate their use of Big Data and Analytics (BDA) as they seek to improve their business performance.

This report presents the results of the economic and market analysis carried out in the context of WP2. The work documented in this report is based on the methodology described in the preceding deliverable D2.1 Economic, Market and Business Analysis Methodology. This document provides a preliminary assessment of the performance measurement metrics that companies are benchmarking to assess their use of Big Data and Analytics (BDA). It is intended to evaluate how these metrics correspond to the real potential business impacts driving companies from the economic or organisational viewpoint. The document is based on desk research from public sources, on IDC research databases, and on a specific survey of 700 European businesses in 11 EU Member States. These companies were selected after confirming their actual or planned use of BDA. The sample is representative of European industry (excluding the Public sector, Education and Construction). The report shows the relevance of business KPIs for BDA users including revenues, profit and quality of service improvements, as well as the average values achieved for each KPI by industry and company size. These benchmarks will be tested and validated through the analysis of case studies carried out by WP4, verified through the analysis in WP5 and updated at the end of the project in 2020.

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Keywords

Benchmarking, Key Performance Indicators (KPIs) big data and analytics, big data technologies, business performance, economic indicator, European significance, industrial relevance, performance metrics, tool, use cases

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Executive Summary

The economic and market analysis presented in this study leads to the development of the preliminary benchmarks of European economic and industrial significance, in order to ensure that the benchmarking metrics developed by DataBench are relevant for the European economy and industry. Here we summarize the key results of this analysis.

The research is based on a combination of statistical sources, IDC research databases, and an ad-hoc survey of 700 European businesses in 11 EU Member States carried out in September 2018. These companies were selected after confirming their actual or planned use of BDA. The sample is representative of the European industry (excluding the Public sector, Education and Construction). The public sector and education were excluded because of DataBench focus on industry. Constraints in the sample size forced us to exclude another sector, our choice fell on the construction industry which according to the European Data Market Monitoring tool[1] is a low user of BDA, is highly fragmented and would have required high screening efforts to identify data user companies.

Economic and Industrial relevance of BDA in Europe

This report analyzed in depth the European industrial and economic landscape in terms of GVA (Gross Value Added), as a way to measure the contribution of the different industries to economic growth, employment and IT/ Big Data investment dynamics. This analysis is relevant because it connects Big Data spending level and trends with total IT spending by industry, and therefore it correlates Big Data investments with economic growth dynamics affecting each industry and the EU economy.

BDA investments increase faster than IT investments (so their share as a total of IT spending is growing). Industries with a high intensity of IT spending are currently leading the move towards Big Data. Companies (of all sectors and size band) with an advanced and sophisticated ICT infrastructure and culture are engaged in digital transformation of which Big Data is an essential ingredient.

Big Data's share of total IT spending is consistent across all industries and IDC expects it to rise from 8.4% in 2016 to 11.1% in 2022. According to the European Data Market Monitoring Tool updated in January 2019 by IDC, spending on the Data Market has reached 11.4% of total IT spending in the EU28 in 2018 and is projected to reach 13.4% by 2025 in the Baseline scenario. This confirms the potential of fast growth of Big Data investments in Europe.

The analysis shows that the Telecom, Finance, Retail and Wholesale industries lead in terms of uptake of Big Data, actual and forecast, but two of these industries are relatively small in terms of GVA (Telecom and Finance). The two largest sectors by contribution to GVA and employment, Professional Services and Manufacturing, in comparison show a lower diffusion of Big Data adoption. This is due to different factors, including the large number of SMEs in these sectors and the need to change traditional supply chains to embrace digital transformation, a complex effort. On the other hand, Big Data innovation in these sectors has the largest potential to drive growth in the European economy, as also indicated in the EC's strategy "Digitising European Industry". Today, the impact of BDA is felt in the most

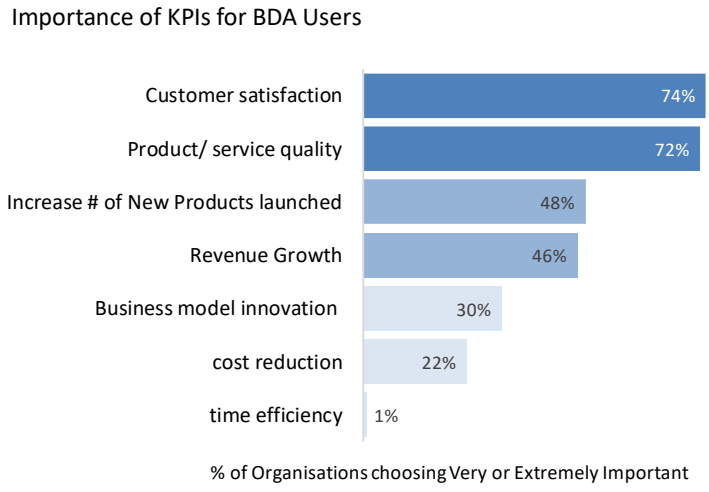
1 First Report on Facts and Figures: Updating the European Data Market Monitoring Tool, http://datalandscape.eu/

dynamic and innovative parts of the EU industry, but its full potential will be realized when BDA adoption will become mainstream also in the largest industry sectors, particularly Manufacturing.

Business Benchmarking of BDA is important

Business organizations recognize the importance of benchmarking the business impacts of BDA, with almost 90% of the DataBench survey respondents considering it moderately or very important. The perception of the importance of benchmarking is positively correlated with the level of adoption (actual users evaluate it very highly) and the company size (with large companies more appreciative of its importance than small ones). The business KPIs selected by DataBench are all relevant for business users, but KPIs measuring the impacts on customer intelligence, innovation and economic impacts are ranked at a higher level than efficiency KPIs (time efficiency and cost reduction).

The industries more advanced and sophisticated in the use of BDA (Finance, Retail, Telecom-Media) again show a higher evaluation of the importance of benchmarking than the others, while laggard industries (Healthcare, Agriculture) show a higher share of respondents not particularly interested in benchmarking. The obvious deduction is that benchmarking becomes more relevant when organizations are engaged with BDA in practice. But this also confirms that awareness of BDA business benchmarking is low among SMEs and industries with lower adoption, and the availability of evidence-based benchmarks would be likely to increase awareness and help to make better business decisions.



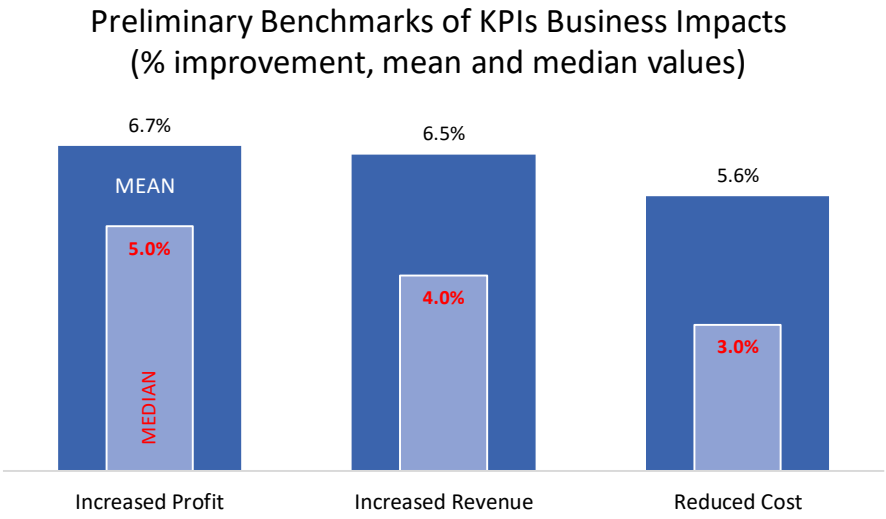
Organizations show a high level of satisfaction with BDA investments, since 80% of respondents have achieved or expect moderate or high benefits and none have seen negative impacts. Moreover, positive impacts are stronger for actual users. This points to a positive dynamic of growing benefits as users progress from the piloting to the scaling up of BDA. Respondents still considering or evaluating BDA are more conservative in their expectations: the majority expects low or medium benefits from BDA. The demand for BDA is driven by multiple business goals, with a strong focus on business and market growth as well as innovation. Based on the survey, there is coherence between the priority business goals and the benefits achieved, measured through the average improvement score of business KPIs. In other words, companies investing in BDA are reaping benefits contributing to the achievement of the business goals which led them to invest in the first place.

Business KPIs preliminary results

The European organizations surveyed by DataBench have achieved substantial business benefits from the adoption of BDA: mean gains reach 6.5% revenue growth (mean value), 6.7% profits increase and 5.6% of cost reductions. The range of variation of KPIs improvements is much wider, with several organizations achieving revenue and profit growth higher than 10%. Moreover, these benefits are expected to increase rapidly in the next 2 years, by 2020 as BDA scales up in the organization. Therefore, we can consider these values as a preliminary benchmark for organizations interested to measure their success in BDA implementation. Similar positive impacts are achieved for product and service quality, improvement of customer satisfaction and new products/ services launched.

The revenue, profit and cost reduction KPIs show a strong variation between the different industries. For all 3 KPIs, the Business/ IT services is first for the level of benefits (plus 9.9% of profit increase) and Agriculture the last (plus 4.8% of profit increase). The largest industry sectors such as Manufacturing and Retail show KPIs improvements above the mean value. Looking at company size, SMEs under 50 employees surprisingly show profit growth around 10% and revenue growth around 8.4%, above the sample average, while companies between 50 and 250 employees show much lower benefits.

The value of the KPIs improvements, calculated for the overall sample, by industry, by company size band, and by use case, corresponds to our preliminary benchmarks. The sample is representative of the EU industry and the business improvements reported by the respondents can be considered as representative of realistic and achievable benefits of the investments in BDA. We have demonstrated that these KPIs are considered relevant by the industrial users interviewed as they measure the business goals driving their adoption of BDA in the first place. In addition, the 7 KPIs cover the main economic, innovation and efficiency benefits sought and expected by industrial users.



Top Level Use Cases

The use cases represent the link between technical solutions and business goals and help to collect data on the main concrete typologies of BDA's exploitation. The report investigates a

list of 12 cross-industry use cases and 23 industry-specific use cases, representing the most frequent and potentially impactful typologies identified so far by DataBench research. Based on survey results, 4 cross-industry use cases collect the higher number of adopters: New product development (420 users), Price optimization (418), Risk exposure assessment (381) and Regulatory Intelligence (378). However, in terms of business impacts the leading use cases are Customer profiling, Social Media analytics and Ad Targeting which consistently are correlated with improvements of more than 10% in the revenue growth, profit growth and cost reduction KPIs.

Next Steps

The preliminary benchmarks presented in this report will be validated through the case studies carried out by WP4 of the project and used to refine and improve the indicators presented here. The first results of the case studies will be presented in Deliverable 4.2. which will be delivered in June 2019.

The study team will continue to deepen the analysis of the survey results and business users' needs through cross-elaborations, clustering and more in-depth analysis particularly of the use cases and the correlations between technology choices and business KPIs. These results will be presented in the next WP2 Deliverable 2.3 "*Analysis of actual and emerging industrial needs and use case mapping* ", also due in June 2019.

The study team will distribute the survey further to the industrial partners of ICT-14 and ICT-15 projects from the Horizon 2020 programme, which are currently carrying out Big Data pilots and experimentations. The survey will continue to remain open until at least the end of 2019, to provide further data and keep enriching the sample of users and use cases. The study team will use the current results to develop a self-assessment web-based tool whose early results will be presented in the next deliverable D2.3. This tool will enable organizations responding to the survey questionnaire to receive in real time a summary of their answers compared to their peers, in order to be able to benchmark their own achievement compared to a group of respondents with similar characteristics. This will enable the project to start providing benchmarking services and sharing knowledge with the H2020 research and benchmarking community, testing the links between technical and business benchmarking. Through this process we expect to be able to further develop and enrich the business KPIs, which will eventually be presented in the DataBench Handbook.

The results of this analysis on KPIs will also feed into the development of the DataBench Toolbox, particularly to develop user-friendly guidelines for business users to use the Toolbox.

1 Introduction

1.1 Objectives

One of the DataBench project's central goals is to design a benchmarking process based on highly relevant business metrics to help European organizations evaluate their use of Big Data and Analytics (BDA) as they seek to improve their business performance. DataBench bridges the gap between technical and business benchmarking of BDA, by investigating existing Big Data benchmarking tools and projects, identifying the main gaps, providing a robust set of metrics to compare technical results coming from those tools, and providing a framework to associate those technical results with key business use cases and economic processes.

This report presents the results of the economic and market analysis carried out in the context of WP2, based on the methodology described in the previous deliverable D2.1 Economic, Market and Business Analysis Methodology, which can be found on the project website www.databench.eu. The main goal is to provide a preliminary assessment of the BDA performance parameters of industrial significance and their estimated business impacts.

Economic and market analysis is a key step of the DataBench research plan, implementing two of the main objectives of the project:

- Objective II "*Performance of economic and market analysis to assess the "European economic significance" of benchmarking tools and performance parameters*".
- Objective III "*Evaluate the business impacts of BDA benchmarks of performance parameters of industrial significance*".

As shown in Figure 1, the KPIs and preliminary benchmarks presented in this report feed into the development of the Benchmarking tool developed in WP3 and tested and validated in the in-depth case studies planned by WP4.

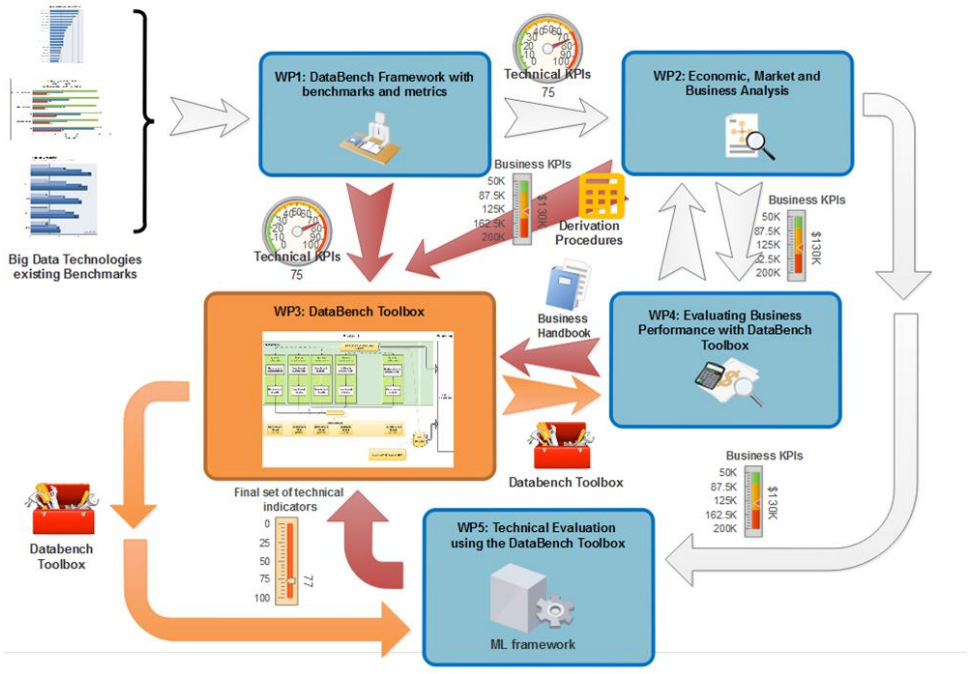


Figure 1 – DataBench Workflow and WP roles

Building on this process, the project will finalise the industrial and business benchmarks (D2.4 at M24) and will illustrate the utilization of this benchmarking methodology in the final DataBench Benchmarking Handbook (D4.4 at M34). This research process is focused on developing useful tools for the BDA user community, for the Big Data Value (BDV) contractual Public-Private Partnership (cPPP) and the European Big Data industry.

The conceptual framework linking technical and business benchmarking and the approach to the design and selection of KPIs is presented in the first deliverable of WP1 (D1.1 "Industry Requirements, benchmarking metrics and KPIs") has been made available in parallel with this report. These activities will also provide material to lead to the desired recognition and acceptance of the benchmarks by the industrial community.

1.2 Structure of the report

The report is organized as follows:

- Chapter 1 presents the main objectives, definitions and sources of the data used in this report, a combination of statistical data from Eurostat and Ilostat and describes the survey implemented for this project in 10 EU Member States;
- Chapter 2 presents the Economic and industrial relevance analysis, leveraging economic indicators such as Gross Value Added[2] (GVA), Gross Domestic Product[3] (GDP) and employment to measure the EU industry users of BDA. This chapter measures the "footprint" of BDA in Europe by industry and shows differences by Member State. The chapter also highlights key differences in focus between those industries that contribute most to GVA, and those industries that are the biggest investors and fastest adopters of BDA.
- Chapter 3 presents the results of the survey in terms of level of adoption of BDA, relevance of business benchmarking, and the analysis of the main use cases by industry and country.
- Chapter 4 presents the results of KPIs measurements for the total sample and broken down by industry, company size, use case.
- Finally, Chapter 5 draws the main conclusions of the analysis highlighting the preliminary economic and industrial benchmarks.
- Annex: the survey questionnaire and the banner tables with the main statistics of the survey. The raw data is available for partners and has already been shared.

1.3 Main Definitions

For the sake of this report we use the following definitions[4].

2 Gross value added (GVA) is the measure of the value of goods and services produced in an area, industry or sector of an economy. In national accounts GVA is output minus intermediate consumption; it is a balancing item of the national accounts' production account.

3 Gross domestic product (GDP) is a monetary measure of the market value of all the final goods and services produced in a period of time, often annually or quarterly. Nominal GDP estimates are commonly used to determine the economic performance of a whole country or region, and to make international comparisons.

4 Source: DataBench D.2.1 **"**Economic, Market and Business Analysis Methodology**"**

BIG DATA

According to IDC[5], the definition of Big Data is based on the following main attributes:

1) The escalation of the dimension of the datasets ('Volume');
2) The increasing pace at which data are produced and exchanged ('Velocity');
3) The growing number of types of data to deal with alongside with the increment of sources that produce data ('Variety').

These attributes are measured, according to IDC, with the following parameters:

Volume:

- Data collected is over 100TB;

Velocity:

- If high-speed messaging technology for real-time streaming data integration and analytics is at or above 60GBps, and/or:
- If the data sets may not be very large today but are growing rapidly at a rate of 60%+ annually
- If technology is deployed on dynamically adaptable infrastructure

Variety:

- If the datasets include two or more data types or data sources (structured/unstructured data flows, numerical, text, audio, video, pictures, images, and metadata)
- If the datasets include high-speed data sources, as clickstream tracking or monitoring of machine-generated data.
- If Different company data sources are employed, for example data from procurement, clients' details from marketing (clients' segmentation and profiling) and from accounts (customer personal data), clients' purchases from sales, inventories data from logistics, and so on.

BENCHMARKS

Benchmarks are result of the assemblage and calculation of performance metrics to be used for comparative purposes. In this task we are focusing on quantitative indicators of business performance improvements achieved by the use of Big Data and Analytics which can be used as target or best performance benchmarks by other organizations. Benchmarks are categorized according to type of use case, business process, industry.

EUROPEAN ECONOMIC SIGNIFICANCE

To employ economic indicators such as value added, revenues and employment to estimate the economic "footprint" of the BDA market in Europe and to identify the industry sectors where the perspective BDA business benchmarks will generate the highest potential economic impact.

INDUSTRIAL SIGNIFICANCE

To identify the BDA business benchmarks responding to the actual and emerging needs of industrial users, with the highest potential impact on business processes.

5 Source: IDC's Worldwide Big Data and Analytics Software Taxonomy, 2017 - IDC #US42353216 www.IDC.com

BIG DATA USE CASES

A discretely funded effort designed to accomplish a particular business goal or objective through the application of Big Data technology to particular business processes and/or application domains, employing line-of-business and IT resources. Examples are: price optimization, fraud risk assessment, customer profiling.

BUSINESS INDICATORS

In the DataBench indicators ecosystem[6], business features correspond to the main parameters used to identify and classify the typologies of BDA implementations in a business organization (use cases) and the performance metrics used to measure their business impacts (business KPIs). As shown in the Figure below, the project conceptual framework aims at connecting the technical benchmarking metrics with the main business impacts measured by business KPIs, selected by this project.

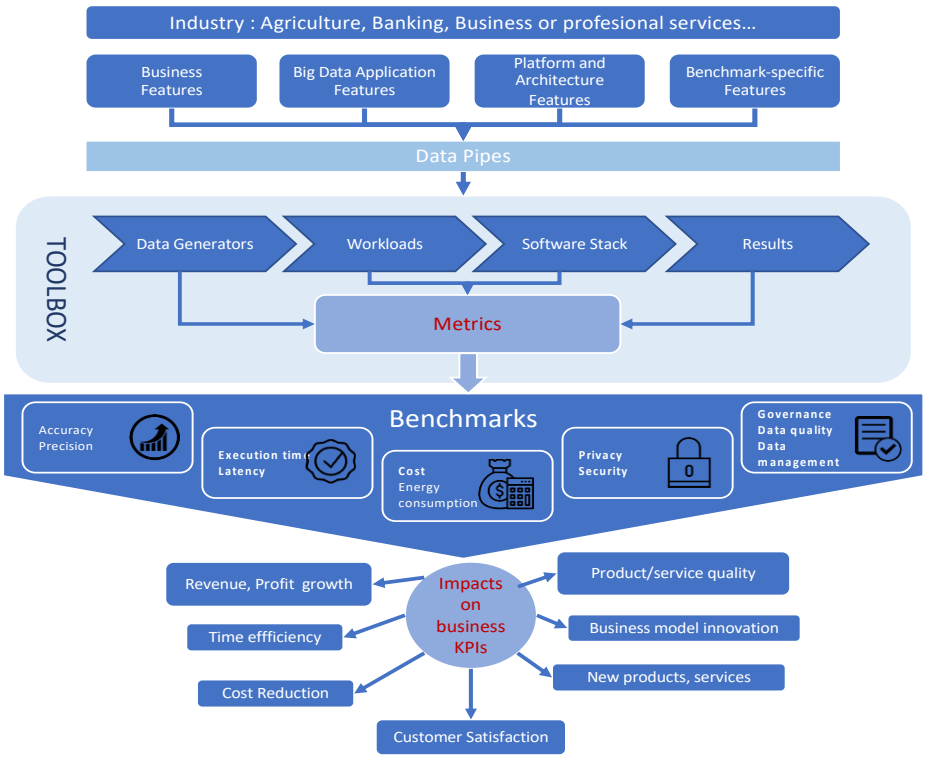


Figure 2 - Technical and Business Benchmarking Framework (Source: DataBench 2018)

The business features indicators can be divided in the following main groups:

1. Classification of business users (industry and company size);
2. Type of BDA implementation (Application area, Level of Business Process integration, Level of BDA Solutions Maturity, Company approach to data management, main business goals);
3. Type of use case (cross-industry and industry-specific);

6 See DataBench, D.1.1 "Industry Requirements, benchmarking metrics and KPIs"

4. Business Impact KPIs.

The indicators categories are presented in detail in the Tables 1-2 below. Groups 1, 2, 3 are semantic indicators measured through simple nominal questions (business users select the category in which they belong) to classify users. The survey results are measured as frequencies of respondents by category. Descriptive parameters can be used to measure the correlation between type of user and type of application and in turn type of business impacts. They will be used in the Benchmarking tool as a user interface to guide users to identify themselves and their type of BDA application, and in turn to look for the type of technical benchmark most relevant for them.

The use cases (group 3, presented in detail in Tables 3-4) represent the link between technical solutions and business goals. The potential list is extremely long, with a long tail of specific use cases. For the sake of the feasibility of the survey we have selected 12 cross-industry use cases and 23 industry-specific use cases, representing the most frequent and potentially impactful typologies identified so far by IDC research.

The business impact KPIs (group 4) are 7 indicators selected on the basis of business literature and research as the most relevant for measuring innovative technologies impacts. They are measured as simple numeric values mainly in percentage (percentage of improvement).

The following two tables provide detail describing the indicator categories used in the investigation:

Industry	Company Size	Application Area	Level of Business Process Integration
• Agriculture • Banking, Insurance, Other financial services • Business or professional services, excluding IT services • IT services • Healthcare • Manufacturing process • Manufacturing discrete • Retail trade • Wholesale trade • Telecommunications • Media • Transport and logistics • Utilities • Oil & Gas	• 10 to 49 employees • 50 to 249 employees • 250 to 499 employees • 500 to 999 employees • 1,000 to 2,499 employees • 2,500 to 4,999 employees • 5,000 or more employees	• Customer service and support • Engineering • Research and development (R&D) • Product innovation (new business initiatives) • Maintenance and logistics • Marketing • Finance • HR and legal • Sales • Product management • Governance, risk, and compliance • IT and data operations	• High (where there is real time integration with business processes for eg real time fraud detection) • Medium (where there are mixed levels of integration with business processes eg propensity models available as part of business processes but not scored in real time) • Low (for eg where big data reports and dashboards are processed in a batch environment and made available the following day)

Table 1 - Business Parameters: Industry, Application area, Level of Business Process Integration

Level of BDA solutions Maturity	Business KPI	Business Goals	Approach to data management
• Currently using • Piloting or implementing • Considering or evaluating for future use • No use and no plans	• Increase in the number of products/services launched • Customer satisfaction • Business model innovation • Revenue and profit growth • Product/service quality • Time Efficiency • Cost reduction	• Better understanding customer behavior and expectations • Optimize pricing strategies and go-to-market programs • Product, services, or program improvement and innovation • Improve understanding of the market and competitors • Improve and optimize business processes and operations • Improve facilities, and equipment design, maintenance, and utilization • Improve operational, fraud, and risk management • Implement better regulatory compliance and financial controls	• Structured and transactional data is captured and processed in a data warehouse or operational data store • Structured and unstructured data from different locations, including on-premise and in the cloud, is captured and processed • Enterprisewide repositories or data lakes are used to capture, organize, and process data from multiple sources and forma • Real-time data (for example, log files, social media, and IoT data) is streamed and used alongside other contextual data • The Big Data platform is available/exposed to external customers, partners and developers to build and extend data-driven benefits

Table 2 - Business Parameters: Maturity, Business KPI, Business Goals, Approach to Data Management

Many of the uses of BDA are present in a number of industries in a number of different scenarios. The following Tables explain which use cases are relevant for which industries and the overlap of some use cases across industries:

Use Case	Industries
Price optimization	All
New product development	All
Risk exposure assessment	All
Regulatory intelligence	All (excluding Agriculture)
Customer profiling, targeting, and optimization of offers	Banking, Insurance, Other Finance, Business or Professional services, IT services, Retail Trade, Telecommunications, Media, Utilities
Customer scoring and/or churn mitigation	Banking, Insurance, Other Finance, Telecommunications, Utilities

Fraud prevention and detection	Banking, Insurance, Other Finance, Business or Professional services, IT services, Healthcare, Telecommunications
Product & Service Recommendation systems	Banking, Insurance, Other Finance, Business or Professional services, IT services, Retail Trade, Telecommunications, Media
Automated Customer Service	Banking, Insurance, Other Finance, Business or Professional services, IT services, Healthcare, Retail Trade, Telecommunications, Media
Supply chain optimization	Agriculture, Manufacturing Process and Discrete, Retail Trade, Wholesale Trade, Transport & Logistics, Utilities, Oil & Gas
Predictive Maintenance	Agriculture, Manufacturing Process and Discrete, Wholesale Trade, Transport & Logistics, Utilities, Oil & Gas
Inventory and service parts optimization	Agriculture, Manufacturing Process and Discrete, Wholesale Trade, Transport & Logistics, Oil & Gas

Table 3 - Classification of BDA Cross-industry Use Cases

Industry	Specific Use Cases
Agriculture	Precision agriculture Yield monitoring and prediction Field mapping & crop scouting Heavy equipment utilization
Banking	Cyberthreat & detection
Insurance	Usage based insurance
Other Financial Services	Cyberthreat & detection
Business or Professional services	Social media analytics
Healthcare	Illness/disease diagnosis and progression Personalized treatment via comprehensive evaluation of health records Patient admission and re-admission predictions Quality of care optimization
Manufacturing Process	Smart warehousing Asset management Quality management investigation
Manufacturing Discrete	Smart warehousing Asset management Quality management investigation Connected vehicles optimization

Industry	Specific Use Cases
Retail Trade	Intelligent Fulfillment
Wholesale Trade	Intelligent Fulfillment Increase productivity and efficiency of DCs/warehouses
Telecommunications	Network analytics and optimization
Media	Ad Targeting Scheduling optimisation
Transport & Logistics	Connected vehicles optimization Logistics and package delivery management
Utilities	Field service optimization Energy consumption analysis and prediction
Oil & Gas	Field service optimization Energy consumption analysis and prediction

Table 4 - Classification of BDA Industry-specific Use Cases

1.4 Methodology Approach

1.4.1 Overview

As described in D2.1 "Economic and Market Analysis Methodology", the methodology used in this report is based on the following steps implemented in the period May 2018-October 2018.

Phase 1

a) Desk research of main public sources (mainly Eurostat and OECD) to select the most relevant economic indicators;
b) Extraction of relevant data from IDC databases and ongoing research on BDA and the European data market;
c) Elaboration of data to identify the most economic significant industries and those with the highest potential impact of Big Data. The potential impact of big data by

industry is evaluated from the share and growth of big data by industry for each of the economically significant industries selected;

d) Preliminary classification of main use cases by industry and business process and main KPIs based on desk and IDC research;
e) Primary data collection, through a survey of a casual sample of 700 European BDA business users, representative of the EU industry;
f) Elaboration of the survey results on KPIs, BDA used and use cases by industry, company size, country;
g) Calculation of preliminary benchmarks of economic and industrial significance.

The next steps (Phase 2) will focus on the development of final benchmarks, as explained in the last chapter of this report.

1.4.2 Survey of Business Users

To ground the analysis in the European economic and industrial landscape, the study team carried out in September-October 2018 a survey of a casual sample of European business organizations in 11 Member States, resulting in 700 valid interviews segmented as follows:

- 11 Member States: France, Germany, Netherlands, UK, Nordics (Denmark, Sweden), South Europe (Italy, Spain), CEE (Czech Republic, Poland, Romania);
- 16 industry sectors and 7 employment size classes, as indicated in Table 1 above.

