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The Deciding Factor:
Big Data & Decision Making

People matter, results count.

Foreword

Big Data represents a fundamental shift in business decision-making. Organisations are accustomed to analysing internal data – sales, shipments, inventory. Now they are increasingly analysing external data too, gaining new insights into customers, markets, supply chains and operations: the perspective that Capgemini calls the "outside-in view". We believe it is Big Data and the outside-in view that will generate the biggest opportunities for differentiation over the next five to ten years.

The topic of Big Data has been rising rapidly up our clients' agenda, and Capgemini is already undertaking extensive work in this area all over the world. That is why we commissioned this survey from the Economist Intelligence Unit: we wanted to find out more about how organisations are using Big Data today, where and how it is making a difference, and how it will be used in the future.

The results show that organisations have already seen clear evidence of the benefits Big Data can deliver. Survey participants estimate that, for processes where Big Data analytics has been applied, on average, they have seen a 26% improvement in performance over the past three years, and they expect it will improve by 41% over the next three.

The survey also highlights special challenges for decision-making arising from Big Data; although 85% of respondents felt the issue was not so much volume as the need to analyse and act on Big Data in real-time. Familiar challenges relating to data quality, governance and consistency also remain relevant, with 56% of respondents citing organisational silos as their biggest problem in making better use of Big Data. For our respondents, data is now the fourth factor of production, as essential as land, labour and capital. It follows that tomorrow's winners will be the organisations that succeed in exploiting Big Data, for example by applying advanced predictive analytic techniques in real time.

I would like to thank the teams at the Economist Intelligence Unit and within Capgemini, along with all the survey respondents and interviewees. I believe this research will do much to increase understanding the business impact of Big Data and its value to decision-makers.

Paul Nannetti

Global Sales and Portfolio Director

About the Research

Capgemini commissioned the Economist Intelligence Unit to write The Deciding Factor: Big data and decision-making.

The report is based on the following research activities:

The Economist Intelligence Unit conducted a survey, completed in February 2012, of 607 executives. Participants hailed from across the globe, with 38% based in Europe, 28% in North America, 25% in Asia-Pacific and the remainder coming from Latin America and the Middle East and Africa. The sample was senior, 43% of participants being C-level and board executives and the balance—other high-level managers such as vice-presidents, business unit heads and department heads. Respondents worked in a variety of different functions and hailed from over 20 industries. Of the latter, the best represented were financial services, professional services, technology, manufacturing, healthcare and pharmaceuticals, and consumers goods and retail.

To supplement the survey, the Economist Intelligence Unit conducted a programme of interviews with senior executives of organisations as well as independent experts on data and decision-making.

Sincere thanks go to the survey participants and interviewees for sharing their valuable time and insights.

43%

of participants are C-level and board executives

Executive summary

When it comes to making business decisions, it is difficult to exaggerate the value of managers' experience and intuition, especially when hard data is not at hand. Today, however, when petabytes of information are freely available, it would be foolhardy to make a decision without attempting to draw some meaningful inferences from the data.

Anecdotal and other evidence is indeed growing that the intensive use of data in decision-making can lead to better decisions and improved business performance. One academic study cited in this report found that, controlling for other variables, firms that emphasise decision-making based on data and analytics have performed 5-6% better—as measured by output and performance—than firms that rely on intuition and experience for decision-making. Although that study examined "the direct connection between data-driven decision-making and firm performance", it did not question the size of the data-sets used in decision-making. In fact, very little has been written about the use of "big data"—which is distinguished as much by its large volume as by the variety of media which generate it—for decision-making. This report is an attempt to address that shortfall.

The research confirms a growing appetite among organisations for data and data-driven decisions, despite their struggles with the enormous volumes being generated. Just over half of executives surveyed for the report say that management decisions based purely on intuition or experience are increasingly regarded as suspect, and two-thirds insist that management decisions are increasingly based on "hard analytic information". Nine in ten of the executives polled feel that the decisions they've made in the past three years would have been better if they'd had all the relevant data to hand.

At the same time, practitioners interviewed for the report—all enthusiastic about the potential for big data to improve decision-making—caution that responsibility for certain types of decisions, even operational ones, will always need to rest with a human being.

Other findings from the research include the following:

The majority of executives believe their organisations to be "data driven", but doubts persist.

Fully two-thirds of survey respondents say that the collection and analysis of data underpins their firm's business strategy and day-to-day decision-making. The proportion of executives who say their firm is data-driven is higher in the energy and natural resources (76%), financial services (73%), and healthcare, pharmaceuticals and biotechnology sectors (75%). They may not be as data-savvy as their executives think, however: majorities also believe that big data management is not viewed strategically at their firm, and that they do not have enough of a "big data culture".

Organisations struggle to make effective use of unstructured data for decision-making.

Notwithstanding the heavy volumes, one-half of executives say they do not have enough structured data to support decision-making, compared with only 28% who say the same about unstructured data. In fact, 40% of respondents complain that they have too much unstructured data. Most business people are familiar with spreadsheets and relational databases, but less familiar with the tools used to query unstructured data, such as text analytics and sentiment analysis. A large number of executives protest that unstructured content in big data is too difficult to interpret.

Although unstructured data causes unease, social media are growing in importance.

Social media tell companies not only what consumers like but, more importantly, also what they don't like. They are often used as an early warning system to alert firms when customers are turning against them. Forty-three percent of respondents agree that using social media to make decisions is increasingly important. For consumer goods and retail, manufacturing, and healthcare and pharmaceuticals firms, social media provide the second most valued datasets after business activity data.

The job of automating decision-making is far from over.

Automation has come a long way, but a majority of surveyed executives (62%) believe there are many more types of operational and tactical decisions that are yet to be automated. This is particularly true of heavy industry where regulation and technology have held automation back. There is, to be sure, a limit to the decisions that can be automated. Although technical limits are constantly being overcome, the increasing demand for accountability—especially following the financial crisis—means that important business decisions must ultimately rest with a human, not a machine. For less critical or risky decisions, however, there is still much scope for decision-automation.

This is particularly true of machine-to-machine communication, where low-risk decisions, such as whether to replenish a vending machine or not, will increasingly be made without human intervention.

Organisational silos and a dearth of data specialists are the main obstacles to putting big data to work effectively for decision-making.

