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## ANALYTICS: A REVIEW OF CURRENT TRENDS, FUTURE APPLICATION AND CHALLENGES

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**Abstract:** Analytics is a body of knowledge that uses scientific process of transforming data into valuable insights for decision-making. With a massive exponential growth of various data, analytics bring benefits to those who fully utilized its capability across multiple strategic and operational levels. However, there is very limited academic papers address on the trends, especially on its future direction. Moreover, lack of study on research challenges demand further investigation in the field. Therefore, a study on current trends, challenges and future application need to be implemented. Based on findings, we found that currently, the analytics is done manually, which required skilful human resources. Meanwhile, the future trend of analytics will be integrated with artificial intelligence capabilities to automate every process in automatic workflow, which called as Augmented Analytics. As a result, the significant of augmented analytics brings a numerous perspectives of analytics that avoid human bias in decision making. The impact of this study provides a new opportunity for other academics, researchers and industrial players to moving forward for a new analytics revolution.

**Keywords:** analytics; current; future; augmented analytics; artificial intelligence

### I. INTRODUCTION

In the new global economy, technological based advancement in various aspects of life has become a central issue for living in the world today. Interestingly, there are 12 clusters of emerging technologies that drives the fourth industrial revolution (IR 4.0) such as block chain and distributed ledger technologies, the internet of things (IoT), artificial intelligence (AI) and robotics, additive manufacturing and multidimensional printing, virtual and augmented realities, biotechnology as well as neuro technologies[1]. Despite the growth in the emerging technologies, however, there is increasing concern over these emerging technologies started to change the human lifestyle. For example, the widespread use of health and

fitness oriented wearable devices that utilize the concept of IoT for better healthcare monitoring.

In fact, the fourth industrial revolution and digital technology is pretty much related to each other in terms of technology advancement. We are now embracing the third wave of digital technology and very near to the fourth wave. In the third wave, which starts on 2010, we can see the emergence of IoT technology[2]–[5]. Furthermore, the fourth wave starts on the year 2020 will highly focus on AI and Robotics as its main technology [2],[3].

Fascinatingly, the potential of all this emerging technologies will be unlock with the new 5G wireless network that foster in speed, capacity and connectivity,

which leads to new products, services, business models as well as entire industries [6][7]. All of these technologies will significantly contribute to the explosive growth of data exponentially. As a matter of facts, data are like a new fuel for this century. It is a golden opportunity for those who really utilize the full potential of data for gaining insight.

Analytics is a body of knowledge that uses scientific process of transforming data into valuable insights for decision-making [8][9]. It often uses mathematics, statistics, machine learning, optimization and simulation in the process of gaining insights. Analytics is seen as a multidisciplinary discipline that has given its significant nature to solve the problem. There are three different types of analytics: (1) Descriptive analytics, (2) Predictive Analytics and (3) Prescriptive analytics. Descriptive analytics seeks to answer questions like “what has happened?”. This is the most basic level of analytics in which historical data and the real time incoming data are analyzed using mostly basic statistical techniques and mathematical techniques.

On the other hand, predictive analytics seeks to answer questions like “what is going to happen?”. This level of analytics uses mostly machine learning and statistics such as linear regression, multivariate regression, random forest, decision trees, Naïve Bayes and k-means. The third level of analytics, which is prescriptive analytics seeks to answer questions like “what should we do?”. This level of analytics often uses optimization and simulation in order to determine the most appropriate solution. Regardless of any type of analytics, each one brings benefit to the organization if it is use wisely. Furthermore, utilizing the benefits of analytics parallel with current technologies and future trend will definitely give any organization competitive advantages.

Considering the benefit and potential of analytics, it is worth for us to view its current trend as well as its future trend. Nevertheless, less academic papers address on this analytics trend. Hence, this paper is written to serve as a short communication to explore the current state as well as the future state of analytics.

Section I shows the introduction, Section II presents the current state of technology while Section III presents the future state of technology. Finally, Section IV presents results and discussion that discuss the challenges of analytics, current technology and its future technology; and Section V gives the conclusion that summarizes the study in paper.