The survey excluded micro-enterprises under 10 employees (unlikely to be advanced adopters of BDA). The survey was conducted in local language by experienced interviewers, targeted senior decision makers and influencers for BDA, and screened respondents on the basis of their actual or planned use of BDA. Business organizations not using and not interested in using BDA were excluded.

The size of the sample was decided in order to allow for an adequate reliability of results (margin of error 3.5% for the whole sample) and the cost (proportional to the overall budget of the project and the relevance of this task compared to the overall workplan).

The survey used hard quotas by country/region and soft quotas by industry and size class to achieve a balanced sample of valid interviews.

The elaboration of results shown in the following chapters may show aggregated values for some sub-segments to guarantee reliability or maximise explanatory value.

The list of countries surveyed was selected based on the following criteria:

- Geographical balance (representing all main geographical areas in the EU)
- Country size (mix of large, medium and small Member States)
- IT maturity balance (mix of MS with high, medium and low intensity IT spending)
- Share of Data Market value (the MS selected represent 87% of the European data market value in 2017[7])
- Adequate coverage of the EU economy (the Member States surveyed together represent 76% of the EU GDP in 2017[8])

The survey results therefore are representative of EU level results.

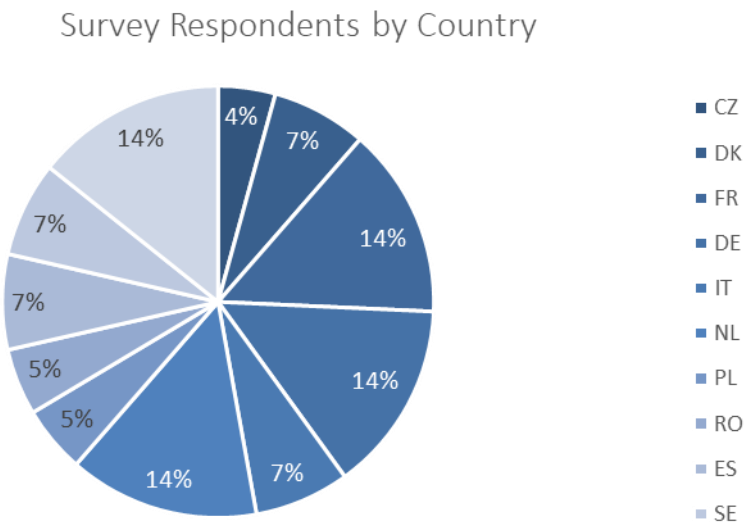
7 Source: Update of the European Data Market Study, Facts and Figures report, January 2018, IDC

8 Sources: Eurostat data, EIU, EC EU growth, December 2017

The industry classification is based on Eurostat's NACE REV. 2 code in order to be able to use statistical data on value added and other parameters as well as IDC's Vertical Market databases. The following industries were excluded for the following reasons:

- Government: DataBench is focused on the private sector, government does not use the same business KPIs as the private sector, and the number of government agencies varies substantially from country to country so that Eurostat does not provide comparable statistics by number of entities.
- Education: a mostly public and no profit sector, very different from private industry, with vastly different dynamics of technology adoption by segment (for example, primary school vs research and university). Investigating it would have required a different type of survey and questionnaire.
- Finally, to achieve a reasonable sample size by industry we had to eliminate another industry and our choice fell on the construction industry which according to the EDM Monitoring tool statistics is a low user of BDA, is highly fragmented and would have required high screening efforts to identify data user companies.

The final breakdown of the 700 interviews is shown in the Figures below and satisfies the targeted criteria, representing a balanced sample by country, industry and size class.



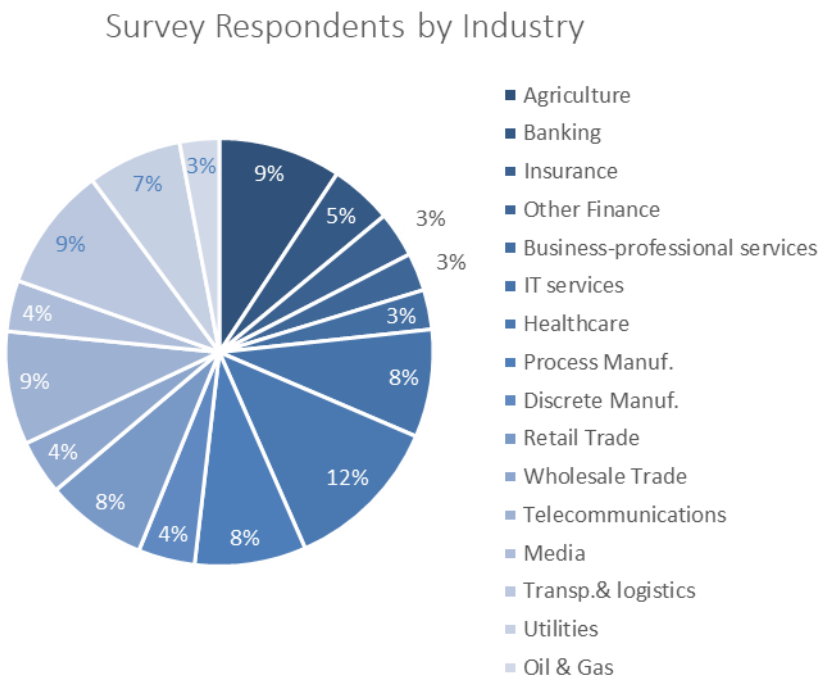


Figure 3 -DataBench Survey Respondents by Country and by Industry

Source: DataBench survey, October 2018, 700 interviews

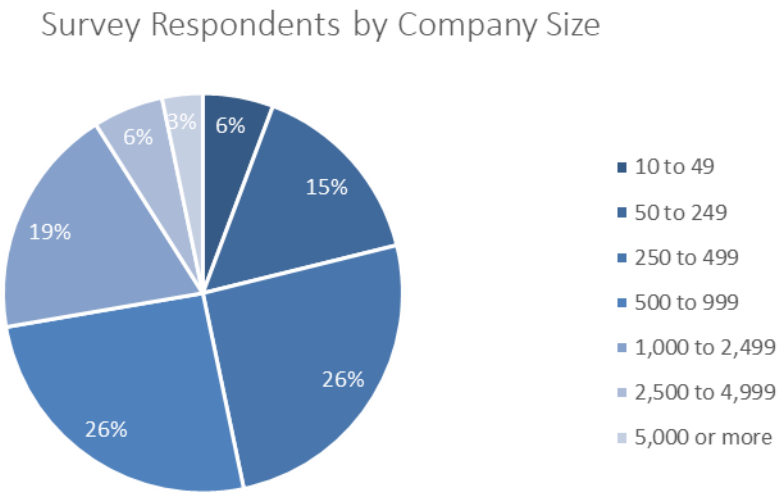


Figure 4 - Survey Sample by Company size
Source: DataBench survey, October 2018, 700 interviews

The survey aims at collecting quantitative evidence on the BDA use cases prioritized in each industry, actual and planned, the KPIs used, why they are used, the potential impacts on business processes and their relevance for business strategies and objectives.

The questionnaire was developed by the DataBench WP2 team with feedback from all the partners. The implementation of the survey was carried out by IDC's specialised end-users

research unit, also responsible for overseeing the survey fieldwork, quality assessments, data validation and analysis. The indicators used in the survey are those presented in the previous paragraph.

The steps involved in developing the questionnaire survey can be broadly categorized as follows:

I. Confirm survey objectives
II. Identify key research topics including:
    a. Importance of BDA to business strategy and objectives;
    b. Level of maturity in BDA adoption;
    c. BDA planned use or current usage;
    d. Use case priorities actual and planned;
    e. KPIs and metrics used;
    f. Perceived and actual business benefits and returns.
III. Translate research topics into survey questions
IV. Organise and structure questionnaire into logical sections including:
    a. Introduction questions that define the objectives of the study and the sponsor/how the data will be used, incentives, confidentiality statement;
    b. Survey screener or qualifying questions to identify target audience;
    c. Warm up key questions to identify where BDA is being implemented, drivers to adoption etc;
    d. Main topic questions as outlined in step 2 above;
    e. Profiling demographics questions to allow data post survey segmentation;
    f. Survey end questions to determined permission to use data and feedback on the survey.
V. Peer review survey questionnaire.
VI. Run quality checks to ensure the questionnaire meets best practice.

The quality and level of completion of the interviews is good and corresponds to the targeted objectives.

2 Economic and Industrial Relevance Analysis

This chapter covers the economic analysis of the EU Member States, giving GVA (Gross Value Added) and GDP (Gross Domestic Product) data that highlights which countries and industries contribute most to growth and employment in the EU. This builds on data from Eurostat, the ILO (International Labour Organization), and the UN (United Nations) as well as IDC research and projects for the European Commission. A key source is the European Data Market Monitor, a study for DG CONNECT measuring annually the European data market, data workers, data companies and impacts on the data economy, for the 28 EU Member States, 11 industry sectors, 3 company size classes[9].

Initially this report looks at the structure of the European industrial economy and then describes the footprint of BDA use in the economy.

As is natural, the EU main countries, Germany, the United Kingdom, and France make the largest contribution to European GVA, accounting for over half of GVA in 2016 – the latest year for which complete data is available. The key industries contributing to total GVA are Business and Professional Services, Manufacturing, and Wholesale and Retail trade. These three industries contribute half of total GVA in Europe in 2016. GVA growth is stable for the leading countries and industries, other than for the UK, which showed a decline in GVA from 2015, mostly due to exchange rate variations. As other countries are in the Euro area, they showed no such variations.

Employment too is stable, and the country and industry profiles are comparable to that for GVA. There are notable differences in GVA and Employment by industry across the Member States though, and these differences are highlighted in this chapter.

2.1 Gross Value Add

Table 5 and Figure 5 below summarise GVA in Euro for the Member States in Europe in the period 2012-2017. The data show clearly the predominant weight of the top 6 European countries, which account for 75% of GVA for the European Union. The relative share of the main MS has not changed significantly over the past 5 years, except for the United Kingdom – soon to exit the European Union. The decline in the UK GVA is mostly due to exchange rate changes between the UK Pound and the Euro.

Rank	Member State	GVA 2017 €M	Rank	Member State	GVA 2017 €M
1	Germany	2,954,696	15	Romania	169,732
2	United Kingdom	2,080,119	16	Portugal	168,677
3	France	2,042,082	17	Greece	157,526
4	Italy	1,546,694	18	Hungary	104,979
5	Spain	1,057,467	19	Slovakia	76,431
6	Netherlands	660,393	20	Luxembourg	50,155
7	Sweden	420,280	21	Bulgaria	44,807
8	Poland	410,256	22	Lithuania	37,917
9	Belgium	391,877	23	Slovenia	37,366
10	Austria	329,941	24	Croatia	36,424

9 Update of the European Data Market study, www.datalandscape.eu

11	Ireland	275,947	**25**	Latvia	23,626
12	Denmark	254,474	**26**	Estonia	20,479
13	Finland	193,268	**27**	Cyprus	16,996
14	Czechia	171,981	**28**	Malta	9,987

Table 5 -Gross Value Add by Member State – 2017
Source: Eurostat

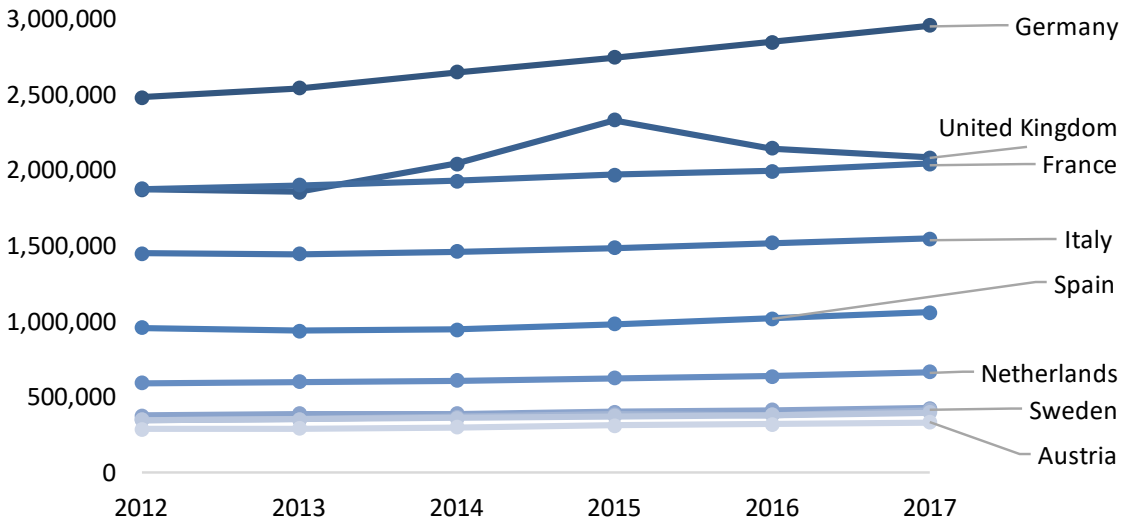


Figure 5 - Gross Value Add, €M – EU MS Trends 2012-2017
Source: Eurostat

Of greater interest and value is the contribution to GVA broken down by industry (Table 6, Figures 6-7). There are no surprises here, with Professional Services, Manufacturing, and Trade accounting for nearly 50 percent of value added in 2016. There are no significant changes in the share of GVA contributed by each of the industries either, apart from a slight growth in Manufacturing's share in 2017. Overall the country and industry contribution of GVA in Europe has been reasonably stable over the past seven years.

Industry	GVA 2017, €M
Business and Professional Services	3,070,902
Manufacturing	2,254,070
Wholesale and retail trade; repair of motor vehicles and motorcycles	1,538,243
Human health and social work activities	1,009,027
Public administration and defence; compulsory social security	849,661
Education	699,334
Information and communication	685,803
Financial and insurance activities	678,802
Transportation and storage	676,329
Utilities	379,053
Agriculture, forestry and fishing	227,302
Other Industries	1,675,992

Table 6 - Gross Value Add by Industry, 2017
Source: Eurostat

This distribution of GVA is not likely to undergo significant changes over the next five years as it shows a strong resilience. Even the impact of technology innovation (for example Artificial Intelligence) will disrupt industrial value chains but without necessarily changing radically GVA relative shares - at least in the short-medium term. The most important variations are likely to come from the impact of Brexit on country and industry shares, which is likely to affect mainly the UK, followed by Ireland and the other EU countries with a high intensity of trade with England.

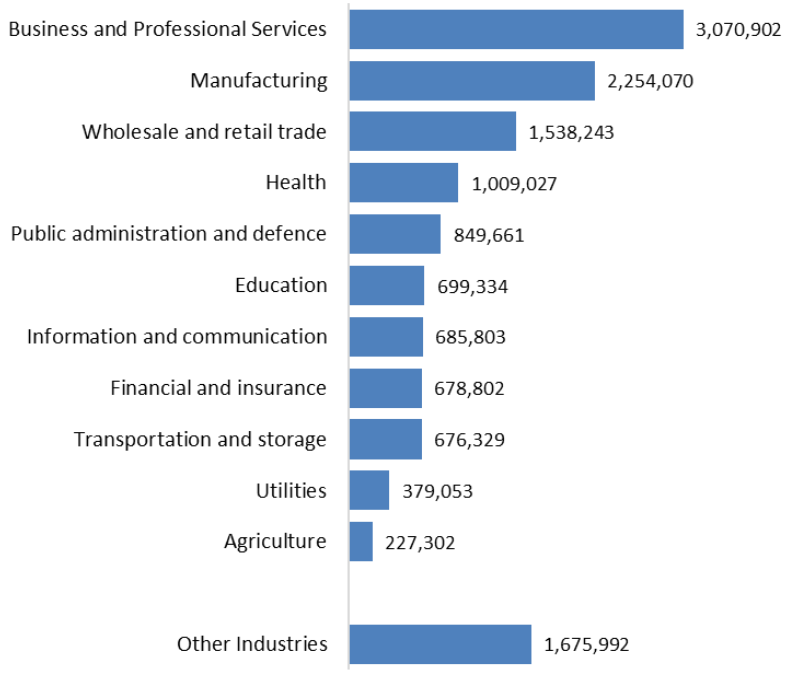


Figure 6 - EU Gross Value Add by Industry – 2017
Source: Eurostat

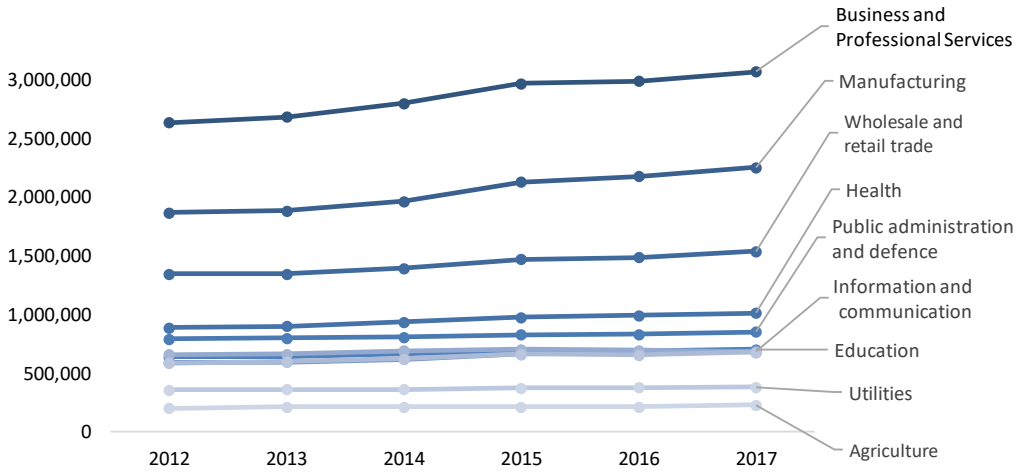


Figure 7 - Gross Value Add, Key Industry Trends 2012-2017
Source: Eurostat

Industry GVA by Member State reflects the different industrial structure of each country. For the sake of analysis, we have aggregated the Member States into five groups based on the size of their contribution to EU GVA, on a descending scale from group 1 (highest share of GVA) to group 5 (lowest share of GVA). Within each group, each country has a comparable size of GVA but may have a different mix of industries, reflecting their different industrial specialization (see Figures 8 to 12).

Industry focus by Member State contributes to shape different adoption paths of BDA, since we know that some sectors are adopting it faster than others and/or may gain different benefits. Those Member States with a greater contribution to GVA from Big-Data-friendly industries are likely to benefit more from the increased value that adoption of Big Data and Digital transformation overall will bring. This will be investigated in detail later in this report, when looking at the added value from adoption of Big Data solutions to specific use cases.

Group 1 – GVA by Industry

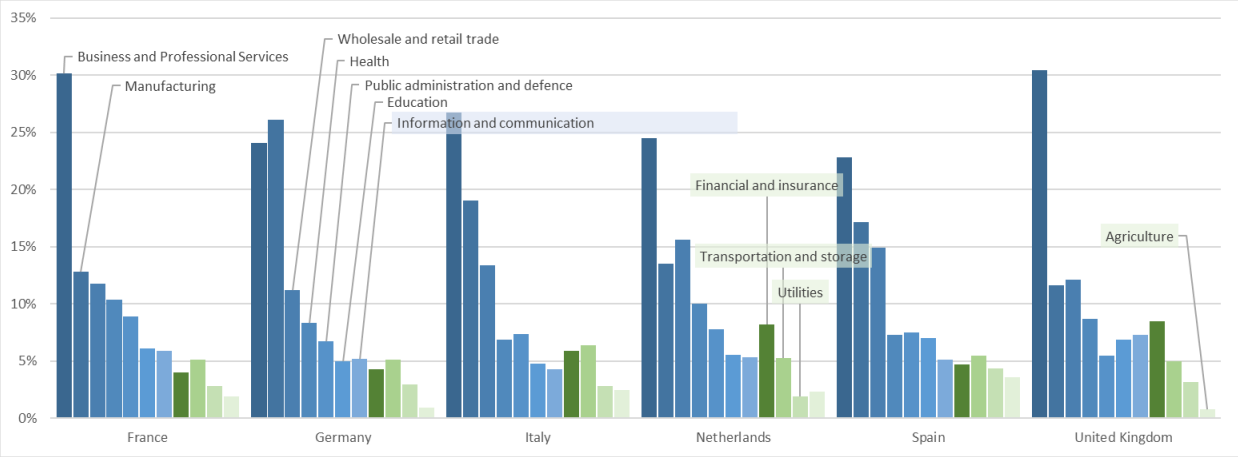


Figure 8 - GVA share by Industry by Member State - Group 1
Source: Eurostat

Of note in this group is the relative higher weight of the Business and Professional Services compared to other industries in France and the United Kingdom. Germany (and Italy) show the well-known strength of Manufacturing which provides a higher share of GVA contribution than Professional Services. German Manufacturing is clearly the backbone of Germany's growth in the last years and a competitive advantage on the other MS.

Group 2 – GVA by Industry

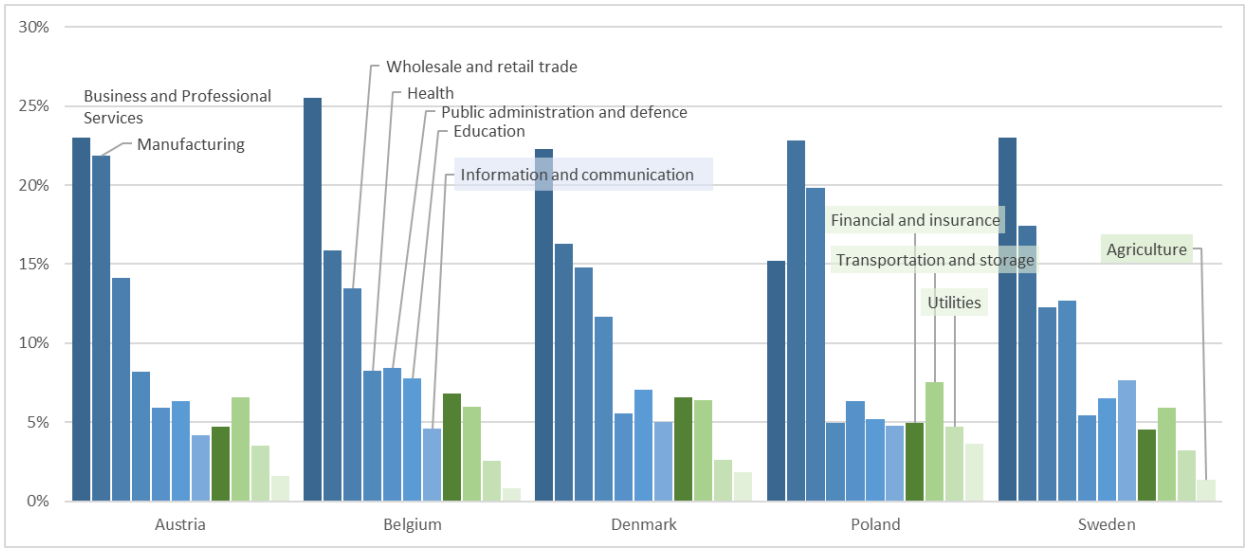


Figure 9 - GVA share by Industry by Member State - Group 2
Source: Eurostat

Within this second group, Manufacturing makes a greater contribution to GVA for most of the MS included (even though the absolute value is clearly much lower than in Group 1). Information and communication show a bump in Sweden, when compared to others in the group, and relatively speaking Education shows a higher contribution to GVA for Sweden too.

Group 3 – GVA by Industry

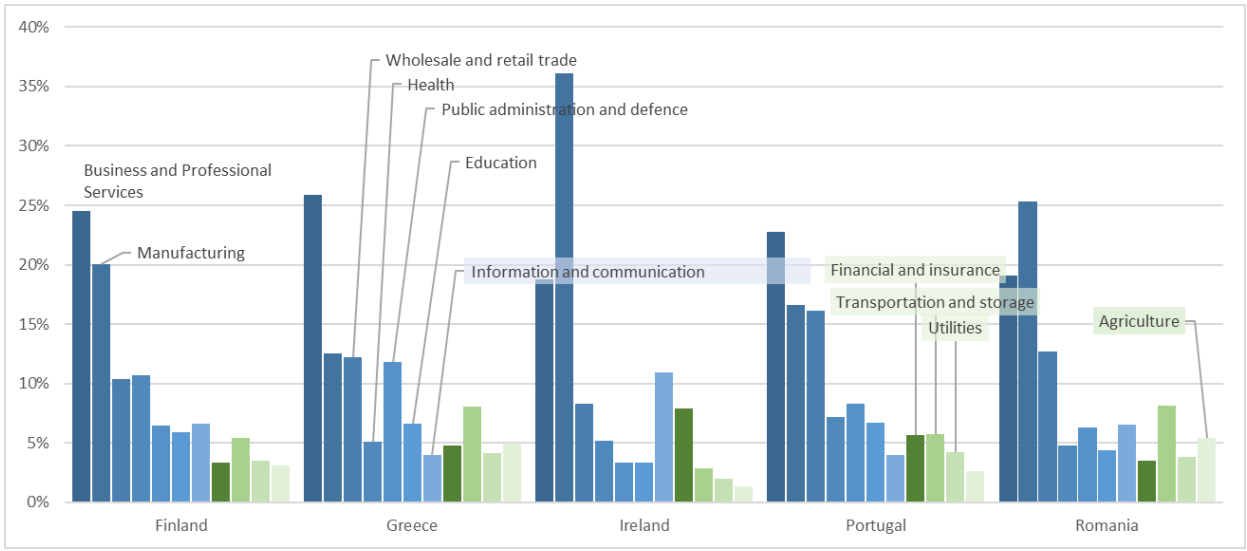


Figure 10 - GVA share by Industry by Member State - Group 3
Source: Eurostat

In the third group Manufacturing again shows greater contributions to GVA for many of the MS, with Ireland and Romania in particular showing relatively strong Manufacturing importance compared with other industries. Ireland also has a relatively strong Financial sector, together with a strong Information and communication sector when compared with

other Member States in this group. Romania is the only Member State where Agriculture is not the smallest industry for GVA.

Group 4 – GVA by Industry

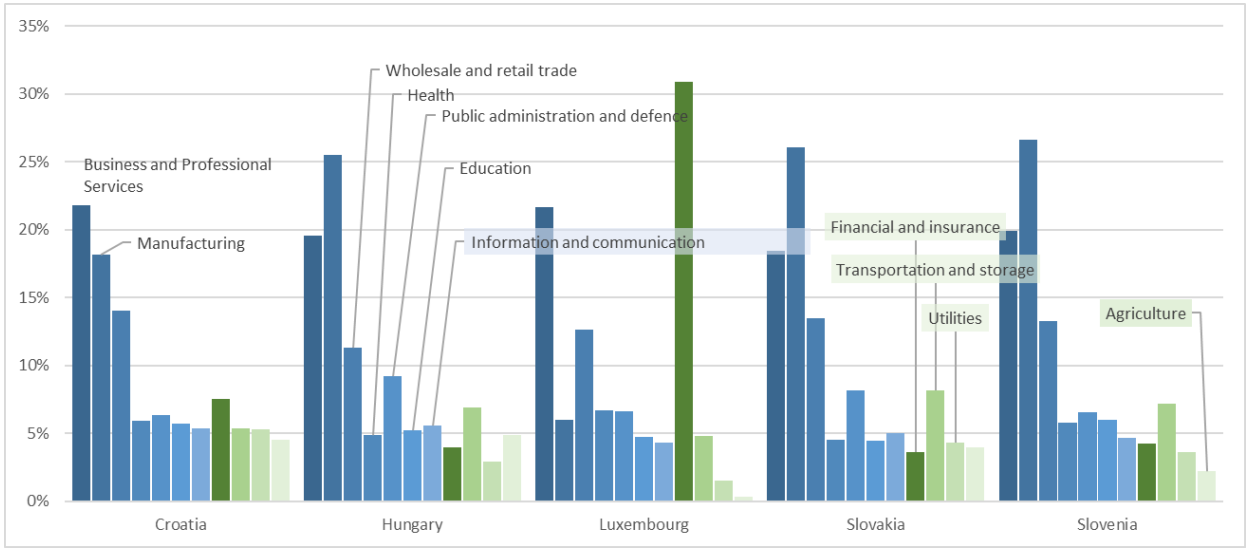


Figure 11 - GVA share by Industry by Member State - Group 4
Source: Eurostat

In this fourth group, composed by very small countries and a medium-small one (Hungary), the size of GVA is considerably lower than in the previous groups. Luxembourg stands out as having exceptionally strong Professional Services and Financial activities compared to every other Member State, as is well known. Hungary presents a notably larger contribution from Wholesale and Retail, and from Public administration.

Group 5 – GVA by Industry

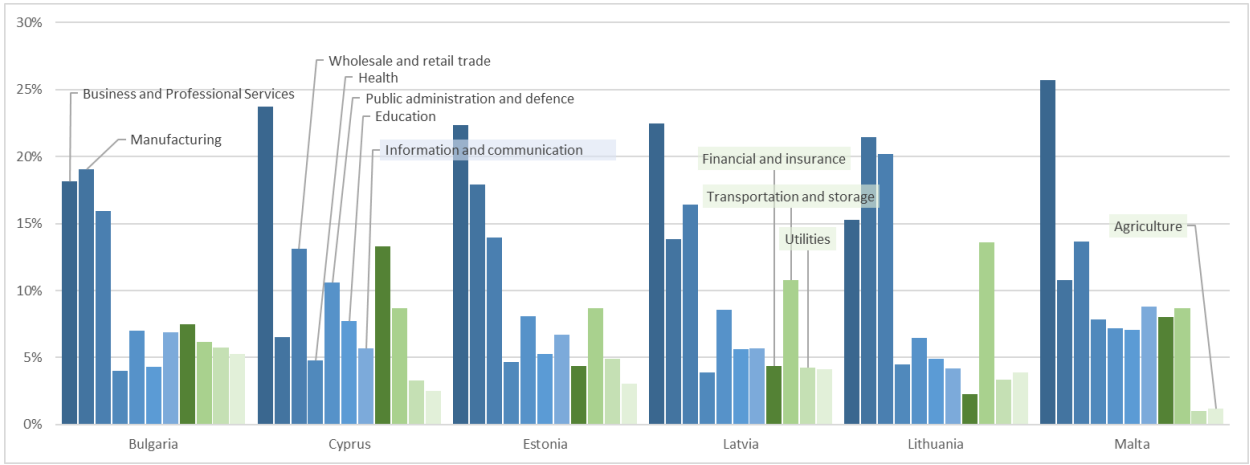


Figure 12 - GVA share by Industry by Member State - Group 5
Source: Eurostat

The final group shows the GVA from the smallest Member States, but there is nothing significantly different in the industries mix for most of these countries. Lithuania is relatively strong in Manufacturing, Wholesale and Retail, and Transport, while Bulgaria have a more balanced industrial portfolio overall. Estonia's contribution from Information and communication is surprising low considering the strength behind the country's ICT interests.