Data silos are a perennial problem, and one which the business process reengineering revolution of the 1990s failed to resolve. Regulation and the emergence of "trusted data aggregators" may help to break down today's application silos, however. Arguably a longer term challenge is the lack of skilled analysts. Technology firms are working with universities to help train tomorrow's data specialists, but it is unlikely that supply will meet demand soon. In the near future, there is likely to be a "war for talent" as firms try and outbid each other for top-flight data analysts.
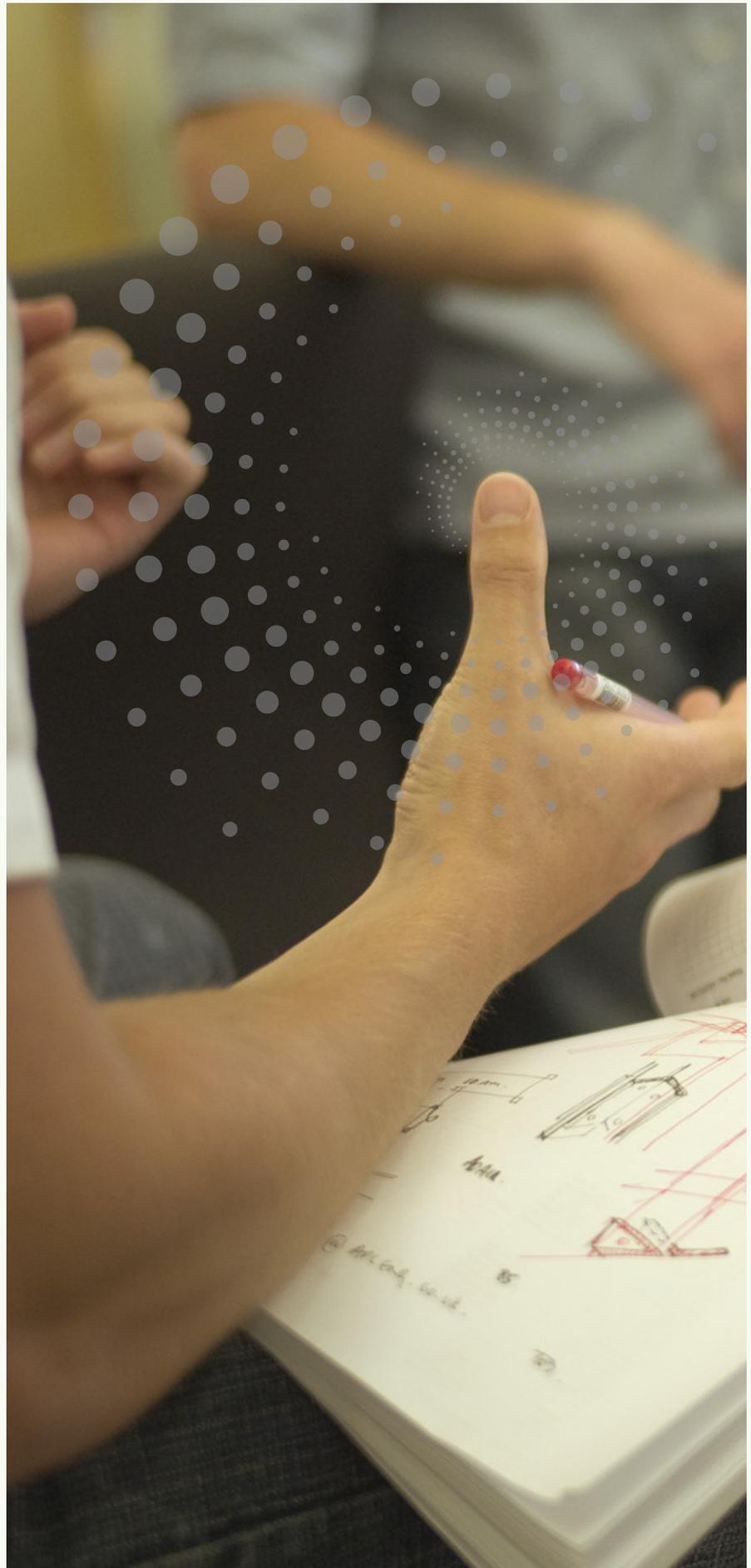
Introduction

26%

is the extent of performance improvement already experienced from big data.

41%

is the performance improvement expected in the next three years.

55%

say that big data management is not viewed strategically at senior levels of their organisation.

[1] www.nytimes.com/2011/10/02/business/after-moneyball-data-guys-are-triumphant.html

[2] Brynjolfsson, Erik, Hitt, Lorin M. and Kim, Heekyung Hellen, "Strength in Numbers: How Does Data-Driven Decision making Affect Firm Performance?" (April 22, 2011). Available at SSRN: http://ssrn.com/abstract=1819486 or http://dx.doi.org/10.2139/ssrn.1819486

Moneyball: The Art of Winning an Unfair Game, by Michael Lewis, is the story of an underperforming American baseball team—the Oakland Athletics—that turned a losing streak into a winning streak by intensively using statistics and analytics. According to the New York Times, the book turned many business people into "empirical evangelists"[1].

An Economist Intelligence Unit survey, supported by Capgemini, of 607 senior executives conducted for this report found that there is indeed a growing appetite for fact-based decision-making in organisations. The majority of respondents to the survey (54%) say that management decisions based purely on intuition or experience are increasingly regarded as suspect (this view is held even more firmly in the manufacturing, energy and government sectors), and 65% assert that more and more, management decisions are based on "hard analytic information".

Until recently there was scant research to back the Moneyball hypothesis—that if organisations relied on analytics for decision-making they could outperform their competitors. In 2011, however, Erik Brynjolfsson, an economist at the Sloan School of Management at the Massachusetts Institute of Technology (MIT), along with other colleagues studied 179 large publicly traded firms and found that, controlling for other variables, such as information technology (IT) investment, labour and capital, firms that emphasise decision-making based on data and analytics performed 5-6% better—as measured by output and performance—than those that rely on intuition and experience for decision-making[2].

Two-thirds of the executives in the survey describe their firm as "data-driven". That figure rises to 73% for respondents from the financial services sector, 75% from healthcare, pharmaceuticals and biotechnology, and 76% from energy and natural

resources. Although financial services and healthcare firms have long been big data users—where big data is defined by its enormous volume and the great diversity of media which generate it—heavy industry appears to be catching up (see case study: GE—the industrial Internet).

Nine in ten survey respondents agree that data is now an essential factor of production, alongside land, labour and capital. They are also optimistic about the benefits of big data. On average, survey participants say that big data has improved their organisations' performance in the past three years by 26%, and they are optimistic that it will improve performance by an average of 41% in the next three years. While "performance" in this instance is not rigorously specified, it is a useful gauge of mood.

One may question whether the surveyed firms are as "data-driven" as their executives say. The research also shows that organisations are struggling with the enormous volumes of data and often with poor quality data, and many are struggling to free data from organisational silos. The same share of respondents who say their firms are data-driven also say there is not enough of a "big data culture" in their organisation; almost as many – 55% – say that big data management is not viewed strategically at senior levels of their organisation.

When it comes to integrating big data with executive decision-making, there is clearly a long road to travel before the results match the optimism. This report will examine how far down that road firms in different industries and regions are, and will shed light on the steps some organisations are taking to make big data a critical success factor in the decision-making process.

On average, respondents believe that big data will improve organisational performance by 41% over the next three years

Survey Question: Approximately to what extent do you believe that the use of big data has improved your organisation's overall performance already, and can improve overall performance in the next three years?

● Now ● 3 Years

	Average	CEO/President	CFO/Treasurer	CIO/CTO
Now	27%	30%	28%	27%
3 Years	42%	38%	40%	41%

Overall, 55% of respondents state that they feel big data management is not viewed strategically at senior levels of their organisation

Survey Question: To what extent do you agree with the following statement:

"Big data management is not viewed strategically at senior levels of the organisation."

