



Supply Chain Big Data Series Part 1

**How big data is
shaping the supply
chains of tomorrow**

March 2017

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“The key challenge for D&A in Operations is the trust of humans in the results generated by machines, especially in Industry 4.0 environments. In addition, continuous improvement (CI) teams from functions along the end-to-end Supply Chain, who exactly know, which question they want to answer with D&A, need to be implemented to get the maximum benefit out of D&A.”

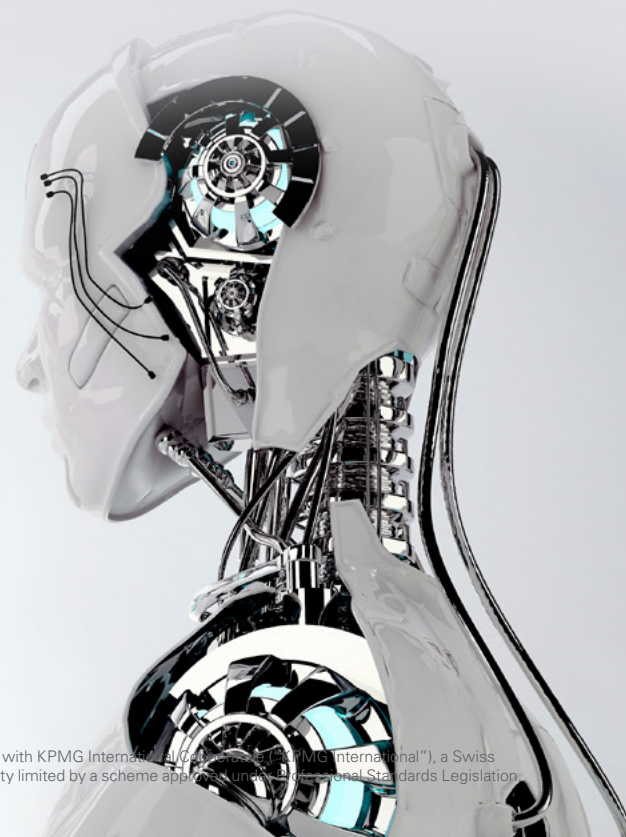
Peter Liddell, Asia Pacific Head of Supply Chain and Operations, KPMG Australia

“The leading retailers will be able to effectively analyse and interpret big data to stand out from their peers by winning customer experience [by 2020].”

Erich Gampenrieder, Global Head of Operations Advisory, KPMG Germany

“Big data is certainly enabling better decisions and actions, and facilitating a move away from gut feel decision making. But as more reliance is placed on algorithms, data and analytics, the question of trust is emerging as an important consideration. Another important consideration is working with external parties to bring together far more meaningful insights and actions. This again emphasises the need to really trust in the analytics to be confident in decision making.”

Anthony Coops, Asia Pacific Data & Analytics Leader, KPMG Australia



Foreword

More than ever before organisations are faced with streams of data flooding in from various channels at an accelerating rate. Data overwhelm can hamper an organisation's ability to keep up with data inflows and derive valuable insights.

The problem can be exacerbated by interactions between internal and external parties up and down the supply chain which, in turn affect business operations.

It is becoming increasingly apparent that supply chains that learn to harness the power of the data sources benefit significantly; leveraging the advantages of advanced analytics, supply chains can become more responsive, demand-driven and customer centric.

Decision makers in supply chains are seeking ways to effectively manage big data sources. There are numerous examples of supply chain operations applying big data solutions which demonstrate the abundance of process improvement opportunities available through the effective use of data:

- Big data solutions that support integrated business planning are currently helping organisations orchestrate more responsive supply chains as they better understand market trends and customer preferences. The triangulation of a range of market, sales, social media, demographic and direct data inputs from multiple static and dynamic data points provides the capability to predict and proactively plan supply chain activities.
- The Internet of Things (IoT)—and machine learning are currently being used in predictive asset maintenance to avoid unplanned downtimes. IoT can provide real-time telemetry data to reveal the details of production processes. Machine learning algorithms that are trained to analyse the data can accurately predict imminent machine fails¹.
- Big data solutions are helping avoid delivery delays by analysing GPS data in addition to traffic and weather data to dynamically plan and optimise delivery routes.
- Applications of big data at a global level are enabling supply chains to adopt a proactive rather than a reactive response to supply chain risks (e.g. supply failures due to man-made or natural hazards, and operational and contextual disruptions).

These examples provide just a glimpse into the numerous advantages derived from the analysis of big data sources to increase supply chain agility and cost optimisation. While it is a relatively new approach, it is being embraced by supply chains globally.

In these series we aim to present a more in-depth exploration of the world of big data and the significant opportunities it provides for supply chains to increase agility and efficiency. To this end, in Part 1 of the paper we explore the concept of big data and how it is differentiated from small data. We then move on to identify big data sources and the applications of big data solutions in supply chain operations, and the skills required for supply chains to gain analytical competence and avoid paralysis by analysis.