2.2 Employment

Table 7 and Figure 13 show the number of persons employed by Member State in 2016 (most recent available data), while Figure 14 shows key employment trends for the top 10 Member States.

Rank	Country	Employees 2016	Rank	Country	Employees 2016
1	Germany	37.0 M	**15**	Hungary	3.0 M
2	United Kingdom	25.8 M	**16**	Bulgaria	2.4 M
3	France	18.4 M	**17**	Denmark	2.0 M
4	Italy	16.7 M	**18**	Ireland	1.9 M
5	Spain	14.2 M	**19**	Finland	1.8 M
6	Poland	9.8 M	**20**	Slovakia	1.7 M
7	Netherlands	8.2 M	**21**	Lithuania	1.2 M
8	Romania	4.6 M	**22**	Croatia	1.1 M
9	Czech Republic	4.1 M	**23**	Latvia	0.7 M
10	Portugal	3.6 M	**24**	Slovenia	0.7 M
11	Austria	3.4 M	**25**	Estonia	0.5 M
12	Belgium	3.4 M	**26**	Luxembourg	0.4 M
13	Greece	3.2 M	**27**	Cyprus	0.3 M
14	Sweden	3.2 M	**28**	Malta	0.1 M
				Total	**173.3 M**

Table 7 - Persons employed in the EU by MS, 2016, Million
Source: Eurostat

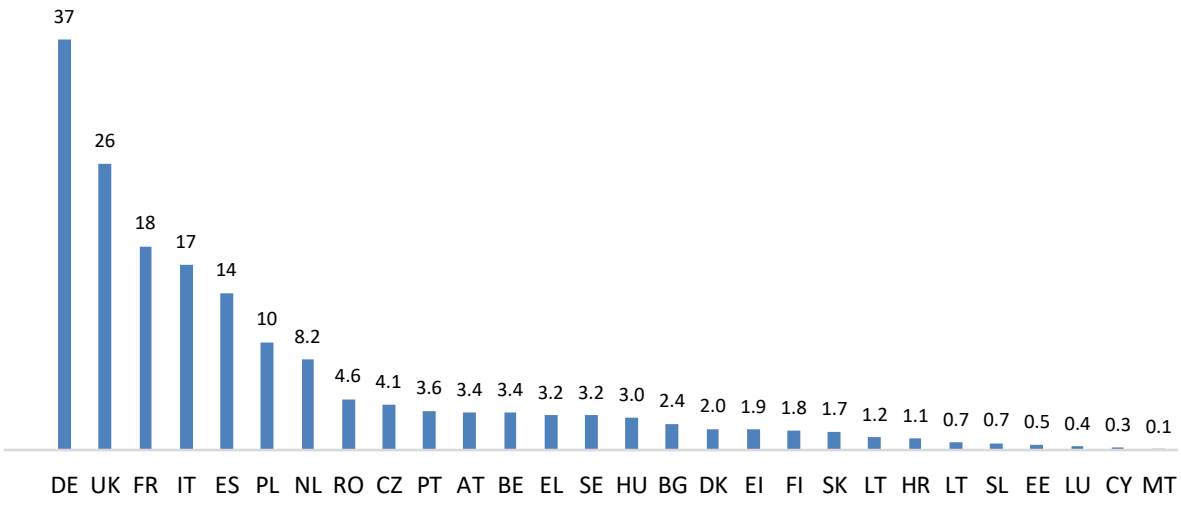


Figure 13 - Persons Employed by EU Member State – 2016
Source: Eurostat

There are no notable changes in the MS ranking by employment size over the period 2013-2016, showing relatively stable employment among the largest MS. The United Kingdom employment grew slightly but steadily from 2008 to 2016, although its position as the second largest employer is unchanged (Figure 14).

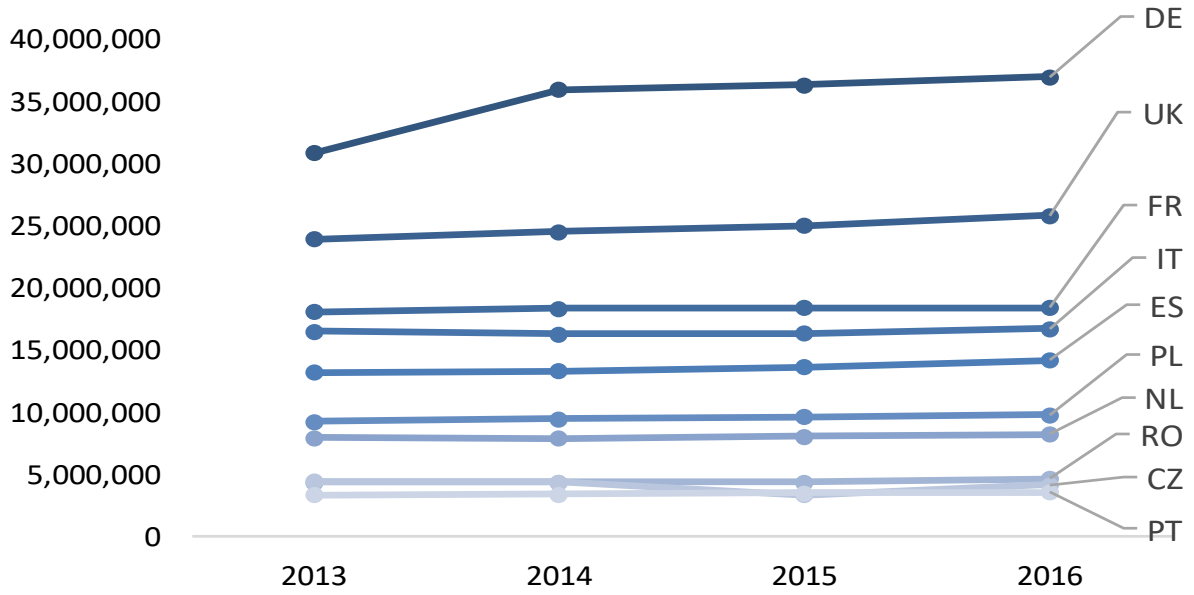


Figure 14 - Persons Employed by Member State - Key Trends (Top 10 MS)
Source: Eurostat

The size of employment by industry was also relatively stable in 2013-2016, although Business and Professional Services has overtaken Manufacturing as the second largest employer in the European Union (Table 8, Figure 15).

Rank	Industry – Number of Employees	2013	2014	2015	2016
1	Wholesale and retail trade	31.0 M	32.4 M	33.3 M	33.3 M
2	Manufacturing	29.2 M	30.0 M	30.3 M	30.5 M
3	Business and Professional Services	27.2 M	28.7 M	30.0 M	30.8 M
4	Health	12.1 M	13.1 M	13.8 M	13.9 M
5	Transportation and storage	9.8 M	10.3 M	10.6 M	10.9 M
6	Information and communication	6.0 M	6.3 M	6.6 M	6.7 M
7	Financial and insurance	5.7 M	5.8 M	5.8 M	5.6 M
8	Education	4.0 M	4.4 M	4.7 M	4.6 M
9	Utilities	2.8 M	2.8 M	2.9 M	2.9 M
	Other Industries	29.1 M	30.6 M	31.8 M	32.3 M

Table 8 - Persons Employed by Industry - Top 10 MS
Source: Eurostat

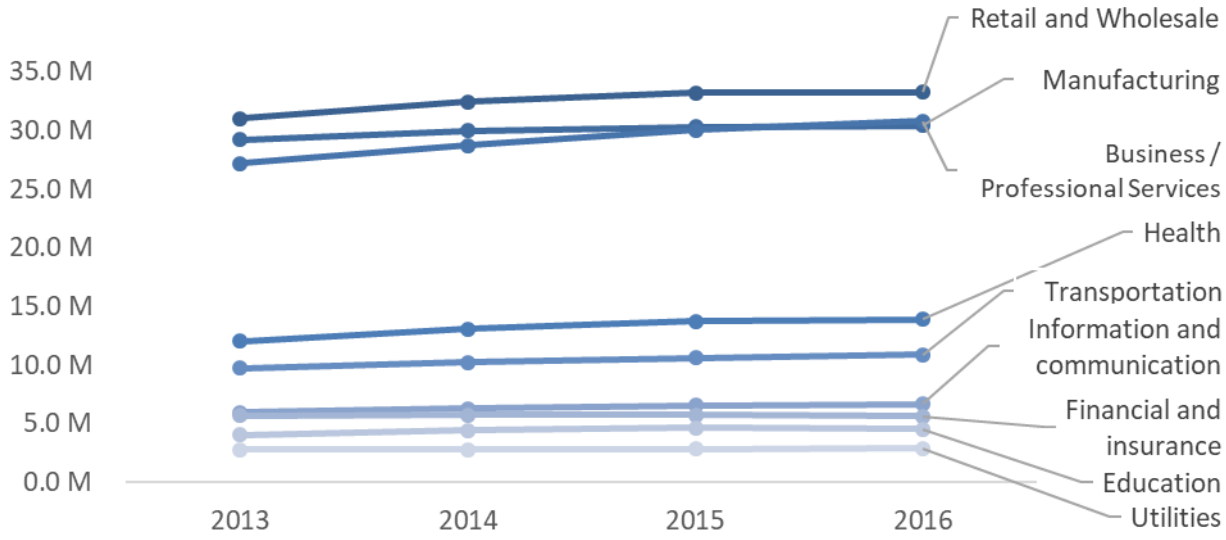


Figure 15 - Persons Employed by Industry – Top 10 Industries, Key Trends
Source: Eurostat

As with GVA, the variations in the structure of employment by industry for the different Member States provide the best insight into the impact of the use of Big Data on employment. However, Big Data and Digital Transformations impact is likely to have a lower impact on employment than on GVA, as many uses for Big Data increase efficiency rather than grow business opportunity with new product and service introductions.

If we analyse the distribution of employment by industry in the same 5 MS groups used for GVA (par.2.1 above), we will notice substantial variations within each group as well as between groups. In the Table below, the order of the industries by employment and by GVA is different. Wholesale and Retail is the largest employer, whereas it is only the third largest contributor to GVA for the whole of the EU. Unfortunately, there are no public figures available for employment in public defence for each of the Member States, and similarly for Agriculture.

Rank	Industry Descending Order by Employment share	Industry Descending Order by GVA share
1	Wholesale and Retail trade	Business and Professional Services
2	Business and Professional Services	Manufacturing
3	Manufacturing	Wholesale and retail trade
4	Human health and social work	Transportation and storage
5	Transportation and storage	Public administration and defense
6	Information and communication	Financial and insurance activities
7	Financial and insurance activities	Information and communication
8	Education	Education
9	Utilities	Human health and social work
10	NA	Utilities
11	NA	Agriculture, forestry and fishing

Table 9 - Industry Order Comparison - Employment and GVA Shares
Source: Eurostat

Group 1 – Employment by industry

	France	Germany	Italy	Netherlands	Spain	United Kingdom
Wholesale and retail trade	3,600,568	5,857,622	3,386,953	1,489,898	3,115,403	4,978,993
Business and Professional Services	3,149,816	6,157,786	2,787,364	1,757,920	2,696,239	5,839,193
Manufacturing	2,800,131	7,497,697	3,670,906	686,194	1,904,089	2,516,575
Human health and social work activities	1,337,688	5,370,497	871,218	1,404,707	808,907	2,175,509
Transportation and storage	1,328,477	2,104,126	1,118,815	401,050	872,588	1,280,924
Information and communication	897,376	1,195,315	559,244	295,949	457,145	1,246,412
Financial and insurance activities	803,027	1,065,260	571,705	224,275	373,990	1,022,733
Education	300,359	1,205,784	105,091	580,411	530,751	1,125,727
Utilities	351,933	614,099	283,794	61,089	194,508	312,962

Figure 16 - Industry order comparison - Employment and GVA – Group 1
Source: Eurostat

Within this first group, the Netherlands stands out because of its smaller employment (logically, given its population size), whereas in terms of GVA contribution the country is comparable to the other MS. This suggests a greater efficiency for the country in terms of GVA per employee. Germany has a high share of employment in Manufacturing, which is consistent with the high GVA generated by the same industry. The country also shows high levels of employment in the top 4 industries. The UK has high employment in Wholesale and Retail, although its GVA in this sector is low in comparison with the other MS.

Group 2 – Employment by industry

	Austria	Belgium	Czech Republi	Denmark	Poland	Sweden
Manufacturing	636,685	493,666	1,326,707	305,386	2,719,559	558,199
Wholesale and retail trade	684,025	626,736	752,504	454,091	2,384,762	642,882
Business and Professional Services	572,678	780,194	566,078	361,051	1,417,964	739,262
Transportation and storage	205,559	209,042	283,147	146,776	850,033	250,720
Information and communication	120,331	130,315	125,146	112,527	358,688	232,391
Human health and social work activities	226,514	457,194	165,764	82,376		
Financial and insurance activities	123,954	122,094	116,825	80,876	358,482	94,923
Utilities	51,637	42,495	86,056	23,029	266,992	49,945
Education	37,801	4,608	18,578	12,331		

Figure 17 - Industry order comparison - Employment and GVA – Group 2
Source: Eurostat

In the second group, Poland and the Czech Republic are the largest employers, but their contribution to GVA is lower than the one by Austria and Belgium. This groups shows clearly the lower GVA by employee generated in Eastern Europe compared to Western Europe.
The Czech Republic's employment is strongest in Manufacturing, which matches its GVA contribution.

Group 3 – Employment by industry

	Finland	Greece	Ireland	Portugal	Romania
Wholesale and retail trade	310,427	727,268	345,911	735,834	987,796
Manufacturing	346,878	322,148	200,047	670,116	1,188,835
Business and Professional Services	328,856	441,636	276,276	708,105	577,347
Transportation and storage	148,531	195,252	94,622	154,438	369,503
Human health and social work activities	90,454	230,945	211,318	162,178	60,524
Information and communication	101,490	85,096	87,597	90,993	180,870
Education	22,071	184,300	153,426	92,423	24,871
Financial and insurance activities	47,999	97,205	97,836	94,226	93,181
Utilities	23,794	48,907	17,586	39,470	155,771

Figure 18 - Industry order comparison -Employment and GVA – Group 3
Source: Eurostat

In this third group, Wholesale and Retail, Manufacturing, and Professional Services are the biggest employers which aligns with the contribution to GVA by the same industries. However, the order is different with Wholesale and Retail being the biggest sector in employment but only the third biggest in GVA. Romania has the largest number of persons employed while it was the smallest when looking at GVA. Romania and Portugal have the largest employment in Wholesale, Manufacturing, and Professional Services which aligns with GVA, but these sectors account for a significant share of employment in these Member States while not showing the same strength in GVA. Ireland, in particular, shows the biggest mis-match between GVA and employment in Manufacturing, with high GVA contribution and relatively low employment share. This is maybe due to the strong presence of multinationals allocating to Ireland also revenues produced in other countries.

Group 4 – Employment by industry

	Croatia	Hungary	Luxembourg	Slovakia	Slovenia
Manufacturing	264,183	725,733	35,145	482,585	198,563
Wholesale and retail trade	228,232	568,896	54,114	347,619	113,797
Business and Professional Services	136,063	573,294	77,269	295,061	98,946
Transportation and storage	83,153	246,446	25,560	112,068	47,793
Information and communication	39,936	134,931	19,511	65,643	26,128
Financial and insurance activities	39,843	77,001	42,524	41,881	21,481
Human health and social work activities	21,625	83,197	29,342	52,956	19,246
Utilities	38,817	72,499	2,951	38,419	18,220
Education	8,591	45,362	1,920	11,497	7,235

Figure 19 - Industry order comparison -Employment and GVA – Group 4
Source: Eurostat

There are few differences between the GVA and Employment data for the fourth group, other than the low employment in Luxembourg when compared with its GVA (reflecting the very high value added by employee, typical of an advanced service economy). Luxembourg has a notable share of its GVA from Professional Services and from Finance, but its employment size for these industries and overall is significantly lower than that of the other Member States in this group. This is not surprising, considering that Luxembourg has approximately 600K inhabitants, with the highest per capita GDP in purchasing power (PPS), two and a half times the EU28 average[10].

10 https://ec.europa.eu/eurostat/tgm/graph.do?tab=graph&plugin=1&language=en&pcode=tec00114&toolbox=type data June 2018

Group 5 – Employment by industry

	Bulgaria	Cyprus	Estonia	Latvia	Lithuania	Malta
Wholesale and retail trade	513,900	64,601	99,789	158,202	267,575	
Manufacturing	550,678	29,374	112,531	116,583	219,689	
Business and Professional Services	262,413	38,534	82,112	121,209	160,105	
Transportation and storage	170,339	16,277	43,893	77,707	122,685	
Human health and social work activities	113,570	10,200	19,685	21,671	93,951	
Education	172,719	12,084	4,054	10,294	51,118	
Information and communication	95,674	10,277	24,222	31,983	36,917	
Financial and insurance activities	61,362	20,083	10,340	18,597	23,011	
Utilities	65,628	3,748	8,893	19,035	28,792	

Figure 20 - Industry order comparison -Employment and GVA – Group 5
Source: Eurostat

The final group is missing data for Malta for employment for 2016, so no comparison can be made to GVA. However, among the other Member States there is little difference between their employment and GVA. Bulgaria employs disproportionately more in Education that the other Member States in this group, but employment is again dominated by Wholesale and Retail, Manufacturing, and Professional Services. Cyprus' share of employment is low compared to others in the group, but its distribution among the industries is tied more closely to Financial and Professional Services.

2.3 Industrial Relevance Analysis

This paragraph presents the analysis of the industries in the EU, looking at the impact of Big Data on each industry. The paragraph will highlight those industries that have the highest growth from the adoption of Big Data technologies, and those that make the biggest overall contribution to overall IT industry growth in the Member States. Analysis in this section is largely based on desk research and includes analysis of data from Eurostat, IDC Black Book, IDC Big Data Spending Guide, and the European Data Market report.

IT Spending in Europe was €409,200M in 2017, with the United Kingdom, Germany, and France accounting for nearly 60 percent of this. Growth to 2016 is reasonably stable, at 3.5 percent per year on average. Growth is forecast to slow though, to 2.8 percent per year from 2017 to 2022. IT Spending by industry is concentrated in Manufacturing, Finance and Insurance, and Public administration, which accounts for just over half of total IT Spending. The leading industries for IT spending do not match those for GVA and employment, with Professional Services – the leading contributor to GVA only the fifth largest spending industry on IT.

Spending on Big Data tools and services accounts for around 8 percent of total IT spending in 2017, but this is expected to rise to 11 percent by 2022. Industry focus for Big Data spending is on Finance and Insurance, Manufacturing, and Public Administration – as for total IT spending. There are significant differences across the Member States as shown below.

2.4 IT Spending

Figure shows IT Spending by Member State in 2017 – with spending greatest in the United Kingdom, followed by Germany and France.

Rank	Country	IT spend €M	Rank	Country	IT spend €M
1	United Kingdom	93,129	**14**	Ireland	4,450
2	Germany	84,959	**15**	Portugal	3,542
3	France	60,702	**16**	Hungary	2,829
4	Italy	29,677	**17**	Romania	2,564
5	Netherlands	24,705	**18**	Greece	1,856
6	Spain	24,200	**19**	Slovakia	1,753
7	Sweden	16,893	**20**	Croatia	1,113
8	Denmark	11,124	**21**	Bulgaria	976
9	Belgium	10,794	**22**	Slovenia	742
10	Poland	9,856	**23**	Lithuania	739
11	Finland	8,890	**24**	Latvia	486
12	Austria	7,849	**25**	Estonia	411
13	Czech Republic	4,943			

Table 10 - IT Spending by EU Member State (€ M) – 2017 (Excluding Luxembourg, Malta, Cyprus)
Source: IDC Worldwide Black Book Standard Edition

The top-ten-Member States show consistency in IT Spending trends evolution in time, as shown in Figure below. There are no changes in trend or rank of the MS over the period 2012 to 2017. IT Spending is therefore a good basis on which to base the analysis of key issues and trends.

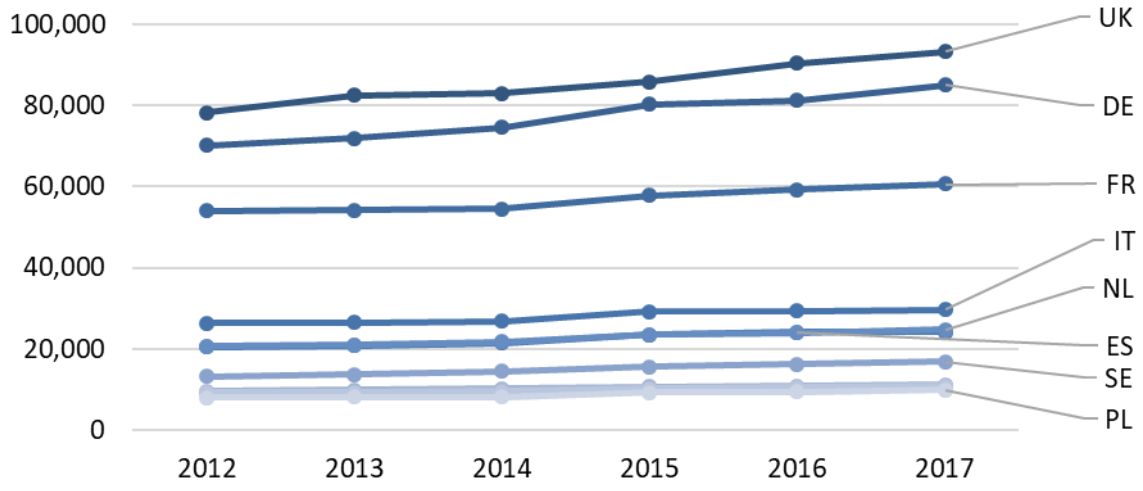


Figure 21 - IT Spend (€) - Key Trends
Source: IDC Worldwide Black Book Standard Edition

Spending by industry gives a clearer insight into IT investments and helps identify the largest potential benefits from the adoption of Big Data Technologies. Table 11 and Figure 22 below show IT Spending by industry. Consumer is excluded as this is not relevant for Big Data trends.

Rank	Industry	IT spend €M 2017
1	Manufacturing (process and discrete)	68,488
2	Financial and Insurance	65,499
3	Public Administration	39,596
4	Information and Communication	36,469
5	Retail & Wholesale	32,304
6	Professional Services	26,778
7	Utilities	14,154
8	Transportation	10,996
9	Health	10,935
10	Education	9,070
11	Agriculture, Mining & Quarrying	3,974
	Other Industries	6,859
	Total	**325,122**

Table 11 - IT Spend by industry (€M), 2017
Source: IDC Worldwide Semiannual ICT Spending Guide Industry and Company Size

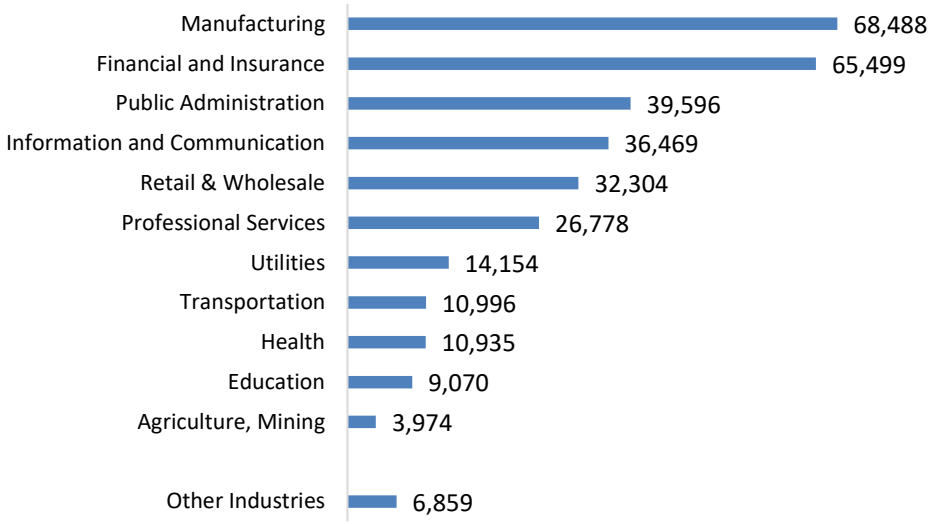


Figure 22 - EU IT Spending by Industry, 2017, €M
Source: IDC Worldwide Semiannual ICT Spending Guide Industry and Company Size

Manufacturing and Financial industries are significantly ahead of other industries in terms of IT spending. In particular, the Financial industry shows a very high intensity of IT investments compared to its GVA and total employment, resulting in a 2nd place in the ranking of IT spending by industry (Figure 22), while it is number 8th in the ranking by GVA (Table 6). Figure 23 shows the key forecast trends of IT spending for the top 10 industries for the period 2016-2022. IDC does not foresee any major changes in the ranking of industry

by absolute spending levels, although the outlook for Manufacturing and for Finance and Insurance shows much higher growth than for the other key industries.

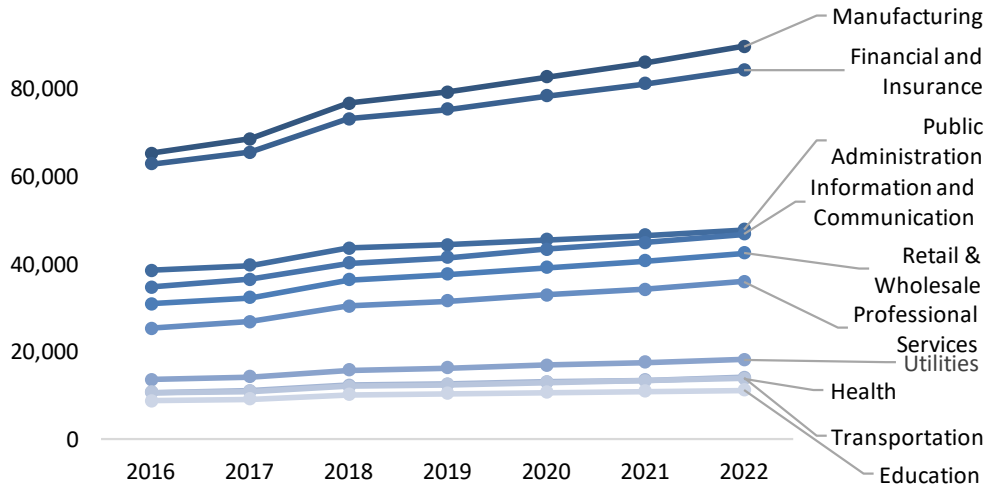


Figure 23 - IT Spending by Industry, Key Trends 2017-2022
Source: IDC Worldwide Semiannual ICT Spending Guide Industry and Company Size

2.5 Big Data Spending

Table 12 and Figure 24 show Big Data spending by EU Member State for 2017. However, data is not available for all Member States, and the smaller states such as Luxembourg, Malta, and Cyprus are not included. Member States from Central and Eastern Europe: Bulgaria, Croatia, Estonia, Latvia, Lithuania, Slovakia, Slovenia are included in Rest of CEE.

The outlook and key trends for Big Data spending for the top-10 Member States are shown in Table 13 and Figure 25. There are no significant changes in the position of the leaders and the dominance of the three major Member States: UK, Germany, and France are clear from the chart. The strength of the United Kingdom relates to its focus on Financial Services, which is a notable investor in IT as seen in IT Spending (Table 10). Both the UK and Germany have strong Manufacturing industries, and this industry also invests notably in IT Spending.

