MARKET SPOTLIGHT

State of Analytics Adoption in Singapore

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In Singapore, organizations are pushing for greater efficiencies, enhanced customer relationships and to accelerate growth. Many are finding that improvements in these areas can be achieved by becoming data-driven across the organization. IDC research shows that organizations that are analytics-driven are twice as likely to outperform their peers. Becoming data-driven offers many insights and opportunities, and as such can be seen as a catalyst in truly innovative organizations. This IDC Market Spotlight examines the current state of analytics usage in Singapore and looks at the past growth and projected future growth. This paper also examines several types of analytics software being utilized in Singapore and their share of the market. After a discussion about how the various industries such as banking, manufacturing and retail in Singapore are using analytics, the IDC Market Spotlight assesses Singapore's Smart City initiatives related to analytics and looks at five of IDC's 2016 big data and analytics (BDA) predictions and their implications on Asia/Pacific excluding Japan (APEJ), as well as their impact on Singapore.

The Current Analytics Landscape in Singapore

Singapore is aiming to establish itself as a global data and analytics hub, as seen by the strong presence and growth of datacenter parks, clear legal frameworks and government-led skills training initiatives.

Datacenters

Singapore has leapfrogged the Southeast Asia region as a datacenter hub in the last two years. Considering the limited amount of space and the premium of land in the small island country, this growth has been exceptional. This can be credited to several factors such as the availability of reliable power supply to ensure constant uptime and efficiency of datacenters, and the unparalleled bandwidth capacity, low-cost and low-latency connectivity of submarine cable network systems.

In addition, the Singapore government's data hub strategy includes initiatives to further boost Singapore’s presence on the global datacenter map. This includes dedicating a chunk of valuable real estate and support to establish a datacenter park for operators.

This government initiative has in fact attracted leading regional telecommunications companies like Telin Singapore to invest in their third state-of-the-art Singapore datacenter at the new datacenter park, with focus on supporting mission-critical analytics solutions such as real-time data analytics and big data.

Personal Data Framework

Large amounts of personal data are collected, used and monetized in Singapore. With new and advanced analytics being introduced at a rapid pace, these personal or human generated data are being consumed, processed and analyzed by organizations. As the data growth trends exponentially, concerns about how personal data is being used and privacy concerns become a hurdle to continued analytics usage and growth in Singapore.

To ensure the continual growth of Singapore as a data analytics hub, the Singapore government developed a data protection framework, based on countries that had implemented similar laws such as the U.K., Canada, Hong Kong, Australia and New Zealand. The key objective was to address the previously mentioned concerns and to ensure compliance by organizations during the collection and use of personal data.

Ultimately, the framework and law's purpose is to increase Singapore's competitiveness and position against regional countries. The Personal Data Protection Act was eventually rolled out in phases and had come into full effect since July 2014. It is with this legal framework that provides a foundation for pushing Singapore forward as a data-enabled and data-driven country.

ICT and Analytics Skill Sets

Singapore's Achilles heel is its high labor and operating costs. Organizations have come to realize that in order to get the best value from their staff, they need to enable knowledge workers to make quick and intelligent decisions.

The demand for analytics resources, however, far exceeds the supply available in Singapore. In late March 2016, Minister for Communications and Information Yaacob Ibrahim highlighted the "talent gap" that the upcoming budget planning needed to address. He pointed to opportunities in data analytics and the Smart Nation initiative that are facing the challenge of a shortage of skilled resources.

Government entities such as the Infocomm Development Authority of Singapore (IDA) and Workforce Development Agency (WDA) are proactively working to develop these skill sets in the existing workforce. WDA has seen highest demand for ICT training in its SkillsFuture Credit initiative, which saw an uptake of 18,000 applicants for the first quarter of 2016.

At the same time, higher education institutions such as the universities and polytechnics have introduced analytics, data science and business intelligence curriculums to increase the pool of analytics resources.

As the supply generated for the workforce by the learning institutions will take some time to be realized, Singapore is expected to continue to experience a shortage of analytics resources in the near future.

Self-Service Analytics

In light of the exponential growth of data, and the desire to extract value from these data, more and more business users are demanding in-depth insights into their data. However, with technical analytics skill sets in shortage, IT departments in Singapore are constantly overwhelmed by business requests for reports and analytics. Analytics software vendors have been addressing this organizational challenge by introducing self-service analytics tools that are geared toward less technically inclined business users.