## II. THE CURRENT STATE OF ANALYTICS

Analytics is a fundamental property of Business Intelligence (BI) and becoming a key instrument in integral elements for various sectors of industries. It can be seen that with analytics, organization can improve operational performance as well as having opportunities to create new market [10]. In fact, professional with data analytics skill who uses algorithm and visualization techniques, as a way

to capture and analyze huge amount of data for decision making is so interesting. This job has been declared as the sexiest job in the 21st century, as reported in [11], [12]. Although the report was released in 2012 and it has been quite sometimes now, analytics is still currently the sexiest job as the demand remain high [13]. In 2018, the job postings that require data analytics skill had been increased by 28% as compared to the previous year and in general account for about 344% increased since 2013 [14]. Moreover, there is still a huge gap between the demand and supply of this professional as the demand for professional data science and analytics continues to rise [15]. As a matter of facts, the number of data professional job is expected to reach about 2,720, 000 in 2020 [16].

Why this is happening? There are various factors that govern this trend. With the emergence of IoT in this fourth industrial revolution together with the availability of 5G, there will be millions of devices and sensors that will be online. Furthermore, new applications will definitely have emerged based on these devices and sensors in which IoT strategies need to be created by the industries. Hence, industries and the high technology companies are now looking for employees who can utilize the analytics skills in order to gather and extrapolate the data along with getting the machine learn and teach from each other through advance machine learning algorithm once they are connected [17]. In some of the cases, advanced algorithms for prescriptive analytics such as optimization and simulation are required to be developed. This skill is important in order to suggest appropriate solutions for some specific problems. Therefore, strong analytics skill is beneficial to be relevant in the industry.

Moreover, most industries now have the perception that analytics is among the top priority in the organization because its capability of improving the performance of the organization [18], [19]. An interesting survey has been done by KPMG among the CEOs of top companies in the world. Based on the survey, significant investment in data and analytics is aimed for three top objectives:(1) bottom-line growth improvement, (2) business transformation and (3) customer engagement [20]. Moreover, analytics is also a key factor in decision-making process. Besides, faster decision-making can be done with the availability of high-speed performance of Hadoop and in memory analytics through immediate analysis of the new sources of data. With the increased awareness of the significance of analytics among the top management in the organization, there is tremendous opportunity for analytics careers to soar.

Analytics requires a strong problem solving skills. These include understanding the problem, applying appropriate quantitative skills and finally close the loop by relating the result and recommendation with the problem being investigated. It must be noted that the quantitative skills that is often use in analytics are mathematics, statistics, machine learning, optimization and simulation in order to obtain meaningful insight from the data. Apart from the view of solving the problem, acquiring quantitative skill is significant to have a logical sense and reasoning. Once analytics professional has completed the phase of solving

the problem by applying appropriate quantitative skills, it is also a great advantage if the data science and analytics professional has a good communication skill to convey the results to the decision makers.

Nowadays, there are many higher institutions in the world offering undergraduate and postgraduate degree in analytics. The proliferations of these academic programs happen in order to meet the growing demand of analytics professional. According to [21], analytics academic program at master degree level can be divided into three main groups: analytics, business analytics and data science and its growth in terms of cumulative number of program in the United States is illustrated in Fig. 1. It can be seen that data science started to emerge in 2013 as a close kin to analytics and both curriculum structure is often described in similar term. MSc in analytics will be like a new MBA for this 21<sup>st</sup> century. Many professionals are now looking for postgraduate degree in analytics in order to up skill and re-skill their career pathway.

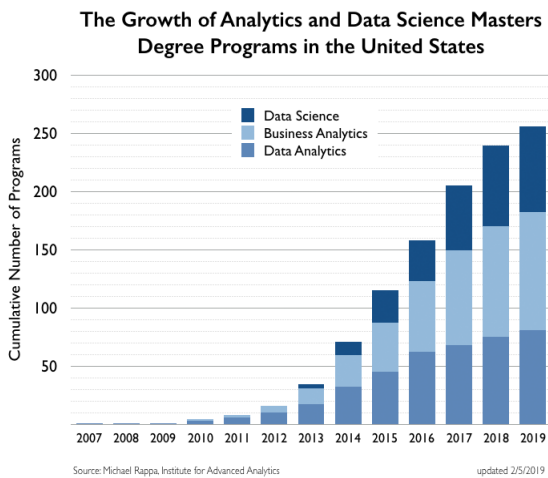


Fig. 1. The growth of analytics academic programme in the United States [21].

