



MGSM
MACQUARIE UNIVERSITY
GRADUATE SCHOOL OF MANAGEMENT

Supply Chain Big Data Series Part 3

**Leveraging data analytics for
supply chain process improvement
and risk management**

June 2018

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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 this 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 series 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.

Simon Rowe

Associate Director, Advisory
KPMG Australia

Adjunct Lecturer
Macquarie Graduate School of Management

Dr. Mehrdokht Pournader

Adjunct Lecturer
Macquarie Graduate School of Management

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.

Big data analytics and supply chain process improvement



How big data drives scalable change in supply chains

The use of D&A has become an invaluable part of businesses. However, despite the potential applications of D&A, a KPMG international survey of 830 senior business executives across 15 countries in 2014-2015 shows that²:

- surprisingly, D&A is used in only 16 percent of businesses to predict future trends
- only 14 percent of respondents believed they had the required capabilities to draw insights from D&A, and
- only 19 percent were very satisfied with the insights they could get for their business data using the D&A tools.

As part of D&A practices, big data analytics aims to consolidate and integrate different sources of data in large volumes to obtain insights and differentiate between white noise and value in decision making. Some of the main features of big data sources that distinguish them from the typical data sources investigated in day-to-day business include the data's volume (i.e. a stream of multi-source petabytes (10¹⁵ bytes of data or more), velocity (i.e. analysis of real-time information to increase agility), and variety (i.e. messages, images, mobile GPS data and social network data).

The time has come for supply chains to benefit from the many advantages of varied high velocity, high volume sources of data to enhance supply chain agility, data integrity, and improve consumer experiences. In a recent survey, more than 64 percent of supply chain executives believed that big data can be a game-changer in helping supply chains to achieve sustainable and repeatable long-term benefits³.

Top-performing supply chains are becoming more inclined to base decision making about operations based on the insights obtained from the analyses of large and relevant volumes of data⁴.

Big data in supply chains can have various applications and implications. For example, big data can be applied to continuous scanning and intervening in healthcare data for millions of people to position medicine to high-demand locations and to improve predictive supply. It can also be used for better planning and forecasting of customer demands based on product characteristics⁵ or in identifying and mitigating imminent risks and bottlenecks that can disrupt global supply chains.

Some of the advantages of using big data analytics in supply chains include:

- better predictability of customer demand, imminent risks and disruptions
- balancing the supply and demand portfolio based on real-time inventory data, customer demand and preference, and supplier status
- greater visibility across supply chain processes by obtaining and analysing various sources of data coming from all supply chain members
- improved supply chain agility through decreased reaction time and order-to-delivery cycle times
- a better understanding of supply chain bottlenecks through increased supply chain visibility, and
- more efficient inventory, working capital, demand and replenishment planning.



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

3 Overcoming 5 Major Supply Chain Challenges with Big Data Analytics, SCMWorld 2014.

4 Big Data, Analytics and the Path from Insights to Value, MIT Sloan Management Review 2011.

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

Big data and the key enablers in supply chains

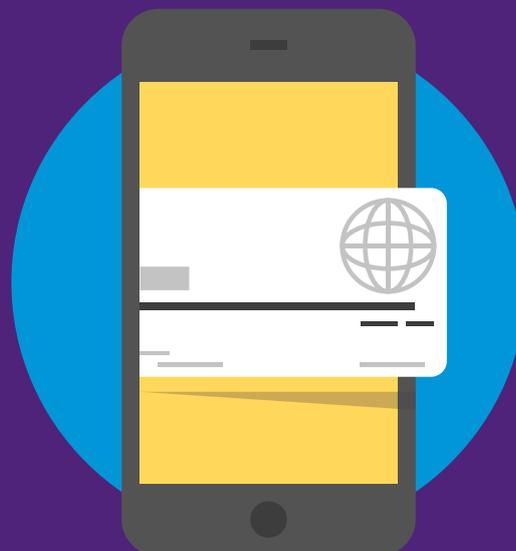
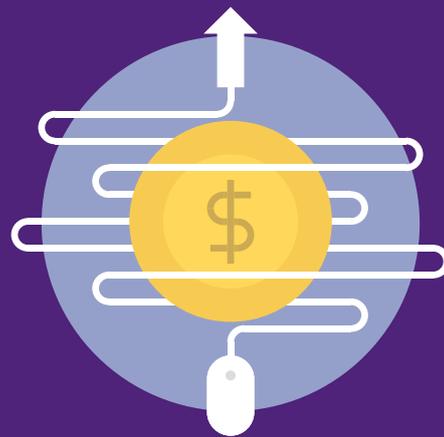
How to achieve superior financial and operational performance through embedding big data analytics and capabilities