Part 2 considers the main tools, platforms and methods currently used to analyse large portions of data depending on the type and form of data available and the problems to be solved.

In Part 3 we investigate supply chains of the future and how we believe they will utilise the power of data to become more agile, responsive, demand driven and customer centric. Furthermore, we discuss supply chain risk management and resilience enhancement practices and illustrate how these practices are being used to benefit from big data solutions to deliver more effective operational results.

Part 4 investigates the role of disruptive technologies such as IoT, machine learning and blockchains in transforming supply chains.

As a leading supply chain consultancy firm, we at KPMG share our experiences with some of our clients of successful applications of big data. Using KPMG tools and methods we reveal future insights into big data applications in supply chain operations.

We would like to thank all the dedicated people including our colleagues at Macquarie Graduate School of Management and our loyal clients that have helped us to compile this study. We would also like to invite the viewers of this paper to contact us with any questions of how we could help their supply chains thrive in the age of big data.

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¹ Jacob LaRiviere, Preston McAfee, Justin Rao, Vijay K. Narayanan and Walter Sun, Where Predictive Analytics Is Having the Biggest Impact, Harvard Business Review 2016.

How big data is shaping the supply chains of tomorrow

Key concepts, issues, and applications of big data principles in supply chains



Big vs. small data and how to avoid paralysis by analysis in your supply chain

Is bigger always the best? When it comes to large volumes of data accumulating at an accelerating rate in supply chain operations, complex questions arise: how much data—and from which source and in what structure and format—is needed to make accurate, timely and beneficial trade-off decisions about supply chain processes?

Making well-informed decisions in context involves a wide range of supply chain operations—from demand sensing and forecasting of inventory planning and logistics planning to execution and warehouse management, just to name a few.

Now more than ever data sources are abundant and in various forms and constructs ranging from GPS data to enable dynamic routing and scheduling of deliveries, point of sales (POS) data, operational data of warehouses, production line data, inventory data and many different forms of structured and unstructured data from numerous parties across the entire logistics network.

The main aim behind the preference of big data over small data is to uncover hidden patterns and insights using large sources of structured and unstructured data that would be obscured if limited selective and small data sources were used. In fact, if used correctly, big data holds the key to enhancing supply chain maturity by ensuring data integrity, and increased visibility and control through the supply chain to increase agility and responsiveness.

Placing too much emphasis on analysing data sources that do not benefit supply chains can waste resources. On the other hand, expending too few to explore the sources of data available to critical supply chain operations may result in lost opportunity and cause unexpected disruptions to supply chain operations, and an unsatisfying customer experience.

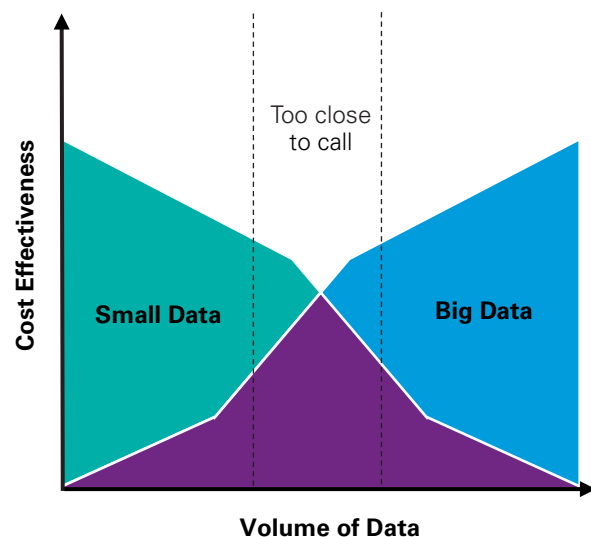
Moreover, big data can be a powerful tool for driving supply chains forward. Big data solutions have helped large retail supply chains monitor customer behaviour and make more accurate predictions of customer preferences. Whether it's Walmart's ability to anticipate the surge in demand for Pop Tarts during a hurricane that

enabled them to stock up in time², Amazon's capability to commence fulfilment and shipping processes before customers even place goods in digital shopping baskets^{3,4}, or eBay's ability to identify the type of web design that will yield the most sales⁵.

Despite the potential provided by big data, many supply chains report that they're unable to harness the power of available data to generate useful insights for their businesses⁶. The underlying reasons reveal a paralysis by analysis due to supply chains either lacking the capabilities to analyse large sums of data or the right portion of data being erroneous and causing the supply chain to incur significant costs without achieving the desired outcomes.

To avoid paralysis supply chains need to correctly identify potential problems and the right set of data. Next, considering the amount and type of data needed to solve the problem, the correct type of analyses, skills and tools required must be selected to enable the problem to be tackled in the most cost effective manner. In the following sections, we will shed light on how progressive supply chains are investing in data and analytics (D&A) capabilities.