Various professional certifications are available for those who want to be recognized as certified data science and analytics professional. The vendor or software provider, professional bodies as well as universities provide these certifications in which it can be a proof of having the right skill sets of analytics. These include having the right knowledge on the concepts and principles as well as applying the appropriate techniques and tools of analytics to solve the problem. According to [22], among the reasons for having analytics certification are (1) the high demand for analytics professional, (2) enormous job opportunity and to close the skill gap (3) positive and exponential growth of salary for data scientist(4) organizations now aware of the top priority of utilizing analytics and finally (5) flexible to work in any sector. Among the top 26 big data and analytics certifications are as follow [23]:

- Amazon Web Services (AWS) Certified Big Data - Specialty
- Analytics: Optimizing Big Data Certificate

- Certification of Professional Achievement in Data Sciences
- Certified Analytics Professional
- Cloudera Certified Associate (CCA) Administrator
- Cloudera Certified Associate (CCA) Data Analyst
- Cloudera Certified Associate (CCA) Spark and Hadoop Developer
- Cloudera Certified Professional (CCP): Data Engineer
- EMC Proven Professional Data Scientist Associate (EMCDSA)
- HDP Apache Spark Developer
- HDP Certified Developer Big Data Hadoop
- Hortonworks Certified Associate (HCA)
- IBM Certified Data Architect – Big Data
- IBM Certified Data Engineer – Big Data
- MapR Certified Data Analyst 1.9
- MapR Certified Hadoop Developer 1.0
- MapR Certified Spark Developer 2.1
- Microsoft Certified Solutions Expert (MCSE): Data Management and Analytics
- Mining Massive Data Sets Graduate Certificate
- MongoDB Certified DBA Associate
- MongoDB Certified Developer Associate
- Oracle Business Intelligence Foundation Suite 11 Certified Implementation Specialist
- Post Graduate Program (PGP) in Big Data Analytics
- SAS Certified Big Data Professional
- SAS Certified Data Scientist Using SAS 9
- Stanford Data Mining and Applications Graduate Certificate

### III. FUTURE TREND OF ANALYTICS

Looking at the current practice of analytics, organizations often perform data preparation, data analyzing, advanced analytics model development, result interpretation as well as story telling manually. With massive explosion of data volume and the increased complexity of data, the number of variables that govern the outcomes will definitely grow. This in turn resulted in difficulty for exploring all possible patterns and it would be almost impossible to determine the most relevant actionable insights manually. Furthermore, business people and analysts tend to explore their bias hypothesis, hence they might miss key finding and this will lead to deriving at incorrect conclusion. This condition will definitely affect decision and outcomes in negative way. Therefore, a new paradigm that is aim at dealing with this issue is now being created for data and analytics: Augmented Analytics.

Augmented analytics is the next wave and the future trend to data and analytics [24]–[26]. According to [27], there is three groups of complimentary trend in the future; Augmented analytics fall into intelligence theme group in which AI is giving an impact. It is an approach that uses machine learning and natural language processing to automate insights [25]. In other words, it is like a virtual data scientist that performs activities of transforming data to insight which includes data preparation, deciphering data

pattern and building model as well as distribute and operationalizing data finding. In some aspect, AI is making the analytics more human by allowing us to consider complex problem in context and thus connecting all the non-linear dots with intuition and empathy [28]. According to Gartner report, most vendors now are integrating augmented analytics capability as a differentiator in their product with premium price [29].

According to Gartner [25], augmented analytics includes: (1) augmented data preparation, (2) augmented data discovery and (3) augmented data science and machine learning. Augmented data preparation allows the business user to augment data profile and quality, harmonize, model, manipulate, enrich as well as develop and catalogue metadata by using machine learning automation [25]. Augmented data discovery allows relevant findings such as cluster, links, correlations, exceptions and predictions to be found, visualized and narrated automatically with no models building or algorithms writing required [25]. As for augmented data science and machine learning, the key aspect for advanced analytics modeling will be automated, which will certainly reduce the required specialized skill [25].

In general, analytics workflow has three main activities. It starts with data preparation and then continues with finding the pattern in data as well as building the models. Finally, the workflow ends up with sharing and operationalizing the findings. Both current analytics and augmented analytics share the same activities. However, it must be noted that the approach and method to perform the three activities differ between current analytics and augmented analytics.

Fig. 2 illustrates the changing approach of the first activity in the analytics workflow. The current analytics, which centered at visual-based data discovery, still use manual approach in preparing the data. Most analytics platform offers basic data preparation capabilities but this is generally very minimum and often very difficult to be used for business users. As a matter of facts, there is a lot of work to be done manually for data profiling, quality, modeling, manipulation, enrichment and development of metadata as well as harmonization work. On the other hand, augmented analytics will perform this activity automatically by using machine learning algorithm in order to find data relationship, profiling and recommending the best approach to clean, reconcile, enrich, manipulate and perform data modeling with capabilities of capturing metadata and lineage for reuse and governance [25].