● Strongly Agree   ● Agree   ● Disagree   ● Strongly Disagree   ● Don't know/Not applicable
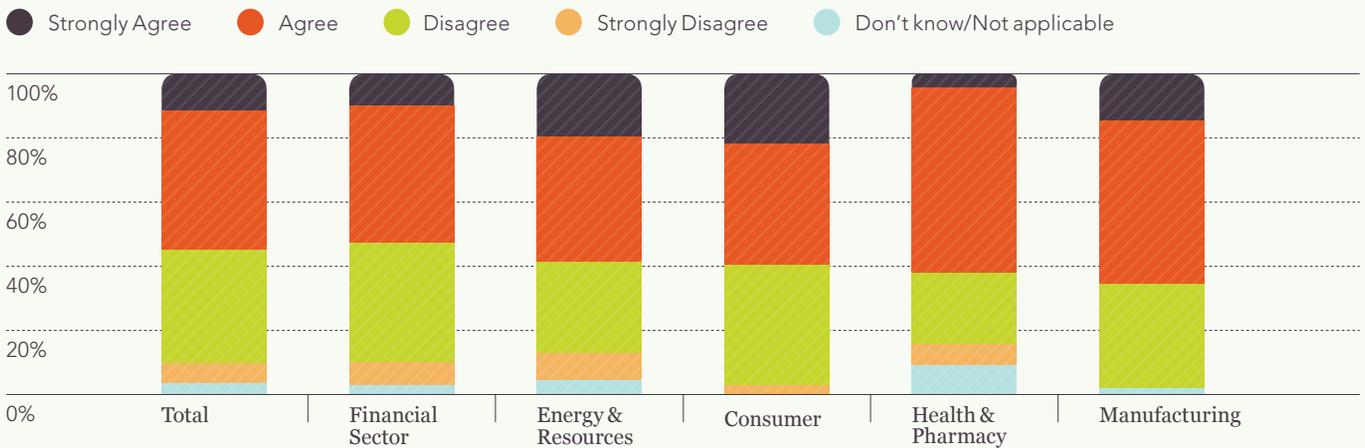
Two thirds of executives believe that there is not enough of a "big data culture" in their organisation - this is particularly notable across the manufacturing sector

Survey Question: To what extent do you agree with the following statement:

"There is not enough of a "big data culture" in the organisation, where the use of big data in decision-making is valued and rewarded."

● Strongly Agree   ● Agree   ● Disagree   ● Strongly Disagree   ● Don't know/Not applicable
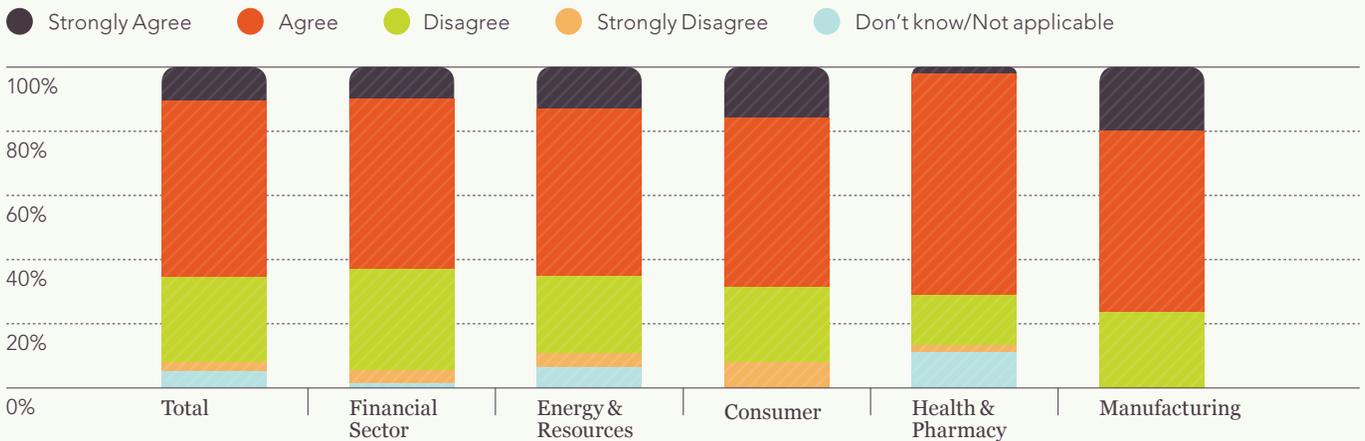
Putting big data to big use

"A lot of people will say data is important to their business, but I think it's incredibly important to healthcare and it's probably getting more and more important," says Lori Beer executive vice president of executive enterprise services at WellPoint, an American healthcare insurer. Ms Beer compares data in healthcare with "oxygen"—without it, the organisation would die.

WellPoint has 34 million members, and making sure their customers get the right diagnosis and receive the right treatment is vital for keeping costs under control. But getting to the right information to make the right decision in healthcare is no mean feat. There are terabytes to sift through: millions of medical research papers, patient records, population statistics and formularies, to name a few types of needed information. Using that to make an effective decision requires powerful computing and powerful analytics (see WellPoint case study).
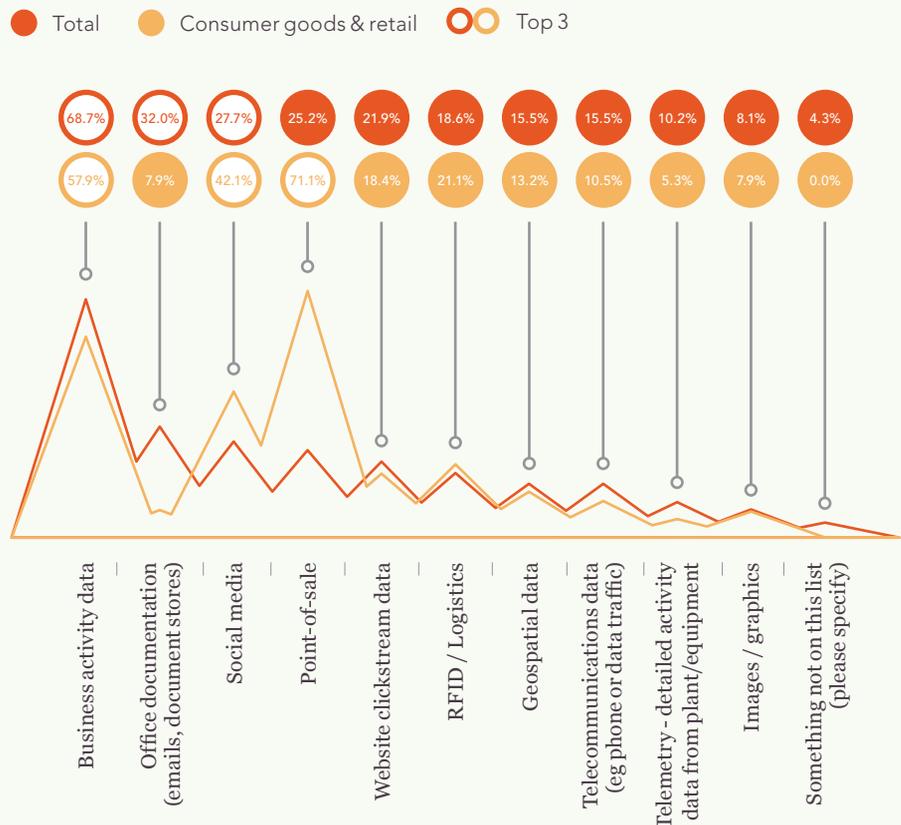
There is near consensus across industries as to which big data sets are most valuable. Fully 69% of survey respondents agree that "business activity data" (eg, sales, purchases, costs) adds the greatest value to their organisation. The only notable exception is consumer goods and retail where point-of-sale data is deemed to be the most important (cited by 71% of respondents). Retailers and consumer goods firms are arguably under more pressure than other industries to keep their prices competitive. With smartphone apps such as RedLaser and Amazon's Price Check, customers can scan a product's barcode in-store and immediately find out if the product is available elsewhere for less.

To keep customers loyal, retailers have to target customers with personalised loyalty bonuses, discounts and promotions. Today, most large supermarkets micro-segment customers in real time and offer highly targeted promotions at the point of sale.