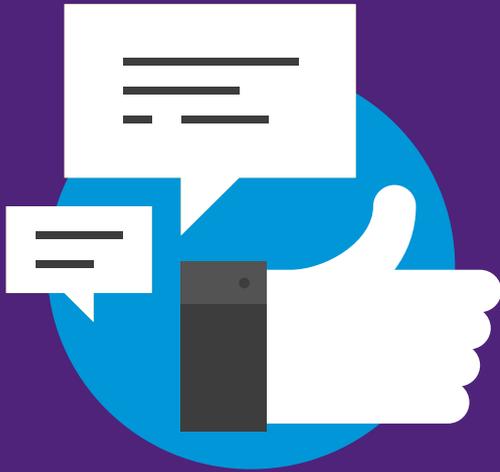
How will top performing supply chains leverage big data to optimise processes and drive performance by 2020?

One of the main supply chain goals across various industries is to meet the rapidly-changing customer demand profiles using optimised and cost-effective processes. Supply chains have started looking for innovative and agile technologies with more effective use of data sources and at lower costs in a more repeatable manner. A recent KPMG report *The Future of Retail Supply Chains*⁶ envisions retail supply chains of the future (2020) and how they will aim to use advanced technological and analytics tools. Indeed, it has been mentioned in the report that "... big data [and technology] will play a critical role in optimising supply chains by 2020". As we discuss later in this paper, one of the pivotal advantages of big data is its ability to enable supply chains to become increasingly demand-driven with increased responsiveness to customer demand and better customer experience.

Big data solutions will enable supply chains of the future in multiple ways—some of the examples in this report include the ability to:

- create a responsive and demand-driven supply chain
- evaluate total supply costs
- reduce the risk of supply chain financing
- adopt a greener focus, and
- develop a proactive tax strategy.





1 Creating a responsive and demand-driven supply chain

We have identified that for many organisations, most of the major policies defined to regulate supply chain processes are developed to account for information latency and demand uncertainty. The combination of uncertainty of demand and lack of visibility in supply chains is likely to result in inaccurate demand forecasting and order variations from downstream to upstream supply chains. This could be substantially resolved by orchestrating supply chains to become more demand-driven.

A demand-driven supply chain needs sufficient visibility so that the sourcing and replenishment quantities are aligned with real-time demand and supply triggers. Demand-driven supply chain visibility is obtained through "...real-time interactive networks, demand-driven business processes and end-to-end supply chain planning capabilities..."⁷ enabled by various streams of data and big data analytics that provide high accuracy in estimating current and future demand.

Retail leaders have been using big data analytics to integrate internal and external sources of demand data and compare store cluster profiles in order to predict demand. This approach has been practised by various retail supply chains, which in turn has increased the accuracy of data forecasting dramatically—up to more than 93 percent in some cases—in less than 12 months.

The increase in the accuracy of supply chain forecasting has in turn resulted in other benefits for supply chains—reducing inventory levels, optimising product mixes, pricing, promotions, new product introduction, product phase out, marketing spend and advertising planning.

KPMG predicts that supply chains will have Chief Data Officers by 2020 to help identify, analyse and access valuable information to support supply chains in becoming more demand-driven.



2 Evaluate total supply costs

Global supply chains that are considering suppliers in new destinations—such as low-cost countries—must consider the overall costs. Costs include supplier charges, taxes, duties and logistics, to name a few.

In order to make well-informed decisions several factors need to be considered, aside from cost parameters, when identifying suppliers: for example, operational performance, quality, quantity and supplier integrity. Moreover, when choosing suppliers, supplier risks should be accounted for as much as supply costs. The use of big data for supplier information management and sharing can minimise risks and provide real-time access to supplier information. A manufacturer can conduct performance appraisals of suppliers in relation to traditional static market benchmarks.

3 Reducing the risk of supply chain financing

Supply chain financing can help improve operational performance by helping to build stronger alliances within supply chains, especially among buyers and suppliers. The pivotal role of supply chain finance providers so far has been to facilitate the on-demand payment of approved invoices by the buyer to the supplier. However, it has been argued that both supply chains and finance providers can benefit if the finance provider could be involved in various post-invoicing supply chain processes that require funding. Some examples include financing the order, production, and delivery components of supply chains.

Usually finance providers evaluate the overall credit risk of supply chain members to make decisions about financing options. Traditionally this has been done by analysing the credit history of buyers and suppliers. An emerging, more sophisticated method of evaluating credit risk is by analysing relevant documentation of supply chain transactions to accurately assess risks.

Big data will enable finance providers to spot risk-inherent processes and bottlenecks in supply chains that would be unrecognisable when only credit history is considered. Alternatively, a closer collaboration between supply chains and finance providers can provide clarity in various supply chain processes by considering all sources of data and mitigating risk-inherent processes. This can offer greater supply chain financing opportunities throughout the whole supply chain while reducing overall cost.