Figure 1: Choice of data analysis method – small vs. big data



² A Different Game, The Economist 2010.

³ Bernard Marr, Big Data: Using SMART Big Data, Analytics and Metrics to Make Better Decisions and Improve Performance, Wiley 2015.

⁴ A recent example of the use of big data in analysing consumer behaviour is Amazon Go that changed the face of the retail industry by its innovative way of selling the products to consumers. Amazon Go includes monitoring customer reactions in browsing products on shelves of its retail stores and registering their purchase data so that the company will be able to create a more accurate profile of shopping preferences for each of their individual customers.

⁵ Davenport, T. H. (2009). Realizing the Potential of Retail Analytics: Plenty of Food for Those with the Appetite. Working Knowledge Report, Babson Executive Education.

⁶ Going Beyond the Data: Achieving actionable insights with data and analytics, KPMG 2014.

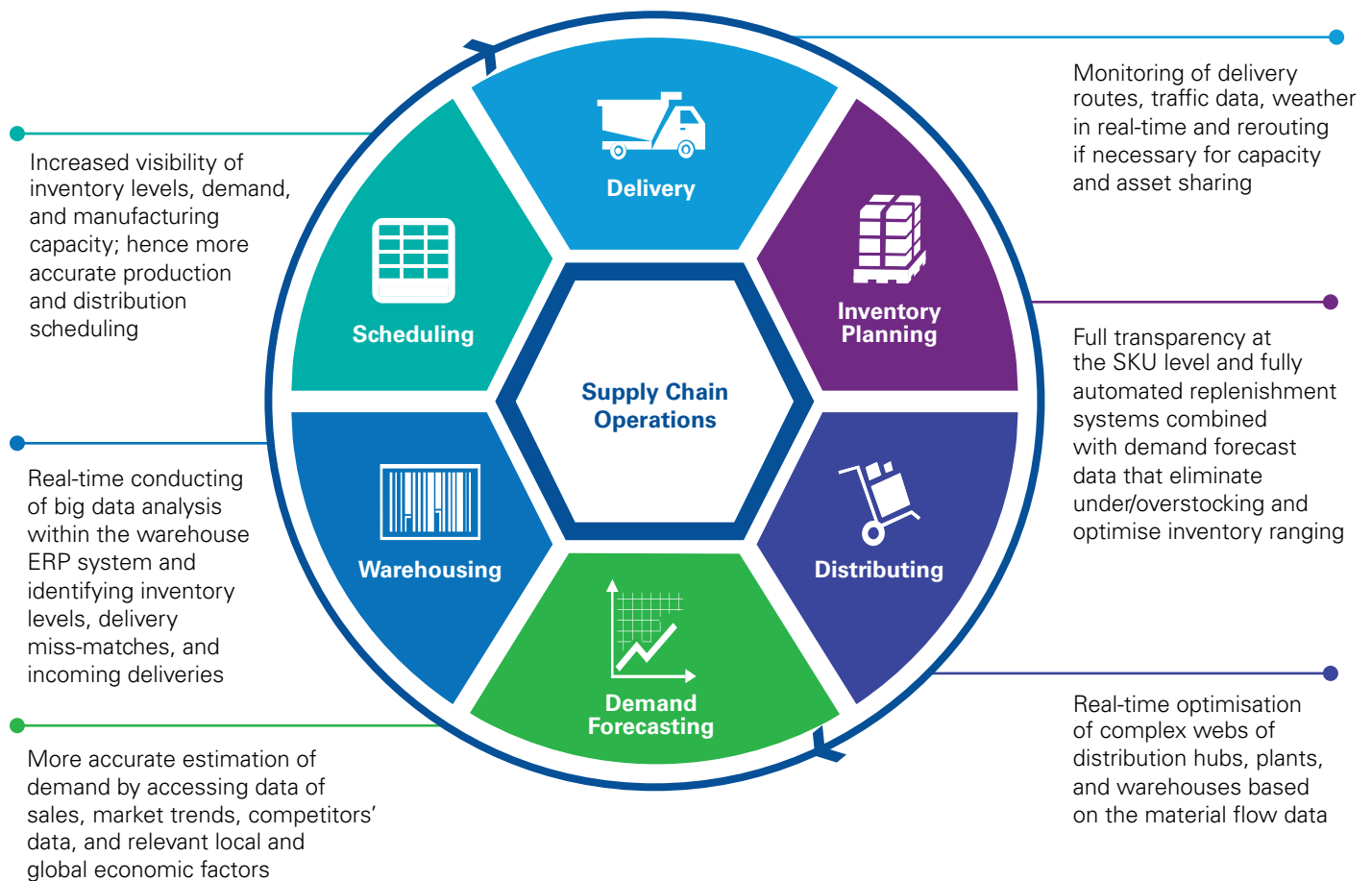
How is big data being applied in supply chain operations?

Despite the largest growth of data analytics being experienced in downstream customer insights, analytics can have applications across the end-to-end supply chain (see Figure 2 below).