> Business activity data and point-of-sale data are considered most valuable across the consumer goods & retail sector

Survey Question: Which types of big data sets do you see as adding the most value to your organisation?

[select up to three options]

● Total　　● Consumer goods & retail　　◯◯ Top 3

Category	Total	Consumer goods & retail
Business activity data	68.7%	57.9%
Office documentation (emails, document stores)	32.0%	7.9%
Social media	27.7%	42.1%
Point-of-sale	25.2%	71.1%
Website clickstream data	21.9%	18.4%
RFID / Logistics	18.6%	21.1%
Geospatial data	15.5%	13.2%
Telecommunications data (eg phone or data traffic)	15.5%	10.5%
Telemetry – detailed activity data from plant/equipment	10.2%	5.3%
Images / graphics	8.1%	7.9%
Something not on this list (please specify)	4.3%	0.0%

42%

of survey respondents say that unstructured content is too difficult to interpret.

Office documentation (emails, document stores, etc) is the second most valued data set overall, favoured by 32% of respondents. Of the other major industries represented in the survey, only healthcare, pharmaceuticals and biotechnology differ on their second choice. Here social media are viewed as the second most valuable data set, possibly because reputation is vitally important in this sector, and "sentiment analysis" of social media is a quick way to identify shifting views towards drugs and other healthcare products.

Over 40% of respondents agree that using social media data for decision-making has become increasingly important, possibly because they have made organisations vulnerable to "brand damage". Social media are often used as an early warning system to alert firms when customers are turning against them. In December 2011 it took Verizon Wireless just one day to make the decision to withdraw a $2 "convenience charge" for paying bills with a smartphone, following a social media-led consumer backlash. Customers used Twitter and other social

media to express their anger at the charge. Verizon Wireless was prompt in responding to the outcry, possibly forestalling customer defection to rival mobile operators.

But not all unstructured data is as easy to understand as social media. Indeed, 42% of survey respondents say that unstructured content—which includes audio, video, emails and web pages—is too difficult to interpret.
A possible reason for this is that today's business intelligence tools are good at aggregating and analysing structured data whilst tools for unstructured data are predominantly targeted at providing access to individual documents (eg search and content management). It may be a while before the more advanced unstructured data tools, such as text analytics and sentiment analysis, which can aggregate and summarise unstructured content, become mass market. This may be why 40% of respondents say they have too much unstructured data to support decision-making, as opposed to just 7% who feel they have too much structured data.

40% of respondents believe that they have too much unstructured data to support decision-making
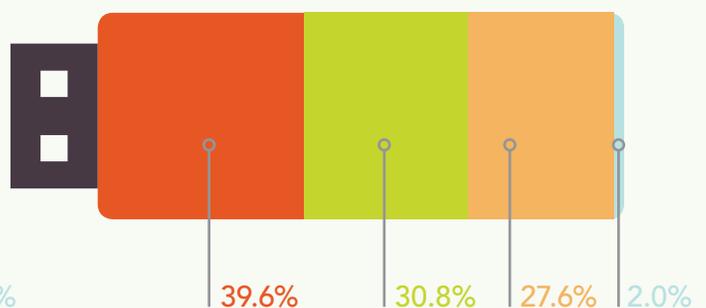
Survey Question: Looking specifically at your department, how would you characterise the amount of data available to support decision-making?

● Too much   ● Enough   ● Not enough   ● Don't know

Structured

7.0%   42.1%   49.8%   1.2%

Unstructured

39.6%   30.8%   27.6%   2.0%
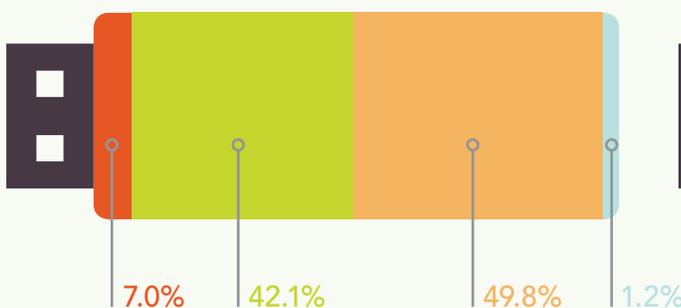
Enough data or too much?

Structured or unstructured, most executives feel they don't have enough data to support their decision-making. In fact, 40% of respondents overall believe the decisions they have made in the past three years would have been "significantly better" if they'd had all of the structured and unstructured data they needed to make their decision. And, despite the fact that respondents from the financial services and energy sectors are more likely than average to describe their firm as data-driven, they are also more likely than the average (46% from financial services, and 48% from energy) to feel they could have made better decisions if the needed data was to hand.

At first blush, this may seem contradictory, given the surfeit of data and the difficulty organisations face in managing it, but Bill Ruh, vice president, software, at GE sees no contradiction. "Because the problems we address are going to get more and more complex, we're going to solve more complex problems as a result," he says. "What we find is the more data we have, the more we get innovation in those analytics and we begin to do things we didn't think we could do."

For Mr Ruh, the journey to data fulfilment will be over when he can put a sensor on every component GE sells and monitor the component in real time. In this way, any aberrant behaviour can be immediately identified and either corrected through a control mechanism (decision automation) or through human intervention (decision support). "We're really trying to get to what we would call 'zero unplanned outages' on everything we sell," says Mr Ruh.

Case study: *Big data at the bedside*

For WellPoint, one of America's largest health insurers, the problem of ensuring the right treatment plan is provided for its members is becoming increasingly complex. "Getting relevant information at the point-of-care, when decisions are getting made, is the holy grail," says Lori Beer, executive vice president of enterprise business services at WellPoint.

By some estimates, the body of medical knowledge doubles every five years. Coupled with an explosion in medical research papers is the rapid conversion of medical records to electronic format. A physician has a pile of digital information to sift through yet, according to Ms Beer, most healthcare providers spend very little time with each patient and only see "a slice of the information". WellPoint wants to provide all the relevant information that a healthcare provider needs, in digestible format, at the patient's bedside.

"If you look at the statistics, evidence-based medicine is only applied about 50% of the time," says Ms Beer. "The issue we often face is that we're not really using the most relevant evidence-based medicine in diagnosis and treatment decisions." A wrong diagnosis and treatment plan can be deadly for a patient and very costly for WellPoint.

WellPoint had been following the advances of IBM's Watson supercomputer for some time and realised that the natural-language-processing abilities of the machine would make it ideal for processing petabytes of unstructured medical information, and drawing meaningful conclusions from it in seconds.

In January 2012, WellPoint began training the supercomputer for the first phase of the project. The pilot system helps WellPoint nurses review and authorise treatment requests from medical providers. It is an iterative process where the nurses follow the existing procedures, examine the response the system provides, and then score it based on how well it does. The feedback is used to educate and fine-tune the system so that it will eventually be able to authorise treatments without human intervention.

For the second phase, WellPoint has partnered with Cedars-Sinai Samuel Oschin Comprehensive Cancer Institute in Los Angeles to develop a decision-support system for oncologists. It is hoped that physicians will be able to review treatment options suggested by the supercomputer at the point of care. Critically, the system won't just provide an answer; it will show the oncologist the documented medical evidence that supports the probability of why it believes the answer is accurate.

"It is the physician who makes the ultimate decision," says Ms Beer. "This is not intended to ever replace the physician."