	Member State	Big Data Spend, 2017
1	United Kingdom	6,575
2	Germany	5,758
3	France	4,155
4	Italy	1,922
5	Netherlands	1,851
6	Spain	1,403
7	Sweden	1,271
8	Denmark	859
9	Belgium	773
10	Finland	684
11	Poland	679
12	Austria	510

13	Rest of CEE	405
14	Czech Republic	360
15	Ireland	340
16	Portugal	192
17	Hungary	156
18	Greece	105
19	Romania	79

Table 12 - EU Big Data Market by MS, 2017
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

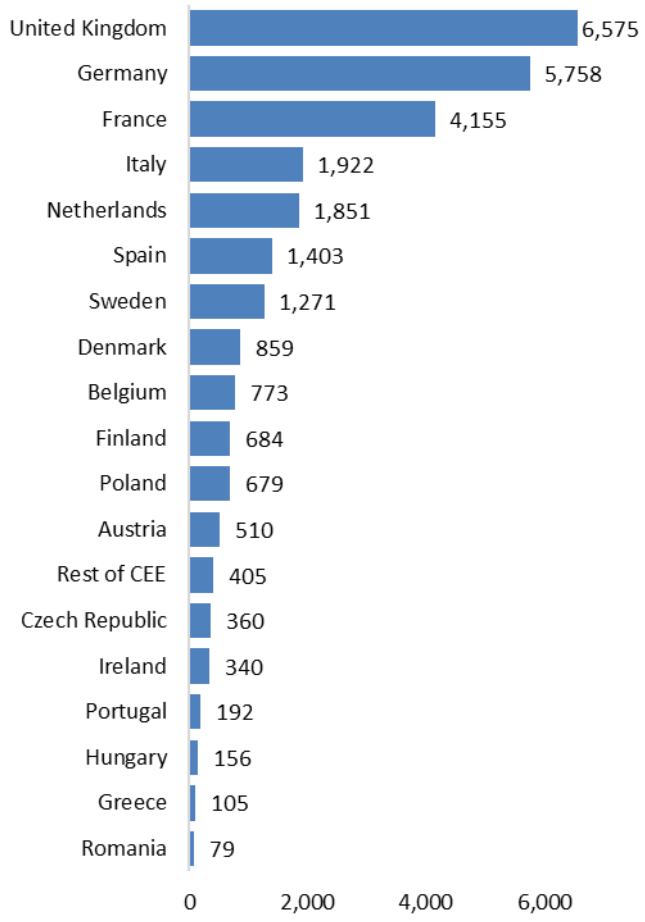


Figure 24 - EU Big Data Market by MS, €M, 2017
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

	Member State	2016	2017	2018	2019	2020	2021	2022
1	United Kingdom	5,943	6,575	7,212	7,826	8,520	9,300	10,174
2	Germany	5,187	5,758	6,320	6,927	7,585	8,343	9,250
3	France	3,759	4,155	4,634	5,100	5,578	6,131	6,781
4	Italy	1,773	1,922	2,087	2,258	2,455	2,668	2,911
5	Netherlands	1,679	1,851	2,029	2,229	2,436	2,662	2,904
6	Spain	1,282	1,403	1,528	1,660	1,802	1,955	2,117
7	Sweden	1,154	1,271	1,403	1,539	1,675	1,829	2,015
8	Denmark	790	859	939	1,025	1,162	1,273	1,370

9	Belgium	713	773	840	915	999	1,087	1,182
10	Poland	624	684	755	838	933	1,029	1,134

Table 13 - Big Data Spending Forecast - Top 10 Member States
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

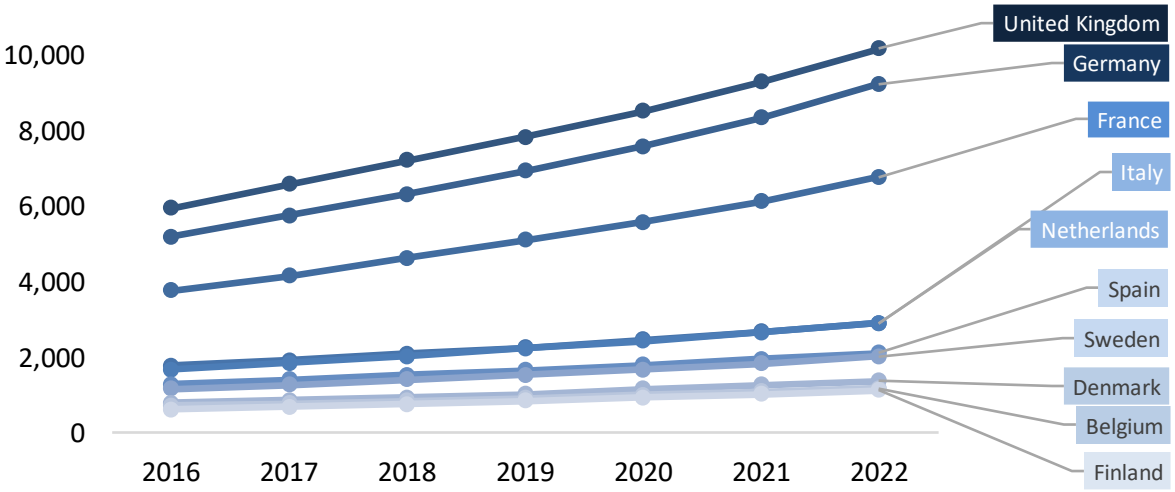


Figure 25 - Big data Spending Forecast - top 10 Member States
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

Finance and Public Administration are the industry key spenders for Big Data, which differs from IT Spending, where Manufacturing is the biggest spender.

	Industry	2017
1	Manufacturing	6,143
2	Finance and Insurance	5,982
3	Public Administration	3,516
4	Retail & Wholesale	2,908
5	Information and Communication	2,505
6	Professional Services	2,386
7	Utilities	1,205
8	Transportation	951
9	Healthcare	902
10	Education	674
11	Agriculture, Mining &Quarrying	348
	Other Industries	557
	Total	**28,077**

Table 14 - EU27, BDA spend by Industry (M.€), 2017
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

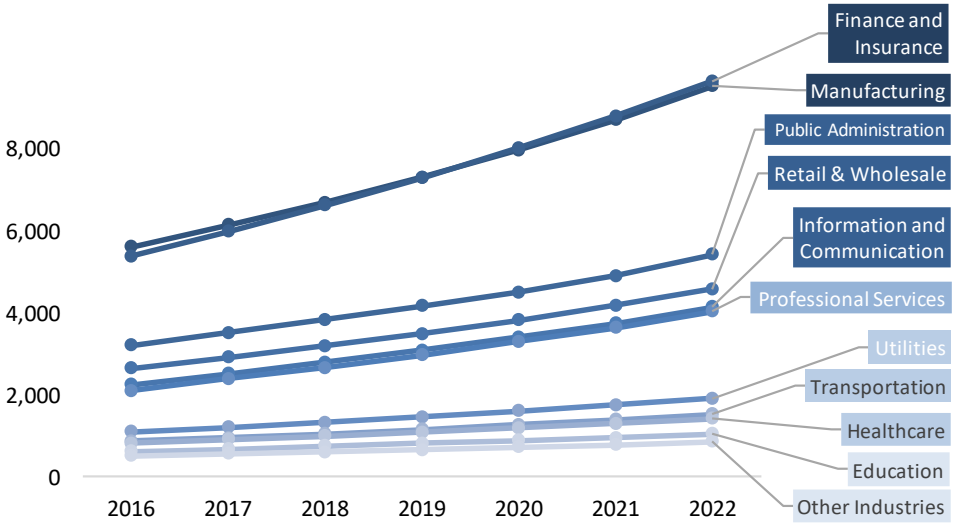


Figure 26 - Big Data spend by Industry – Forecast 2016-2022
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

	Industry	2016	2017	2018	2019	2020	2021	2022
1	Manufacturing	5,614	6,143	6,691	7,307	7,981	8,717	9,536
2	Finance and Insurance	5,380	5,982	6,622	7,300	8,030	8,807	9,660
3	Public Administration	3,211	3,516	3,838	4,163	4,507	4,907	5,430
4	Retail & Wholesale	2,643	2,908	3,188	3,491	3,822	4,184	4,586
5	Information and Communication	2,249	2,505	2,787	3,084	3,407	3,747	4,137
6	Professional Services	2,103	2,386	2,659	2,967	3,294	3,629	4,030
7	Utilities	1,089	1,205	1,327	1,458	1,598	1,746	1,907
8	Transportation	871	951	1,047	1,150	1,264	1,387	1,522
9	Healthcare	820	902	989	1,081	1,182	1,292	1,410
10	Education	614	674	742	809	881	954	1,041
	Other Industries	511	557	607	660	718	781	851

Table 15 - Big Data Spend by Industry – Forecast 2016-2022
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

Looking more closely at the breakdown by sub-industry in the sectors Finance, Manufacturing and Trade, some interesting considerations emerge (Figure below). It is clear that Banking leads Insurance in terms of intensity of spending, as does Retail within the Trade sector. Within Manufacturing there is less difference in the Big Data spending shares by Discrete and Process Manufacturing, although Discrete does account for slightly more than half of total Manufacturing spend on Big Data solutions This is significant when it comes to considering use cases for Big Data investments, and the relevant benchmark tools used to evaluate use cases within these sub-industries.

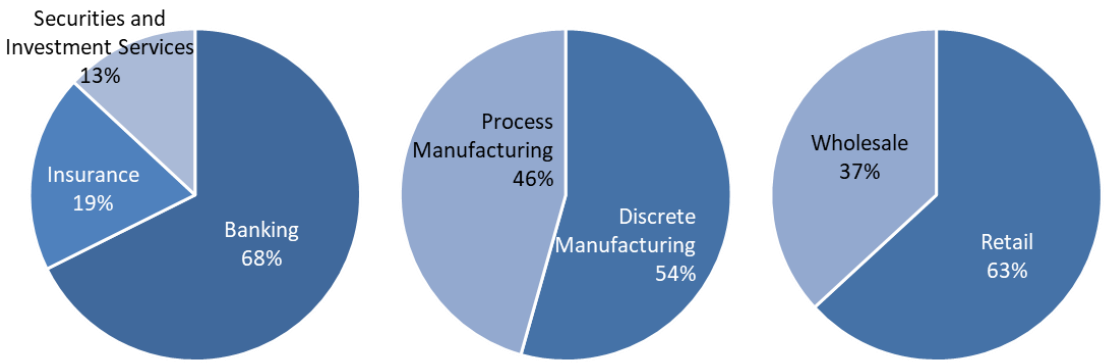


Figure 27 - EU Big Data Spend Shares within main Industries, 2017, %
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

Following the same approach used for Employment and GVA, we have aggregated the EU MS in 5 groups in order to explore the differences in Big Data spending by country and industry, investigating their relative industry specialisations and potential impacts on Big Data exploitation. The following tables highlight these differences. As with GVA and employment, Member States are grouped by size, in this case ordered by total Big Data spending for each Member State, from the largest spenders (Group 1) to the smallest (Group 5). In addition, the industry spending is ordered by total Big Data spending for each industry across all Member States. Each group includes countries with similar spending on Big Data technologies. Each group shows the share of Big Data spending by industry and gives a comparison of the relative importance of each industry in the Member State.

Group 1 – Big Data spending

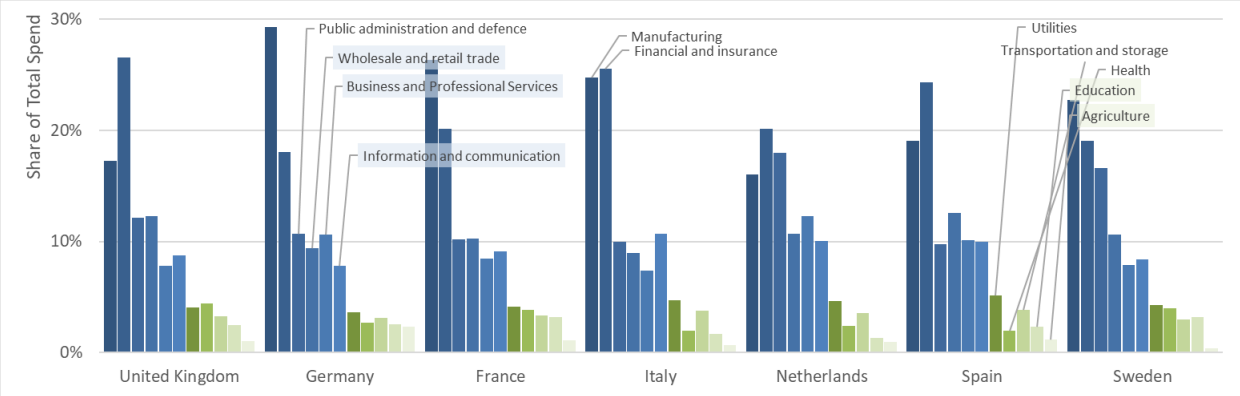


Figure 28 - Big Data Spending by Country and Industry 2017, Group 1
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

Within Group 1, the order of industry spend in Big Data by size in each country is similar to the overall ranking for the whole EU, with the exception of the UK whose share of Big Data spending in Finance and Insurance is very high. This is despite Finance and Insurance being only the fifth largest contributor to GVA for the UK, and the second smallest employer. Italy and Spain also show a high share of Big Data spending by the Financial industry, which probably reflects more lower spending by other industries lagging behind, rather than a particular strength of Banking. Similarly, Italy has a strong Retail sector but its investment in Big Data technology in this sector is relatively low, ranking fifth while in most other countries investment in Retail ranks fourth. This is most likely due to the larger share of

small businesses in the Italian retail sector: Big Data adoption is notably lower among smaller organizations. Given the great potential benefits of Big Data in retail in terms of costs savings and customer profiling, this lower adoption is a missed opportunity for Italian retailers – at least until 2017.

The rate of technology development within Finance means companies within this industry need to invest considerably to remain competitive. The Finance and Insurance industry tends to be an early adopter of technology and many Big Data use cases are aligned well with Finance – hence the greater investment in BDA. Figure 2-25 shows the dominance of Big Data spending in the Manufacturing sector in Germany, France, and Italy, all strong manufacturing countries. However, adoption of Big Data technology in Manufacturing is low when compared with others, with Manufacturing ranked fifth in terms of adoption. Although the large manufacturing Member States show relatively high Big Data spending in their industries, their adoption is moving more slowly than other industries and there is potential for strong further growth.

Group 2 – Big Data spending

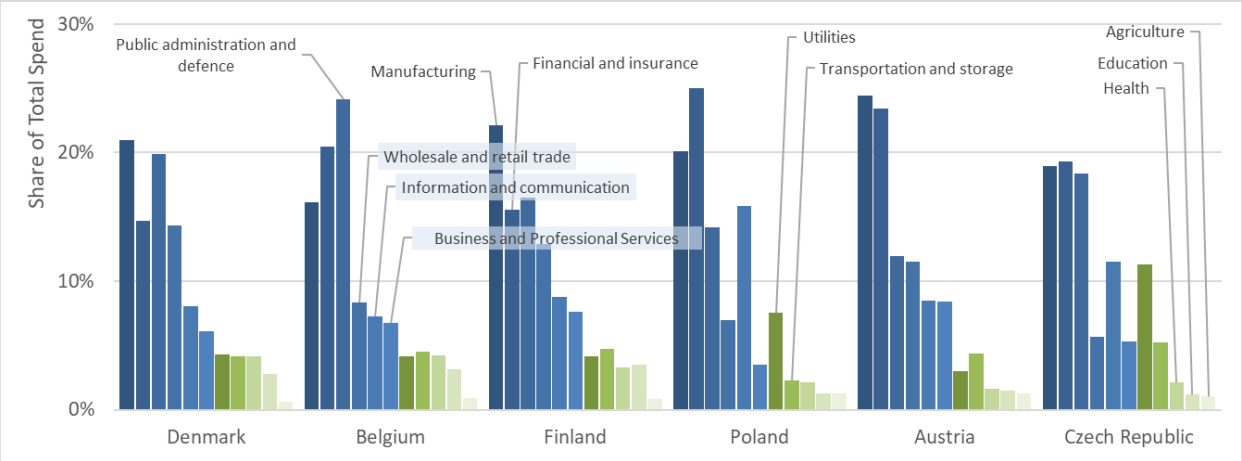


Figure 29 - Big Data Spending by Industry 2017, Group 2
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

The middle group of Member States shows greater diversity in the industry mix, particularly Big Data spending by Public Administration is relatively much higher within this group than within Group 1. However, IDC data does not show a high adoption of Big Data in Public Administration (this sector is not involved in the survey). Government is a no-profit sector where the main drivers of technology adoption are improving efficiency by reducing costs and improving effectiveness by better, satisfying citizens and businesses' needs. Big Data impact on transparency and participatory democracy are also important drivers, with a specific focus on Open Data. Given the complex organizational infrastructure of the public sector, the adoption of innovation faces higher barriers and higher investments than the private sector. However, governments can afford to take the long view, even though innovative investments are vulnerable to the changes of the political cycle. Changes of government after elections often may affect the timing and ambition of technology investments, and this is true also for Big Data.

Manufacturing still accounts for the greatest part of the spending within this group, but there is more of a balance across the leading industries. For each of the Member States in this group, Healthcare and Education Big Data investments appear much lower than their contribution to GVA. is notably lower when compared to GVA, where both are seen as

notable contributors to GVA. Healthcare in particular has a notable number of use case for optimizing and developing patient care, so this could be a lost opportunity for these Member States.

Group 3 – Big Data spending

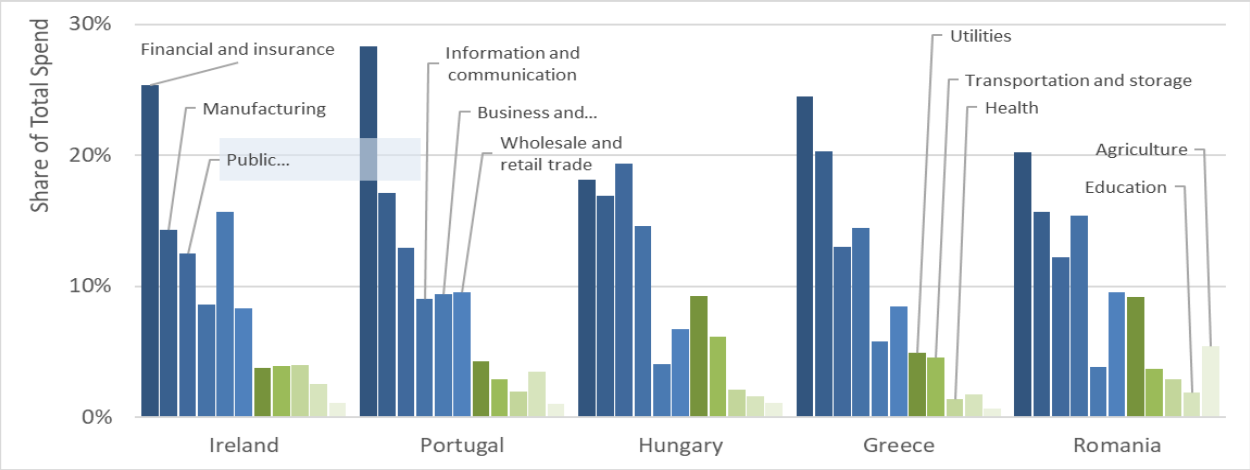


Figure 30 - Big Data Spending by Industry 2017, Group 3
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

In the third group total spending on BDA is low, when compared to the other Member States in the larger groups. Finance is the leading industry for IT spending in this group – ahead of Manufacturing. However, this is mostly due to the high concentration of Finance BDA spending in Ireland, which is also strong in BDA spending on Professional Services.

2.6 Big Data Industrial relevance

Building on the previous evidence we can now examine the industrial relevance of BDA and the impact of Big Data spending by industry in correlation with the other main economic indicators.

Big Data's share of total IT spending is consistent across all industries and IDC expects it to rise from 8.4% in 2016 to 11.1% in 2022. Figure 31 shows the variation of this share by major industry. Notice how Agriculture (an industry with a relatively low IT investment until now) shows the highest share of actual and forecast Big Data investments on IT. At the other extreme we find Education, which according to IDC is lagging behind all the other industries in its share of Big Data spending.

This analysis is relevant because it connects Big Data spending level and trends with total IT spending by industry and GVA, and therefore it correlates Big Data investments with economic growth dynamics again by industry.

Comparing Big Data spending by Industry to GVA shows the leverage for each of the major industries. According to IDC forecasts, Big Data Spending growth trends are consistent over the next five years, which provides a robust basis for impact estimation. IT spending on Big Data technologies grows notably faster than total IT spending, which is why its share of total IT spending grows so much.

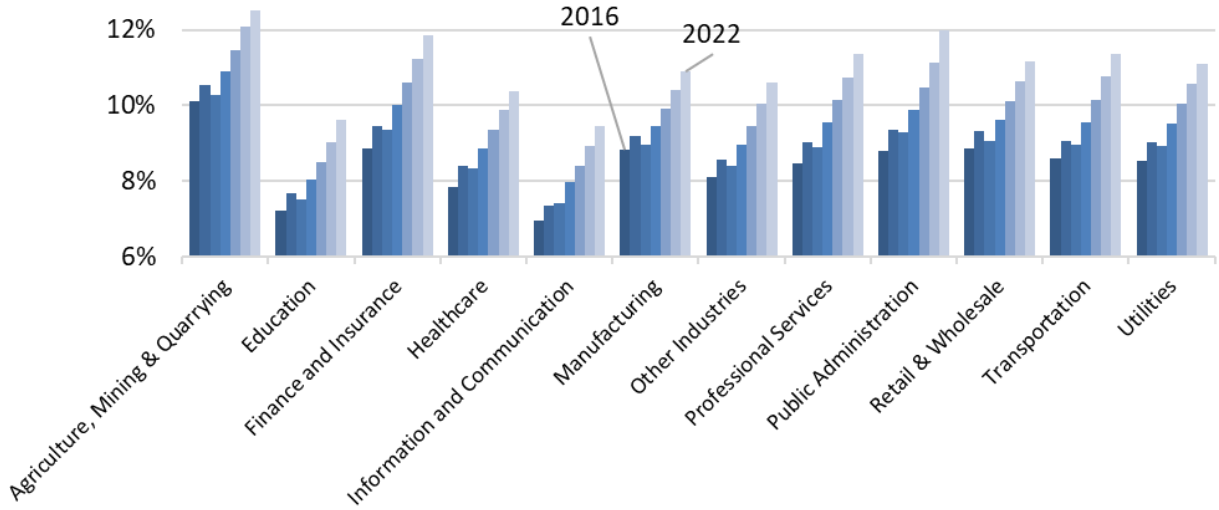


Figure 31 - Big Data spending as a share of total IT Spending, 2016 to 2022
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

Now we need to compare this Figure 31 with the following one, which shows each industry's contribution to total GVA growth in the period 2012-2017. From this chart it is clear that a 1% increase in Professional Services GVA will have a much greater impact on EU GVA than a 1% increase in Agriculture GVA.

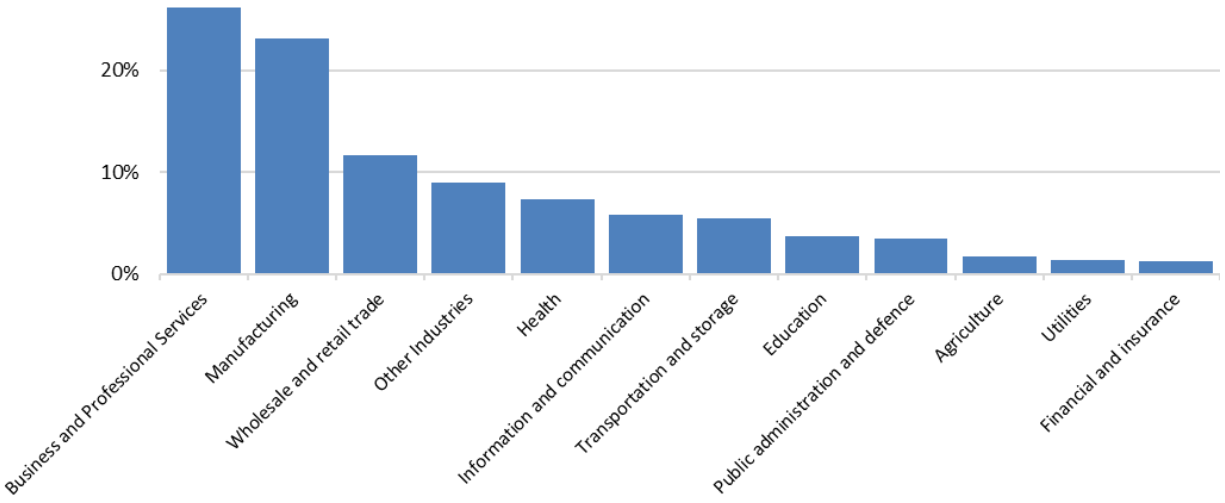


Figure 32 - Ranking of EU Industries by GVA Growth Impact, 2012-2017
Source: Eurostat

As shown in chapter 3, today the leading industries in terms of BDA adoption are Finance, Telecommunications, Media and Retail.

The analysis shows that the Telecom, Finance, Retail and Wholesale industries lead in terms of uptake of Big Data, actual and forecast, but two of these industries are relatively small in terms of GVA (Telecom and Finance). The two largest sectors by contribution to GVA and employment, Professional Services and Manufacturing, in comparison show a lower diffusion of Big Data adoption. This is due to different factors, including the large number of SMEs in these sectors and the need to change traditional supply chains to embrace digital transformation, a complex effort. On the other hand, Big Data innovation in these sectors

has the largest potential to drive growth in the European economy, as also indicated in the EC's strategy "Digitising European Industry".

The contribution by industry to GVA, from Figure 8Figure 8 to Figure 12, shows the biggest contributors by industry to GVA for each Member State, and the dominance of the key industries: Manufacturing, Financial Services, Public Administration, and Retail is clear. However, for each Member State the leading industry spend does not match this. Choosing the first group from as an example, France shows Business and Professional Services as easily the biggest contributor to GVA, while its Big Data investment is dominated by Manufacturing and Finance. Professional Services is ranked only fourth (only just ahead of Public Administration) for its Big Data investments. Germany is a little better aligned: it has a slightly broader spread of industry contribution to GVA with Manufacturing and Professional Services accounting for more than half of the Member State's GVA, with Manufacturing the lead Big Data industry spend, but Finance is again in second place for Big Data spending, with Professional Services again ranked fourth. The story is similar for the other Member States in this big spending group.

The differing industries have specific affinities for Big Data investment, as is shown in the following chapter looking at use cases and Big Data investments. Finance, Business Services, Telecom, and Retail are the leading industries for Big Data adoption, but these industries are not aligned with the biggest contributors to GVA. It could be that the key GVA contributing industries are late adopters, inherently more conservative when implementing big data solutions in production rather than as pilot.

2.7 Conclusions

In conclusion, BDA investments increase faster than IT investments (so their share as a total of IT spending tends to increase). Industries with a high intensity of IT spending are currently leading the move towards Big Data. Companies (of all sectors and size band) with an advanced and sophisticated ICT infrastructure and culture are engaged in digital transformation of which Big Data is an essential ingredient. The strong correlation between IT and Big Data spending by industry, sourced from IDC data, is clearly shown by Figure 33 (comparing IT and BDA spending growth and share by industry in 2017).

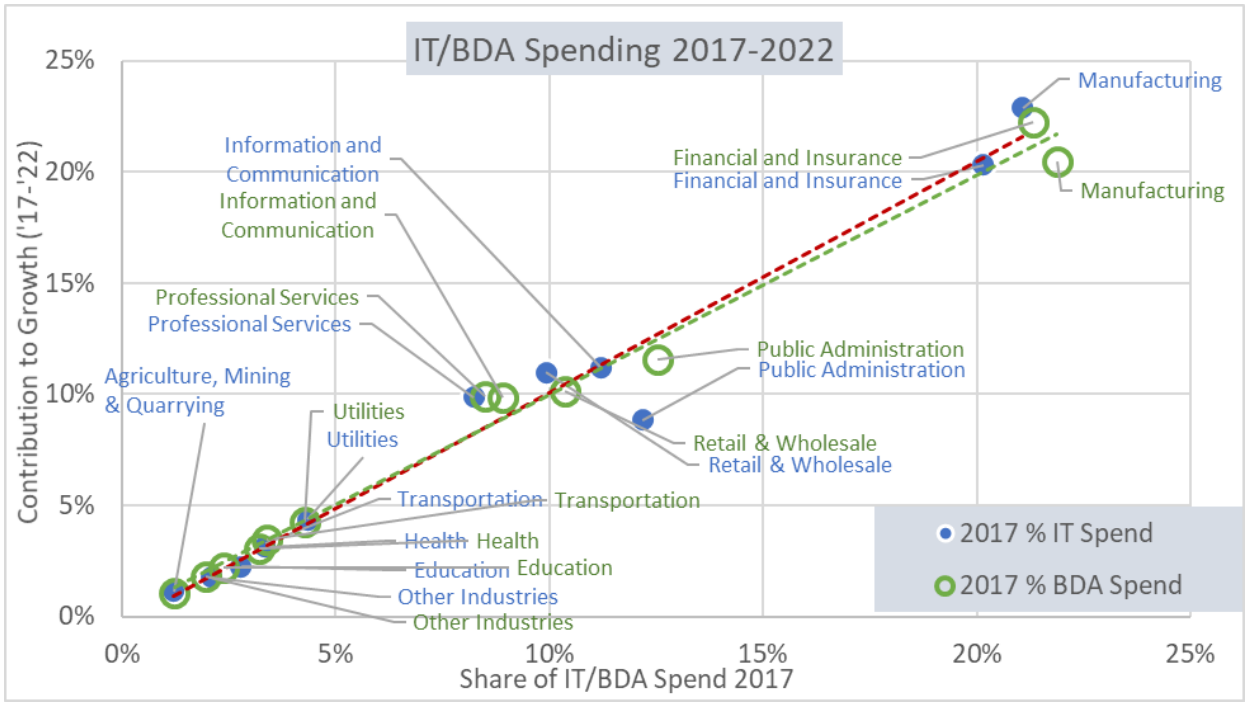


Figure 33 - IT and BDA spending correlation, 2017
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide, IDC Worldwide Semiannual ICT Spending Guide Industry and Company Size

However, a closer look at the industrial share, aligned with those industries that are more likely to invest in Big Data technologies shows a different picture, as can be seen from Table 2-12. This shows the difference in rank for each industry between IT Spending and Big Data Spending. Big Data spending fits well in some key use cases and applications, such as Finance and Business services (see the analysis in par.3.5 below on use cases by industry).

The two leading industries for Big Data spending are finance and insurance, and manufacturing, and these changes in ranks 1 and 2 mostly reflect a swapping of order of these two industries in terms of IT spending. However, Information and Communication is one of the leading industries in IT spending and falls notably in rank when considering Big Data spending. In addition, Big Data spending on Manufacturing is notably lower in many counties, while Public Administration shows an increase in importance in many countries – which reflects mostly those government's intentions to improve efficiency in their execution and provision of services. This is shown in the use case analysis in the subsequent chapter. The industries with the most improvements in rank include Public Administration and Retail & Wholesale, while those with the most drops in rank include Information and communication and Manufacturing.