Supply chains that are embracing big data capability development, first need to become aware of the benefits that big data solutions can deliver to their operations.

Decisions need to be made about the cost effectiveness of prioritising certain parts of their operations. Holistic big data solutions applied to the whole supply chain can involve high costs, making supply chain decision makers more selective in customising solutions to specific operations.

Figure 2: Applications of big data analytics in supply chain operations

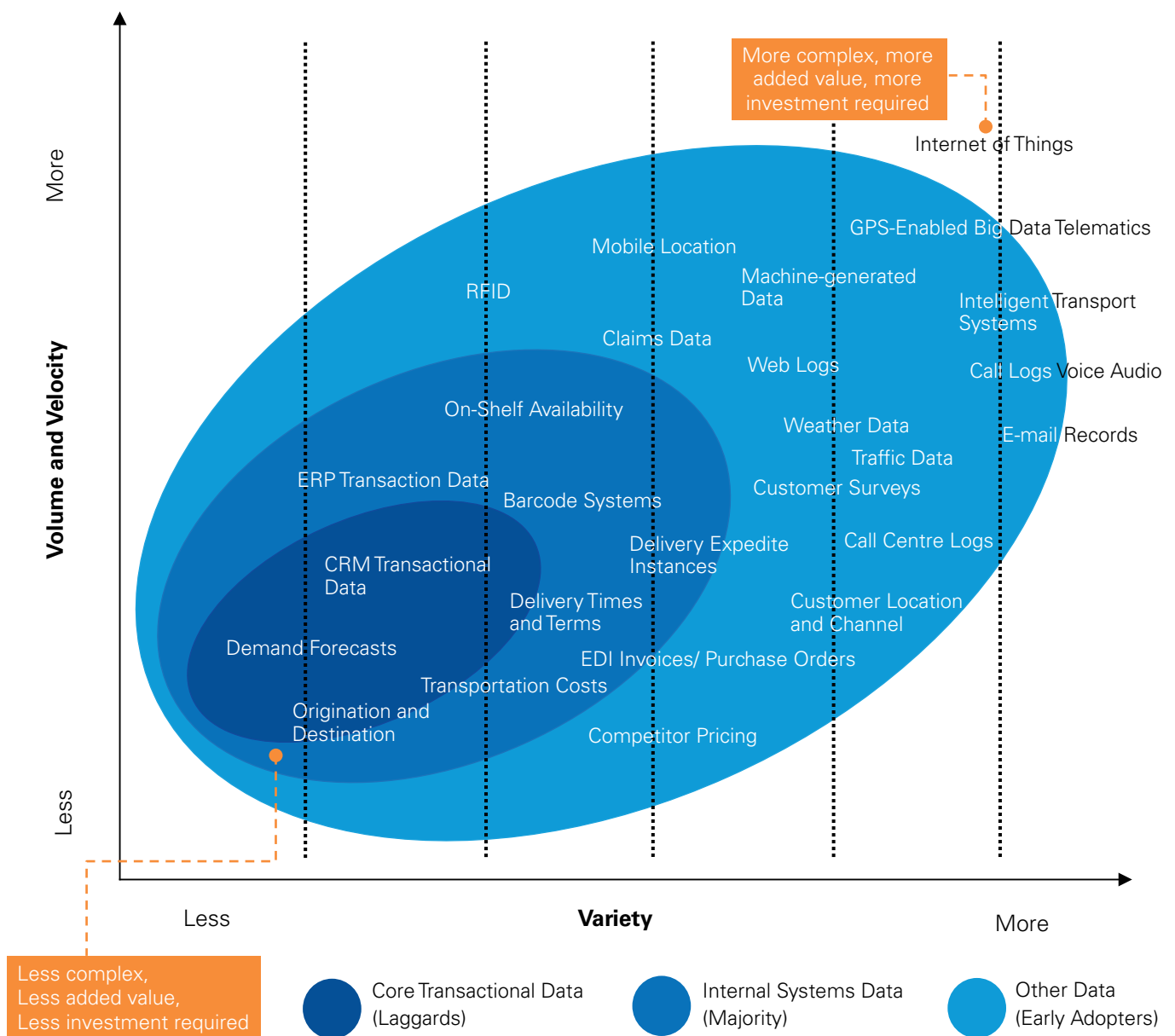


Identifying value-creating big data sources in supply chains⁷

Mainstream sources of big data in supply chains according to volume and velocity versus variety are illustrated in Figure 3. The three main ovals of the diagram show core transactional data, internal supply chain data and various external sources of data that supply chains are exposed to.

The outer oval (other data) has the widest horizon along the variety axis, showing the various natures of external data sources to supply chains. Moreover, the volume and velocity of change in external data is higher on average than core transactional and internal system data.