There is no end date for the project, and various decision-support and decision-automation tools will be developed over time. The intent is that the more the WellPoint system is trained, the more accurate diagnoses and treatment plans will become. If this pans out, it will help to drive down the cost of healthcare in the US, where wasted health spending in 2009 was estimated to be between $600 billion and $850 billion.

The virtues & risks of automation

Data can either support a manager in making a decision (eg, information on key performance indicators displayed on a business intelligence "dashboard") or it can automate decision-making (eg, an automatic stock replenishment algorithm). According to the survey, on average big data is used for decision support 58% of the time, and 29% of the time it is used for decision automation. For Michael Knorr, head of integration and data services at Citi, a financial services group, deciding whether to use big data for decision support or decision automation depends on the level of risk.

"In the consumer space, where amounts are small and if you make an error it's easy to compensate for that error, then automation might be applicable," says Mr Knorr. If there is a "false positive"—that is, a loan is rejected by the system based on various set parameters when it should have been approved—the situation can easily be remedied with a phone call.

With corporate clients, however, it is much more difficult. "Suppose that a ship cannot leave a port due to late payment, and suddenly all the bananas go rotten; from a commercial perspective, this involves a much higher risk because the amounts are much larger," says Mr Knorr. "The human element and review by somebody for larger amounts of money won't go away."

However, the job of automating decision-making at Citi is far from over. Mr Knorr says the drive for more automation comes from the increasing expectations of customers and regulators for rapid decision-making. "If you do not have the right level of automation in place, that means your costs have increased," says Mr Knorr. "If there is more data and you haven't kept up with automating, then the number of items you need to review manually will have increased, which means you need more resources and people to do so. This strengthens the business case for automation."

58%
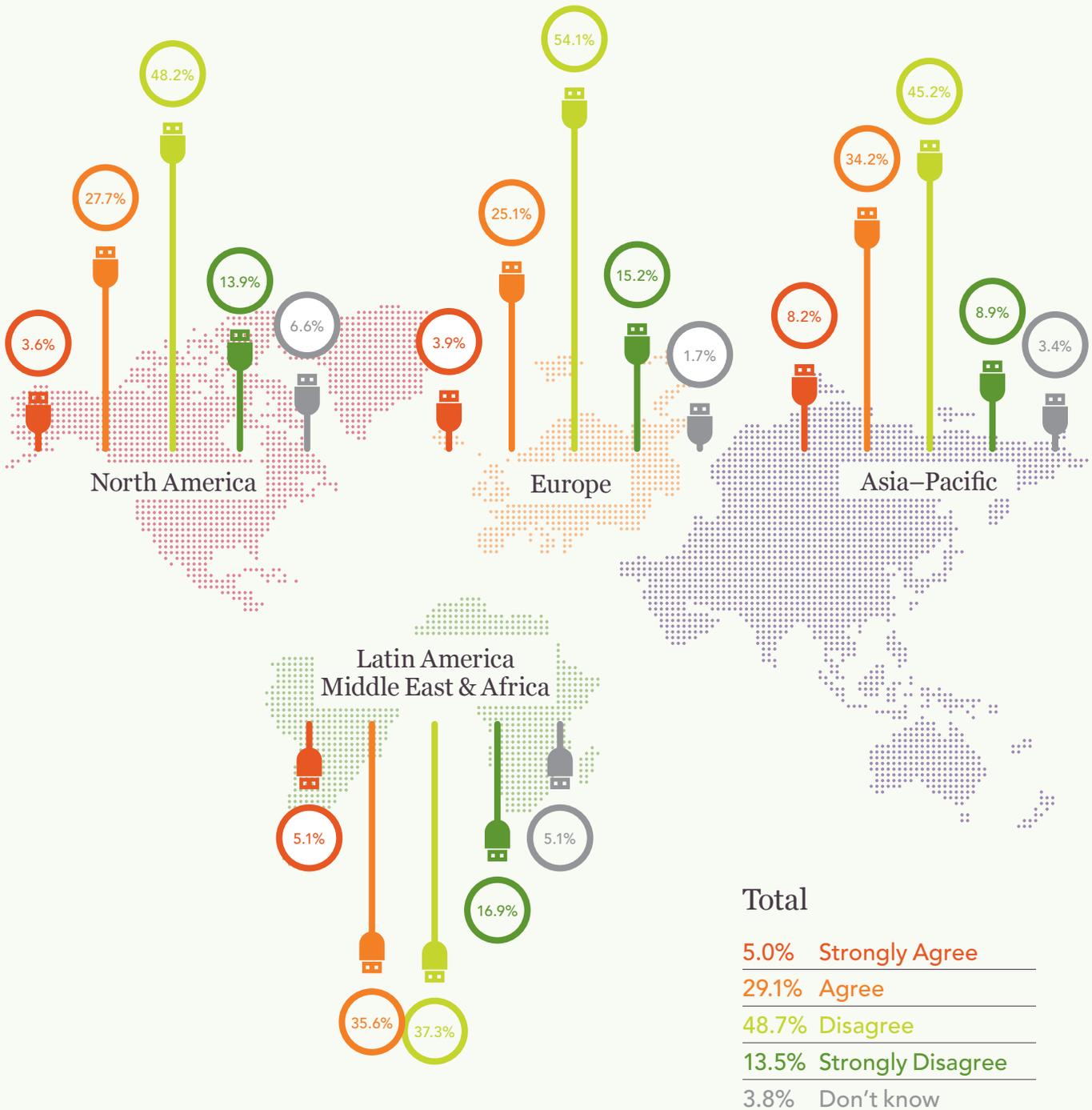*on average use big data for decision support.*

29%
of the time it is used for decision automation.

60% of respondents dispute the proposition that most operational/ tactical decisions that can be automated, have been automated

Survey Question: To what extent do you agree with the following statement:
"Most operational/tactical decisions that can be automated, have been automated."

48.2%

27.7%

3.6%

13.9%

6.6%

North America

54.1%

25.1%

3.9%

15.2%

1.7%

Europe

45.2%

34.2%

8.2%

8.9%

3.4%

Asia–Pacific

**Latin America
Middle East & Africa**

5.1%

5.1%

16.9%

35.6%

37.3%

Total

5.0%	Strongly Agree
29.1%	Agree
48.7%	Disagree
13.5%	Strongly Disagree
3.8%	Don't know

Across all industries and regions, a majority of survey respondents concur that there is scope for further decision automation at their firm. Over 60% of respondents dispute the proposition that "most operational/tactical decisions that can be automated, have been automated." This view is fairly consistent across industries, although fewer healthcare and pharmaceuticals companies agree with the statement (52%) than manufacturing companies (68%). (Respondents from the education sector also appear less certain than peers elsewhere that there is much still to be automated.) There is some regional variation, too. No more than 54% of executives in Asia-Pacific believe the job of automation is incomplete, compared with 71% in western Europe.

Mr Ruh of GE explains why automation is far from complete in his industry: "One reason is that many of the environments we operate in are highly regulated, so we have to move at a speed that makes sense within the regulation," he says. "The second is because the sensors and the data weren't really there to automate anything."

Certainly decision-automation tools have evolved from simple "if then else" programmable statements (eg, "if credit rating = AAA, then approve loan, else reject") to sophisticated artificial intelligence programs that learn from successes and failures. The more sophisticated the tools become, the more decisions that can be automated. Decision automation, however, can introduce unnecessary rigidity into business processes. At times of high instability—such as the current economic climate—companies need to be nimble in order to adapt to the changing conditions. Hard-coded decisions can be costly and time-consuming to change.

