

***Data evaluation in laundry facilities
— state-of-the-art and the future trends***

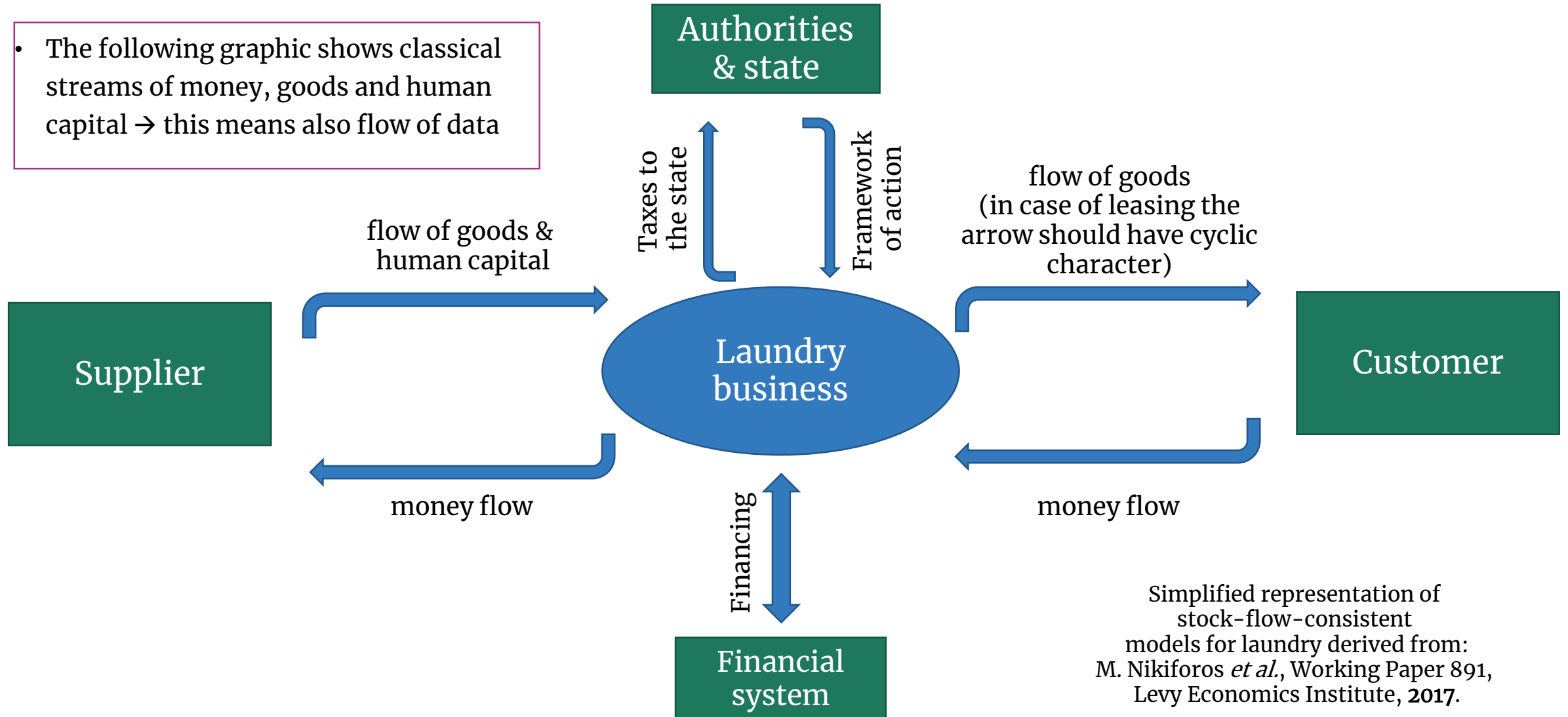
Outline

- Data acquisition and evaluation in laundries
- Software-based solutions for evaluation of data streams
- Which tools may be used in the future?
- Big data analysis & related topics
- Application cases



Data acquisition and evaluation in laundries

- The following graphic shows classical streams of money, goods and human capital → this means also flow of data