	IT Spending				
	1	2	3	4	5
Austria	Financial and Insurance	Manufacturing	Public Administration	Retail & Wholesale	Information and Communication
Belgium	Public Administration	Financial and Insurance	Manufacturing	Information and Communication	Retail & Wholesale
Czech Republic	Manufacturing	Financial and Insurance	Public Administration	Information and Communication	Utilities
Denmark	Manufacturing	Public Administration	Financial and Insurance	Retail & Wholesale	Information and Communication
Finland	Manufacturing	Public Administration	Financial and Insurance	Retail & Wholesale	Information and Communication
France	Manufacturing	Financial and Insurance	Information and Communication	Public Administration	Retail & Wholesale
Germany	Manufacturing	Financial and Insurance	Public Administration	Professional Services	Information and Communication
Greece	Financial and Insurance	Information and Communication	Manufacturing	Public Administration	Retail & Wholesale
Hungary	Information and Communication	Manufacturing	Financial and Insurance	Public Administration	Utilities
Ireland	Financial and Insurance	Manufacturing	Public Administration	Professional Services	Information and Communication
Italy	Manufacturing	Financial and Insurance	Information and Communication	Retail & Wholesale	Public Administration
Netherlands	Financial and Insurance	Public Administration	Manufacturing	Professional Services	Information and Communication
Poland	Financial and Insurance	Information and Communication	Manufacturing	Public Administration	Retail & Wholesale
Portugal	Financial and Insurance	Manufacturing	Information and Communication	Public Administration	Retail & Wholesale
Rest of CEE	Information and Communication	Manufacturing	Financial and Insurance	Public Administration	Retail & Wholesale
Romania	Information and Communication	Manufacturing	Financial and Insurance	Public Administration	Retail & Wholesale
Spain	Financial and Insurance	Manufacturing	Information and Communication	Retail & Wholesale	Professional Services
Sweden	Manufacturing	Financial and Insurance	Public Administration	Retail & Wholesale	Information and Communication
United Kingdom	Financial and Insurance	Manufacturing	Public Administration	Retail & Wholesale	Information and Communication
Grand Total	Manufacturing	Financial and Insurance	Public Administration	Information and Communication	Retail & Wholesale

Figure 34 - Ranking of IT Spending by Industry and MS – 2017 – IDC elaborations
Source: IDC Worldwide Semiannual ICT Spending Guide Industry and Company Size)

	BDA Spending				
	1	2	3	4	5
Austria	Manufacturing	Financial and Insurance	Public Administration	Retail & Wholesale	Professional Services
Belgium	Public Administration	Financial and Insurance	Manufacturing	Retail & Wholesale	Information and Communication
Czech Republic	Financial and Insurance	Public Administration	Manufacturing	Utilities	Information and Communication
Denmark	Manufacturing	Public Administration	Financial and Insurance	Retail & Wholesale	Information and Communication
Finland	Manufacturing	Public Administration	Financial and Insurance	Retail & Wholesale	Information and Communication
France	Manufacturing	Financial and Insurance	Retail & Wholesale	Public Administration	Information and Communication
Germany	Manufacturing	Financial and Insurance	Professional Services	Public Administration	Retail & Wholesale
Greece	Financial and Insurance	Manufacturing	Information and Communication	Public Administration	Retail & Wholesale
Hungary	Financial and Insurance	Public Administration	Manufacturing	Information and Communication	Utilities
Ireland	Financial and Insurance	Professional Services	Manufacturing	Public Administration	Information and Communication
Italy	Financial and Insurance	Manufacturing	Information and Communication	Public Administration	Retail & Wholesale
Netherlands	Financial and Insurance	Public Administration	Manufacturing	Professional Services	Retail & Wholesale
Poland	Financial and Insurance	Manufacturing	Information and Communication	Public Administration	Utilities
Portugal	Financial and Insurance	Manufacturing	Public Administration	Professional Services	Retail & Wholesale
Rest of CEE	Manufacturing	Financial and Insurance	Public Administration	Information and Communication	Retail & Wholesale
Romania	Financial and Insurance	Information and Communication	Manufacturing	Public Administration	Retail & Wholesale
Spain	Financial and Insurance	Manufacturing	Retail & Wholesale	Professional Services	Information and Communication
Sweden	Manufacturing	Financial and Insurance	Public Administration	Retail & Wholesale	Information and Communication
United Kingdom	Financial and Insurance	Manufacturing	Retail & Wholesale	Public Administration	Information and Communication
Grand Total	Manufacturing	Financial and Insurance	Public Administration	Retail & Wholesale	Information and Communication

Figure 35 - Ranking of Big Data Spending by Industry and MS – 2017 – IDC elaborations
Source: IDC Worldwide Semiannual Big Data and Analytics Spending Guide

These Figures show the differing country focus on different industries and the subsequent likely impact on Big Data spending. Countries that already have a higher IT spend in industries such as Finance and Retail are also most likely to invest in Big Data because of the inherent demand for either business improvement or efficiency improvements that arise from Big Data investments.

A key point worth mentioning about the correlations between industries and Big Data investments is the statistical mantra: "correlation is not causation". In this analysis there are correlations between the industries, Big Data use cases, IT Spending, Big Data spending, and GVA. There is some causality which flows from those countries what have a strong industrial presence in e.g., Retail or in Manufacturing, and this leads to increased spending in these industries. However, there are no confirmed causal links between Big Data spending and Finance or Retail GVA and the correlation relates to analytic expertise, where survey results reinforce but do not confirm the relationship between higher GVA and stronger Big Data spending. This is arrived at through analytic expertise and experience rather than a causal relationship found through surveys and other research.

Organisations adopt Big Data technologies to impact efficiency, revenue, or both. The following chapter shows a large share of use cases focus on efficiency improvements, and this is likely to affect employment. Those industries with high employment include Retail. Professional Services, and Manufacturing, but of these, only Manufacturing has high investment planned in Big Data technologies. These three key industries are very data intensive too and would benefit from efficiency improvements and revenue growth opportunities afforded by Big Data technologies.

As demonstrated in par.2.6, a 1% increase in professional services GVA will have a much greater impact on EU GVA than a 1% increase in Agriculture GVA. Therefore, Big Data adoption in the industries with highest GVA (Professional Services, Manufacturing, and Wholesale and Retail) will potentially have a largest impact on the EU overall economy. On the other hand, adoption of BDA in industries with a smaller footprint in the economy such as Agriculture may still have high specific impacts and bring a high level of benefits.

3 BDA and business benchmarking

This chapter will present the main results of the users' survey focusing on the level of adoption of BDA, the main type of use cases and the relevance of KPI benchmarking.

3.1 BDA Adoption

3.1.1 BDA Adoption by Business Area

As shown in Figure 36, when assessing the penetration of Big Data among business functions marketing, customer service and support, product management and finance are current implementation areas for Big Data solutions. This reflects current trends and highlights the business units that have previously had a higher disposition to invest in Big Data and Analytics technologies. IT and operations, customer service and support alongside logistics show a higher concentration of activity for piloting and implementing Big Data technologies. HR and legal have low rates of adoption. Reflecting their lower rates of maturity and likely lack of Big Data (compared with other types of data such as transactional data).

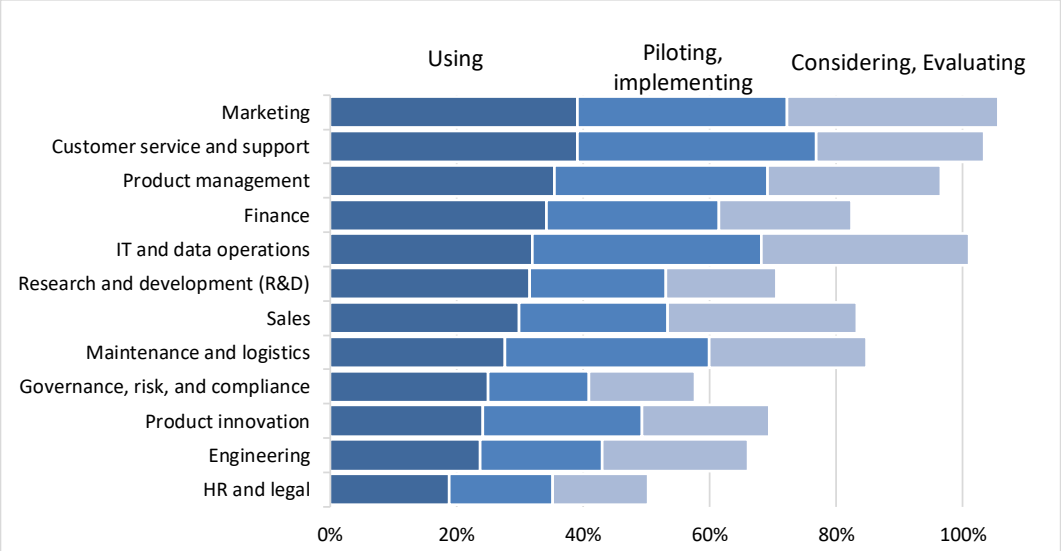


Figure 36 - BDA Adoption by Business Area
Source: DataBench Survey, October 2018

3.1.2 Big Data Adoption by Industry

When examining the penetration of Big Data across industries some interesting observations are apparent from the survey, as illustrated in Figure 37. Financial Services (43%), Business/ IT services (37%), Telecom and Media (37%), and Retail & Wholesale (35%) are the biggest adopters of Big Data. Whereas, Telecoms and Media, Transport and Logistics, and Retail and Wholesale have firm commitments to grow Big Data deployments. Higher rates of adoption may stem from these industries have higher level of investment in IT modernization and the fact that they generate and store vast amounts of customer data, which is routinely used for marketing purposes including initiatives such as loyalty cards.

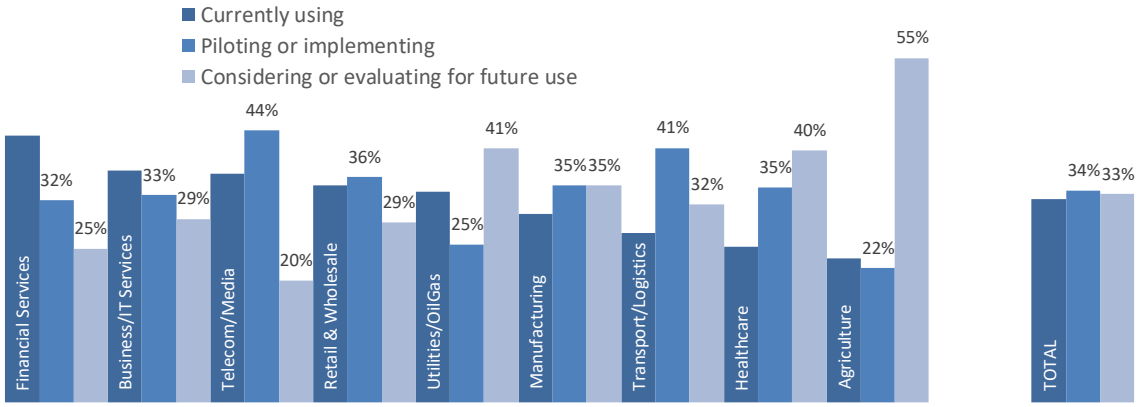


Figure 37 - BDA current and planned Adoption by Industry
Source: DataBench survey, October 2018

	Currently using	Piloting or implementing	Considering or evaluating for future use	TOTAL
TOTAL	32.6%	34.0%	33.4%	N=700
Financial Services	42.9%	32.5%	24.7%	N=65
Business/IT Services	37.2%	33.3%	29.5%	N=77
Telecom/Media	36.8%	43.7%	19.5%	N=78
Retail & Wholesale	34.9%	36.1%	28.9%	N=84
Utilities/Oil & Gas	33.8%	25.4%	40.9%	N=89
Manufacturing	30.3%	34.8%	34.8%	N=83
Transport/Logistics	27.3%	40.9%	31.8%	N=87
Healthcare	25.0%	34.5%	40.5%	N=66
Agriculture	23.1%	21.5%	55.4%	N=65

Table 16 - BDA Level of Adoption by Industry
Source: IDC elaboration on DataBench survey, October 2018

When examining adoption trends, the following observations can be made at an industry level:

- Financial institutions are using Big Data to conduct risk analysis, understand risk exposure, and construct optimal portfolios. Alternatively, the application of

algorithmic trading and the correlation of social media sentiment with stock returns to support investment decisions are also key considerations.

- Business and IT services are implementing Big Data solutions to support sales and marketing as well as to understand or target customers through customer profiling including ad targeting, analysis, forecasting, and optimization. Campaign management and demand signaling, and social media presence to assess clients' competitive positioning are also popular key drivers.

- In Retail, Big Data can be used to accelerate process improvements and digital transformation by allocating resources more effectively, understanding product performance, rationalizing product lines, developing new products, and supporting marketing or sales activities. Additionally, they apply Big Data technologies to track an extensive variety of processes, as logistics, consumer behavior to supply chain management.

Aside from top industries, Healthcare and Agriculture have lower levels of adoption. The prevalence of legacy IT infrastructures or historic lack of IT investment (particularly in Agriculture) would partly explain the lower adoption. Similarly, regulation around the use and sharing of patient data continuing to develop, data-security issues are also an inhibitor to the widespread adoption of big data by healthcare companies.

However, it is notable is that both industries demonstrate a high intention to consider Big Data for future use. Modern agricultural tools and machines are equipped with scanners and sensor that are able to precisely measure the distances, the number of seeds dispersed, the correct distance to display seeds on the ground to obtain a higher productivity, etc. In addition, in agriculture satellite images, drone photo and aerial photos are gaining momentum because they allow farmers, to create detailed agricultural plans to increase productivity and efficiency of the operations.

3.1.3 Big Data Adoption by Company Size

The survey sample clearly shows SMEs under 250 employees lagging behind medium and large enterprises in terms of adoption of BDA, with only 16% of them already using while 47% of very large companies over 1000 employees already do.

This is due to multiple reasons, including lower awareness of BDA benefits, uncertainty about the value of the business case and difficulty to find the appropriate skills. Nevertheless, pioneer SMEs using BDA are already achieving benefits as shown by the KPIs estimates.

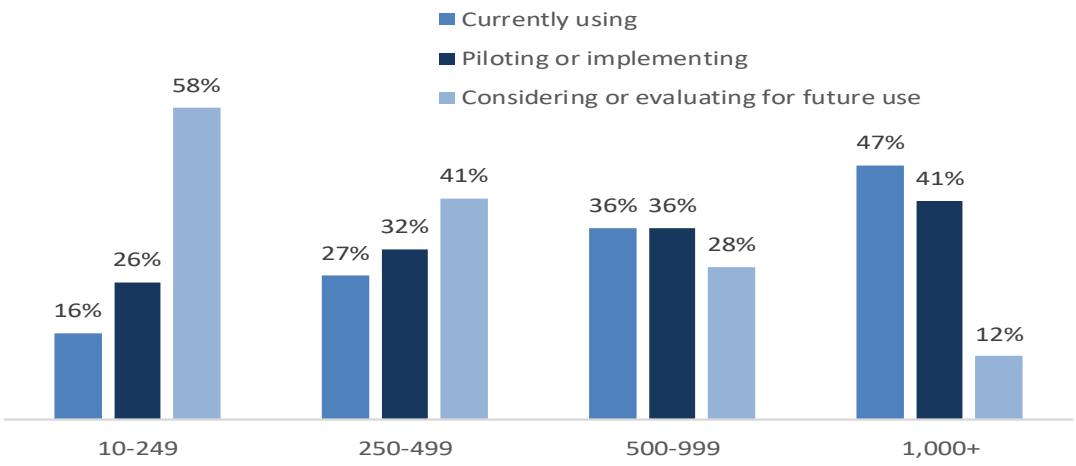


Figure 38 - Big Data current and planned adoption by company size
Source: DataBench survey, October 2018

	Currently using	Piloting or implementing	Considering or evaluating for future use	TOTAL
TOTAL	33%	34%	33%	N=700
10-249	16%	26%	58%	N=148
250-499	27%	32%	41%	N=179
500-999	36%	36%	28%	N=179
1,000+	47%	41%	12%	N=194

Table 17 - Big Data current and planned Adoption by Company Size
Source: DataBench survey, October 2018

3.2 Expected Benefits

The survey shows a high level of satisfaction or expectation with BDA, since 80% of respondents have achieved or expect moderate or high benefits (Figure 39) and none have seen negative impacts. Moreover, positive impacts are stronger for actual users, of which 15% have achieved a high level of benefits and 80% a moderate level (Table 18), while 6% of the users in the piloting phase have achieved high benefits and 73% moderate benefits. This points to a positive dynamic of growing benefits as users progress from the piloting to the scaling up of BDA. Respondents still considering or evaluating BDA are more conservative in their expectations: the majority expects low or medium benefits from BDA.

Survey q5. What level of benefits has your organisation achieved so far or expects to achieve from the use of a Big Data and analytics environment?

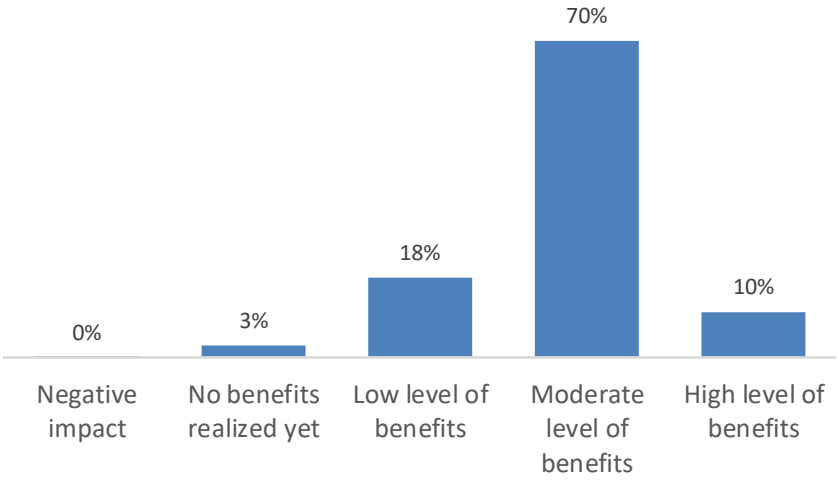


Figure 39 - BDA Expected Impacts (Total Sample, % of Respondents)
Source: IDC elaboration on DataBench survey, October 2018

	Achieved Impacts BDA Using	Achieved Impacts BDA Piloting/implementing	Expected Impacts BDA Considering/Evaluating
Negative impact	0.00%	0.00%	0.43%
No benefits realized yet	0.89%	3.80%	3.43%
Low level of benefits	4.00%	17.30%	30.90%
Moderate level of benefits	79.56%	73.00%	56.22%
High level of benefits	15.56%	5.91%	9.01%
Total	**N=225**	**N=237**	**N=233**

Table 18 - BDA Expected Impacts by Level of Adoption (Total Sample, % of Respondents)
Source: IDC elaboration on DataBench survey, October 2018

3.3 Importance of Business Benchmarking

3.3.1 Overall Importance

Business organisations realize the importance of benchmarking the business impacts of BDA, as shown by Figure 40 below, only 10% of them dismiss it as not at all or slightly important: moreover, 45% consider benchmarking very or extremely important.

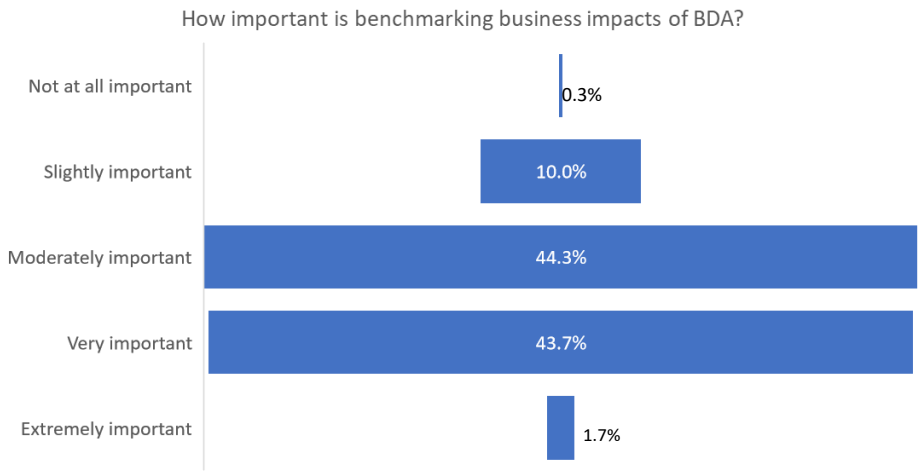


Figure 40 - Importance of Benchmarking BDA Business Impacts (% of Respondents)
Source: IDC elaboration on DataBench survey, October 2018

The perception of the importance of benchmarking is positively correlated with the level of adoption (actual users evaluate it very highly) and the company size (with large companies more appreciative of its importance than small ones) (Table 19). The industries more advanced and sophisticated in the use of BDA (Finance, Retail, Telecom-Media) again show a higher evaluation of the importance of benchmarking than the others, while laggard industries (Healthcare, Agriculture) show a higher share of respondents not particularly interested in benchmarking (Table 20).

The obvious deduction is that benchmarking becomes relevant when organizations are engaged in practice with BDA. But this also confirms that awareness of BDA business benchmarking is low among SMEs and industries with lower adoption, and the availability of evidence-based benchmarks would be likely to increase awareness and help to make better business decisions.

	Business Size (Number of Employees)				Big Data/Analytics Status		
	10-249	250-499	500-999	1,000+	BDA Using	BDA Piloting/ implementing	BDA Considering/ Evaluating
Very or extremely important	26.35%	36.31%	47.75%	66.32%	66.52%	44.12%	26.18%
Not at all or slightly important	25.00%	8.94%	6.18%	4.15%	4.41%	4.62%	21.89%

Table 19 - Importance of Benchmarking BDA by Company Size and Level of Adoption
Source: IDC elaboration on DataBench survey, October 2018

	Agriculture	Finance	Business /IT Services	Health care	Manuf.	Retail Wholesale	Telecom/ Media	Transport Logistics	Utilities/ Oil Gas
Very or extremely important	33.85%	55.84%	43.59%	27.38%	45.45%	52.44%	63.22%	40.91%	42.25%
Not at all or slightly important	24.62%	7.79%	3.85%	13.10%	15.91%	8.54%	3.45%	7.58%	9.86%

Table 20 - Importance of Benchmarking BDA by Industry
Source: IDC elaboration on DataBench survey, October 2018

3.3.2 Importance of Benchmarking by KPI

The next step in our analysis is to assess the relative importance of business KPIs used for benchmarking. DataBench conceptual framework has selected 7 main KPI categories measuring the most relevant business impacts (see par.3.1), including business growth (revenues and profit), customer focus, innovation and efficiency (cost and time).

Figure 41 below shows a clear ranking of KPIs evaluated very or extremely important, topped by the improvement of product or service quality and customer satisfaction: cost reduction is last even though 25% of respondents still consider it highly. This seem to reflect a strong focus on business development, marketing and customer care, and overall economic and profit growth, with attention paid to productivity (time efficiency) but much less on traditional cost-cutting.

However, there are some interesting differences in the viewpoints of some respondent categories (Figure 42). The majority of BDA users underline the relevance of product or service quality and customer satisfaction as the most important KPIs, relegating cost reduction and time efficiency to the bottom of the ranking. Innovation KPIs are also considered very important. SMEs don't have the same focus and concentration on a few KPIs, but they also prioritize innovation KPIs, particularly business model innovation which in this subgroup is ranked 2nd while in the total sample is 6th. Finally, Figure 43 shows the relevance of KPIs by industry.

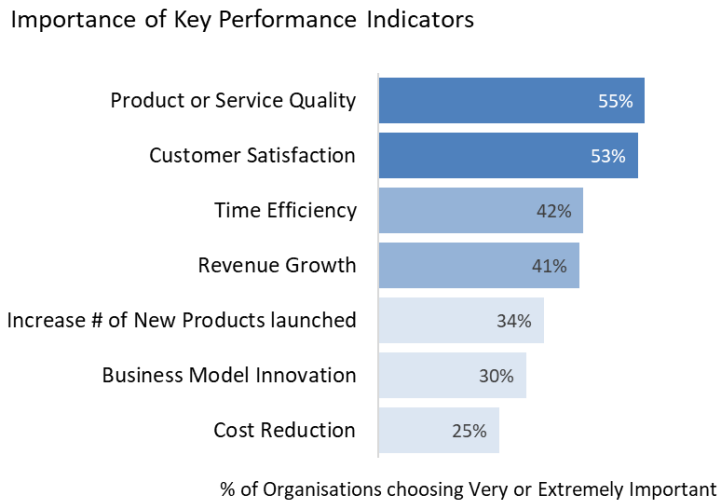


Figure 41 - KPIs Ranking by Importance (Total Sample, % of very or extremely important answers)
Source: IDC elaboration on DataBench survey, October 2018

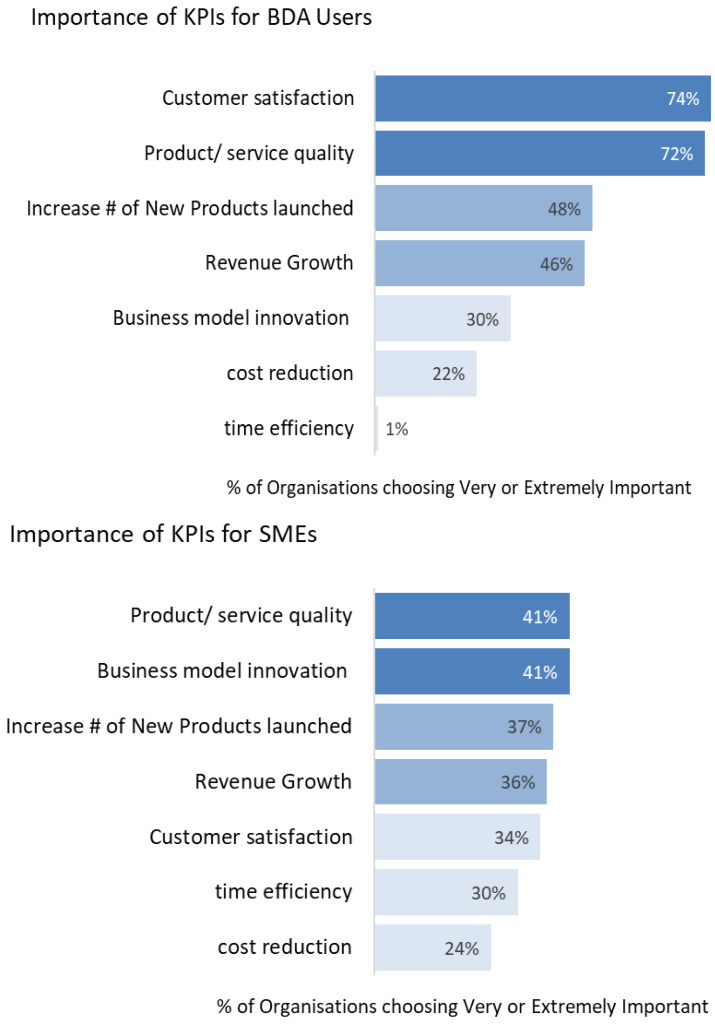


Figure 42 - KPIs Ranking by Importance for BDA Users and for SMEs
Source: IDC elaboration on DataBench survey, October 2018

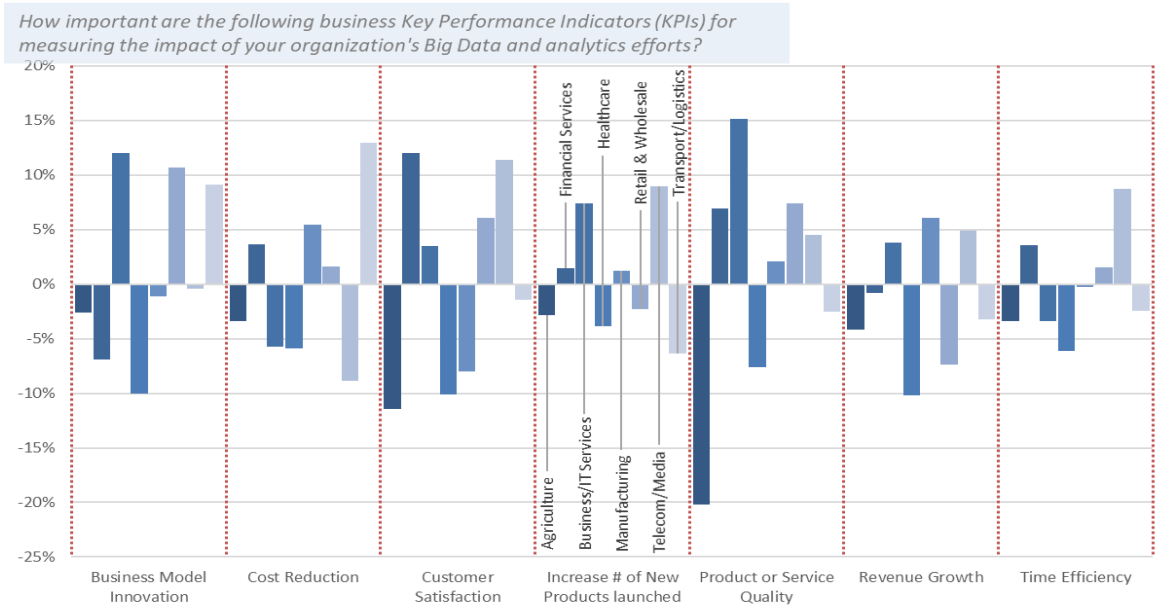


Figure 43 - KPIs Ranking by Importance by Industry
Source: IDC elaboration on DataBench survey, October 2018

3.4 Business Goals driving BDA Adoption

The survey shows that the demand for BDA is driven by multiple business goals, since the gap between the most frequently mentioned goal (improvement of business process, 44% of respondents) and the last one (Improve Fraud and Risk management, 38% of respondents) is not so wide (Figure 44). Nevertheless, based on the ranking in the Figure respondents seem to have a stronger focus on business and market strategies goals versus more operational and specific goals (for example improving compliance and fraud/risk control).

Survey question N.2 "Which of the following business goals are driving the adoption or consideration of Big Data and Analytics in your organization? (Multiple answer, choose all that apply)

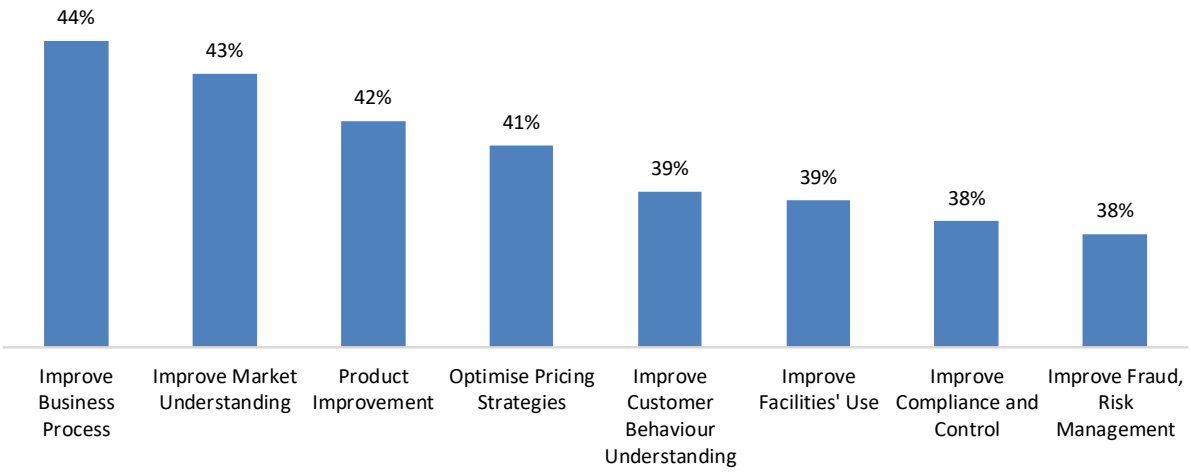


Figure 44 - Business Goals driving BDA Adoption (% of Respondents)
Source: DataBench Survey, October 2018

Looking at the same question by company size does not show great variations. Figure 45 below shows that SMEs give a higher relevance to efficiency-related business goals (such as the improvement of facilities' use) but they are also aligned with MLEs in prioritizing the improvement of business processes.