4 Adopting a greener focus

The Paris climate treaty and increasing consumer awareness of environmental, social, and governance (ESG) issues are driving supply chains to move faster towards sustainable supply chain operations—in other words, green supply chains. To gain a better understanding of ESG operational impacts, supply chains need to trace the results of their activities within and beyond their inbound processes. Nevertheless, the abundance of ESG-related factors to be considered, even within inbound supply chain processes, is overwhelming.

Big data can provide a platform to make a more accurate assessment of various sustainability-related supply chain considerations and environmental impacts—e.g. tracking fleet travel, waste produced in supply chain tiers, real-time supply chain ESG performance measurement—and issue reports or warnings when there is non-compliance with relevant ESG standards.

5 Develop a proactive tax strategy

Due to the increasing complexity and constant changes in local, regional and global tax regulations due to globalisation, varying business models and government demands⁸, organisations are finding it challenging to remain aware of and comply with indirect tax requirements.

Tax authorities are moving towards data-based technologies for more accurate tax assessment of global business trade. In many cases, tax authorities require transaction-based data of businesses for retrospective tax audits. By analysing various sources of relevant data, big data solutions can help supply chains navigate the complexity of global trade—e.g. free trade agreements—by identifying tax compliance challenges and paying the right tax at the right time and in accordance with compliance requirements.

Big data can also help deliver a clear record of tax data required by authorities. This will eventually culminate in a unified view of tax compliance across supply chain tiers that can be constantly updated and provide compliance insights to tax regulations⁹.

8 A recent example of rapid-changing tax regulations is the new value-added tax (VAT) regulations introduced by 28 members of EU for both EU and non-EU vendors in communications, broadcasting, and electronic services industries. The regulations are overall 248 pages of legislation only to familiarise vendors with the new provisions.

9 Gillis T., McStocker A., Percival A., Indirect Tax Compliance in an Era of Big Data, KPMG 2015.

A data-driven approach to supply chain risk management

Reaction vs. Mitigation

56% of supply chain executives do not have access to real-time reporting¹⁰

50% have a limited knowledge of risk and compliance issues¹⁰

13% do not have complete end-to-end visibility of supply chains¹⁰

80% of all cyber breaches occur in the supply chain¹¹

¹⁰ Supply Chain Risk Management: Overview for ALM Intelligence, KPMG 2016.

¹¹ Integrating Cybersecurity into Supply Chain Risk Management, National Institute for Standards (NIST), 2016.

From reactive to proactive supply chain risk management

The emerging and increasingly important role of big data to assure global supply chains and support trade

Supply chain risk leaders

Gone are the days of traditional risk control and management in supply chains when the main emphasis was on tackling organisational risks. Now supply chains are more actively looking to identify, analyse and mitigate more indirect groups of risks including upstream and downstream operational risks, supply chain network risks and external risks.

The increased reliability of global supply chains on outsourcing and the broader operational scope that extends across borders, requires supply chains to consider different sources of risk arising from their suppliers' and retailers' operations, and the socio-political contexts in which they operate.

According to a recent study, the factors differentiating supply chain risk leaders from others are:

- Leaders make operations risk management a higher priority. 61 percent of leaders (compared with 37 percent of others) consider supply chain risk management very important. They recognise the importance of capabilities that can enable them to gain greater visibility and predictability across their supply chains.
- Leaders have greater centralisation of responsibility for supply chain risk management. 43 percent of leaders, versus 32 percent of others, said they have a central risk management function led by a C-level or vice president-level executive.
- Leaders invest aggressively in supply chain risk management capabilities with a specific focus on end-to-end supply chain visibility and analytics. Leaders are nearly three times as likely as other companies to boost their investments in supply chain risk management by 20 percent or more in the next two years.

Three pillars of supply chain risk management and analytics

One of the main issues in supply chain risk management practices has been supply chains' reactive approach to risks which often disrupt operations. A more proactive and predictive approach to identifying and mitigating risk before it affects operations can eliminate many unnecessary financial and operational losses.

A proactive and predictive approach to supply chain risk management is built on three pillars¹²:

- **Increased visibility and control**—over tiered networks of suppliers to guide risk management activities and resources to the most critical areas,
- **Supply chain integration and alignment**—among existing ad hoc, functional programs through the design and implementation of new operating models, frameworks and processes, and
- **Increased agility and resilience**—to predict and respond to risk events as a way of gaining market share and building trust with customers, thereby transforming risk management into differentiation.

A deeper look into the three pillars reveals that one of the main pre-requisites to achieve a proactive and predictive approach is to gain access to and analyse various sources of transactional and non-transactional data within supply chains.