Monitoring money flow in laundries

- The following tables (try) to summarize all data streams, data acquisition and data evaluation methods in laundry industry

Data stream	Estimated amount of data	Data acquisition	Data evaluation
Data for external accounting	Middle-size volume of data (gigabyte to terabyte)	Digitization of all financial transactions; SAP, DATEV, Lexware, SoCom	Annual report, Tax return
Data for internal accounting or benchmarking of several laundry facilities	see above	See above	Strategic report for internal use (documentation, control, planning)
Cash flow & behavioral analysis of the supply chain, market or competitors	Large data volume (petabyte to exabyte)	Large databases, big data analysis tools e.g. Apache Hadoop/Spark + cloud computing	Report regarding reliability, sustainability and social responsibility along the supply chain

Monitoring goods & human capital flow

Data stream	Estimated amount of data	Data acquisition	Data evaluation
Data of consumed and generated resources (energy, fuel, gas, water, wash chemistry, waste)	Middle-size volume of data (gigabyte to terabyte)	e.g. SAP, SoCom, Excel; specific acquisition systems e.g. for process-resolved energy consumptions monitoring e.g. econ solutions; use of sensors and offline analysis for monitoring of wastewater parameters	Report of all resource streams and related data streams
Data of goods/assets (machine equipment, laundry infrastructure, transport fleet, work wear)	see above	see above	Report of all assets
Good flow & sustainability analysis in the supply chain	Large data volume (petabyte to exabyte)	Large databases, big data analysis tools e.g. Apache Hadoop/Spark + cloud computing	Report regarding sustainability and life cycle assessment
Data of laundry (can be also an asset in leasing contracts)	Middle-size volume of data (gigabyte to terabyte)	Barcode and/or RFID + Data Base + visualization	Specific software connected to RFID; flow of all laundry items
Data of employees	See above	e.g. SAP system, SoCOM	Data base with personal data; Report regarding education & efficiency of employees

Monitoring of process workflow, quality assurance & other business areas

Data stream	Estimated amount of data	Data acquisition	Data evaluation
Monitoring the process parameters (e.g. temperature, pH, drying time, logistic efficiency)	Middle-size volume of data (gigabyte to terabyte)	Excel, Jupyter Notebook, tailor-made programs in R or Python; offline analysis or sensor-based solutions	Titration protocol, report of all process parameters
Monitoring of quality assurance measures (i.e. stability and reproducibility of processes, predictions, statistical evaluation)	Middle-size to large data volume (terabyte to exabyte)	Excel, Jupyter Notebook, tailor-made programs in R or Python; or commercial solutions	Strategic report for quality assurance measures & optimization strategy; often statistical evaluation is necessary
Monitoring of marketing measures & complaint management	Middle-size volume of data (gigabyte to terabyte)	Excel or commercial solutions	Report regarding marketing & complaint management strategies

Big data – important for the future

- The small and middle size companies can solve the most data acquisition & data evaluation tasks with Microsoft Office package (Excel, Access, SharePoint...) and specific tasks with other commercial software (SAP, DATEV, Design Expert etc.)
- For (highly automated) middle-size or larger laundry companies (with several laundry facilities) **big data** analysis is of specific interest for several tasks e.g. market analysis, life cycle assessment, supply chain analysis etc.