Brynjolfsson, Erik, "Riding the Rising Information Wave—Are you swamped or swimming?", MIT Sloan Experts, http://mitsloanexperts.com/ /2011/05/18.

Case study: *General Electric and the industrial Internet*

If the first phase of the Internet was about connecting people, says Bill Ruh, vice president of software at General Electric (GE), then the second phase is about connecting machines. Some people call this "the Internet of things", but Mr Ruh prefers the term "the industrial Internet". Like many good ideas, the concept preceded the technology. But now, sensors and big data analytics have reached a level of maturity that makes the industrial Internet achievable. Machines are able to talk to each other over vast distances and make decisions without human intervention.

"When you look at business process automation, the main productivity gains have been the low hanging fruit in the consumer, retail and entertainment sectors," says Mr Ruh. "But we have not seen many automation and productivity gains in industrial operations." National electricity grids, for example, are some of the world's biggest "machines", yet the fundamentals around how the technology is used and how it interacts with other systems have not kept pace over the course of a century. But with sensors, control systems and the Internet, a "smart grid" could make decisions, such as which energy supply to switch to, or which part of the network to isolate in the case of a fluctuation or disturbance.

In November 2011, GE showed its commitment to catching up with the business-to- consumer (B2C) sectors by opening a new software centre in San Ramon, California, with Mr Ruh as its head. GE is in the process of hiring 400 software engineers (with 100 on board to date) to complement the company's 5,000 software workers who are focused on developing applications for power plants, aeroplanes, medical systems and electric vehicle charging stations.

"We are putting more and more sensors on all the equipment that we sell, so that we can remotely monitor and diagnose each device," says Mr Ruh. "This represents a huge productivity gain, because you used to require a physical presence to know what was going on. Now we can sell a gas turbine and remotely monitor its operating state and help to optimise it."

"Trip Optimizer" is a fuel-saving system that GE has developed for freight trains. It takes into account a wealth of data, including track conditions, weather, the speed of the train, GPS data and "train physics", and makes decisions about how and when the train should brake. In tests, Trip Optimizer reduced fuel use by 4-14%, according to Mr Ruh. With fuel being one of the biggest overheads for freight train companies (at Canadian Pacific, one user of GE's system, it makes up nearly one-quarter of operating costs), a 10% reduction in fuel use represents a huge cost saving.

Mr Ruh likens the industrial Internet to Facebook or Twitter for machines. Whether it is a jet engine or oil rig, a machine is constantly providing status updates on performance. Big data analytics look for patterns in performance, and when an anomaly is identified, a decision about the best corrective action is automatically taken or a person is alerted so that a decision can be made on the best course of action.

"I believe that we're in the early stages of this," says Mr Ruh, "and we haven't even begun to imagine the algorithms we're going to build and how they're going to improve the kinds of products and services we offer."

Standing in the way

The perceived benefits of harnessing big data for decision-making mentioned by the survey respondents are many and varied.

Perceived benefits of harnessing big data for decision-making

"More complete understanding of market conditions and evolving business trends"

"Better business investment decisions"

"More accurate and precise responses to customer needs"

"Consistency of decision making and greater group participation in shared decisions"

"Focusing resources more efficiently for optimal returns"

"Faster growth of my business (+20% per year)"

"Competitive advantage (new data-driven services)"

"Common basis—one true starting point for evaluation"

"Better risk management"

The road to these riches, however, is laced with potholes. The biggest impediment to effective decision-making using big data, cited by 56% of survey respondents, is "organisational silos". This appears especially the case for large firms—those with annual revenue in excess of $10 billion—whose executives are more likely to cite silos as a problem (72%) than smaller firms with less than $500 million in revenue (43%).

The intractable silos

The business process reengineering (BPR) movement of the 1990s—led by Michael Hammer and Thomas Davenport—attempted to eradicate function silos. By mapping processes (eg, "fulfil order") that ran "horizontally" through several functions (sales, distribution, accounts receivable), duplicated tasks and other inefficiencies were identified and eradicated, and data was made to flow more easily across function boundaries. BPR was given a boost by the arrival of enterprise resource planning (ERP) software which automated a number of common business processes. However, while BPR undoubtedly improved efficiency and made the inner machinations of functions visible—often for the first time—the "vertical" function silos were soon replaced by "horizontal" application silos. Before, data was trapped in functions; now it is trapped in ERP, CRM (customer relationship management) and SCM (supply chain management) systems.

To some extent, increasing regulation, especially in the financial services, pharmaceuticals and telecommunications industries, has begun to erode data silos and will

continue to do so as the overlap between different regulatory authorities is rationalised. "Historically, you could say the islands of data provided some sort of job security," says Mr Knorr of Citi. "If different areas have their own vernacular, then they keep to themselves and avoid transparency. That has obviously broken down, mainly through the regulatory efforts to ensure that the financial services industry can have a consistent, end-to-end data model that's easily understood and can relate the various transactions and products across the board."

Silos may also be eroded over time by what Kurt Schlegel, a research vice president at Gartner, an analyst firm, calls "trusted data aggregators". He points to aggregators which collect data that different firms (often in the same industry) can access and analyse for their own purposes. But Mr Schlegel believes that the trusted data aggregator model can also work within organisations themselves. And even where data protection or privacy laws prevent a given department from revealing personal information, an aggregator could anonymise the data and make it available to other departments.

56%

of survey respondents cited "organisational silos" are the biggest impediment to effective decision-making using big data.

Across all sectors, "organisational silos" are the biggest impediment to using big data for effective decision-making

Survey Question: What are your organisation's three biggest impediments to using big data for effective decision-making?
[Select up to three options]

55.7% 57.1% 63.0% 52.6% 59.7% 58.2% 54.3%
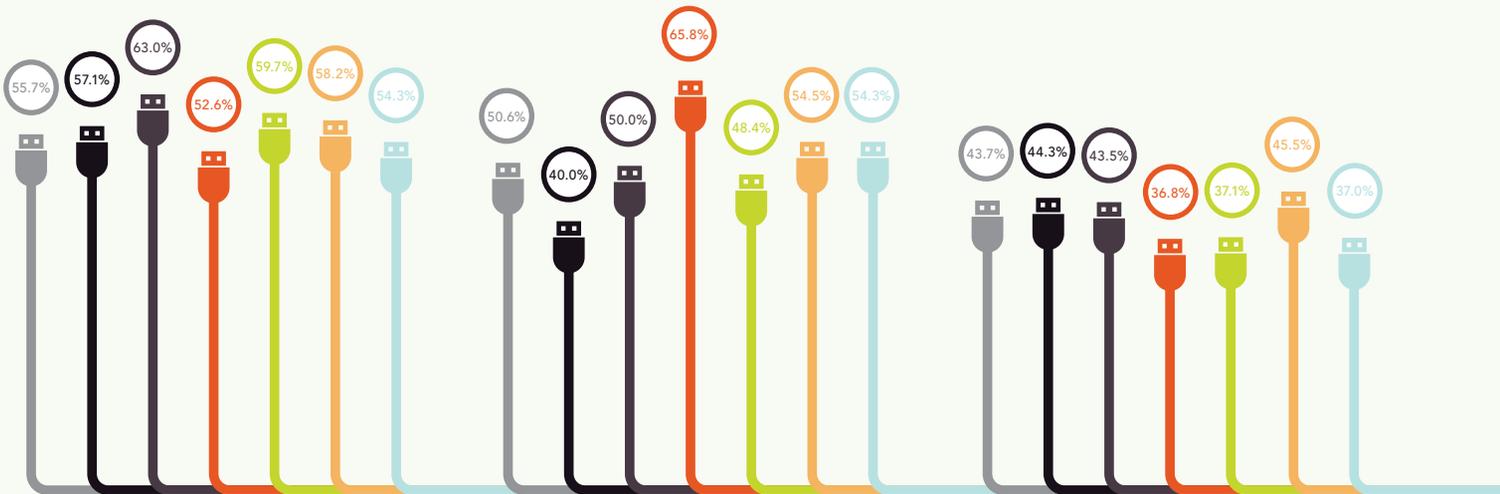
Too many "silos"—data is not pooled for the benefit of the entire organisation.