For instance, transportation risks in supply chains generally come in three kinds:

- Risk of delayed shipments,
- Risk of disruptions, and
- Risk of hazardous material.

The types of risk mitigation strategies that an organisation can consider, supported by predictive data and analytics, are:

- Decreasing the probability of disruptions (i.e. spread the risk),
- Have alternative routings, carriers and modes prepared in advance, and
- In case of hazardous materials, the use of modified containers, low-risk transportation models, modification of physical and chemical properties can prove to be effective.

As risk goes hand-in-hand with reward when it comes to operating in the global economy, it's better to be safe than sorry and this can only be done effectively and efficiently by being prepared in advance through a clear risk management and mitigation strategy. By focusing

on supplier risk assessments, for instance, big data can help consolidate anecdotal data available from suppliers along with additional survey data obtained by risk and compliance standards defined within supply chains (sometimes held by third parties such as regulators). Analytics can enable supplier performance across various areas to be compared with industry benchmarks, which can highlight any underperformers in a supply chain that threaten operational performance.

The power of big data, especially for organisations that rely on thousands of suppliers, can provide holistic insights into the performance of each and every supplier and suppliers' suppliers if necessary—resulting in extended supply chain risk management.

During supply chain integration and alignment, supply chain risk management efforts are usually isolated and informal activities confined to the premises of a single supply chain member. With data analytics, this can become a more coordinated effort that can benefit the whole supply chain rather than individual members. To achieve a coordinated supply chain risk management program across the whole supply chain, all various sources of data relevant to the operational risks to be addressed should be obtained, consolidated and analysed to provide a better understanding of common issues and threats ahead. This is another role that big data tools and techniques can play in helping supply chains achieve coordinated risk management efforts faster and more efficiently. Last but not least, supply chain risk management should not be all about preventing and tackling risks.

A very crucial part of it is to increase agility and resilience in supply chains for the realised risks already disrupting supply chain operations. Achieving resilience is a multi-faceted effort comprising:

- 1 increasing resilience in human capital resources—education and training of employees, the capability for post-risk analysis and employee understanding of cost/benefit trade-offs when managing risks in supply chains
- 2 organisational and inter-organisational resources—defined communication protocols, cross-functional supply chain risk management teams, developing supplier relationship programs, and
- 3 physical capital resources—use of safety stock, ability to quickly redesign the supply network, risk monitoring systems giving real-time data on all supply chain members¹³.

To achieve a desirable level of resilience in supply chains, big data solutions are critical for analysing in real time the large volumes of data relevant to each of the resilience enhancement resources.

Cyber risks in supply chains

There are three trends exacerbating cyber risks to supply chains¹⁴:

- 1 Internet of Things—everything is smart and interconnected,
- 2 IT-enabled supply chain management—product and supply chain data run on top of business software that connects supply chains, and weak links abound globally, and
- 3 3D printing—production is going viral and digital.

In leading supply chain networks many partners, suppliers and customers have access to different areas of your business. According to the 2016 Vendor Vulnerability survey from Bomgar¹⁵, an average of 89 third-party vendors access a typical company's network each week, and 75 percent of the surveyed organisations said the number of third parties they work with have increased over the last two years. Additionally more and more companies are outsourcing critical business infrastructure to third parties that provide numerous "As-A-Service" capabilities. This in turn creates or magnifies an additional business resilience risk that is largely unchecked.

To relate this in terms we can understand, some examples include:

- Supplier-provided keyboard software gave hackers access to owner data on 600 million Samsung Galaxy phones.
- Poor information security by service suppliers led to data breaches at Target, Home Depot, Goodwill, and many companies and organisations.

Existing tools to mitigate other types of supply chain risk are also relevant for cyber risks. Best practices and tools to mitigate cyber risks in the supply chain often exist in other parts of the company. Therefore, to become a leader in SC Risk Management, a cross-functional approach, also including IT, Tax and Quality, is mandatory.

Tools like *KPMG's Digital Responder*, the first flat-rate cyber investigations tool on the market, automate cyber response from the point of collection to reporting, significantly reducing cost and time of cyber investigations by shifting time spent from collecting data to actual analysis, and most importantly, providing more time to organisations to make faster, more informed strategic business decisions to manage potential cyber security risks. It can be easily deployed via the cloud, encrypted USB stick or network shares.

13 Blackhurst, J., Dunn, K.S. and Craighead, C.W. (2011), "An empirically derived framework of global supply resiliency," *Journal of Business Logistics*, Vol. 32 No. 4, pp. 374-391.