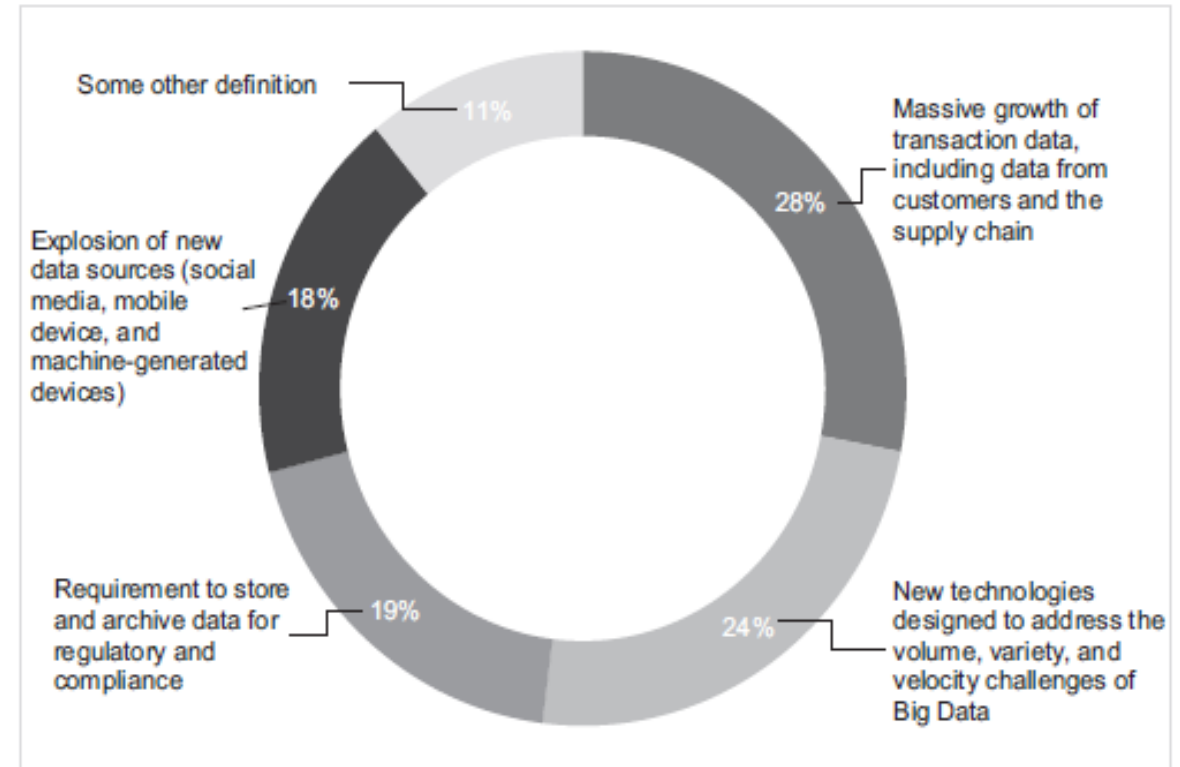
Big data

- “Big data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information.”

TechAmerica Foundation’s Federal Big Data Commission, 2012

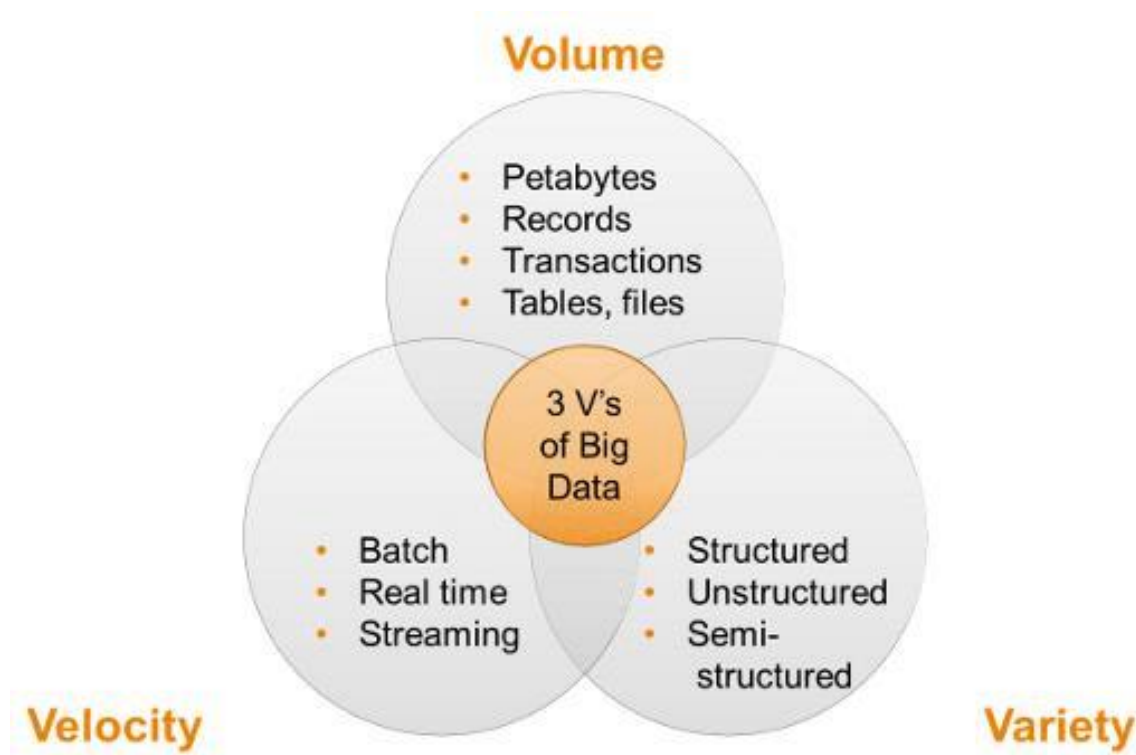
- The Three V’s (Volume, Variety and Velocity) have emerged as a common framework to describe big data