50.6% 40.0% 50.0% 65.8% 48.4% 54.5% 54.3%

Shortage of skilled people to analyse the data properly.

43.7% 44.3% 43.5% 36.8% 37.1% 45.5% 37.0%

The time taken to analyse large data sets.

41.7% 32.9% 47.8% 36.8% 48.4% 41.8% 13.0%

Unstructured content in big data is too difficult to interpret.

34.9% 34.3% 39.1% 34.2% 27.4% 49.1% 45.7%

Big data is not viewed sufficiently strategically by senior management.

17.1% 24.3% 13.0% 18.4% 14.5% 20.0% 10.9%

The high cost of storing and manipulating large data sets.

14.7% 17.1% 10.9% 7.9% 8.1% 12.7% 41.3%
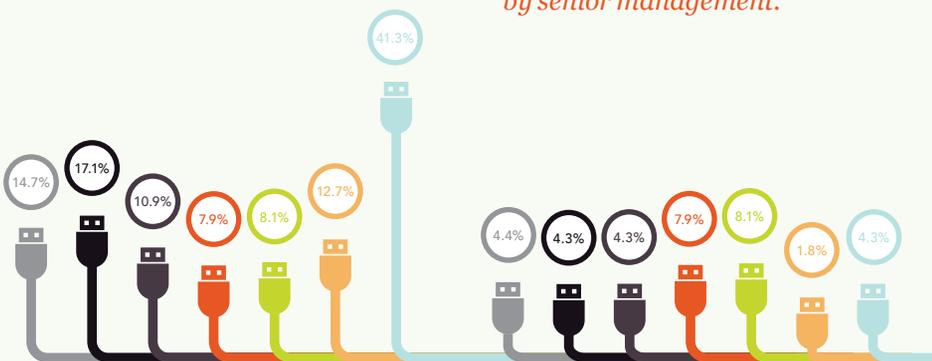
Big data sets are too complex to collect and store.

4.4% 4.3% 4.3% 7.9% 8.1% 1.8% 4.3%

Something not on this list (please specify).

- Total
- Financial Sector
- Energy & Natural Resources
- Consumer goods & retail
- IT & Technology
- Manufacturing
- Healthcare & Pharmacy

Finding the right skills

The second big impediment to making better decisions with big data is the dearth of talented people to analyse it, mentioned by 51% of respondents. For consumer goods and retail firms it is the single toughest obstacle, cited by two-thirds of respondents from those sectors.

"In terms of modelling, there is going to be a considerable shortage [of specialists]," says Professor K Sudhir, James L. Frank '32 professor of marketing at Yale School of Management. "As a nation we generally find math and sciences less exciting, and I think people have been moving away from this to 'softer' sciences. Clearly, there is a shortfall, especially in the analyst domain, and it is going to continue unless we systemically fix it." Bill Ruh of GE agrees. "There is going to be a war for this kind of talent in the next five years," he says.

Aside from a master's degree or PhD in economics, mathematics, physics, or other relevant field of science, analysts are also expected to have in-depth domain knowledge—something which usually takes years to acquire. Interviewees for this report also say that the ideal analyst should have an ability to communicate complex ideas in a simple manner and should be customer-focused. Finding people with all of these abilities is never going to be easy, and retaining them is going to be even harder as the benefits of big data become apparent to more firms.

Technology companies recognise the problem and are working with schools and universities to develop these much needed skills. For example, SAS, a business analytics software firm based in Cary, North Carolina, developed Curriculum Pathways, a web-based tool for teaching data analytics to high school students. The course, aimed at science, technology, engineering and mathematics students, has been running for 12 years in the US and is used in 18,000 schools; it will be offered to UK schools, for free, from March 2012. SAS has also developed advanced analytics courses with a number of universities, including Centennial College, Canada, North Carolina State University and Saint Joseph's University, Philadelphia, to provide the next generation of data analysts.

The time factor

The time it takes to analyse large data sets is seen as another major impediment to more effective use of big data in decision-making. "I think big data is going to stimulate the need for more CPU [microprocessor] power, because people are going to get very creative and they're going to invent new algorithms, and we're going to say 'My God, everything's slow again'," says Mr Ruh of GE. "We are going to have to redo our compute and storage architectures because they will not work where all this is going."

Most of the survey respondents have not experienced a slowing of decision-making due to having to process large quantities of data. Only 7% say that it has slowed down decision-making significantly, while 35% say it has slowed it but only moderately. (Respondents from transport, government, telecommunications and education suggest a greater deceleration of decision-making than other sectors.) The impediment must be, then, not that decision-making is slowing, but that it is not getting faster. This seems to be borne out by the fact that the vast majority (85%) of executives believe that the issue is not the growing volumes of data, but rather being able t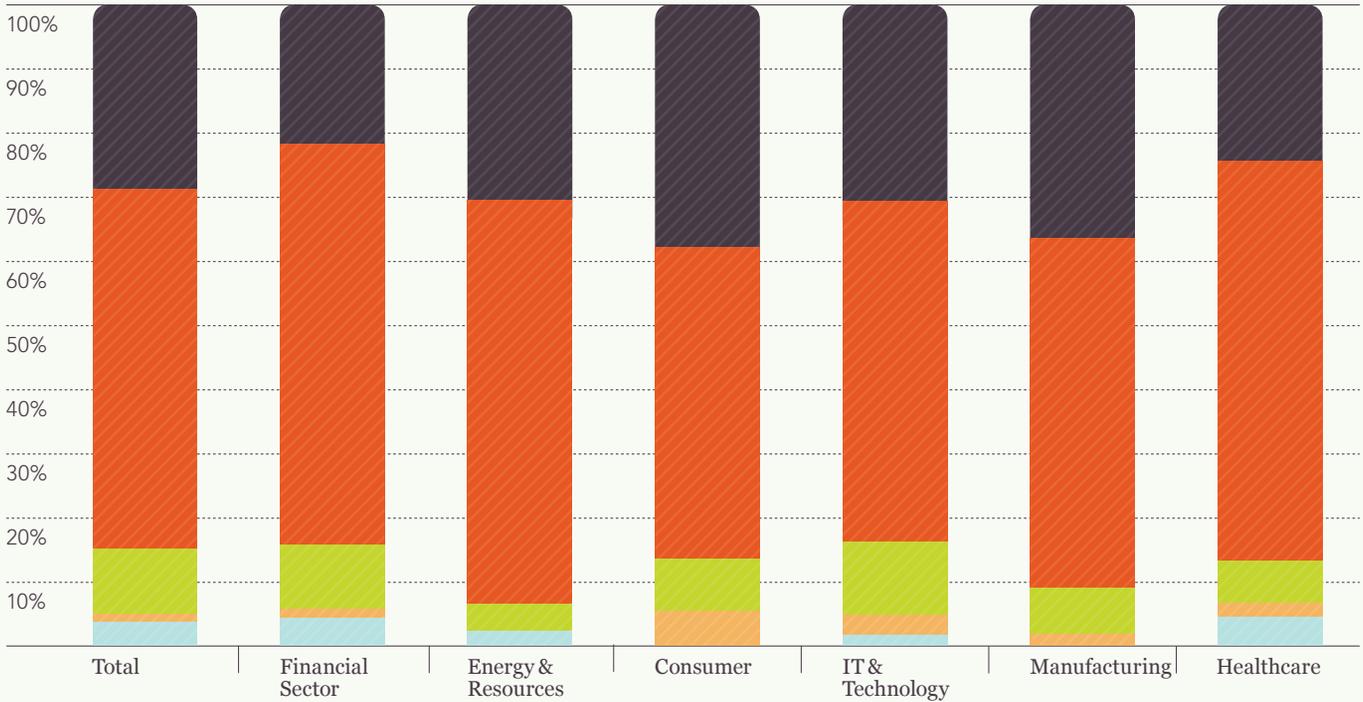o analyse and act on data in real-time. As "in memory analytics"—where data sets are loaded into memory (RAM), making analysis much faster—become more refined and widely deployed, decision-making at the operational and tactical level, at least, is likely also to become faster.