14 Integrating Cybersecurity into Supply Chain Risk Management," National Institute for Standards (NIST), 2016.

15 Vendor vulnerability: How to prevent the security risk of third-party suppliers, Bomgar, 2016.

Case. KPMG delivers: strategic risk management framework from a data analytics platform¹⁶

KPMG's approach to risk management using big data is a key component of the firm's global supply chain strategy. As of 2014, the solution was already used by many well-known global clients across multiple industries, supporting over 9,000 suppliers in the network.

The KPMG risk-sensing approach is a holistic value-driven methodology that supported one of our corporate clients to identify how it could best assess, continuously monitor and respond to future supply-based risks in a forward-looking (predictive) manner.

With this approach, our client can define how to better manage their entire supply risk profile and determine the tolerance they wish to accept. Risk tolerances can be set by country, risk type and brand so that appropriate business decisions can be made to reduce risk.

At the core of this approach lies cloud-based technology that is cost effective and quick to deploy globally or incrementally by country or region. There is no maintenance and no system downtime required. This cloud-based tool makes sure it gathers all the necessary data from internal and external supply chain entities and integrates them in a common repository system, extracting managerial insights that can be used constantly for monitoring and improving supply chain processes.

KPMG's technology solution aggregates four types of risk that are material to managing supply chain risks:

- 1 Financial risk
- 2 Regulatory risk
- 3 Operational (performance) risk
- 4 Geo-political (macro) risk

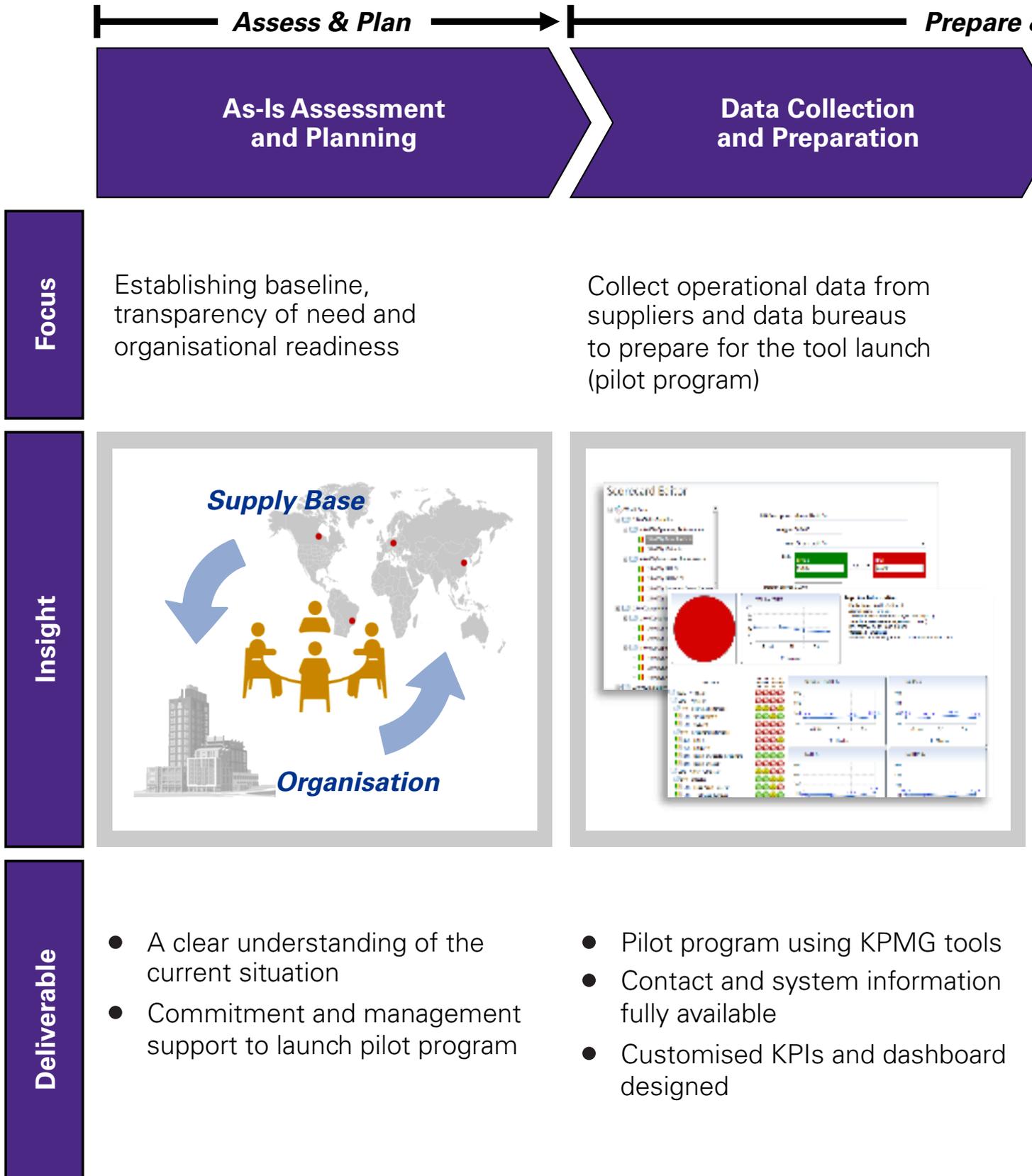
The KPMG technology solution facilitates the creation of external and internal supplier entities—providing a way to assess, monitor and manage risks associated with internal organisations such as factories with the same rigour as external suppliers; all in the critical path of the company's production and distribution processes.