Such self-service tools are democratizing data by getting the right information to decision makers in a timely manner. These tools are typically easy to use and allow for self-service data discovery and visualization. These tools provide data analysts and business users with limited technical skills access to advanced analytics such as on-the-fly forecasting from complex data sets.

Data Management

One of the ongoing challenges for Singapore organizations is data management. Data can have multiple issues such as inconsistency, varied formats, ownership and (lack of) governance. Information is typically siloed within departments or lines of business, preventing organizations from extracting valuable insights across the enterprise. The combination of the lack of accessible data and bad data is a roadblock for organizations looking to gain the competitive edge with new analytical tools such as machine learning and cognitive systems.

These next-generation analytic tools require significant amounts of data to fuel the statistical machine learning that, in turn, provides useful answers, recommendations and predictions. In order for organizations to move to a more data-driven culture, the data walls have to be broken down as it is only through the integration of different sources of data will value-added content be created, hence improving analysis and decision making.

Analytics Software Functional Markets Overview

This section takes a closer look at the adoption and growth of data discovery and visualization tools in Singapore, with a focus on four specific areas of analytics software: advanced and predictive analytics; data integration and access; end-user query, reporting and analysis; and marketing.

- Advanced and predictive analytics software includes data mining and statistical software. It uses a range of techniques to create, test and execute statistical models.
- Data integration and access software enables the access, blending and movement of data among multiple data sources.
- End-user query, reporting and analysis software includes ad hoc query and multidimensional analysis tools as well as dashboards and production reporting tools.
- IDC breaks the marketing software market into several broad categories including interaction systems, data and analytics.

The last two years have seen a 15% annual growth rate in Singapore for these four analytics segments. The growth can be attributed to the following factors:

- **Better access.** The advanced and predictive analytics software market continues to grow as the tools and techniques that were previously reserved for a few highly trained and qualified data analysts are becoming (in different forms) more broadly available, more economically accessible and more easily understood by a broader business audience. New machine learning and deep learning platforms are being introduced as cloud services, allowing organizations to quickly create their own predictive models or deep learning networks. In addition, the number of qualified data analysts and scientists is growing in leading data-driven organizations as they hire more data experts as part of their growth and innovation strategy.
- **Advanced technical requirements.** The data integration and access software market continues to grow and expand, as technologies evolve to meet the new needs of computing on the 3rd Platform. Data is bigger, faster and more diverse, and is being used in innovative ways to find cost-savings opportunities, uncover risks, improve service delivery and grow revenue.
  - Dynamic data movement and composite data framework segments are growing in response to the age of "now," helping enable the real-time enterprise.
  - Data quality, master data definition and control, and metadata management segments are experiencing new levels of innovation and adoption in response to concerns of data trust, availability, security and compliance compounded by the 3rd Platform.
  - The increase in number of sensors such as machine sensors, connected CCTV, wearables, and the Internet of Things (IoT) devices have resulted in the need for data streaming, capture, filtering, persistence and analytics.
- **Predictive insights.** Digitization of everything and growth in data producers are driving demand for data capture, management and analysis software. Insights into IoT data, consumer behavior tracking and risk management requirements are some of the biggest factors contributing to the demand growth of end-user analytic tools. End-user query, reporting and analysis software that provides actionable business intelligence are key drivers for such growth. This is especially so in the self-service data discovery and visualization area where it drives a strong growth for the end-user query, reporting and analysis functional market. In addition, organizations are seeking predictability across all fronts. Predictability affects cash management, service delivery, process reorganization and other aspects of running a business.

- **Personalized customer experience and engagement.** Marketing organizations are aggressively adopting new solutions and updating aging systems. Systems that interact with customers such as real-time next best action analytics engines are the largest area of investment, followed closely by data and analytics.