Figure 3: Supply chain big data sources: Volume and Velocity vs. Variety



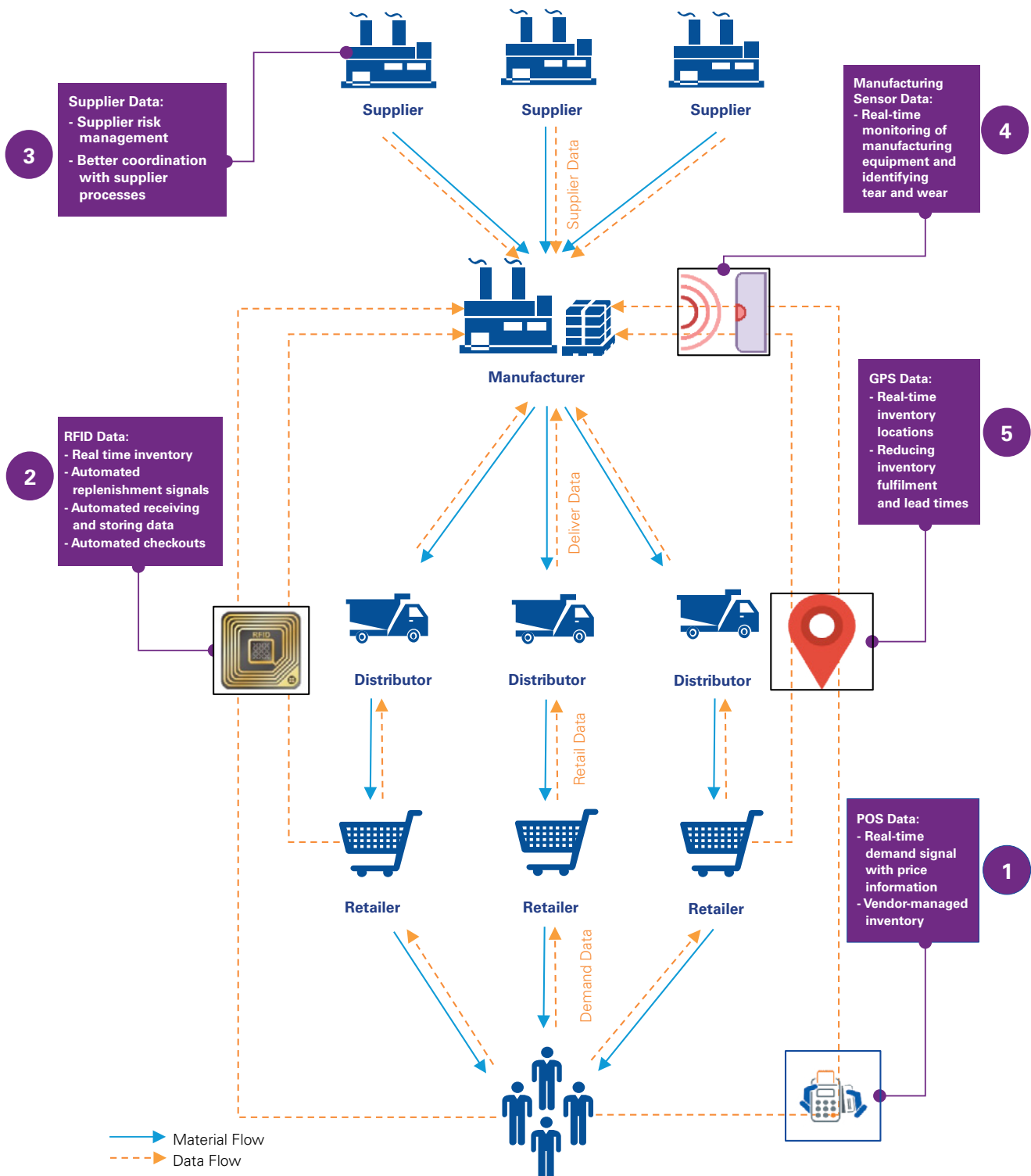
7 Ivan Varela Rozados and Benny Tjahjono, Big Data Analytics in Supply Chain Management: Trends and Related Research, 6th International Conference on Operations and Supply Chain Management, Bali (2014).

The five main sources of big data in supply chains are included in Figure 3. RFID and GPS big data can help in real-time inventory positioning and warehousing. Point of sale (POS) data is one of the main enablers of demand forecasting and customer behaviour analysis. Supplier big data can help manufacturers monitor supplier performance, and manage risk and capacity.

Manufacturing big data and telemetry will help identify production bottlenecks and impending machine failures, thus eliminating disruptive machine breakdowns.

Overall the five sources of big data in Figure 4 can help strike a better balance between supply and demand and increase supply chain efficiency and market responsiveness.

Figure 4: Future supply chains will be powered by sophisticated algorithms, simulations and prescriptive analytics.