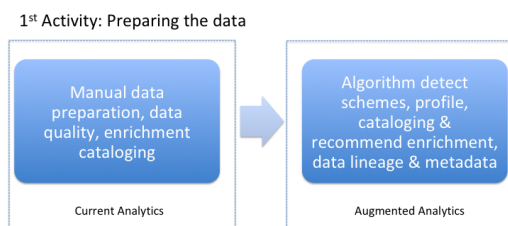


Fig. 2. The changing approach of the first activity in the analytics workflow [25].

Fig. 3 illustrates the changing approach of the second activity in the analytics workflow. The current analytics, which centered at visual-based data discovery, still explore the relationship and patterns in data manually using interactive visualization. Moreover, all feature engineering and the processes of building the model are done manually. It would be a very time consuming task especially when dealing with large, complex and highly dimensional data (for example with 10 or more columns). Hence, business users often decide to explore the data based on their own hypothesis that leads to bias. Besides, business user might miss important insight and relationship when all possible combinations are not fully covered. On the other hand, augmented analytics use algorithm automatically to detect correlations, clusters, segments, outliers as well as relationships. Another distinct advantage of augmented analytics is there are various algorithms being applied in parallel to the data in which this approach will reduce the risk of missing important insight. The insight can be both visual and interestingly, in a form of narrated in natural language [25].

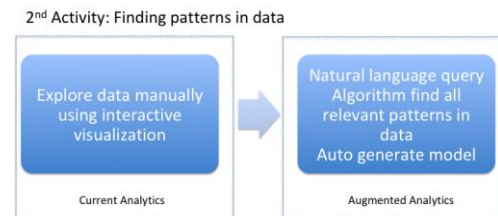


Fig. 3. The changing approach of the second activity in the analytics workflow [25].

Fig. 4 illustrates the changing approach of the third activity in analytics workflow. The current analytics, which centered at visual-based data discovery, visualize the findings through dashboards and storytelling. This includes offering collaboration capabilities in sharing and socializing the findings. As a matter of facts, visualization only is not enough to show clearly what is significant in the data and also some users are lacking in the ability to interpret the statistically significant visual based insight. On the other hand, augmented analytics enhanced this particular third activity by not only visualized the insight but also narrate the finding in natural language by incorporating the natural language generation [25].

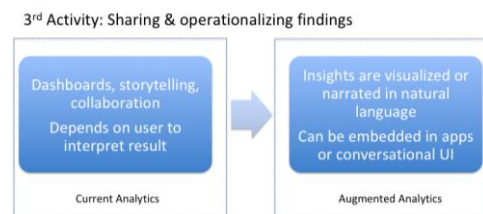


Fig. 4. The changing approach of the third activity in the analytics workflow [25].

#### IV. RESULT AND DISCUSSIONS

Based on the investigation of the current and future trend of analytics, a time line of the revolution starting from 2018 onwards can be visualized as in Fig. 5. Findings from the existing major study are maps into the time line in order to give a general overview of the trend of analytics job market. In this study, the time line can be divided into three

phases. The first phase which is the current one until 2021 is focusing on the human intervention on analytics. Majority of the industries are still looking for human to conduct analytics in most of the process in order to improve various operations. With very strong growth of the job that requires analytics, it has been coined as the sexiest job in the 21<sup>st</sup> century. This is another reason why there is a lot of academic institutions offers academic program related to analytics.