IDC expects the Singapore market for the abovementioned four segments of the analytics software market to grow at a compound annual growth rate (CAGR) of about 8.6% from US$125 million to US$160 million between 2016 and 2019. The factors driving the growth in Singapore include the following:

- Cloud-based delivery of business analytics software will continue to accelerate. IDC believes the year 2015 represented a turning point in the availability of cloud business analytics, which saw the emerging adoption of cloud analytics.
- Self-service data discovery software will continue to outpace the growth of other business intelligence market segments over the forecast period. Longer-term prospects of this market, however, will be inhibited by the rise in cognitive computing, which will automate many of the currently manual data manipulation and analysis tasks.
- Solutions based on cognitive computing have begun to be adopted across industries. After decades of false starts by purveyors of artificial intelligence (AI) technology, it is finally ready to hit the mainstream. Mass adoption will still take time as go-to-market, pricing and packaging strategies evolve.
- Other new capabilities in the analytics field will be an important market driver and source of competitive advantage growth as software companies continue to offer greater commercial integration between capabilities and to increase speed, ease of use and lowered cost of ownership.

Shining the Analytics Spotlight on Industries

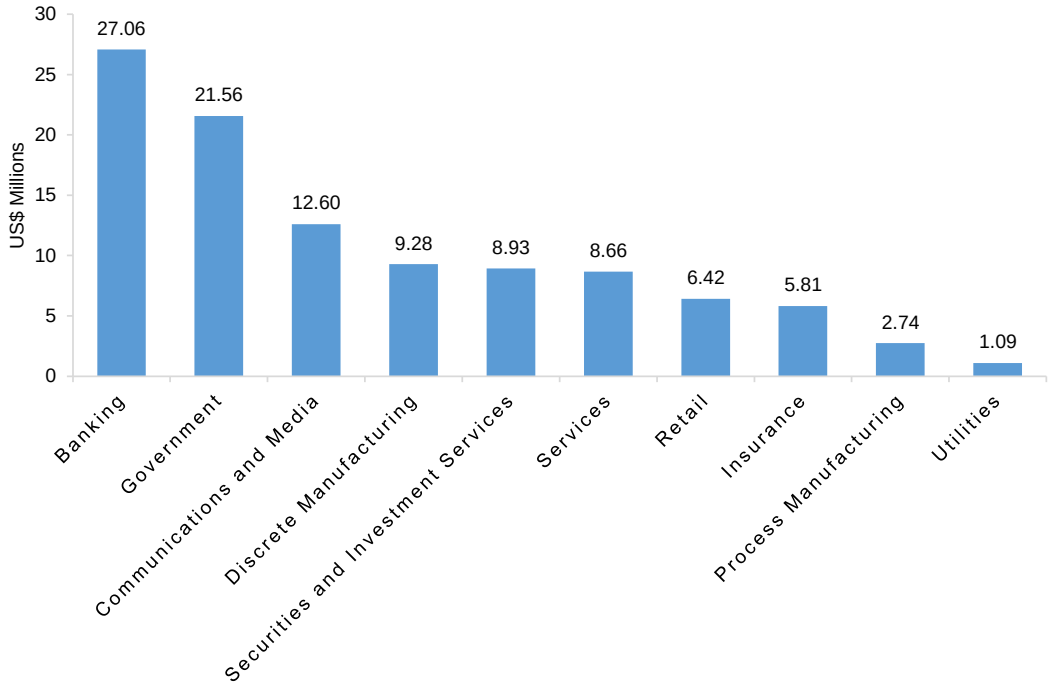
Homegrown and foreign multinational corporations are taking advantage of the skills, infrastructure and data protection offered in Singapore. These corporations are also facing competitive markets in the region as they seek expansion and growth. Banking, financial services, manufacturing and telecommunications are all data-intensive industries that are aggressively seeking new business opportunities.

As such, the need for on-demand access to the freshest data with easy-to-use tools or applications as well as a need for associated data integration and management tools continue unabated.

The following Figure 1 shows the spending on analytics software in the four functional markets in Singapore by key industry verticals.

Figure 1

Spending on Analytics Software in Four Key Functional Markets by Industry, 2014



Source: IDC Software Tracker, 2015H1

As shown in Figure 1, banking is the leading private industry investing in analytics software followed by telecommunications. This can be attributed to the fact that both industries are data-intensive ones providing huge potential into customer insights. In North America, applications and usage of analytics in these verticals are much more advanced and matured. This is especially so in the banking, insurance and other financial services sector where analytics is being applied in every aspect of operations (e.g., customer retention, risk management, fraud detection). Such advances are propagating worldwide, and Singapore organizations in these verticals have been adopting these industry-specific analytics software as they seek to be competitive.