“The immediate opportunities for supply chain leaders to exploit the billions of gigabytes of data being produced every day are potentially game changing. The vast majority of this data is unstructured but the technology and tools are now available to analyse and drive real-time decision making like never before. Supply chains of the future will be powered by sophisticated algorithms, simulations and prescriptive analytics allowing enterprise-wide decision making.

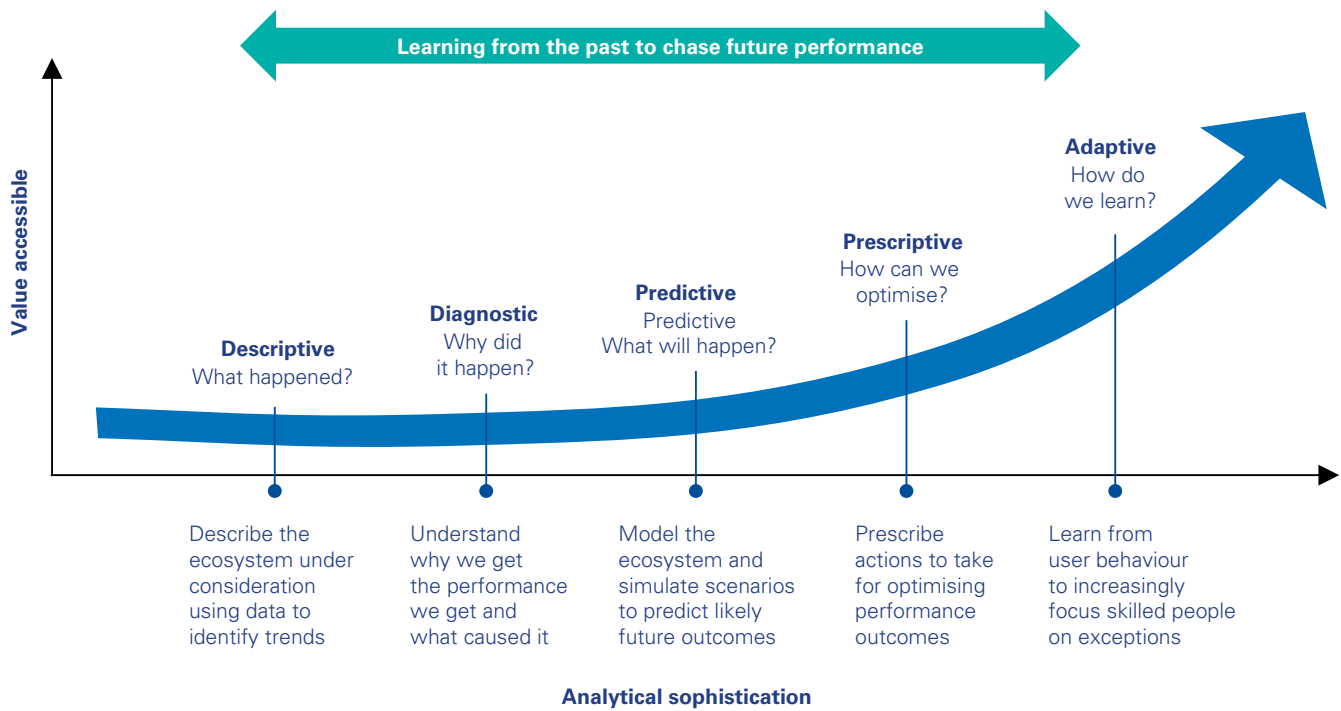
“This level of big data analytics is already allowing organisations to truly understand cost to serve and economic contribution at a granular level across product, supplier, distributor, customer as well as business unit and geography.

“Over the last 20 years, analytics within the supply chain has moved across five levels of analytical sophistication:

- Descriptive – What happened?
- Diagnostic – Why did it happen?
- Predictive – What will happen?
- Prescriptive – How can we optimise?
- Adaptive – How do we learn?

“The level of prescriptive, and in due course, adaptive analytics capabilities an organisation can develop will determine both the speed and level of operational efficiencies. The race for data-savvy supply chain professionals is already underway.

Figure 5: Future supply chains will be powered by sophisticated algorithms, simulations and prescriptive analytics



Source: KPMG Operations Excellence 2017

“These advanced analytics capabilities are now being used to take a cross functional view of an organisation where commercial, finance and supply chain operations are able to combine the vast data pools and make customer centric decisions whilst balancing cost, revenue and profit drivers.”

Andrew Underwood, Advisory Lead Partner, European Tax Efficient Supply Chain Management

What are the capabilities of future big data practitioners?

A survey of more than 3,000 business executives, managers, and analysts in 108 countries across 30 industries conducted by MIT showed that most of the respondents identified three core obstacles for effective application of big data solutions⁸:

- 1 lack of understanding of big data to improve business
- 2 lack of management bandwidth to interpret insights from big data, and
- 3 lack of big data skills in the line of business.