The solution provides insight into the impacts of risks to products, business processes and organisational units. The features enable risks to be monitored and associated with suppliers and supply chains in a holistic and integrated manner.

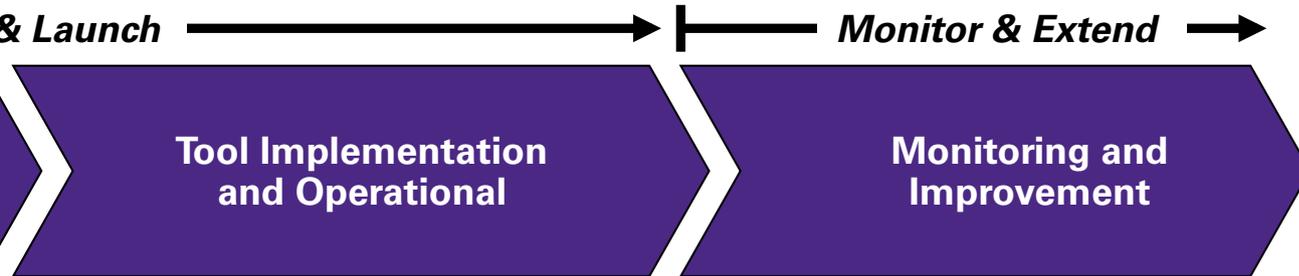
This innovative risk modelling framework shows not only the traditional measures of the impact and likelihood of a risk but also its velocity (how fast the risk event could impact the supply chain) and connectedness (any other risks likely to arise because of the risk event).

The data that KPMG's solution takes into consideration to provide insightful analyses of risks within supply chains includes thousands of global and local news feeds, social media feeds, industry publications, and weather and market data to detect potential risk signals that may affect supplier portfolios and supply chains they are affiliated with.

KPMG's pragmatic Strategic Risk Management approach to help reduce the impact of all risk types in all supply chains¹⁷



17 Strategic Risk Management Workshop, Client Workshop Output Summary, KPMG 2014



Ensure that all required information is submitted to the system and pilot is proven to be successful