The Singapore government itself invests significantly in analytics as it continues to push toward a culture of shared data among public entities and developing a data-driven culture in the public service. This approach started with the 2014 announcement to transform Singapore into a Smart Nation and momentum is gaining as more public-funded initiatives are put into place to meet the government's goals.

The following sections highlight insights, trends and use cases for the key verticals of banking, insurance and other financial services, government, manufacturing, retail and wholesale, and utilities.

Banking, Insurance and Other Financial Services

The Singapore government has been aggressively pushing for local, regional and global banks to centralize their analytics operations in Singapore. Several key factors drive this area of data growth and the need for data analysis, including the demand for wealth management and the growth of online and mobile payment systems. The key success factors for new financial products and services are driven by the next generation of analytics such as machine learning for trends identification and cognitive systems in sentiment analysis of customers or the market where data is unstructured (e.g., news headlines, call center recordings, social media).

Customer data is a treasure trove of insights into banks' customers, enabling banks to personalize product and services for their customers to increase market share and revenue. Such insights into customer behavior allow for effective multiple highly focused campaigns that target different segments of the customer base. At the same time, real-time data analytics allows banks to acquire new customers by offering next best offers that can convert leads.

Similarly, global insurance companies are actively setting up centers of excellence to address the need for data analytics. Such centers or teams are based out centrally of their regional Singapore headquarters with focused rotation through the regional branches to assist in data acquisition and analysis. The objective of such initiatives is to remove the technical data challenges and enable regional decision makers to have insights into regional and local data that were previously unavailable to them.

Government

The Singapore government has created initiatives to build public sector capabilities in analytics and drive the adoption of analytics by government agencies. One such initiative, Government Technology Organisation's (GTO) Government Business Analytics Programme, seeks to increase the adoption of analytics by government agencies by implementing shared business analytics services. The key objective is to develop a data-driven and evidence-based decision-making culture within the public service.

Progress for such a change in culture can be seen in social-focused projects curating and analyzing social services data from all non-profit social welfare organizations in order to improve the access and care for the less fortunate.

Manufacturing

In the manufacturing space, analytics plays a vital role in everyday decisions. Whether it is a local plant of a global LCD manufacturer or a local food production factory, the usage of analytics is essential in every aspect of the production process. From demand forecast to supply chain optimization, Singapore's position as a global trading hub provides an opportunity for analytics to increase revenue, lower costs and ultimately deliver high profitability.

In the last 18 months, there has been an uptick in both interest and adoption of advanced analytics such as in the area of predictive analytics and big data. This is due to a combination of factors which can be summarized by:

- The availability of large sets of manufacturing data including but not limited to the massive amount of real-time/near real-time machine data being generated by sensors or IoT devices which are ready for analytics consumption.
- The highly competitive local and global markets where the potential to reduce every single attribute of production costs and yield counts is being pursued.
- The highly technically inclined workforce which is receptive to testing and adopting new advances and innovation in advanced analytics.

Manufacturers are typically not adopting cloud solutions whether it is for storage or business analytics as a service. This can be attributed to the fact that the highly competitive industry seeks to protect valuable intellectual property and data, where safeguarding trade secrets and processes is of top priority.

This mindset might start to change as providers offer compelling value proposition through solutions in the cloud where it is not possible with an on-premises solution.

Based on IDC research, manufacturers have been seen to be strategizing to develop centers of excellence in analytics by setting up dedicated "SWAT" teams comprising both technical and business resources to test and prototype new analytics tools. Most are at an early adoption stage

of testing these new advanced analytics tools, and with vendors introducing user-friendly and self-service tools, the barriers of entry will continue to drop and allow organizations to quickly adopt and gain new insights using these new analytics platforms.

Retail and Wholesale

In the retail and wholesale sector, organizations use analytics to deliver three key objectives: maximizing and increasing revenue, optimizing inventory management and improving customer retention.

Organizations are utilizing near or real-time analysis of sales data and customer data to cross- or upsell products. This is applicable in both ecommerce and brick and mortar organizations.

At stores or warehouses, retailers are putting data in the hands of the frontline resources, allowing them to make timely decisions on negotiations, offers or managing inventory and staffing. For example, SingTel uses foot-traffic analysis to help determine the operating hours to allocate the optimal number of store employees at various retail store locations (e.g., increasing staff after office hours).