Big data definitions

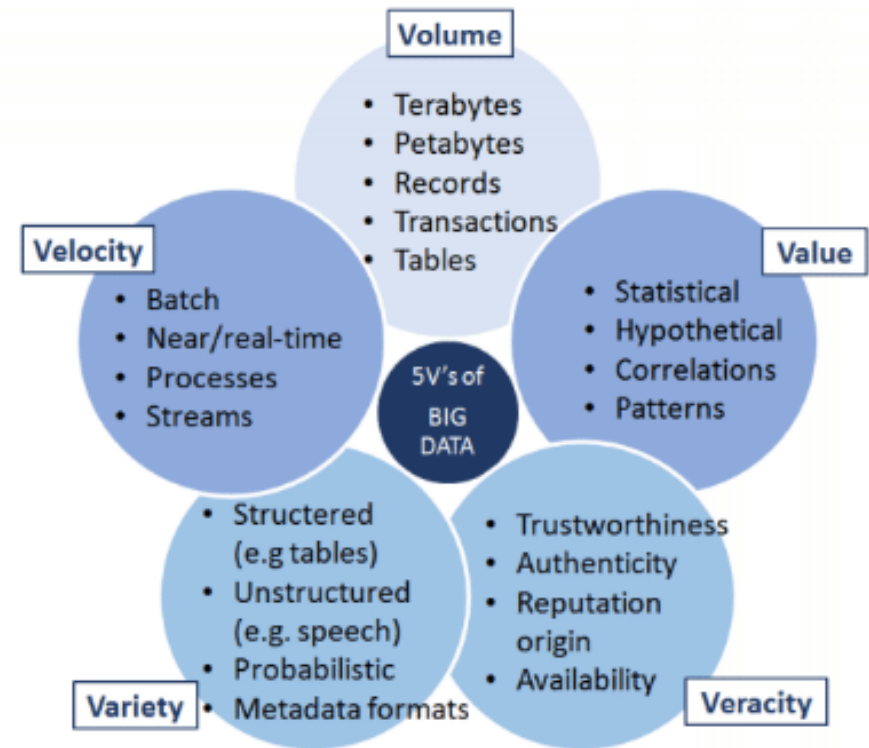


A. Gandomi *et al.*, International Journal of Information Management, 35, 137–144, 2015.

3 V's vs. 5 V's definition of „Big Data“



researchgate.net



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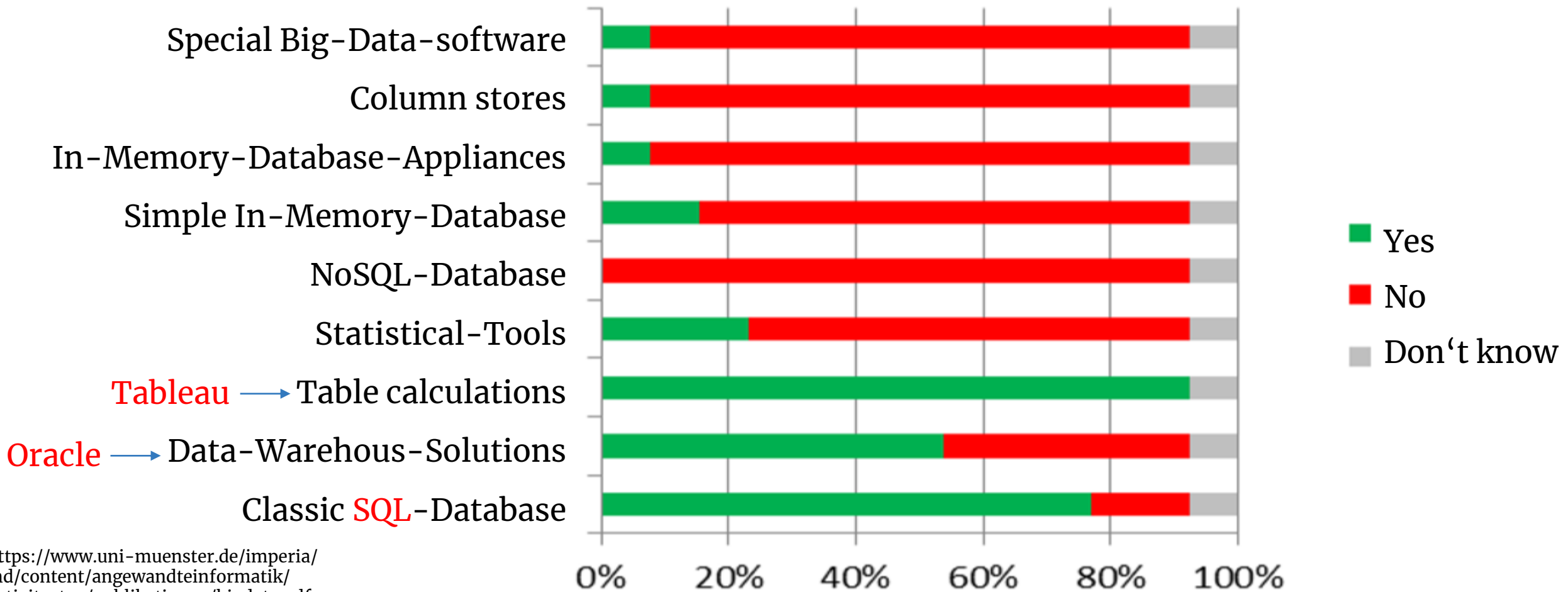
Data mining, process mining and business intelligent

- **Data Mining**
 - Statistical-mathematical methods for recognizing patterns in data
 - With the help of algorithms, data can be searched, preprocessed, processed and evaluated
- **Business Intelligent**
 - Multidimensional analysis to evaluate and display the data for risk and cost reduction as well as optimization in the value chain
 - The focus is on key indicators (including key performance indicators, or KPIs)
- **Process Mining**
 - Digitalization / modeling of processes for real-time analysis
 - The analysis enables an end-to-end view and helps with the optimization decision as well as the problem definition in processes