Ongoing monitoring and assessment of results and planning for extension of usage

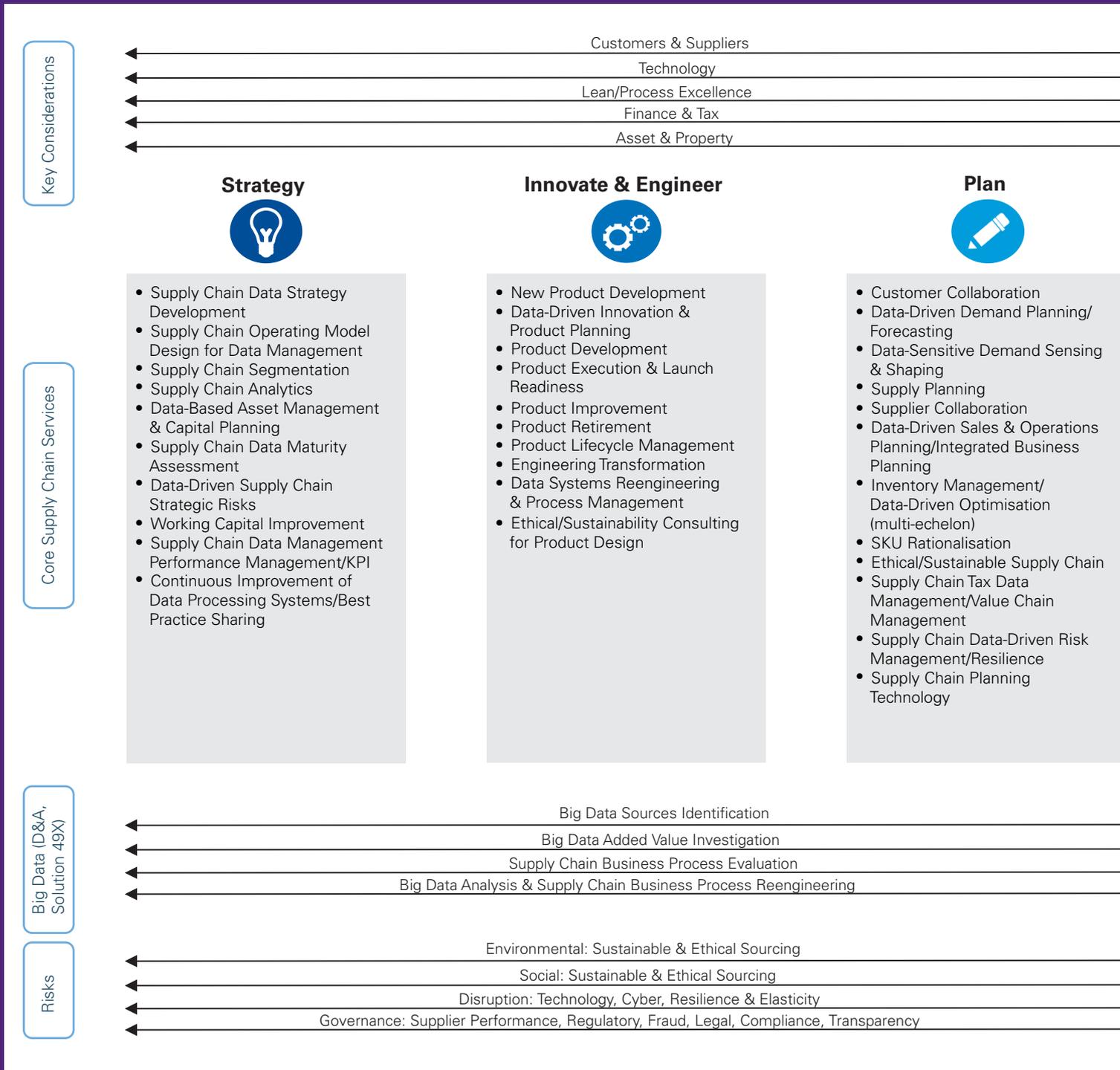


- Successful pilot program
- Secured complete collection of required data from suppliers
- Ongoing tool training provided to OEM

- Real-time visibility of scorecard results
- Performance and gaps evaluated
- Next steps planned

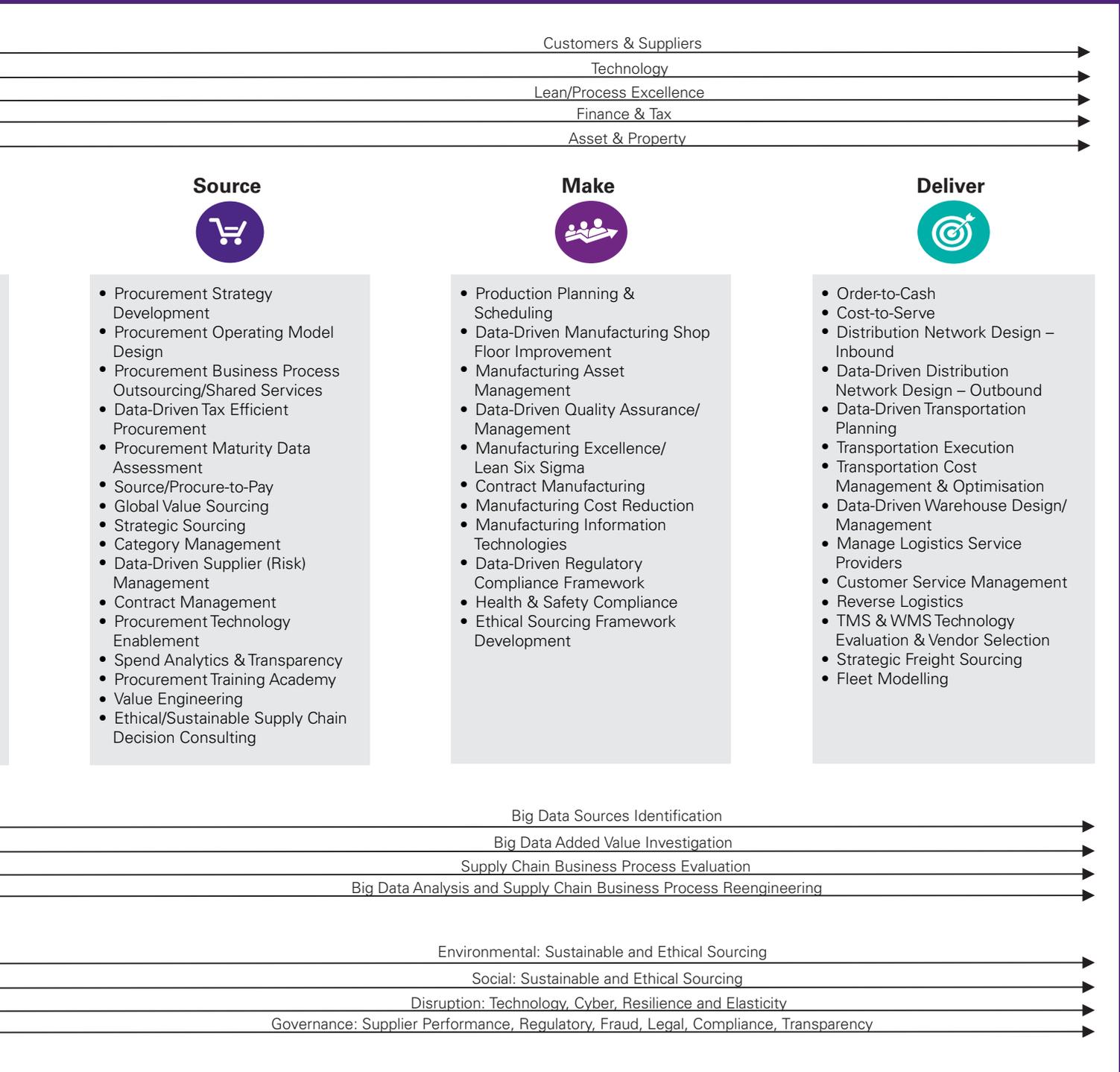
How KPMG can help your organization be enabled in supply chain management