Online retailers have been the strongest adopter of analytics as they seek to grow revenue rapidly to gain market dominance. Some of the advanced analytics include profiling their customers' purchase history, demographics and tracking their web behavior in order to optimize their recommendation and next best offer models.

Similarly, at the enterprise planning level, fact-based analytics are used for budget, sales, marketing, store operations and merchandising. Such across-the-board insights are used to quickly respond to business trends in order to deliver topline growth and profitability for organizations.

In the wholesale sector, organizations are facing increasing pressure to reduce cost, and increase margins and quality. Many large distributors have already implemented predictive analytics whereas mid-sized distributors are starting to move into this area of analytics. Predictive analytics are used across the business processes in wholesale. For example, with the multicultural population of Singapore, purchasing and inventory optimization is done by analyzing historical inventory and order history of products. Predictive analytics is able to recommend purchasing quantities and schedules after identifying seasonal trends from the mentioned data.

For wholesalers, an important aspect of their business is management of customer credit facilities. With recent reports of business closures exceeding openings (in the months of December 2015 and February 2016), wholesalers are placing more importance using analytics on accounts receivables and customer profile data to build in advanced warning alerts.

Utilities

The Singapore government’s policy to progressively liberalize the retail electricity market has also increased the need for analytics in the sector such as capital planning, forecasting models to increase efficiencies in generation and customer insights. With market liberalization, the utility industry faces many new demands in data management and analytics. Commercial and residential customers have increased service expectations and regulatory policies and tariffs/pricing become key data-driven components.

Additionally, with the focus on smart/intelligent grid and adoption of smart meters come data challenges and a data opportunity for utilities to extract value from that data. Whether it is a smart metering device or a manual meter reading process, meter data requires data management to ensure quality of the data that is generated in volume. The smart grid is an electric transmission and distribution network that uses ICT to predict and adjust to network changes autonomously, to improve reliability, and to connect new sources of generation.

In the area of solar power generation, Singapore is aiming to increase solar deployment from the current 47MWp to provide about 350MWp of electricity by 2020. As such, the Energy Market

Authority (EMA) had awarded grants on analyzing the impact of solar energy on the grid while vendors seek to optimize the generation of energy by monitoring and analyzing generator data.

Continued investments by the Singapore government related to analytics include enhancing the security of Singapore's electricity grid against cyberattacks and developing smarter energy systems.

Analytics: Helping Put the "Smart" in Smart Nation

Singapore's Smart Nation initiative, spearheaded by the Infocomm Media Development Authority of Singapore (IMDA), will drive adoption of analytics in Singapore in the next five years. Analytics and data-driven insights are imperatives to the "smart" in smart cities. With the Smart Nation vision, investments from the government agencies focus on availability of infrastructure, data and talent. This will in turn provide opportunities for organizations as follows:

- **Infrastructure.** The continued enhancement of pervasive network and communications backbone, with developments such as Aggregation Gateway (AG) boxes and Heterogeneous Network (HetNet), will allow organizations to build sensor network and collect more data. As part of the Smart Nation, forming a “Data Center Corridor” can allow companies to access domestic and international markets faster and more easily.

- **Data.** Singapore aims to create a trusted data marketplace, where private and public data sets are available in a systematic way. The public sector is sharing data on the open data portal, data.gov.sg, which has been continuously improved for user accessibility. In 2014, IDA embarked on a data-as-a-service pilot to encourage standard sharing of data from private organizations.

- **Talent**. The lack of analytics skills is a key challenge for effective analytics adoption. Educational institutions are building labs and courses to groom data and analytics talent. The government is also working with industry players on the Company-Led Training (CLT) Programme.

For individuals and organizations, there are opportunities to leverage the infrastructure, capitalize on data, and even collaborate and develop innovative solutions. Government agencies have also kick-started their internal development with data analytics to better serve citizens. For example, investment in mobile apps to aggregate demand and delivery of real-time status for public transportation.

Future Outlook: Five Key Trends Impacting the Analytics Market and Smart Nation Initiative

In the next five years, IDC foresees five trends from the IDC FutureScape: Worldwide Big Data and Analytics 2016 Predictions — APEJ Implications that will impact the analytics market in Singapore, and the journey toward Smart Nation.