### The Trend: Job Market

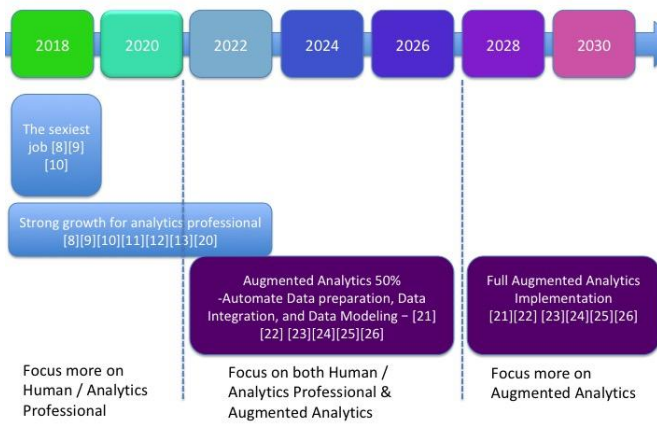


Fig. 5. The time line for current and future of analytics

In the second phase of the time line that start on 2022 onwards, most of the industries will focus on the use of augmented analytics in their operations. It is reported that about 50% of the analytics workflow will be handled by the new approach. Having said that, the processes in analytics work flow such as data preparation, data integration and data modeling will be automated. With this regards, the investment will be on the augmented analytics platform rather than only human professional. However, the analytics job is still seen as one of the emerging job and the growth of analytics professional is still strong.

Finally, the third phase of the time line which start on 2028 onward will be focusing on the massive use of augmented analytics. Most industries will rely on the augmented analytics platform to assist decision making. The impact of this new approach is expected to be felt by various industries such as healthcare, education, telecommunication, banking and finance, consumer goods industry, transportation, manufacturing and cyber security. Although all the analytics process can be done automatically at that time, but human is still required to verify the result and do some judgment when necessary.

However, there are still current challenges that need to be faced in order to move on to the future trend. One of the obvious challenges is the readiness of the data. Although the data is continuing to grow exponentially, but to date, there are still organizations or institutions that do not have strategy or mechanism to pull in and integrate the data optimally. In some cases, although the data originally comes from the organization, but the ownership of the data belong to outsider such as the vendor that provides the services. It would be troublesome to perform analytics

when the data is not available especially bureaucracy is required when dealing with government agencies. Therefore, organizations or institutions need to have proper strategies and mechanism in order to ensure the data platform available and well organized.

Another challenge is that most of the current analytics techniques are fit for small to medium size of data scale. When it comes to big or huge data, the techniques need to be improves so that the science of analytics can be fully utilized. Therefore, in order to move on to the new approach of augmented analytics, it is not only the process to be automated but serious focus need to be highlighted on the specific algorithm or techniques to transform big data into insight. Hence, more research work need to be done to explore new analytics techniques for big data application.

Academic institutions or universities that offer undergraduate and postgraduate analytics program should reevaluate their current curriculum structure. With the new trend, universities need to come out with a new brand of academic program that is parallel with the new paradigm of analytics. The concepts such as Natural Language and Machine learning need to be more advanced and blend together in the program in order to move to the new direction. Certainly there must be new revolution and advancement related to the concept along the way which must be integrated into the academic program. Therefore, the director or coordinator of analytics program must take into account the advancement of this knowledge. This includes enrich on the existing curriculum structure as well as introduce any relevant subjects in order to produce graduate that is relevant to the industry. Moreover, the direction of the research activities toward enriching the knowledge required for augmented analytics should also be considered.

Analytics solution providers definitely will view the new trend as an opportunity. In order to stay competitive advantage, most of the business intelligent vendors are now working towards integrating the capabilities of augmented analytics in their platform. Further research and development is extremely crucial for producing relevant solution and technology tailored to the new trend. This must include all three types of analytics to be augmented; (1) Descriptive (2) Predictive and (3) Prescriptive. On the other hand, business owners need to be aware of this emerging technology in order to help them make a better decision and judgment for investing in analytics products. This technology will help and prepare them to run their business and compete in the world without boundaries. As analytics is very significant in giving meaningful insight for their business performance, they should invest to hire very good expert data analysts. Although the augmented analytics will be adopted in the business operation and strategies, the expert data analysts are still required as these persons can validate the smart data discovery, visualizations, self-service, data governance, planning and predictive insights of the business. They will help the business owners take the necessary steps to grow the business and compete globally.

## V. CONCLUSION

The power of analytics could not be denied in giving meaningful insight based on the data in order to come out with fact-based decision. It is a body of knowledge that uses scientific methods such as mathematics, statistics, machine learning, optimization and simulation to find meaningful pattern and knowledge. Answers can be produced to the questions that we are trying to find in which instinct only is not good enough. As have been presented in previous sections, analytics will make its journey into a new paradigm in which the workflow of analytics is being automated. This leads to a new trend that known as "Augmented Analytics" where AI is giving an impact to the analytics body of knowledge. With the new paradigm, organization such as academic institution, analytics solution providers as well as business users certainly need to think of appropriate strategies for responding to this disruption in data and analytics market.

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