We offer a variety of big data and analytics services to our clients. By leveraging our global KPMG teams—supply chain, D&A advisory and Solution 49X—we can

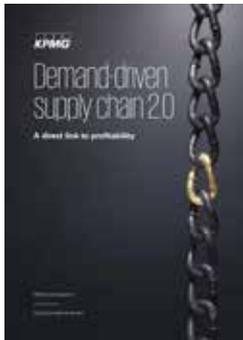


Organisation become big-data management

g the latest advancements and technologies, and the skills and experience of
n assist your supply chain in becoming agile, efficient and forward thinking.



Related KPMG thought leadership publications



Demand-driven supply chain 2.0: A direct link to profitability, 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
<https://home.kpmg.com/cn/en/home/insights/2016/05/the-future-of-retail-supply-chains.html>



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The disruptors are the disrupted: Disruptive technologies barometer: Technology sector, KPMG 2016
<https://home.kpmg.com/sg/en/home/insights/2016/11/disruptive-technologies-barometer-technology-sector.html>



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Consensus: Immutable agreement for the Internet of value, KPMG 2016
<https://home.kpmg.com/us/en/home/insights/2016/06/consensus-opportunities-blockchain-and-beyond.html>

Contacts

Authors

Simon Rowe

Associate Director, Advisory
KPMG Australia
srowe3@kpmg.com.au

Dr. Mehrdokht Pournader

Adjunct Lecturer
Macquarie Graduate School
of Management
mehrdokht.pournader@mgs.edu.au

Global Operations Advisory

Erich L. Gampenrieder

Global Head of Operations
Advisory and Global Head
of Operations
Center of Excellence
KPMG International
egampenrieder@kpmg.com

Contact

Alana Mohan

Global Marketing Lead,
Operations Advisory
KPMG Canada
aamohan@kpmg.ca

www.kpmg.com/us/supplychain

Regional contacts

Americas

Brian J. Higgins

Principal, Product and
Operations Advisory
bhiggins@kpmg.com

Asia Pacific

Peter Liddell

Asia Pacific Head of Supply Chain
and Operations
KPMG Australia
pliddell@kpmg.com.au

Anthony Coops

ASPAC Data & Analytics Leader
KPMG Australia
acoops@kpmg.com.au

Europe, Middle East, Africa

Andrew Underwood

Advisory Lead Partner
KPMG UK
andrew.underwood@kpmg.co.uk

Ricardo Tulkens

EMA Operations Leader
KPMG Netherlands
tulkens.ricardo@kpmg.nl

Contributors

Australia

Prof. Norma Harrison

Acting Dean,
Macquarie Graduate School
of Management
Australia
norma.harrison@mgs.edu.au

Henry Brunekreef

Director, Advisory
KPMG Australia
hbrunekreef@kpmg.com.au

Tristan Masters

Director, Solution 49x
KPMG Australia
tmasters@kpmg.com.au

Amelia Hartney

Associate Director, Advisory
KPMG Australia
ahartney@kpmg.com.au

US

Yatish Desai

Managing Director
KPMG US
ydesai@kpmg.com

Singapore

Bob Hayward

Principal
KPMG Singapore
bobhayward@kpmg.com.sg

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