1. Analyzable Data — By 2020, the High-Value Data Worth Analyzing to Achieve Actionable Intelligence Will Double

Singapore organizations are collecting more unstructured content from non-traditional data sources such as customer interactions, web clickstreams, sensors, audio and video. But analysis of these data is still not extensive in most organizations. According to IDC's APEJ MaturityScape Benchmark Survey 2015, 45% of Singapore organizations are collecting rich media data, such as video, audio and images, but not analyzing them. Similarly, 37% of these organizations are collecting web clickstreams but not deriving insights from them. These data contain potential value that is untapped.

IDC predicts that much of the growing high-value data will be from the unstructured content. The adoption of the new generation of text, audio, video, image and sensor data analytics technology,

as well as applications of machine learning, will radically improve the ability of technology and people to separate signal from noise.

Singapore government agencies have started to experiment on rich media analytics for crowd management and flood monitoring, leveraging the CCTVs around the island. However, the adoption of unstructured data is still limited in some industries. As the technologies mature, more Singapore organizations can leverage this high-value data to achieve actionable intelligence.

2. Actionable Information — By 2020, 40% of Information Delivered to Decision Makers Will Be Considered by Them as Always Actionable, Doubling the Rate from the Current Level

In Asia/Pacific, about 1 in 5 organizations consider information as actionable now. For Singapore organizations, only 10% think their insights are actionable. However, the demand for actionable intelligence is rising. Advances in and adoption of predictive analytics, cognitive computing, and analytic-transactional data platforms and applications (enabled by in-memory computing) will ensure that actionable information is delivered to decision makers including executives, managers, frontline employees, and increasingly, automated systems.

The data-driven actions will be key to delivering value in the Smart Nation initiative. In 2015, A*STAR Institute for Infocomm Research launched the A*STAR Data Analytics Exchange Platform (A*DAX) to help citizens, business and public agencies to make informed decisions and take data-driven actions. These efforts will provide more technology options for decision makers to ensure more insights delivered are actionable.

3. Shortage of Skilled Staff Will Persist and Extend from Data Scientists to Architects and Experts in Data Management

There is no doubt that skill shortages in the BDA field is a global phenomenon, but this trend is even more prevalent in APEJ. In fact, based on findings from IDC's AP Continuum Survey 2015, 39% of respondents have indicated data-related issues (e.g., inability to scale with the increasing amounts of data, issues with data quality) as their biggest challenge in BDA deployments. In Singapore, concerns over data-related issues are even stronger with 54% citing this as a challenge.

Singapore is relatively mature in analytics among the Asia/Pacific region, and the Smart Nation efforts will develop more analytics skills. However, data analysts and scientists alone are not sufficient. The roles of specialized professionals such as data architects and data management experts (e.g., ETL developers, NoSQL, Hadoop, Python experts) will become more important as access to and integration of multiple data sources are key in all analytics and big data initiatives.

Organizations should consider taking a skills inventory to understand the skill gaps, upskill existing data analysts or developers where possible and build a multi-disciplinary team to tackle various challenges.

4. Through 2020, Spending on Self-Service Visual Discovery and Data Preparation Market Will Grow 2.5X Faster Than Traditional IT-Controlled Tools for Similar Functionality

Through 2015, self-service in the context of BDA has been mostly associated with visual discovery. Latest demand and supply trends point to a greater recognition that self-service analytics can't exist without self-service data acquisition and preparation. In Asia/Pacific, the demands for consumable data insights and shorter deployment cycles have driven the growth of self-service visual discovery. Data quality and availability, however, remain as the top IT challenge for BDA, based on IDC's APEJ Big Data Pulse 2014.

Time spent on cleansing, curating and integrating data is still disproportional to analyzing data. Organizations will embrace more accessible data preparation tools as they drive a wider use of

data in decision making. The growth of self-service capabilities will also help in alleviating the challenges of the analytics skill shortage in Singapore.

5. By 2020, 40% of All Business Analytics Software Will Incorporate Prescriptive Analytics Built on Cognitive Computing Functionality

Cognitive software analyzes, organizes, accesses and provides advisory services based on a range of structured and unstructured information, and provides a platform for the development of analytic and cognitive applications. Cognitive software supports human decision making with more accuracy, confidence, speed and agility based on broader and deeper bodies of evidence applied to a more comprehensive view of pertinent conditions without bias. These platforms provide for data curation and continuous automatic learning (e.g., machine learning, deep learning, AI) based on past experiences.