Categories of big data technologies

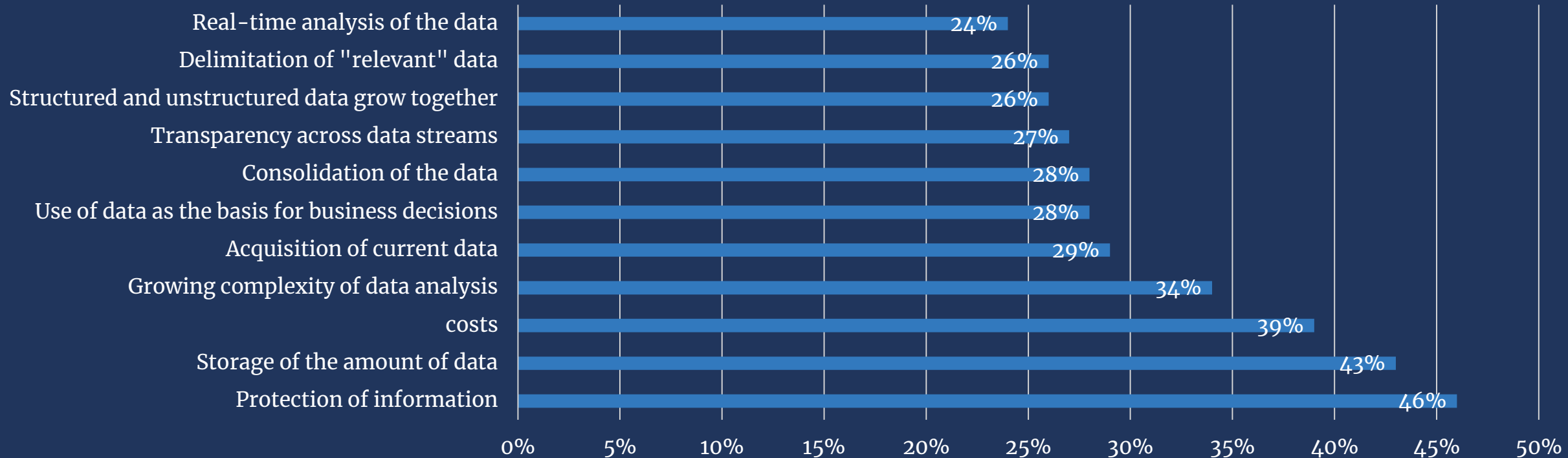
- **Standardized analytics** – suitable for applications with a tendency to lower demands on time and data diversity
- **In-memory technologies** – suitable for very large data evaluations
- **Hadoop** – these solutions are recommended for a wide variety of data formats
 - Hadoop is open source and has the ability to store and process a huge volume of differently structured data and it can scale almost unlimited
- **Complex event processing and streaming** – suitable for the event data that has to be recorded and evaluated as it is being created

An empirical Inventory of the use of “Big data” in small and medium-sized companies



Challenges in data storage and data management - An empirical inventory

Proportion of respondents



The advantages of big data analytics

- **Transparency**

- Big Data holds the potential to ensure complete transparency of supply chains, enabling to trace the source of their products, for example to ensure that they have been sourced ethically
- Furthermore, Big Data is now making accessible information which was previously unavailable and prevents the maintenance of information asymmetries

- **Research, Development and Innovation**

- Big Data can help businesses to gain an understanding of how others perceive their products or identify customer demand and adapt their marketing strategy or the design of their products accordingly
- Big Data can also be used during the design and development stage of new products; for example by helping to test thousands of different variations of computer-aided designs in an expedient and cost-effective manner

- **Efficiency and Productivity**

- businesses are facing enormous pressures on their budgets; the desire to reduce waste and inefficiency has never been greater
- Big Data can help to alleviate such problems, leading to the better utilization of scarce resources and a more productive workforce

M., Scott, „Benefits and Harms of „Big Data““, <https://cis-india.org/internet-governance/blog/benefits-and-harms-of-big-data>, 15.11.2018.

Critical review on big data utilization

- big data slows the decision making process and the implementation of decisions as well, because executives tend to wait for more data
- what are the right questions to ask? Without hypotheses, the questions are endless
- Big Data complexity and the need for data reduction
- By far the biggest concern raised by researchers in relation to Big Data is its risk to privacy:
 - Yet as Big Data has begun to play an increasingly central role in our daily lives, a broad range of new threats have begun to emerge including issues related to security and scientific epistemology, as well as problems of marginalization, discrimination and transparency
- **For example:** Anti-Competitive Practices – Large and established companies are increasingly developing a market advantage over small start-up companies due to their analytical power of the huge amount of data available to them

Håkonsson, T. *et al.*, J Org Design, 5, 2016.

M., Scott, „Benefits and Harms of „Big Data““, <https://cis-india.org/internet-governance/blog/benefits-and-harms-of-big-data>, 15.11.2018.

Application cases

1. Fraud-Detection
2. Risk assessment
3. Management and Governance
4. Market research and sales forecasts
5. Marketing and customer focus
6. Individualized product recommendation
7. Product development and improvement
8. M2M – Machine-to-Machine-communication
9. Predictive maintenance and logistics
10. Monitoring and control



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