85% of respondents say the issue is not about volume but the ability to analyse and act on the data in real time

Survey Question: To what extent do you agree with the following statement:
"The issue for us is now not the growing volumes of data, but rather being able to analyse and act on data in real-time."

- ● Strongly Agree
- ● Agree
- ● Disagree
- ● Strongly Disagree
- ● Don't know/Not applicable

Total		Financial Sector		Energy & Resources		Consumer	
28.7%		21.7%		30.4%		37.8%	
56.1%		62.3%		63.0%		48.6%	
10.1%		10.1%		4.3%		8.1%	
1.3%		1.4%		0.0%		0.0%	
3.7%		4.3%		2.2%		5.4%	

IT & Consumer		Manufacturing		Healthcare	
30.6%		36.4%		26.4%	
53.2%		54.5%		62.2%	
11.3%		7.3%		6.7%	
3.2%		1.8%		2.2%	
1.6%		0.0%		4.4%	
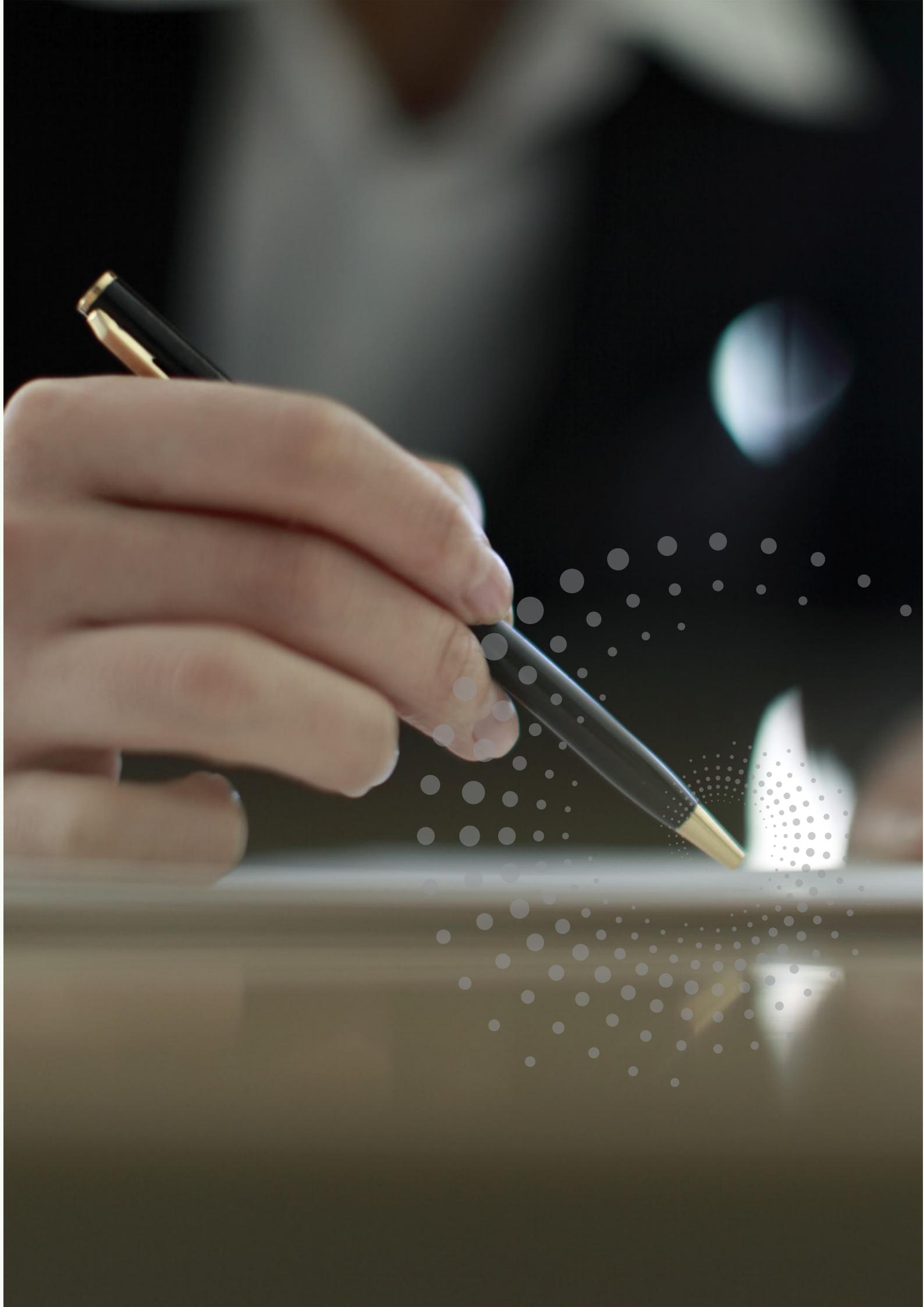
Conclusion

Professor Alex Pentland, director of the Human Dynamics Laboratory at MIT, says big data is turning the process of decision-making inside out[3]. Instead of starting with a question or hypothesis, people "data mine" to see what patterns they can find. If the patterns reveal a business opportunity or a threat, then a decision is made about how to act on the information.

This is certainly true, but improvements in computing power and artificial intelligence systems mean that asking direct questions of big data and getting an answer, in real time, is now a reality (see WellPoint case study). Although these systems are still very costly and not widely deployed, this research suggests that the appetite for real-time decision-making is huge. And when there is a business demand, it is only a matter of time before the need if fulfilled.

Most of the executives polled for this report are also optimistic about the cost reductions and efficiencies that can be had from automating decision-making using big data. While there is certainly much scope for decision-automation in heavy industry, especially in areas such as energy production and distribution ("smart grids") and transportation ("smart cars", etc), excessive automation of business processes can hamper flexibility. Besides, the growing post-financial-crisis regulation calling for greater accountability requires humans to ultimately make the decisions. Prosecutors cannot put an algorithm in the dock.

The financial crisis has also led to calls for greater transparency. As the survey shows, people are increasingly wary of business decisions based purely on intuition and experience. Even if a sizeable minority agree that business managers have a better feel for business decisions than analytics will ever provide, managers will increasingly need to show how they arrived at their decision. And big data will provide a post-decision review—was it a good decision or not? As one of the survey participants puts it, using big data for decision-making will lead to "better decisions; better consensus; better execution".

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