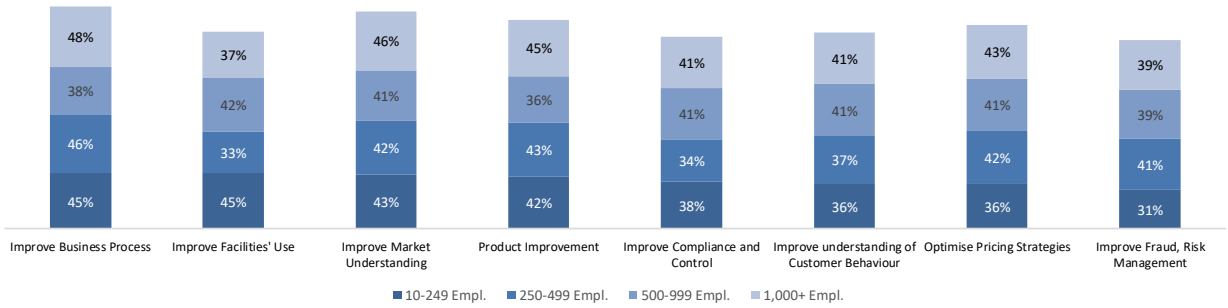


Figure 45 - Business Goals driving BDA Adoption by Company Size (% of Respondents)
Source: DataBench Survey, October 2018

Looking at the same question by industry confirms this perception of multiple business goals, with some differences due to the business models (fraud detection for example is driving BDA adoption for 52% of Finance respondents versus 25% of Agriculture respondents). The answers confirm indirectly the greater awareness of BDA business goals in leading adopters such as retail and wholesale, while in Agriculture the overall frequency of answers by business goal is lower (Figure 46).

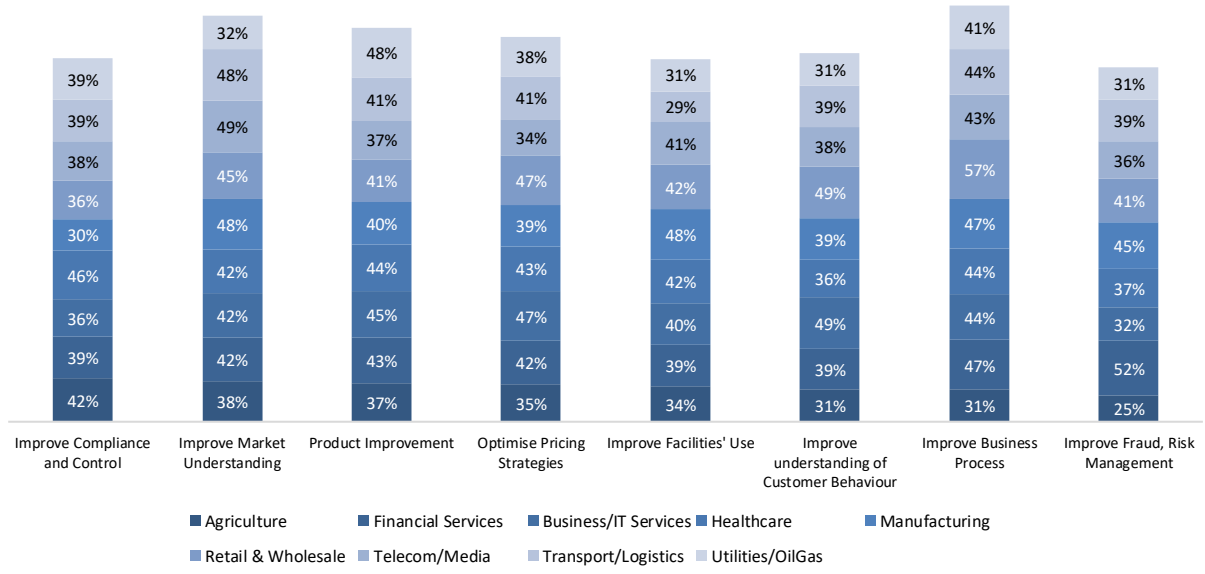


Figure 46 - Business Goals driving BDA Adoption by Industry (% of Respondents)
Source: DataBench Survey, October 2018

3.4.1 BDA Business Goals and KPIs

An interesting correlation links the achievement of business KPIs with the achievement of business goals. In other words: companies investing in BDA reaped certain benefits (measured by KPIs, as declared in these surveys); do these benefits contribute to the achievement of the same business goals which drove the respondents to adopt BDA in the first place? Or viceversa: companies focusing on certain business goals are collecting the benefits they wanted by adopting BDA?

The Figure below illustrates for each business goal, the relative impact of KPIs (based on separate achievement scores for each KPI). The red rows in the Figure highlight the business KPIs with the lower impacts on the respective business goals; yellow and orange mean a medium impact; green means a high impact. Overall the range of scores is positive (all the scores are around or over score 3 which means an achievement of at least 5-9% of improvement and above). This means that the adoption of BDA does contribute to the priority business goals of respondents. But there are clear variations by type of KPI.

First of all, 3 KPIs (Improvement of product-service quality, revenues growth and improvement of customer satisfaction) have a consistently high impact on the majority of business goals. For example, by successfully focusing on activities such as improving the understanding of markets and competitors, organisations can expect to increase the product or service business KPI in the region of 10-24%, similarly by undertaking initiatives to better understand customer behaviour and improving risk management organisations can expect to significantly contribute to the same KPI by a similar factor. The analysis shows also that cost reduction and launching new products and services have a far lower contribution to the success of business goals across the board.

Rating	Expected Increase
1	None (0%)
2	Less than 5%
3	5%-9%
4	10%-24%
5	25%-49%

Business Goal

Key Performance Indicator	Better understand customer behavior and expectations	Optimize our pricing strategies and go-to-market programs	Product, services, or program improvement and innovation	Improve our understanding of the market and our competitors	Improve and optimize our business processes and operations	Improve our facilities, and equipment design, maintenance, and utilization	Improve our operational, fraud, and risk management	Implement better regulatory compliance and financial controls
Cost reduction	3.31	3.19	3.37	3.23	3.29	3.19	3.22	3.20
Time efficiency	3.76	3.84	3.91	3.87	3.84	3.83	3.83	3.92
Product/service quality	4.12	4.15	3.96	4.28	4.12	4.04	4.14	4.16
Revenue growth	4.03	4.06	3.98	4.09	4.03	3.99	4.11	4.06
Customer satisfaction	4.08	4.20	4.05	4.09	4.16	4.08	4.06	4.11
Business model innovation	3.60	3.64	3.67	3.71	3.65	3.65	3.65	3.78
Number of new products/services launched	3.71	3.78	3.78	4.01	3.88	3.80	3.83	3.94

Lowest — Key Performance Indicator that contributes most to achieving Business Goal — Highest

Figure 47 - Business KPIs Contribution toward Business Goals
Source: IDC elaboration on DataBench survey, October 2018

Figure 48 below shows a similar but opposite elaboration, calculating for each business goal what is the achievement in terms of KPIs (based on the survey answers of course). In Figure 3-14 it is apparent for example that organisations driven to invest in BDA in order to optimize pricing strategies and go-to-market programs are seeing positive business KPIs in

terms of improvement of customer satisfaction (in the +10-24% range), of product and service quality improvement, of revenues growth. Organisations prioritising the use of BDA for better compliance improve their time efficiency and business model KPIs, but also their innovation KPIs (number of new products and services launched).

Rating	Expected Increase
1	None (0%)
2	Less than 5%
3	5%-9%
4	10%-24%
5	25%-49%

Key Performance Indicator	Business Goal: Better understand customer behaviour and expectations	Optimize our pricing strategies and go-to-market programs	Product, services, or program improvement and innovation	Improve our understanding of the market and our competitors	Improve and optimize our business processes and operations	Improve our facilities, and equipment design, maintenance, and utilization	Improve our operational, fraud, and risk management	Implement better regulatory compliance and financial controls
Cost reduction	3.31	3.19	3.37	3.23	3.29	3.19	3.22	3.20
Time efficiency	3.76	3.84	3.91	3.87	3.84	3.83	3.83	3.92
Product/service quality	4.12	4.15	3.96	4.28	4.12	4.04	4.14	4.16
Revenue growth	4.03	4.06	3.98	4.09	4.03	3.99	4.11	4.06
Customer satisfaction	4.08	4.20	4.05	4.09	4.16	4.08	4.06	4.11
Business model innovation	3.60	3.64	3.67	3.71	3.65	3.65	3.65	3.78
Number of new products, services launched	3.71	3.78	3.78	4.01	3.88	3.80	3.83	3.94

Lowest — Business goal that contributes most to achieving key performance indicator — Highest

Figure 48 - Business goals impact on business KPIs
Source: IDC elaboration on DataBench survey, October 2018

For example, it is likely that organizations are using Big Data and Analytics to develop smart customer retention and pricing techniques to not only retain the highest value customers but provide a higher level of customer service and hence customer satisfaction. Similarly, as sales forces become increasingly mobile, it is imperative for competitiveness that they have high quality data insights that enable rich interactions with customers, again increasing the possibility of delivering higher rates of customer satisfaction. Correspondingly, for organizations looking to improve the understanding of markets and customers, they can expect to see that this will contribute more significantly to the business KPI number of new products and services launched. In many cases big data and analytics would be used as part of the research and development phase of a product or service launch initiative.

These elaborations improve our insight of the complex interrelation between business strategies, BDA adoptions and business impacts, confirming by and large their coherence and the likeliness to achieve expected benefits.

3.5 Diffusion of Big Data Use Cases

The use cases represent the link between technical solutions and business goals and help to collect data on the main concrete typologies of BDA's exploitation. One of the objectives of this survey is to identify the patterns of diffusion of use cases by type of organization, size and industry, in order to have a pragmatic and realistic view of the footprint of BDA adoption. The use cases defined within this report are pertinent to storing, transforming, analyzing and harnessing Big Data technologies as a method of enabling organizations to extract value from data to achieve the main business goals.

The potential list of use cases is very rich, with a long tail of specific use cases. For the sake of the feasibility of the survey we have selected 12 cross-industry use cases and 23 industry-specific use cases, representing the most frequent and potentially impactful typologies identified so far by IDC research (see Figures 49 and Table 21). The survey investigated the frequency of these use cases by industry, company size and country.

There are two ways to look at the results on the diffusion of use cases. By presenting absolute numbers of users, we can identify the use cases most relevant for the overall economy and their maturity: a use case implemented in several industries and hundreds of cases can potentially deliver high scale benefits for the overall economy, thanks to its high duplication potential. Cross-industry use cases will appear at the top of absolute diffusion lists, because they are asked to all respondents. Use cases specific by industry will appear to be smaller in terms of diffusion but may deliver very high benefits for the specific industry and be adopted by a majority of the industry respondents. Therefore, we present the use case take-up data also as a share of the respondents who were asked about it.

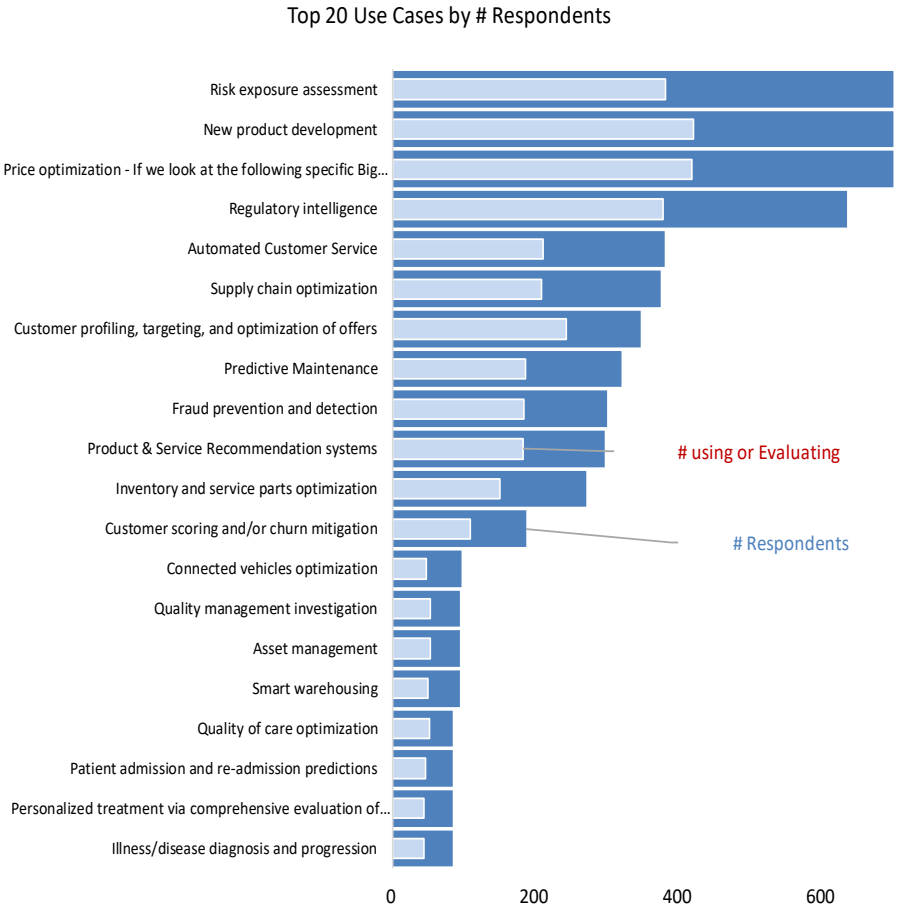


Figure 49 - Top 20 Use Cases by Number of Respondents
Source: IDC elaboration on DataBench survey, October 2018

The Figure shows the ranking of use cases in terms of absolute numbers of respondents using them. The shadow bars in the Figure show the size of the respondents' sample for the specific use case. The top 4 use cases are horizontal ones: risk exposure assessment, new product development and price optimization, regulatory intelligence.

Table 21 shows the ranking of all use cases, based on the share of respondents who are using or evaluating them, on the total who were asked about them. From this point of view the ranking changes, with some niche use case showing higher adoption rates than the top 20 identified above. Number one is a use case focusing on improving the efficiency of warehouses, followed by scheduling optimization. The most frequent use case is Customer profiling which ranks very high both in terms of absolute number of respondents and of share on the total who were asked about it.

Use Case	Number respondents	% Using or evaluating	Use Case	Number respondents	% Using or evaluating
Increase productivity and efficiency of DCs/warehouses	29	72%	Customer scoring and/or churn mitigation	187	58%
Scheduling optimisation	27	70%	Heavy equipment utilization	65	57%
Customer profiling, targeting, and optimization of offers	346	70%	Yield monitoring and prediction	65	57%
Field mapping & crop scouting	65	68%	Intelligent Fulfillment	83	57%
Logistics and package delivery management	66	67%	Energy consumption analysis and prediction	71	56%
Field service optimization	71	63%	Supply chain optimization	374	56%
Usage based insurance	24	63%	Inventory and service parts optimization	270	56%
Cyberthreat & detection	53	62%	Quality management investigation	94	55%
Social media analytics	21	62%	Asset management	94	55%
Product & Service Recommendation systems	296	61%	Automated Customer Service	380	55%
Fraud prevention and detection	299	61%	Patient admission and re-admission predictions	84	55%
Quality of care optimization	84	61%	Risk exposure assessment	700	54%
New product development	700	60%	Personalized treatment via comprehensive evaluation of health records	84	52%
Price optimization	700	60%	Illness/disease diagnosis and progression	84	52%
Regulatory intelligence	635	60%	Smart warehousing	94	52%
Ad Targeting	27	59%	Precision agriculture	65	51%
Network analytics and optimization	60	58%	Connected vehicles optimization	96	49%
Predictive Maintenance	320	58%			

Table 21 - List of Use Cases by Number of Respondents
Source: IDC elaboration on DataBench survey, October 2018

3.5.1 BDA Use Cases by Industry

A deeper analysis of use cases by industry provides some interesting considerations, as shown by the Tables below (from Table 22 to Table 26). They show the use cases implemented by industry with the absolute number of responses and their share on those who took the question.

Agriculture	# Responses	% Responses	Finance	# Responses	% Responses
Field mapping & crop scouting	44	68%	New product development	56	73%
Price optimization	42	65%	Customer profiling, targeting, and optimization of offers	55	71%
Inventory and service parts optimization	42	65%	Risk exposure assessment	53	69%
Risk exposure assessment	38	58%	Regulatory intelligence	53	69%
New product development	37	57%	Fraud prevention and detection	50	65%
Predictive Maintenance	37	57%	Automated Customer Service	47	61%
Yield monitoring and prediction	37	57%	Price optimization	46	60%
Heavy equipment utilization	37	57%	Product & Service Recommendation systems	45	58%
Supply chain optimization	34	52%	Customer scoring and/or churn mitigation	43	56%
Precision agriculture	33	51%	Cyberthreat & detection	33	43%

Table 22 - Top Use Cases per Industry, Agriculture and Finance
Source: IDC elaboration on DataBench survey, October 2018

Business/ IT services	# Responses	% Responses	Healthcare	# Responses	% Responses
Customer profiling, targeting, and optimization of offers	57	73%	Regulatory intelligence	52	67%
Risk exposure assessment	52	67%	Fraud prevention and detection	51	65%
Price optimization	51	65%	Quality of care optimization	51	65%
New product development	50	64%	Automated Customer Service	47	60%

Fraud prevention and detection	48	62%	Risk exposure assessment	46	59%
Product & Service Recommendation systems	47	60%	Patient admission and re-admission predictions	46	59%
Regulatory intelligence	46	59%	Illness/disease diagnosis and progression	44	56%
Automated Customer Service	41	53%	Personalized treatment via comprehensive evaluation of health records	44	56%
Social media analytics	13	17%	Price optimization	43	55%
Customer profiling, targeting, and optimization of offers	57	73%	New product development	42	54%

Table 23 - Top use cases per industry, Business/ IT services and Healthcare
Source: IDC elaboration on DataBench survey, October 2018

Manufacturing	# Responses	% Responses	Retail and Wholesale	# Responses	% Responses
Regulatory intelligence	56	63%	New product development	54	65%
New product development	55	62%	Price optimization	53	64%
Price optimization	54	61%	Supply chain optimization	49	59%
Supply chain optimization	51	57%	Intelligent Fulfillment	47	57%
Predictive Maintenance	51	57%	Regulatory intelligence	42	51%
Asset management	49	55%	Risk exposure assessment	36	43%
Quality management investigation	49	55%	Customer profiling, targeting, and optimization of offers	34	41%
Smart warehousing	47	53%	Product & Service Recommendation systems	32	39%
Inventory and service parts optimization	43	48%	Automated Customer Service	25	30%
Risk exposure assessment	39	44%	Increase productivity and efficiency of DCs/warehouses	21	25%
			Predictive Maintenance	15	18%

Table 24 - Top use cases per industry, Manufacturing, Retail and Healthcare

Source: IDC elaboration on DataBench survey, October 2018

Telecom/ Media	# Responses	% Responses	Transport / Logistics	# Responses	% Responses
Customer profiling, targeting, and optimization of offers	67	77%	Logistics and package delivery management	44	67%
Product & Service Recommendation systems	58	67%	New product development	42	64%
Price optimization	51	59%	Inventory and service parts optimization	40	61%
Regulatory intelligence	50	57%	Price optimization	38	58%
Automated Customer Service	50	57%	Risk exposure assessment	36	55%
New product development	48	55%	Regulatory intelligence	36	55%
Risk exposure assessment	42	48%	Predictive Maintenance	36	55%
Customer scoring and/or churn mitigation	39	45%	Supply chain optimization	34	52%
Network analytics and optimization	35	40%	Connected vehicles optimization	34	52%
Fraud prevention and detection	34	39%			
Scheduling optimisation	19	22%			

Table 25 - Top use cases per industry, Telecom/ Media, Transport/ Logistics
Source: IDC elaboration on DataBench survey, October 2018

Utilities & Oil and Gas	# Responses	% Responses
Predictive Maintenance	47	66%
Field service optimization	45	63%
Regulatory intelligence	43	61%
Price optimization	40	56%
Supply chain optimization	40	56%
Energy consumption analysis and prediction	40	56%
Risk exposure assessment	39	55%
New product development	36	51%
Customer profiling, targeting, and optimization of offers	30	42%
Customer scoring and/or churn mitigation	26	37%

Inventory and service parts optimization	9	13%
Asset management	3	4%
Quality management investigation	3	4%

Table 26 - Top use cases per industry, Utilities/ Oil and Gas

Source: IDC elaboration on DataBench survey, October 2018

Overall, the survey illustrates that industries are looking at Big Data as a key solution toward Digital Transformation and the achievement of their business objectives. In fact, with the increasing volume and variety of information from both internal business processes and external data sources there is an opportunity for organizations to mine this data to gain a better understanding of how companies are performing and how they can improve.

Exploiting Big Data can be helpful for a large number of use cases such as optimizing conversion rates, detecting and avoiding risk, streamlining operations, monitoring consumer behavior, promoting sales, and producing predictive analysis.

Enhancing the decision-making process is an ongoing effort for many organizations and big data and analytics can contribute toward achieving business goals and profitable results. Big Data adoption varies according to specific vertical markets' goals, meaning that each sector implements big data solutions according to its own specific purpose and business model.

4 BDA impacts on Business KPIs

4.1 Impact on Business KPIs

A key objective of this survey is estimating the order of magnitude of BDA investments' impacts on business KPIs. First of all, and in line with the considerations already made about expected benefits, the majority of surveyed organizations consider BDA an important driver of business impacts, particularly of moderate/ high level improvements in product/service quality and customer satisfaction KPIs (Figure 50). Slightly less than half of respondents have seen moderate/high impacts on time efficiency, while more than a third see impacts on business model innovation and the launch of new products and services. The driving role of BDA in marketing and customer care improvements is by now more than established, while its influence on complex production and innovation processes is still evolving.

Average economic gains are quite relevant: organizations claim about 6.5% improvements of revenue growth (mean value), 6.7% in profits and 5.6% for cost reductions.

The range of variation of KPIs improvements however is much wider, with several organizations achieving revenue and profit growth higher than 10%. Moreover, these benefits are expected to increase rapidly by 2020 (Figure 51, showing the share of organizations claiming gains over 10% for each KPI by 2020).

Survey q7. To what extent has your organisation's deployment of Big Data and Analytics impacted (or will impact) the following business KPIs? Answers: Decrease, No change, Slight increase, Moderate increase, High increase
Survey q6a In percentage terms, what is the actual benefit realized (or expected) from the use of BDA for profit and revenue growth and cost reduction?

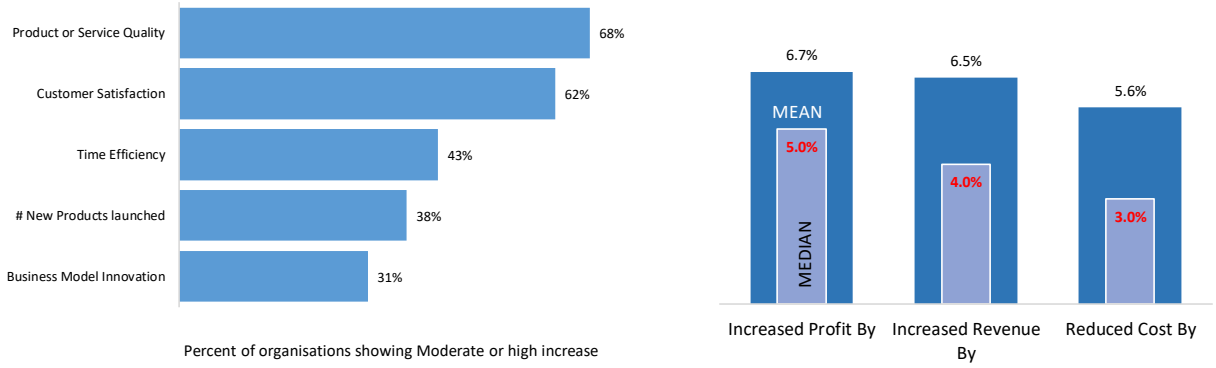


Figure 50 - Level of BDA impacts on business KPIs
Number of respondents: Q.7 = 700; Q.6a Profit = N.592, Revenues N.=497 Reduced Cost = N.537
Source: IDC elaboration on DataBench survey, October 2018

Survey q8. For the following business KPIs please estimate what percentage of expected improvement will be linked to the adoption of Big Data and Analytics in 2020?

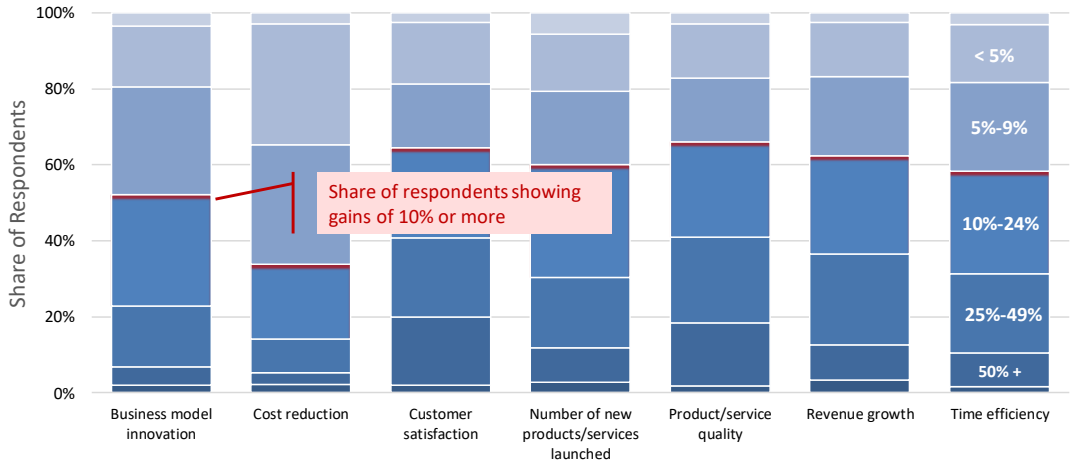


Figure 51 - BDA expected impacts on KPIs improvements by 2020
Source: IDC elaboration on DataBench survey, October 2018

4.2 Business KPIs by Company Size

The analysis of KPIs impacts by company size is equally interesting (Figure 52). Contrary to expectations, very small enterprises under 50 employees show higher KPI improvements for profit, revenue and particularly cost reduction than the overall sample. Medium-small enterprises between 50 and 500 employees instead show KPIs values below the total sample. Cost and revenues improvements tend to be very similar (again, excluding the smallest size band) with cost reductions are slightly lower. The base of respondents is adequate for the reliability of indicators (Table 27).

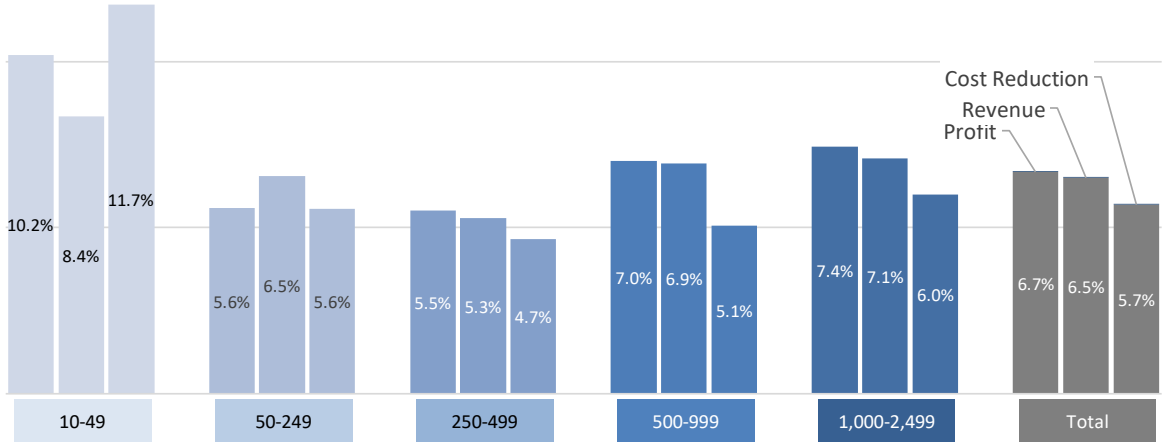


Figure 52 - BDA Impact on Business KPIs by Company Size
Source: IDC elaboration on DataBench survey, October 2018

Base of respondents, KPI	Business Size (Number of Employees)			
	10-249	250-499	500-999	1,000+
Profit	N=124	N=152	N=151	N=155
Revenues	N=120	N=125	N=123	N=120
Reduced Cost	N=116	N=144	N=137	N=134

Table 27 - Base of Respondents by KPI and Company Size
Source: DataBench survey, October 2018

On further inspection, it is evident that these data are influenced also by the industry. The biggest industry cohort for companies in the 10-49 size bracket in the sample is Agriculture, followed by Utilities/Oil and Gas, and then Business/IT Services. These are industries where BDA is generating high and disruptive impacts also for small enterprises. For example, Agriculture is moving towards 'smart farming', where BDA plays a critical role: predicting crop yields using mathematical models to analyze weather, yield and sensor data patterns is generating vast insights that help identify what to plant, as well as where and when to plant it, with high benefits for efficiency and effectiveness. Elsewhere, Big Data and Analytics help SMEs to deliver high business impacts in terms of operations, equipment management, and risk management.