A KPMG International survey of 800 senior executives revealed three main concerns about the application of [big] data analytics, namely:

- 1 implementing the right solutions to accurately analyse and interpret data,
- 2 identifying the right risk indicators, and
- 3 reacting in a timely fashion to insights as they arise⁹.

Furthermore, the results of a D&A survey by KPMG indicated that¹⁰:





- 85 percent of organisations experience difficulties in evaluating data quality and reliability, and
- only 14 percent of organisations believe they have the required skills to conduct [big] data analysis.

Therefore, to perform big data analysis in a way that adds value to supply chain processes, supply chain practitioners need to develop data science capabilities and skill sets. In fact, competition over the significant values of big data is becoming so intense that in the future, recruiting and retaining people with the skills to analyse big data will be a priority for companies and supply chains.

However, there is still a shortage of data scientists capable of interpreting large sums of data to extract insightful information for organisations. It is reported that the US alone has a shortage of between 140,000 and 190,000¹¹ data scientists to investigate big data sources.

In the context of supply chains, data scientists should have the necessary skills to extract value from large volumes of upstream and downstream data (i.e. real-time and anecdotal) to help key stakeholders within the organisation make better-informed decisions regarding demand forecasting, inventory planning and logistics management, to name a few.

Table 1: Some of the main capabilities needed for supply chain big data analysts¹²

Capability Application	Capability Description
 Supply chain statistics	Awareness of methods of statistical estimation and sampling
 Supply chain forecasting	Understanding of qualitative and quantitative methods of forecasting
 Supply chain optimisation	Capability to adopt analytical and numerical methods of optimisation
 Supply chain simulation	Redesigning supply chain processes using simulation models, data visualisation, and data repositories

⁸ Big Data: The Management Revolution, Harvard Business Review 2012.

⁹ KPMG International D&A Survey 2013.

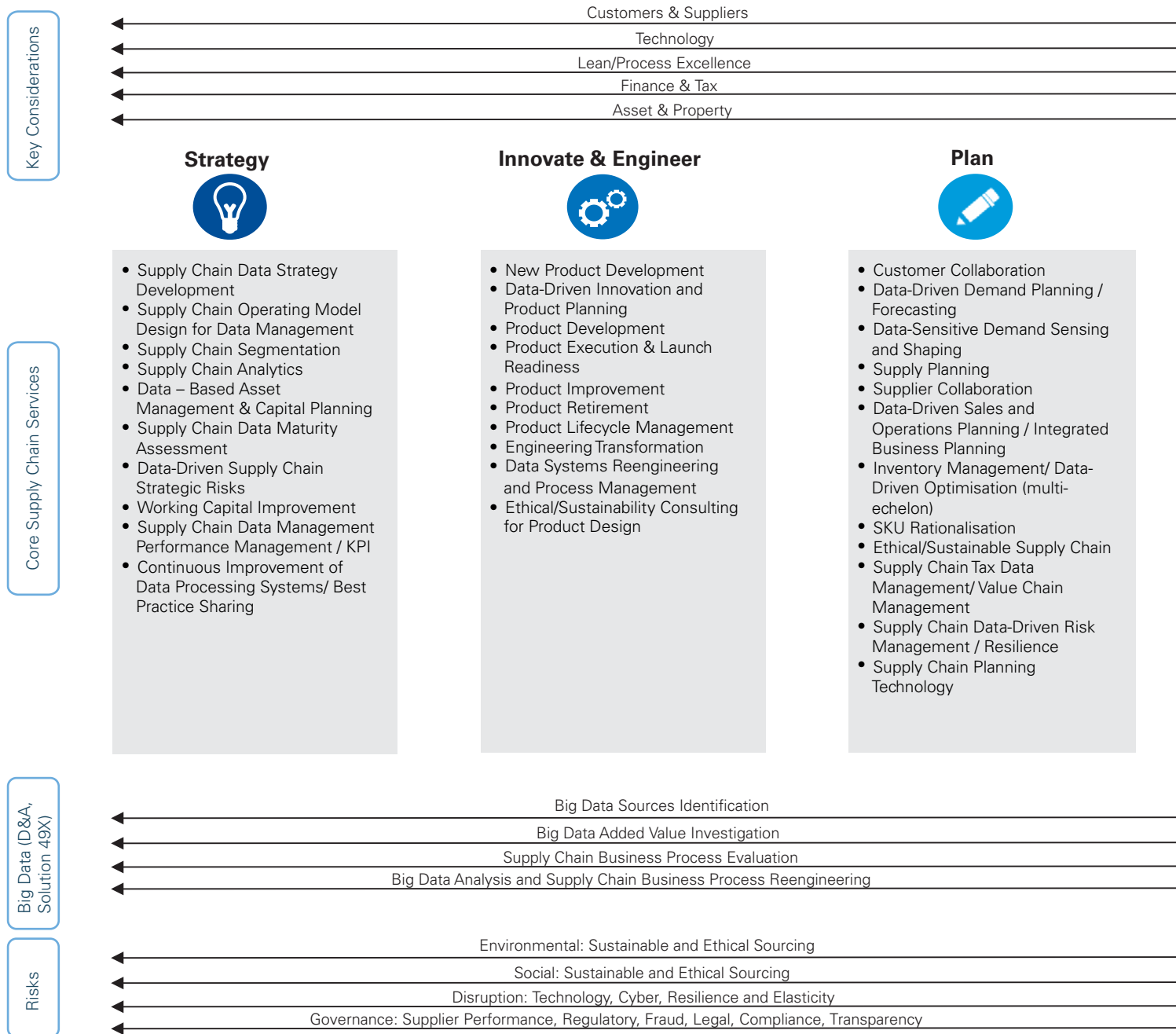
¹⁰ Going beyond the data: Turning Data from Insights into Values, KPMG 2015.