Cognitive computing is becoming an important and integral part of society as organizations progress through the maturity stages of BDA — from basic descriptive and diagnostic requirements to more predictive and prescriptive undertakings. Cognitive computing is able to extend human capabilities beyond understanding by quickly ingesting vast amounts of data and presenting accurate insights through a feedback loop (learning over time via human guidance and interactions).

The need for more actionable and automated insights will drive the demand for cognitive computing functionality. Many vendors have started to tackle this problem by embedding cognitive capabilities (e.g., machine learning, deep learning) in their BDA solutions. IMDA is encouraging start-ups and tech companies in Singapore to develop cognitive-enabled applications to serve various industries. IDC expects, in the next two years, the cognitive capabilities to become available in many new applications to serve data demands in both the public and private sectors.

Conclusion

Singapore's economy is slowing as it faces economic headwinds and risks of entering a contractionary period in 2016. However, it has made good investments for the future, including ambitions to become the data hub for Asia. Due to Singapore's high operating costs, cost optimization initiatives driven by data analytics are at the top of every organization's agenda.

In IDC's MaturityScape Benchmark Report for Big Data and Analytics in Asia/Pacific for 2016, Singapore is in the same leading group as Australia, New Zealand and Korea for BDA maturity in APEJ, followed by Hong Kong, China, Taiwan and India. Despite the leading maturity level, there is a significant number of Singapore organizations (e.g., manufacturers, small and medium-sized enterprises) that are green to BDA, and where it is only through the initiatives of proof-of-technology/concept with relevant use cases that these organizations will understand the BDA value to move up the maturity curve.

As organizations strive toward better efficiencies and being market competitive, two innovation-related trends will emerge:

- **Adoption of cloud-based analytics solutions.** 5% of IDC's AP C-Suite Barometer respondents plan to deploy BDA as a service in 2016. IDC predicts that through 2020, spending on cloud-based BDA technology will grow three times faster than spending for on-premises solutions in Asia/Pacific. Several factors will drive this growth:
  - Open source technology and innovations will entice organizations to be able to quickly adopt and be able to access such innovations by having cloud vendors provide the infrastructure and services. Organizations' IT department can thus focus on core business processes.
  - Changes in data and privacy regulations will remove obstacles for using cloud-based BDA.
  - An OPEX model offered by cloud solutions is a more cost-effective solution compared to a CAPEX on-premises solution for organizations seeking to reduce costs.

  In the near-term, hybrid cloud analytics solutions are being offered to organizations that allow an organization's core data to remain on-premises while at the same time be able to move a

subset of their data to the cloud for processing and analysis. Such solutions, although complex in management, allow organizations to take advantage of BDA offerings on the cloud while having all their data being seamlessly integrated.

- **Adoption of cognitive computing analytics solutions.** Two key factors will drive the usage of cognitive computing in the next generation of analytics:
  - Cognitive computing technology such as unsupervised learning will alleviate some of the demand for data experts. Unsupervised learning allows organizations to curate large amounts of data that are refreshed regularly to be analyzed for trends and insights without requiring experts to "train" the network.
  - Graphics processor units from chipmakers such as nVidia and AMD are delivering and commoditizing supercomputing processing power, allowing for parallel processing of large datasets (e.g., SQL) or as dedicated deep learning and machine learning systems in the cloud or on-premises. For example, context-aware analysis can be done on unstructured data (e.g., online reviews, social media data streams) a hundred times faster so that retailers can react quickly to seize an opportunity or address deficiencies. Similarly, on the manufacturing front, more machine data can be analyzed a lot faster for fine-tuning of yield or for prescriptive equipment maintenance.

The Singapore government's initiatives to promote a data-driven culture as part of its Smart Nation initiative, coupled with government programs and collaborations with the private sector and tertiary educational institutes to groom a data-trained workforce, bodes well for organizations operating in Singapore as they strive to lead and innovate in the complex new convergent economy. However, to spur the next growth in BDA adoption and move up the maturity curve, the government has a critical and pivotal role in continuing to accelerate its push to publish more data including real-time data across all government-related agencies. Combined with initiatives such as data science challenges (e.g., Kaggle, Tianchi), it will spur innovations by organizations and promote growth of analytics skill sets. The success of Smart Nation is dependent on organizations being data analytics enabled and driven.