Perhaps more significant however is that a higher percentage of small companies in the 10-49 size bracket are considering or evaluating the use of Big Data, compared to those that are actually piloting/implementing projects or currently using Big Data – the smallest percentage. This suggests that smaller companies are more bullish in terms of their future expectations around the benefits and impact from big data use.

It is also notable that smaller companies are often entrepreneurial and innovative in nature. Big Data investments can deliver both bottom- and top-line benefits by enabling them to create or re-engineer products or services to meet new market demands, enhance productivity, or develop new techniques to expand sales. Furthermore, smaller firms are increasingly present in technology-intensive industries such as Healthcare, Telecoms and Media and Business and IT Services and so have the right attitude toward Big Data technology investments and how they can benefit their business.

Organizations in the 1000 to 2499 size segment constitute 19% of respondents within the survey. The data shows that like small firms, they experience above average improvements to business performance due to their use of big data. In particular, large organizations can expect to see 7.4% increase in profit and 6% decrease cost reduction and around 7% increase in revenue. This compares to the average across all company sizes of a 6.7% and 6.5% increase in profit and revenue respectively and around 5.7% in cost reduction.

Large enterprises are typically more mature in their Big Data use since they were early adopters of big data platform. Enterprise business and IT leaders were quick to recognize that leveraging a new generation of technologies and architectures could enable them to economically extract value from data, and it rapidly became top agenda item and priority for them.

Similarly, larger organizations typically demonstrate higher levels of investment in skills, resources, and technology which can have a significant bearing on the level and degree of benefits delivered. Indeed, IDC research indicates that organizations that are able to achieve greater business outcomes tend to have greater Big Data maturity across key business

dimensions particularly those concerned with optimizing technology, people, process, data and organizational readiness.

Large enterprises also display certain characteristics that predispose them to deriving more value from their big data investments. First, they generate a large amount of data that grows exponentially that can in turn be mined for better business effect. Second, they have very large investments in their data ecosystem which consist of thousands of data instances that often drive complexity but requires harnessing Big Data technologies to resolve. Third, they require unique and often complex answers to the questions they have about their business which requires the ability to perform analysis at scale against varied forms of data. And finally, larger companies have the capacity and greater willingness to embrace Digital Transformation because they understand the benefits and can dedicate teams to this.

Industries with a higher prevalence for Big Data use in the 1000-2499 size band, include Business/IT Services, Telecoms and Media and Retail and Wholesale. The data shows us that these industries are driving greater improvements from big data such as increased revenue and profit by using it to understand or target customers through customer profiling, targeting, and optimization of offers. Similarly, they are using big data to avoid risk and fraud to help drive down costs and improve efficiencies. And the ability to enhance productivity and operations is a popular choice for larger enterprises using Big Data to reduce costs.

4.3 Business KPIs by Industry

The variations of business KPIs by industry are quite relevant, as shown below. The Business and IT services industry leads all 3 rankings of profit, revenues and cost reduction KPIs. In terms of profit it is the only industry close to a median increase of 10%, followed by 3 industries over 7% (Retail and Wholesale, Manufacturing and Finance). The industries with the lowest profit KPI are Healthcare and Agriculture (Figure 53).

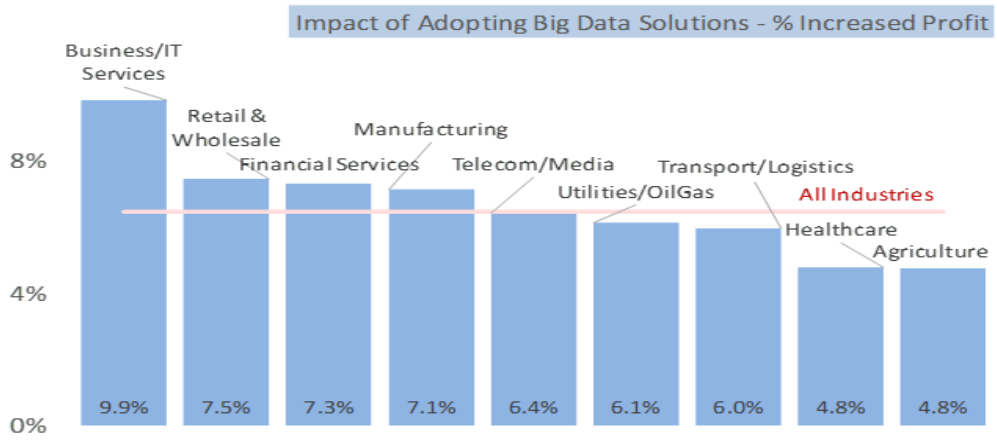


Figure 53 - Ranking of Increased Profit KPI by Industry (median improvement)
Source: IDC elaboration on DataBench survey, October 2018

The increased revenues KPI (Figure 54) shows an absolute value higher than, but correlated with, the increased profit KPI, as it is logical (Figure 53). However, the ranking is slightly

different since Transport/ Logistics is the runner up to Business services, displacing Finance – but all the other industries are in the same ranking as for profit KPI.

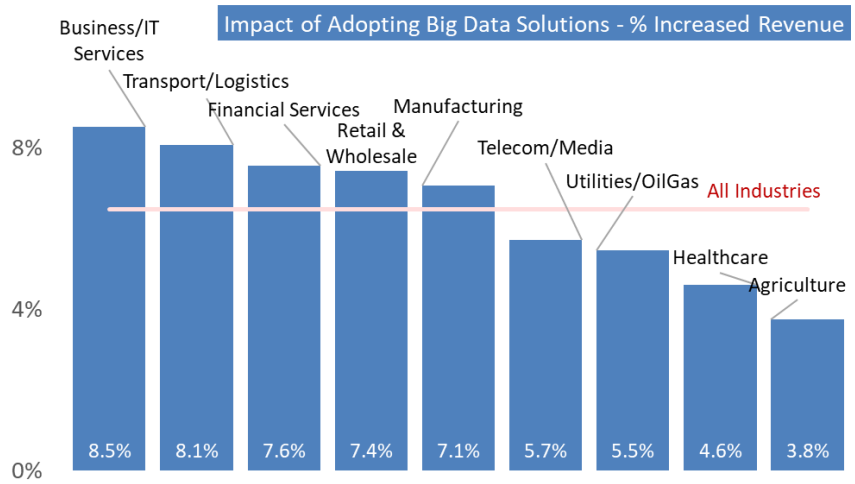


Figure 54 - Ranking of Revenue Growth KPI by Industry (median improvement)
Source: IDC elaboration on DataBench survey, October 2018

For the reduced cost KPI (Figure 55), Business Services confirms its leading role, but Manufacturing is the runner-up (no doubt thanks to the role of BDA in industrial processes streamlining and automation). Behind the two best performers sectors, the other industries show KPI values quite similar in the range from 4.4% to 5.5%. Agriculture remains quite distant from the others though, showing only an average 2.9% of cost reductions. As anticipated above, the role of BDA in farming is quite innovative, with the need for investments and potential impacts on revenue and profit growth rather than cost cutting. In addition, the industry starts from already low costs with few margins for improvement.

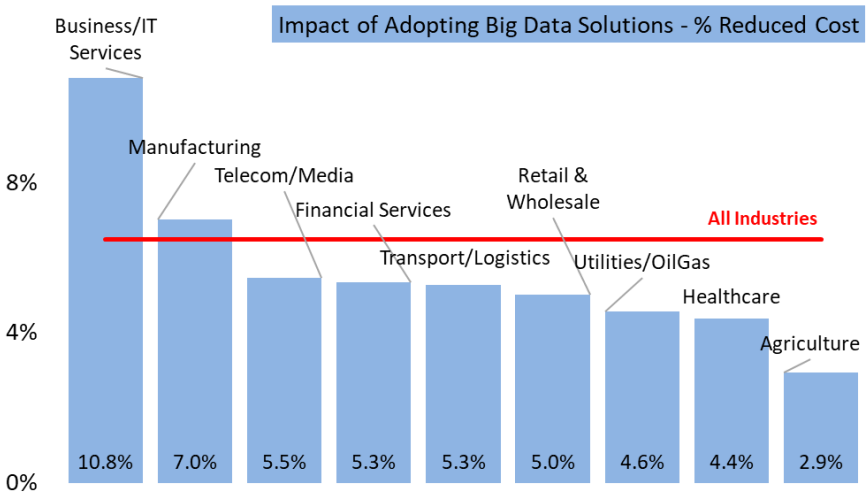


Figure 55 - Ranking of Reduced Cost KPI by Industry (median improvement)
Source: IDC elaboration on DataBench survey, October 2018

4.4 Business KPIs by Use Case

What are the business benefits of specific use cases? The table below shows the level of improvement achieved by the top 10 use cases for each of the 7 business KPIs by the organizations using them. To simplify, the level of improvement has been aggregated in 6 rating classes from 1 (no improvement) to 6 (over 50% improvement).

For example, social media analytics shows a class 5 average rating for the Customer satisfaction KPI, corresponding to an average improvement of customer satisfaction over 25% for the organizations using it. Social media analytics is also associated with improvements of more than 25% of revenues and around 10% of cost reduction and time efficiency. Overall, social media analytics appears to be the use case with the highest benefits. It should be noticed that no single use case shows a KPI improvement range greater than 24% (up to band 4) or less than 5% (below band 3) (excluding only social media analytics for customer satisfaction which hits just about 5). Use cases in the marketing area are quite impactful. Besides social media, the Ad Targeting use case is correlated with significant improvements across all business KPIs (appearing in first place for KPIs measuring the number of new products/services launched, time efficiency and product/service quality). And finally, the use case customer profiling, targeting and optimization of offers contributes to improvements in the range of 10 to 24% of the launch of new products and services, and other less relevant improvements for the other KPIs excluding only business model innovation.

Another use case generating benefits across the board is scheduling-optimization, appearing in the top half of Table 28 for all business KPIs except for business model innovation.

The use cases most relevant for the KPI business model innovation in fact are quite different from the others. They tend to belong to industries where big data is having rather disruptive impacts, such as agriculture, utilities, industry automation and connected vehicles. As a KPI, business model innovation is less immediate to define and probably more difficult to measure with quantitative metrics than the others, which may generate a wider range of variations in the answers.

Revenue growth	Rating
Usage based insurance	4.64
Social media analytics	4.54
Ad Targeting	4.44
Increase productivity and efficiency of DCs/warehouses	4.43
Scheduling optimisation	4.37
Energy consumption analysis and prediction	4.23
Customer scoring and/or churn mitigation	4.19
Inventory and service parts optimization	4.15
Supply chain optimization	4.14
Customer profiling, targeting, and optimization of offers	4.13

Customer satisfaction	Rating
Social media analytics	5.08
Ad Targeting	4.81
Energy consumption analysis and prediction	4.61
Field service optimization	4.55
Scheduling optimisation	4.53
Cyberthreat & detection	4.39
Customer profiling, targeting, and optimization of offers	4.38
Customer scoring and/or churn mitigation	4.38
Usage based insurance	4.27
Fraud prevention and detection	4.27

Business model innovation	Rating
Energy consumption analysis and prediction	3.92
Quality management investigation	3.90
Yield monitoring and prediction	3.89
Precision agriculture	3.88
Inventory and service parts optimization	3.86
Increase productivity and efficiency of DCs/warehouses	3.86
Risk exposure assessment	3.84
Asset management	3.82
Usage based insurance	3.80
Connected vehicles optimization	3.78

Number of new products/services launched	Rating
Ad Targeting	4.80
Scheduling optimisation	4.72
Energy consumption analysis and prediction	4.19
Customer profiling, targeting, and optimization of offers	4.15
Intelligent Fulfillment	4.07
Customer scoring and/or churn mitigation	4.07
Product & Service Recommendation systems	4.02
Field service optimization	3.98
Risk exposure assessment	3.95
Increase productivity and efficiency of DCs/warehouses	3.94

Cost reduction	Rating
Increase productivity and efficiency of DCs/warehouses	3.80
Social media analytics	3.77
Usage based insurance	3.60
Scheduling optimisation	3.42
Ad Targeting	3.38
Price optimization	3.31
Customer profiling, targeting, and optimization of offers	3.31
Predictive Maintenance	3.29
Smart warehousing	3.29
Risk exposure assessment	3.26

Time efficiency	Rating
Ad Targeting	4.50
Scheduling optimisation	4.32
Cyberthreat & detection	4.19
Social media analytics	4.15
Usage based insurance	4.13
Energy consumption analysis and prediction	4.11
Precision agriculture	4.03
Customer profiling, targeting, and optimization of offers	4.02
Risk exposure assessment	3.97
Fraud prevention and detection	3.96

Product/service quality	Rating
Ad Targeting	4.81
Scheduling optimisation	4.74
Network analytics and optimization	4.43
Quality management investigation	4.41
Intelligent Fulfillment	4.37
Customer scoring and/or churn mitigation	4.36
Smart warehousing	4.34
Logistics and package delivery management	4.33
Customer profiling, targeting, and optimization of offers	4.33
Product & Service Recommendation systems	4.28

Rating	Improvement
1	None (0%)
2	Less than 5%
3	5%-9%
4	10%-24%
5	25%-49%
6	50% or higher

Table 28 - KPIs Improvement achieved by Use Case
Source: IDC elaboration on DataBench survey, October 2018

4.5 Business KPIs and Technology

The correlation between technical performance metrics and business KPIs is one of the most interesting aspects investigated by our survey, very close to DataBench main goal.

Figure 56 below shows the level of improvement of business KPIs achieved by organizations employing these technical performance metrics, ranked by value. Figure 57 shows the same data expected in 2 years' time, which does not show relevant changes.

It is clear from the figure that in most cases Product or Service Quality is the biggest contributor to performance improvement, with the exception of Cost (e.g., $ per transaction), and here, surprisingly, it is customer satisfaction that makes the biggest contribution to improving cost. In most cases – except for Accuracy, Quality, and Veracity – the contribution to the KPI improvement made by cost reduction is notably lower than the other technical measures.

Survey q18. What are the top technical performance metrics currently used to measure your Big Data and Analytics environment? How about in two years from now - what will you start using? Choose all that apply.

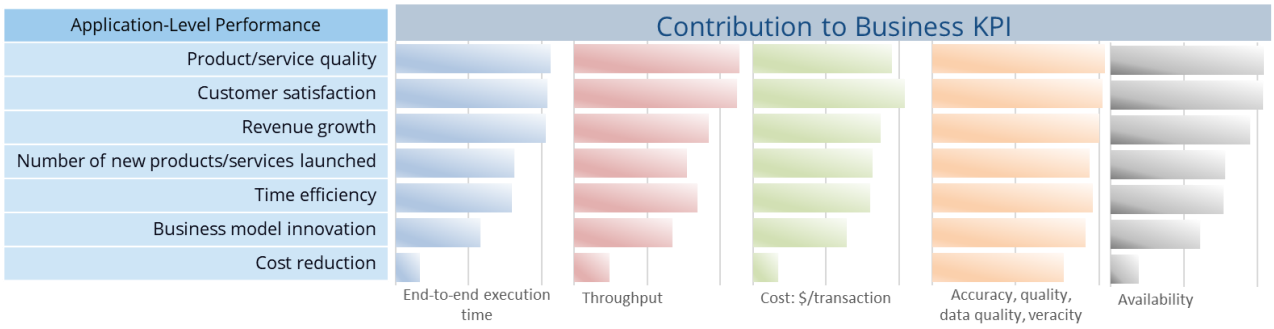


Figure 56 - Correlation between Technical Performance Metrics and Business KPIs
Source: IDC elaboration on DataBench survey, October 2018

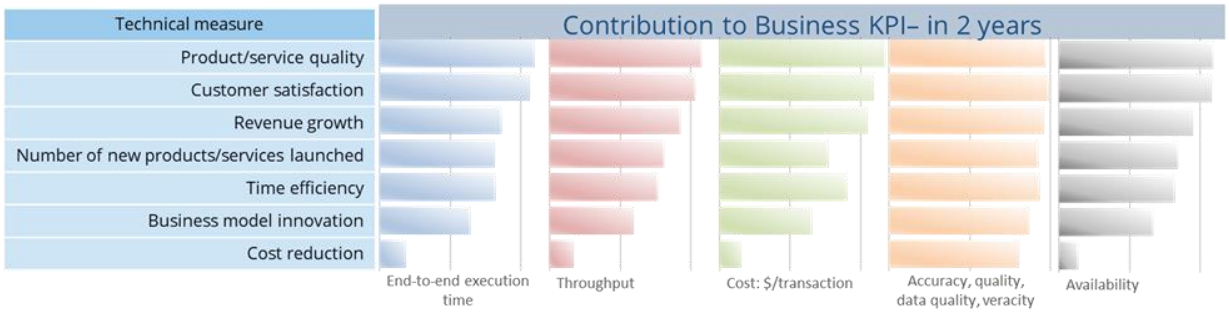


Figure 57 - Correlation between technical performance metrics and business KPIs
Source: IDC elaboration on DataBench survey, October 2018

5 Conclusions

The economic and market analysis presented in this study leads to the development of the preliminary benchmarks of European economic and industrial significance, in order to ensure that the benchmarking metrics developed by DataBench are relevant for the European economy and industry. Here we summarize the key results of this analysis.

5.1 Economic and Industrial Relevance of BDA in Europe

This report analysed in depth the European industrial and economic landscape in terms of GVA (Gross Value Added), employment and IT/ Big Data investment dynamics. This analysis is relevant because it connects Big Data spending level and trends with total IT spending by industry and GVA, and therefore it correlates Big Data investments with economic growth dynamics affecting each industry and the EU economy.

BDA investments increase faster than IT investments (so their share as a total of IT spending tends to increase). Industries with a high intensity of IT spending are currently leading the move towards Big Data. Companies (of all sectors and size band) with an advanced and sophisticated ICT infrastructure and culture are engaged in Digital Transformation of which Big Data is an essential ingredient.

Big Data's share of total IT spending is consistent across all industries and IDC expects it to rise from 8.4% in 2016 to 11.1% in 2022. According to the European Data Market Monitoring Tool updated in January 2019 by IDC, spending on the Data Market has reached 11.4% of total IT spending in the EU28 in 2018 and is projected to reach 13.4% by 2025 in the Baseline scenario (Figure 58).

Figure 58 shows the variation of this share by major industry. Agriculture (an industry with a relatively low IT investment until now) shows one of the fastest growth rates of Big Data investments. At the other extreme we find Education, which according to IDC is lagging behind all the other industries in its share of Big Data spending.

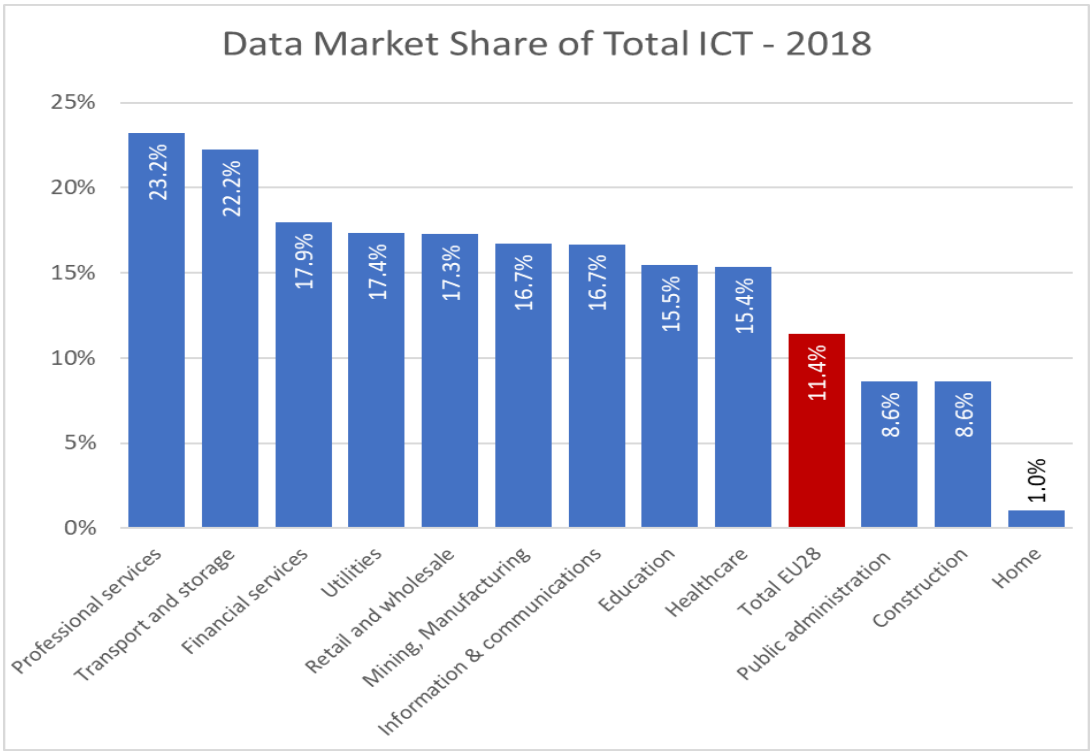


Figure 58 - European Data Market spending on ICT spending, 2018
Source: European Data Market Monitoring Tool, IDC 2019

Organizations adopt Big Data technologies to impact business growth and/or efficiency. A large share of use cases (mapped in chapter 3.5) focus on efficiency improvements, and this is likely to affect employment. Industries with high employment include Retail, Professional Services, and Manufacturing, but of these, only Manufacturing has high investment planned in Big Data technologies. These three key industries are very data intensive too and would benefit from efficiency improvements and revenue growth opportunities afforded by Big Data technologies.

As demonstrated in par.2.6, a 1% increase in professional services GVA will have a much greater impact on EU GVA than a 1% increase in Agriculture GVA. Therefore, Big data adoption in the industries with highest GVA (Professional Services, Manufacturing, and Wholesale and Retail) will potentially have a largest impact on the EU overall economy. On the other hand, adoption of BDA in industries with a smaller footprint in the economy such as Agriculture may still have high specific impacts and bring a high level of benefits.

The analysis shows that the Telecom, Finance, Retail and Wholesale industries lead in terms of uptake of Big Data, actual and forecast, but two of these industries are relatively small in terms of GVA (Telecom and Finance). The two largest sectors by contribution to GVA and employment, Professional Services and Manufacturing, in comparison show a lower diffusion of Big Data adoption. This is due to different factors, including the large number of SMEs in these sectors and the need to change traditional supply chains to embrace digital transformation, a complex effort. On the other hand, Big Data innovation in these sectors has the largest potential to drive growth in the European economy, as also indicated in the EC's strategy "Digitising European Industry". Today, the impact of BDA is felt in the most dynamic and innovative parts of the EU industry, but its full potential will be realized when BDA adoption will become mainstream also in the largest industry sectors, particularly Manufacturing.

5.2 Business Benchmarking of BDA is important

Business organizations recognize the importance of benchmarking the business impacts of BDA, with almost 90% of the DataBench survey respondents considering it moderately or very important. The perception of the importance of benchmarking is positively correlated with the level of adoption (actual users evaluate it very highly) and the company size (with large companies more appreciative of its importance than small ones). The industries more advanced and sophisticated in the use of BDA (Finance, Retail, Telecom-Media) again show a higher evaluation of the importance of benchmarking than the others, while laggard industries (Healthcare, Agriculture) show a higher share of respondents not particularly interested in benchmarking.

Business organizations are interested in all the 7 business KPIs indicators suggested by DataBench, but the majority single out by importance the KPIs on product or service quality, while cost reduction and time efficiency are relegated at the bottom of the ranking.

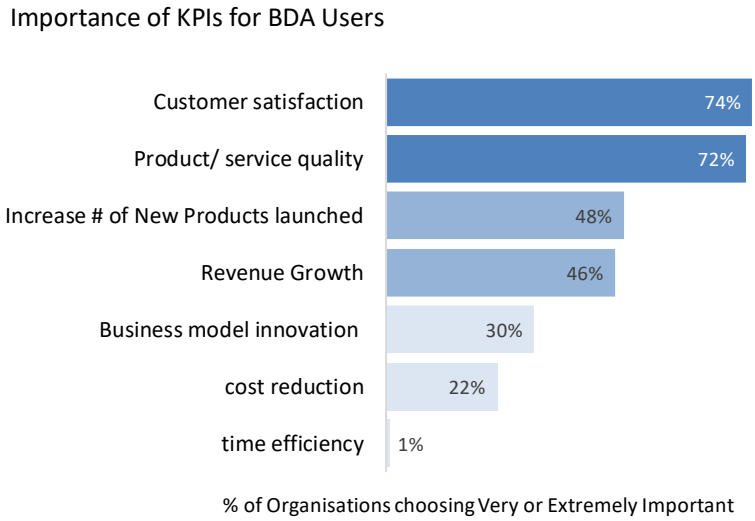


Figure 59 - Ranking of KPIs by importance, BDA users
Source: IDC elaboration on DataBench survey, October 2018

Innovation KPIs are also considered very important. SMEs do not have the same focus and concentration on a few KPIs as large enterprises, but they prioritize innovation KPIs, particularly business model innovation, more than other companies. This seem to reflect a strong focus on business development, marketing and customer care, and overall economic and profit growth, with attention paid to productivity (time efficiency) but much less on traditional cost-cutting. Over 79% of organizations already engaged in using BDA (rather than piloting or still evaluating BDA) select customer satisfaction and product/service quality improvement as the most relevant KPIs.

The obvious deduction is that benchmarking becomes more relevant when organizations are engaged in practice with BDA. But this also confirms that awareness of BDA business benchmarking is low among SMEs and industries with lower adoption, and the availability of evidence-based benchmarks would be likely to increase awareness and help to make better business decisions.

5.2.1 High Level of Benefits

Organizations show a high level of satisfaction with BDA investments, since 80% of respondents have achieved or expect moderate or high benefits and none have seen negative impacts. Moreover, positive impacts are stronger for actual users (Figure 60). This points to a positive dynamic of growing benefits as users progress from the piloting to the scaling up of BDA. Respondents still considering or evaluating BDA are more conservative in their expectations: the majority expects low or medium benefits from BDA.

This gap between expectation and reality highlights the potential positive role of measuring and benchmarking impacts as a way to accelerate the uptake of BDA among laggards and reluctant innovators.

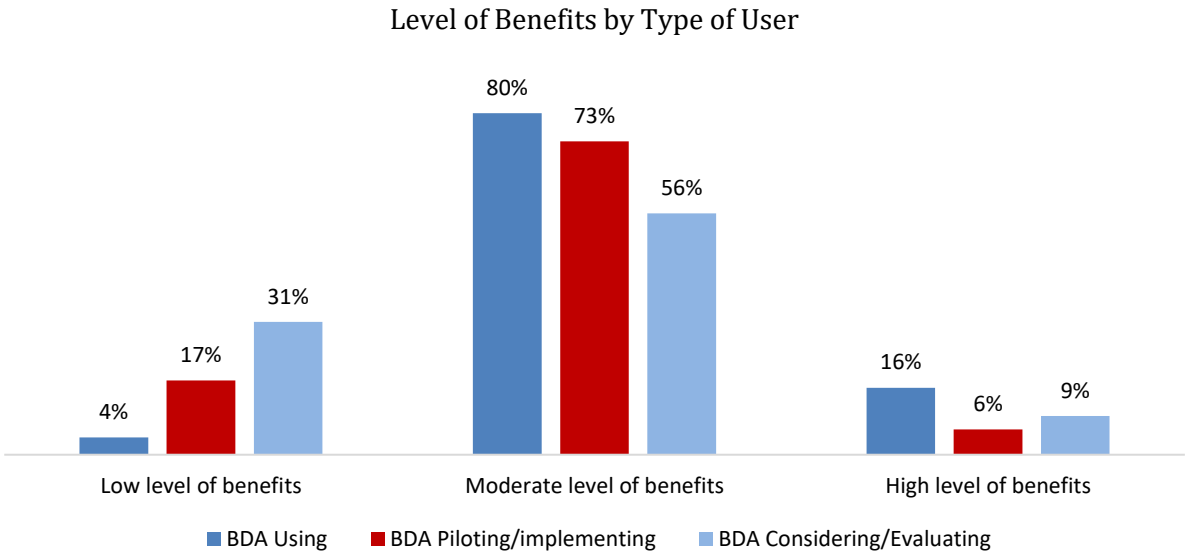


Figure 60 - Benefits achieved from BDA Adoption
Source: DataBench survey, October 2018

5.2.2 BDA drivers: Business Goals and KPIs

The survey shows that the demand for BDA is driven by multiple business goals, with a stronger focus on business and market strategies goals versus more operational and specific goals (for example improving regulatory compliance and fraud/risk control) (Figure 61 below). Looking at business goals by company size and industry does not show radical differentiations, even though some industries are more focused than others on customer marketing because of the type of their core business (Telecom, Media, Retail).

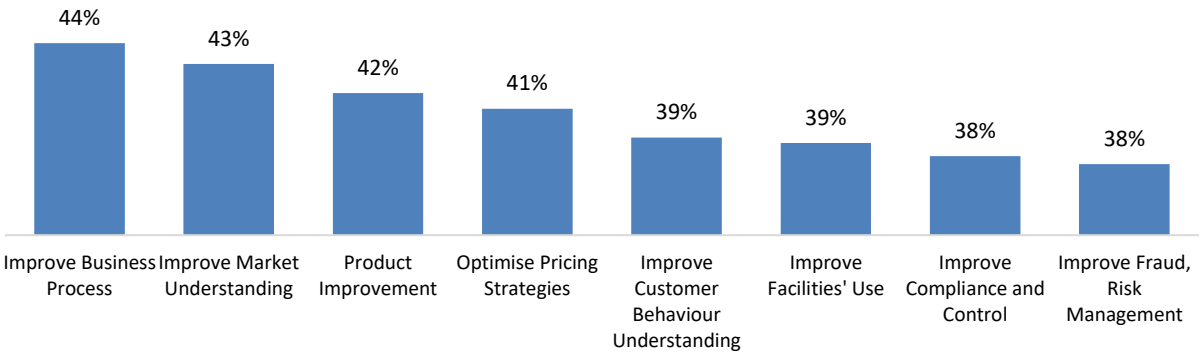


Figure 61 - Business Goals driving BDA Adoption (% of Respondents)
Source: DataBench Survey, October 2018

An interesting correlation links the achievement of business KPIs with the achievement of business goals (Figure 61). Based on the survey, there is coherence between the priority business goals and the benefits achieved, measured through the average improvement score of business KPIs. More specifically, we notice that 3 KPIs (Improvement of product-service quality, Revenues growth and improvement of Customer satisfaction) show an average improvement score over 10% which significantly contribute to achieve the top 3 business goals in the relevance ranking, but also the other business goals. In other words, companies investing in BDA are reaping benefits contributing to the achievement of the business goals which led them to invest.