¹¹ Big data: The next frontier for innovation, competition, and productivity, McKinsey 2011.

¹² Waller, M. A. and Fawcett, S. E. (2013), Data Science, Predictive Analytics, and Big Data: A Revolution That Will Transform Supply Chain Design and Management. Journal of Business Logistics, Vol. 34, pp. 77–84.

How KPMG can help your organisation become big-data enabled in supply chain management

We offer a variety of big data and analytics services to our clients. By leveraging the latest advancements and technologies, and the skills and experience of our global KPMG teams—supply chain, D&A advisory, and Solution 49X—we can assist your supply chain in becoming agile, efficient and forward thinking.





Source



- Procurement Strategy Development
- Procurement Operating Model Design
- Procurement Business Process Outsourcing / Shared Services
- Data-Driven Tax Efficient Procurement
- Procurement Maturity Data Assessment
- Source / Procure-to-Pay
- Global Value Sourcing
- Strategic Sourcing
- Category Management
- Data-Driven Supplier (Risk) Management
- Contract Management
- Procurement Technology Enablement
- Spend Analytics & Transparency
- Procurement Training Academy
- Value Engineering
- Ethical/Sustainable supply chain decision consulting

Make



- Production Planning & Scheduling
- Data-Driven Manufacturing Shop Floor Improvement
- Manufacturing Asset Management
- Data-Driven Quality Assurance/ Management
- Manufacturing Excellence / Lean Six Sigma
- Contract Manufacturing
- Manufacturing Cost Reduction
- Manufacturing Information Technologies
- Data-Driven Regulatory compliance framework
- Health and safety compliance
- Ethical Sourcing Framework development

Deliver



- Order-to-Cash
- Cost-to-Serve
- Distribution Network Design - Inbound
- Data-Driven Distribution Network Design - Outbound
- Data-Driven Transportation Planning
- Transportation Execution
- Transportation cost management and optimisation
- Data-Driven Warehouse Design / Management
- Manage Logistics Service Providers
- Customer Service Management
- Reverse Logistics
- TMS and WMS Technology Evaluation and Vendor Selection
- Strategic Freight Sourcing
- Fleet Modelling



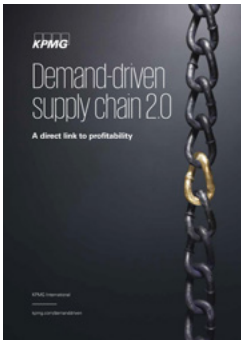
“The power of big data and the opportunities it renders for improvement in supply chains have become imperative both in academic studies and in practice. Business schools around the globe including Macquarie Graduate School of Management are gradually moving towards developing relevant curricula and courses that can equip MBA and Master of Management students with the set of knowledge and skills required to handle big data within their organisations and their supply chains. It is worth noting that the quality of learning in these courses would substantially increase when there is a close collaboration between academia and practice and the mutual exchange between the two would expedite the maturity of the field of big data both theoretically and practically.”

Professor Norma Harrison, Acting Dean, Macquarie Graduate School of Management

“As the complexity of supply chains only increases, the ability to analyse and derive meaningful and timely insights will become central to organisations. Organisations that fail to do so will quickly become irrelevant. For supply chain leaders of today, identifying the required capabilities of tomorrow is of vital importance to equip the supply chain organisation in readiness for this emerging mega trend.”

Simon Rowe, Associate Director, Advisory, KPMG Australia

Related KPMG thought leadership publications



Demand-driven supply chain 2.0, KPMG 2016
<https://home.kpmg.com/xx/en/home/insights/2016/04/demand-driven-supply-chain-2-0.html>



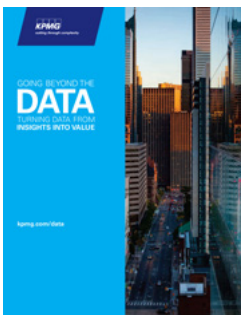
The Future of Retail Supply Chains, KPMG 2016
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<https://home.kpmg.com/us/en/home/insights/2016/06/consensus-opportunities-blockchain-and-beyond.html>

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March 2017. VIC N15266ADV