5.2.3 Top Level Use Cases

The use cases represent the link between technical solutions and business goals and help to collect data on the main concrete typologies of BDA's exploitation. This survey has helped to identify the patterns of diffusion of use cases by type of organization, size and industry, in order to have a pragmatic and realistic view of the footprint of BDA adoption. The potential list of use cases is very rich, with a long tail of industry specific use cases. The respondents were asked to select from a list of 12 cross-industry use cases and 23 industry-specific use cases, representing the most frequent and potentially impactful typologies identified so far by IDC research. Cross-industry use cases will appear at the top of the ranking by number of adopters, because they are asked to all respondents.

Given this context, in terms of absolute number of adopters, 4 cross-industry use cases rank at the top (Figure 62): new product development (420 users), Price optimization (418), Risk exposure assessment (381) and Regulatory Intelligence (378). However, in terms of share of respondents, 2 use cases related with production processes rank at the top followed by customer profiling, which is also number 5 in terms of number of adopters. The report provides also the ranking of use cases by industry.

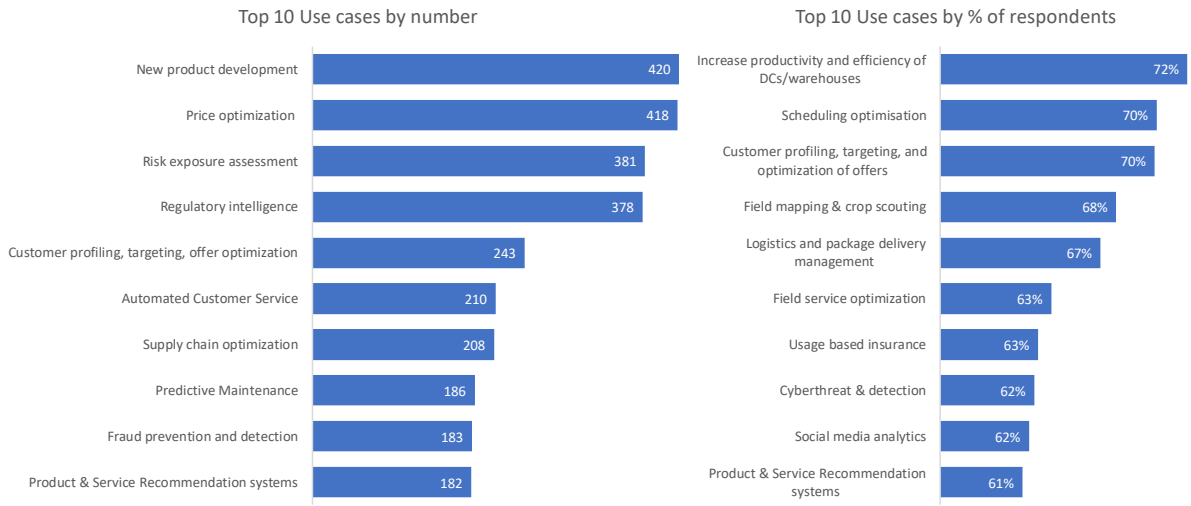


Figure 62 - Top 10 Use Cases by Number of Respondents and % Share of Respondents

Source: IDC elaboration on DataBench survey, October 2018

5.3 Preliminary Benchmarks based on Business KPIs

Finally, we are in the position to outline the preliminary benchmarks of industrial significance, the ultimate objective of this report. The value of the KPIs improvements, calculated for the overall sample, by industry, by company size band, and by use case, corresponds to our preliminary benchmarks.

The sample is representative of the EU industry and the business improvements reported by the respondents can be considered as representative of realistic and achievable benefits of the investments in BDA. We have demonstrated that these KPIs are considered relevant by the industrial users interviewed as they measure the business goals driving their adoption of BDA in the first place. In addition, the 7 KPIs cover the main economic, innovation and efficiency benefits sought and expected by industrial users.

The European organizations surveyed by DataBench have achieved substantial business benefits from the adoption of BDA: mean gains reach 6.5% revenue growth (mean value), 6.7% profits increase and 5.6% for cost reductions. The range of variation of KPIs improvements is much wider, with several organizations achieving revenue and profit growth higher than 10%. Moreover, these benefits are expected to increase rapidly in the next 2 years, by 2020 as BDA scales up in the organization. Therefore, we can consider these values as a preliminary benchmark for organizations interested to measure their success in BDA implementation.

The analysis of KPIs by company size provides some surprises, for example SMEs under 50 employees expect profit growth around 10% and revenue growth around 8.4%, above the sample average.

The revenue, profit and cost reduction benchmarks show a strong variation between the different industries. For all 3 KPIs, the Business/ IT Services is first for the level of benefits (plus 9.9% of profit increase) and Agriculture the last (plus 4.8% of profit increase). The largest industry sectors such as Manufacturing and Retail show KPIs improvements above the mean value.

The identification of the most frequent use cases by industry and the measurement of their impacts on the KPIs provides an additional dimension to the understanding of the business dynamics of BDA technology innovation. These KPIs can be used as target benchmarks for organizations investing in BDA to assess whether they are best performers or can aim for better gains. This analysis contributes to building the business case for enterprises interested in investing in BDA.

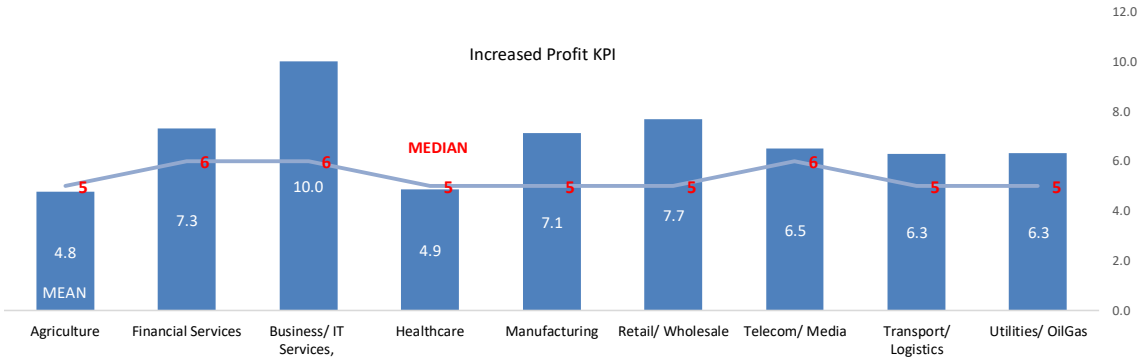


Figure 63 - Profit KPIs Improvements by Industry
Source: IDC elaboration on DataBench survey, October 2018

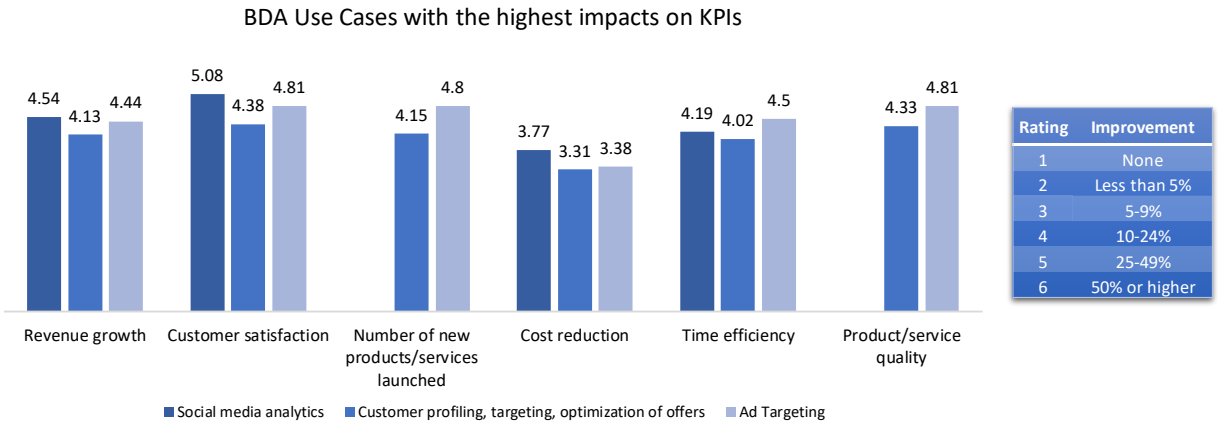


Figure 64 - BDA Use Cases with the highest Impact on KPIs
Source: IDC elaboration on DataBench survey, October 2018

5.4 Next Steps

The preliminary benchmarks presented in this report will be validated through the case studies carried out by WP4 of the project and used to refine and improve the indicators presented here. The first results of the case studies will be presented in Deliverable 4.2. which will be delivered in June 2019.

The study team will continue to deepen the analysis of the survey results and business users' needs through cross-elaborations, clustering and more in-depth analysis particularly of the

use cases and the correlations between technology choices and business KPIs. These results will be presented in the next WP2 Deliverable 2.3 "*Analysis of actual and emerging industrial needs and use case mapping* ", also due in June 2019.

The study team will distribute the survey further to the industrial partners of ICT-14 and ICT-15 projects from the Horizon 2020 programme, carrying out Big Data pilots and experimentations. The survey will continue to remain open until at least the end of 2019, to provide further data and keep enriching the sample of users and use cases. The study team will use the current results to develop a self-assessment web-based tool which will enable organizations responding to the survey questionnaire to receive in real time a profile of their answers compared to their peers, in order to be able to benchmark their own achievement compared to a group of respondents with similar characteristics. This will enable the project to start providing benchmarking services and sharing knowledge with the H2020 research and benchmarking community, testing the links between technical and business benchmarking. Through this process we expect to be able to further develop and enrich the business KPIs, which will eventually be presented in the DataBench Handbook.

The results of this analysis on KPIs will also feed into the development of the DataBench Toolbox, particularly to develop user-friendly guidelines for business users to use the Toolbox.

6 Annex

6.1 Questionnaire

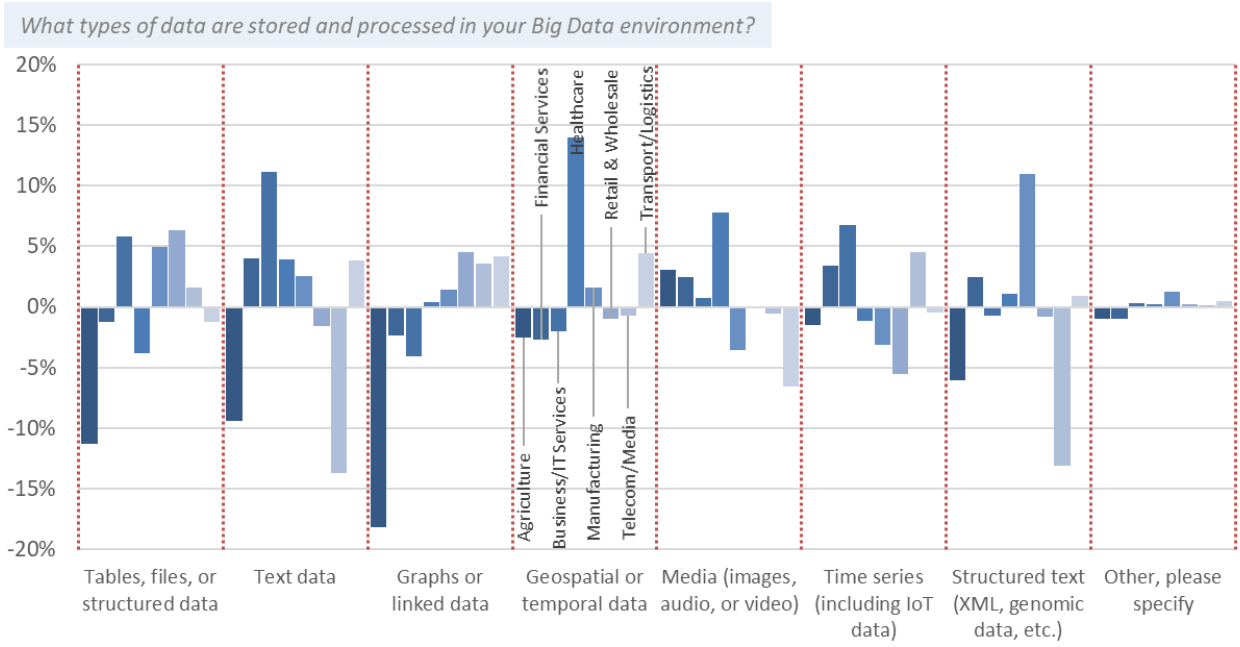
Screening Questions
qs1. In which country is your organization located?
qs2. Approximately how many people are currently employed (full-time or part-time) in your organization in your country, including all branches, divisions, and subsidiaries?
qs3. Which of the following best describes your position within your organization?
qs4. What is your role in decisions regarding your organization's use or potential plans for using Big Data and analytics? [...].
qs5. Which of the following industries best describes your organization's primary business? Please make sure you are referring to your company, not your specific role within the organization.
qs6. What is the status of your organization's use of Big Data and analytics technologies and solutions today?
Core Questions – Business Alignment and KPIs
q1. In which of the following areas has your company implemented or does it plan to implement Big Data and analytics initiatives? [Choose all that apply]
q2. Which of the following business goals are driving adoption or consideration of Big Data and analytics in your organization? [Choose all that apply]
q3. How important is the ability to benchmark the business impact of your organization's Big Data and analytics efforts?
q4. How important are the following business Key Performance Indicators (KPIs) for measuring the impact of your organization`s Big Data and analytics efforts? [...]
Main benefits
q5. What level of benefits has your organisation achieved so far (alt: does your organisation expect to achieve) from the use of a Big Data and analytics environment?
q6a. In percentage terms, what is the actual benefit realised (alt: what benefit do you expect to realise) from the use of Big Data and analytics for the following business KPIs? [...]
q6r. Please try to estimate the benefit (alt: expected benefit) realized from the use of Big Data and analytics for the following business KPIs.
q7. To what extent has your organisation's deployment of Big Data and analytics impacted (alt: will your organisation's deployment ... be impacted by) the ability to attain the following business KPIs?
q8. For the following business KPIs please estimate what percentage of expected improvement will be linked to the adoption of Big Data and analytics in 2020?
q8a. What was your organization's revenue in <COUNTRY> last year, in <CURRENCY>?
Use Cases
q9. If we look at the following specific Big Data and analytics business use cases, what is your organization's position on each of these?
Technical Questions
q10. How would you describe the level of business process integration currently achieved within your Big Data and analytics environment?
q11. Do you believe that supplying capabilities such as real-time integration with business processes will improve Big Data and analytics' impact on your organization and/or community?

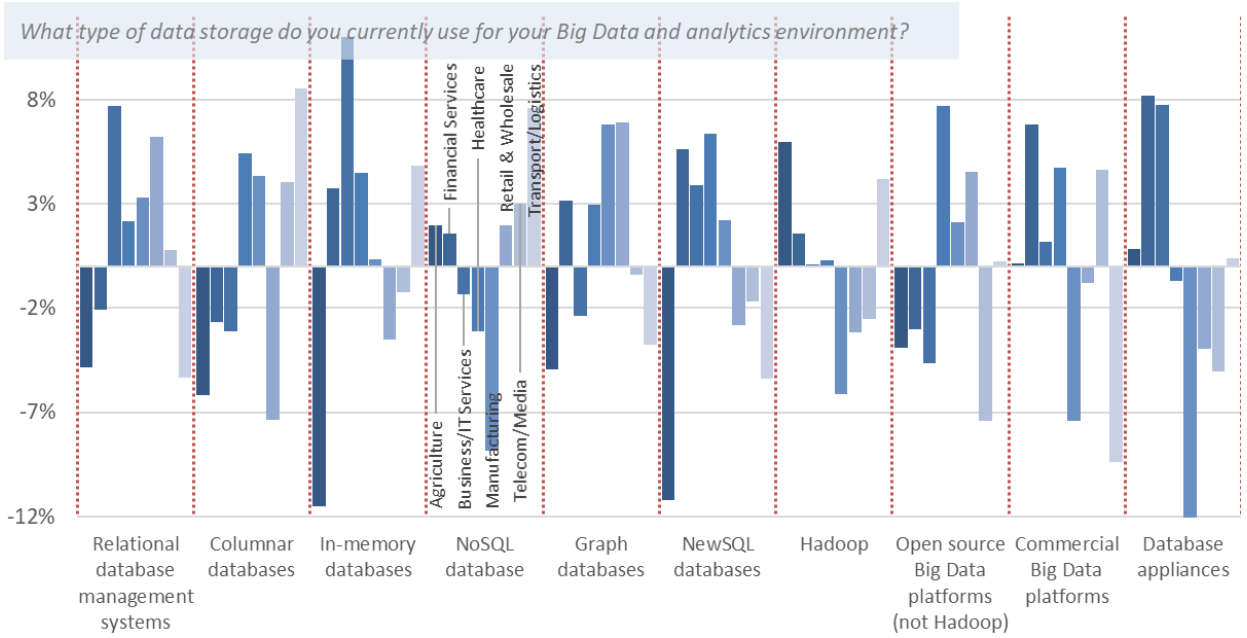
q12. To what extent is your Big Data and analytics environment linked or aligned with other technology investments?
q13. In data storage terms, what measurement is typically used to gauge the size of your Big Data and analytics environment(s)?
q14. What type of data storage do you currently use for your Big Data and analytics environment? [Choose all that apply]
q15. What types of data are stored and processed in your Big Data environment? [Choose all that apply]
q16. Which of the following best describes your organization's current approach to the management of data?
q17. To what extent are the following types of data processing paradigms important in your Big Data environment?
q18. What are the top technical performance metrics currently used to measure your Big Data and analytics environment? How about in two years from now - what will you start using? Choose all that apply.
q19. What is the current state of your organization's use of these different analytic techniques?
q20. Looking at Big Data skills requirements, in which areas — if any — do you have difficulty finding enough resources? [Choose all that apply]

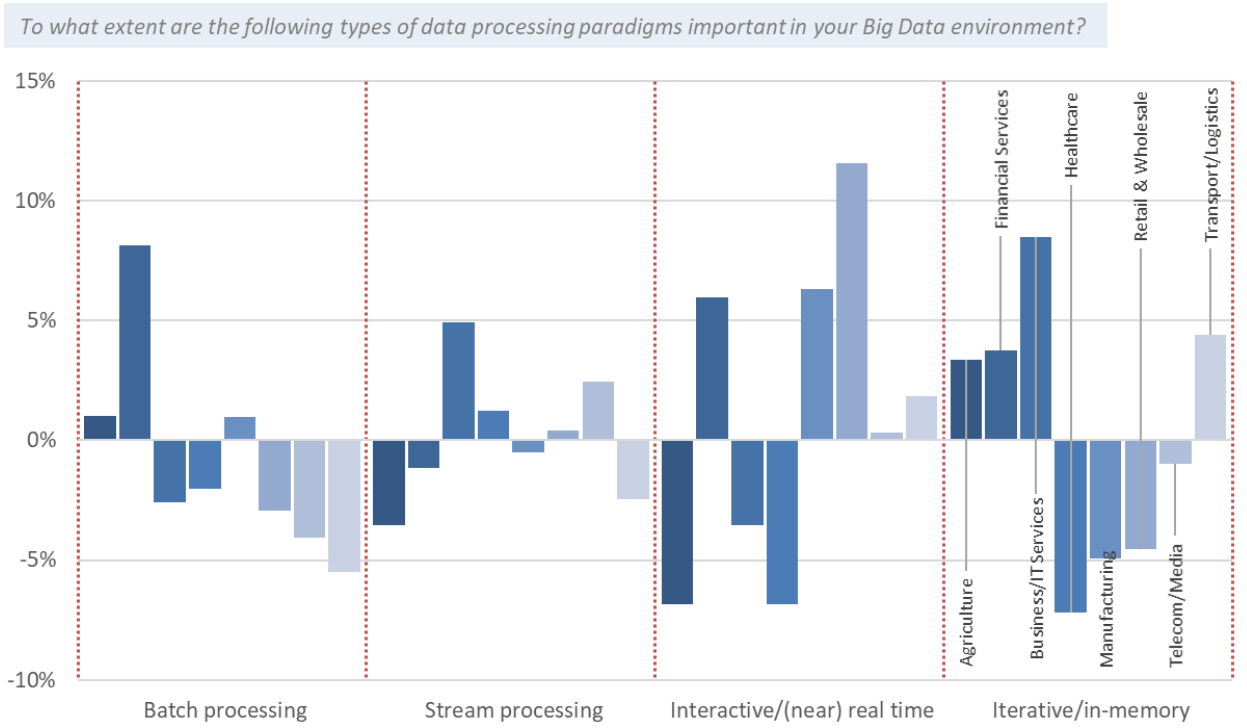
6.2 Matching Technical Measures with KPIs

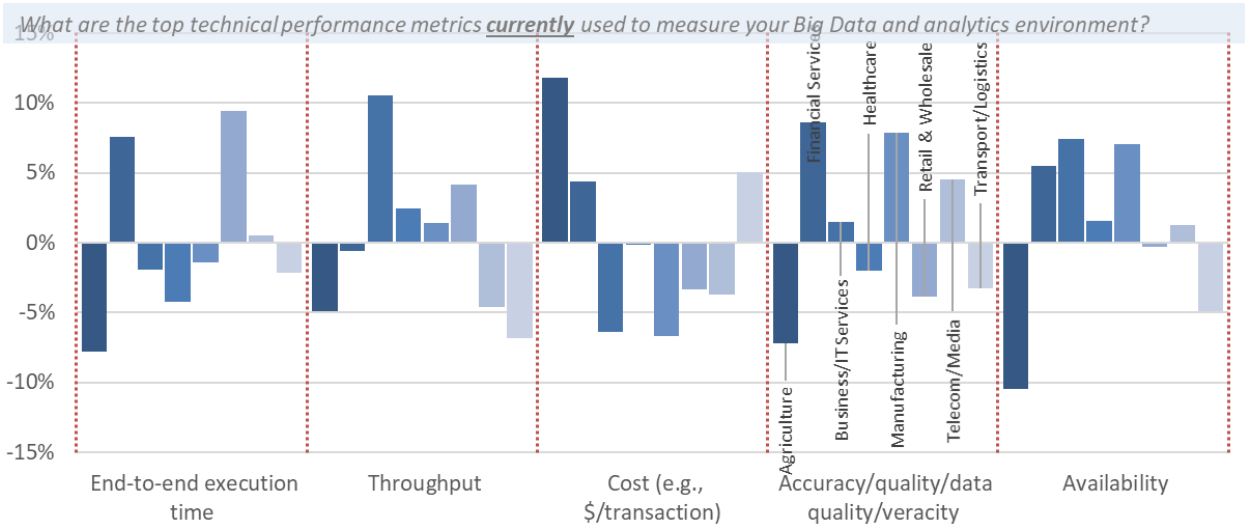
The Figures below visualize the correlation between some of the technical questions of the survey and the use of business for future expectations of technical measures' contributions to KPIs is not much different for the leading technical measures, although for the cost KPI customer satisfaction drops slightly its contribution to the KPI, and time efficiency becomes a bigger contributor to KPI success.

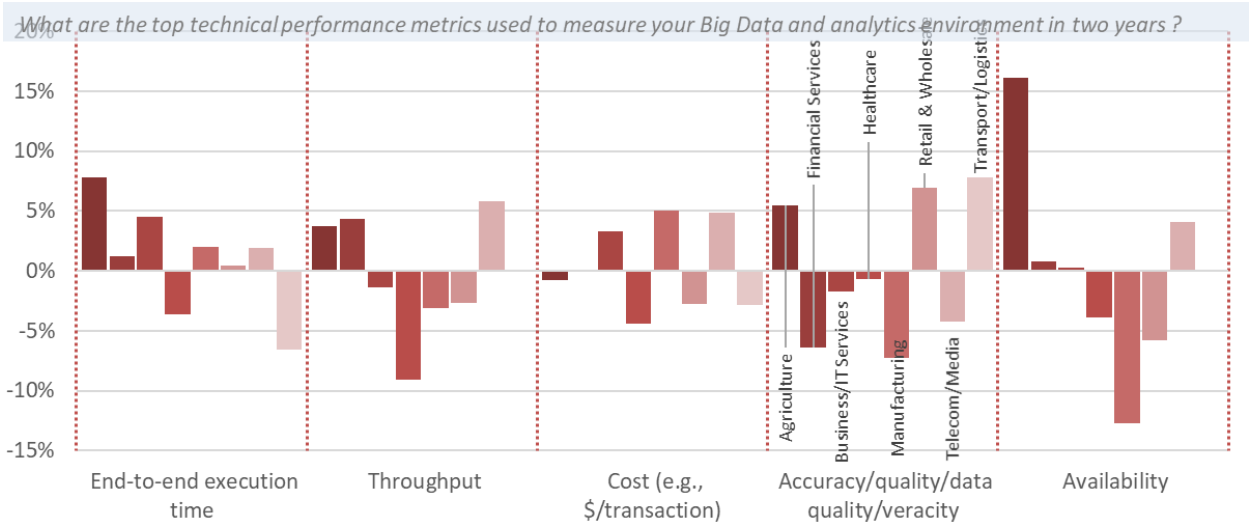
These weights give a matrix used to map between the technical measures and the KPI's and choose appropriate measures and benchmarks for specific use cases.

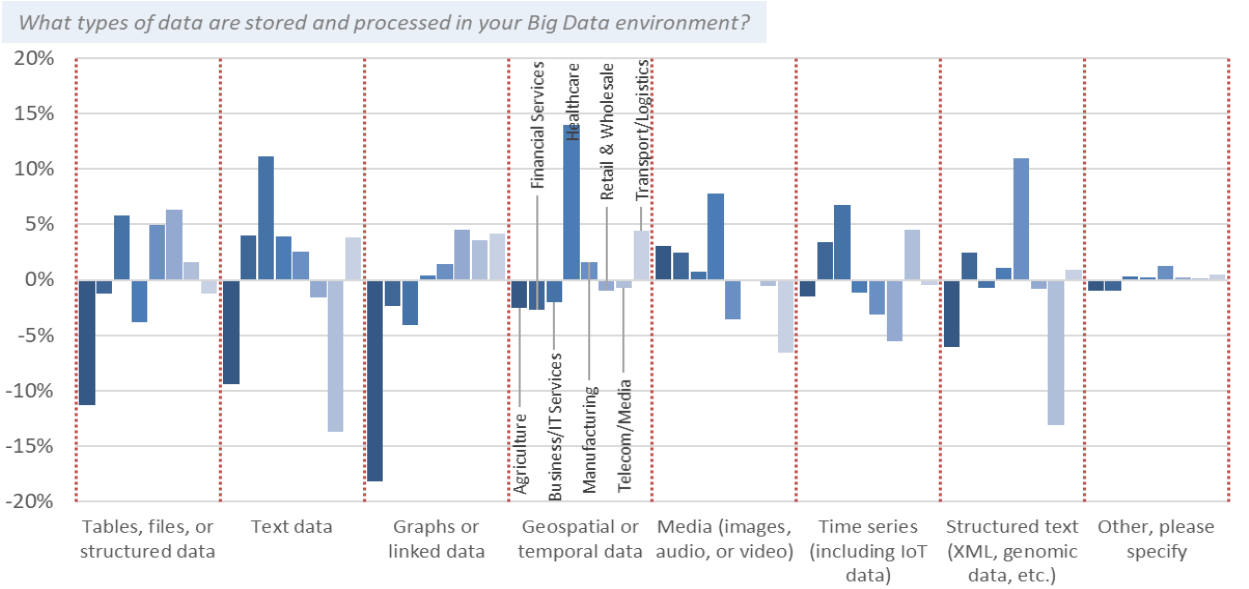



What type of data storage do you currently use for your Big Data and analytics environment?
8%
3%
-2%
-7%
-12%
Agriculture
Business/IT Services
Manufacturing
Telecom/Media
Financial Services
Healthcare
Retail & Wholesale
Transport/Logistics
Relational database management systems
Columnar databases
In-memory databases
NoSQL database
Graph databases
NewSQL databases
Hadoop
Open source Big Data platforms (not Hadoop)
Commercial Big Data platforms
Database appliances


To what extent are the following types of data processing paradigms important in your Big Data environment?
15%
10%
5%
0%
-5%
-10%
Agriculture
Business/IT Services
Manufacturing
Telecom/Media
Financial Services
Healthcare
Retail & Wholesale
Transport/Logistics
Batch processing
Stream processing
Interactive/(near) real time
Iterative/in-memory


What are the top technical performance metrics currently used to measure your Big Data and analytics environment?
15%
10%
5%
0%
-5%
-10%
-15%
Financial Services
Healthcare
Retail & Wholesale
Transport/Logistics
Agriculture
Business/IT Services
Manufacturing
Telecom/Media
End-to-end execution time
Throughput
Cost (e.g., $/transaction)
Accuracy/quality/data quality/veracity
Availability


What are the top technical performance metrics used to measure your Big Data and analytics environment in two years ?
20%
15%
10%
5%
0%
-5%
-10%
-15%
Financial Services
Healthcare
Retail & Wholesale
Transport/Logistics
Agriculture
Business/IT Services
Manufacturing
Telecom/Media
End-to-end execution time
Throughput
Cost (e.g., $/transaction)
Accuracy/quality/data quality/veracity
Availability


What types of data are stored and processed in your Big Data environment?
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
Financial Services
Healthcare
Retail & Wholesale
Transport/Logistics
Agriculture
Business/IT Services
Manufacturing
Telecom/Media
Tables, files, or structured data
Text data
Graphs or linked data
Geospatial or temporal data
Media (images, audio, or video)
Time series (including IoT data)
Structured text (XML, genomic data, etc.)
Other, please specify

6.3 DataBench Survey Banner Tables

The tables annexed present all the questionnaire survey answers broken down by country, industry and company size.