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Kirstin Gillon
ICAEW, kirstin.gillon@icaew.com

Sinan Aral
MIT Sloan School of Management

Ching-Yung Lin
IBM T. J. Watson Research Center

Sunil Mithas
Robert H. Smith School of Business, University of Maryland

Mark Zozulia
Deloitte Information Management Practice

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Abstract:

Business analytics systems are seen by many to be a growing source of value and competitive advantage for businesses. However, it is not clear if increasingly advanced analytical capabilities create opportunities for radical change in business or just represent an incremental improvement to existing systems. What are the key questions that researchers should be focusing on to improve our understanding of analytics? And are Information Systems (IS) programs teaching students the right things to be successful in this environment? This panel at International Conference on Information Systems (ICIS) 2012 took stock of technological possibilities, practical experience and leading research to assess the current state and future direction of business analytics. In doing so, it brought together senior researchers and industry representatives to share the leading challenges, opportunities and good practice that they see.

Keywords: big data; business analytics; intelligent systems; competitive strategy; data mining; decision support systems; disruptive technologies; information resources; IS curriculum; IS research agenda; panels

Editor's Note: The article is based on a panel presentation at the International Conference on Information Systems, held in Orlando, December 2012.

Business Analytics: Radical Shift or Incremental Change?

I. INTRODUCTION

Business analytics systems are seen by many to be a growing source of value and competitive advantage for businesses [Davenport, 2006; Dhar, 2013; LaValle, Lesser, Shockley, Hopkins and Kruschwitz, 2011]. There is strong industry enthusiasm for analytics, as well as the associated trend of big data [Eaton, Deroos, Deutsch and Lapis, 2012]. There is also a growing academic literature on the opportunities to create value through data-driven decision making, both at a macro and micro level [See Aral and Walker, 2011; Brynjolfsson, Hitt and Kim, 2011; Mithas, Ramasubbu and Sambamurthy, 2011; Muchnik, Aral and Taylor, 2013; Aral and Walker, 2012].

However, it is not clear if increasingly advanced analytical capabilities create opportunities for radical change in business or just represent an incremental improvement to existing systems. Furthermore previous generations of decision-support technologies have frequently failed to deliver their full potential in practice and many businesses are struggling to make sense of their already large volumes of data. Are businesses well-positioned to take advantage of the new opportunities created through analytics and big data?

This panel session at ICIS 2012, organized by ICAEW[1], brought together leading researchers and practitioners to share knowledge and insights on analytics and big data. The session aimed to articulate what is new about these trends and understand the implications for businesses.

Background

While conceptually the same as previous generations of decision-support technologies, business analytics systems are marked by their increasing focus on pattern recognition and prediction, rather than historical reporting. These systems take advantage of the convergence of two key developments in technology.

First, they draw on the vast explosion of "big data" in recent years, which is projected to continue in the future. While content continues to grow, the explosion in data is being driven particularly by internet activity, much greater use of pictures and videos, mobile technology and the embedding of chips in everyday physical items. Therefore, businesses can increasingly access a vast digital trail about where we are, what we are doing, what we like and the state and location of our physical assets [Brynjolfsson and McAfee, 2011a; Lohr, 2012; McAfee and Brynjolfsson, 2012].

The trend of big data is associated with 3 V's: Volume (large scale), Velocity (moving or streaming data), and Variety (data in different forms, e.g. numerical, text, video) [Eaton et al. 2012]. One can add a fourth "V": Veracity. Increasingly, organizations have to deal with more and more uncertain data, i.e., inconsistent, imprecise, ambiguous, and sometimes deceptive data, especially from social media and sensors.

Second, analytics techniques are becoming more powerful, from reporting data to understanding and predicting, and increasingly to optimizing and learning systems that can continually adapt to new conditions.

This powerful combination of data and analytical techniques enables increasingly complex decisions to be automated. As a result, the possibility of automation is moving far beyond traditional transaction processing tasks into territory which has historically been seen as reliant on human judgment [Brynjolfsson and McAfee, 2011b]. In other words, the combination of data and analytical techniques can potentially enable firms to move beyond description to prediction, and eventually to prescription in their analytics maturity.

However, to what extent does this represent radical change in the business environment?

Panel Overview

In order to answer this question, it is necessary to consider two aspects. Firstly, analytics may change the external environment and require businesses to rethink their business models, their competitors and the way that they compete in the marketplace. Secondly, analytics may change the internal environment and require businesses to rethink the skills and resources they need, as well as their governance and decision-making structures. Therefore, to

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[1] Institute of Chartered Accountants in England and Wales

address the overall theme of whether we are seeing a radical shift in the business environment, the session explored two questions:

- To what extent do increasingly advanced analytics systems represent a qualitative change in opportunities to generate value and competitive advantage?
- To what extent do organizations need to develop new resources, capabilities and skills to maximize the impact of analytics systems?

The panel was based on a dialogue between practice and research and the panelists represented a diverse range of knowledge and experience. Kirstin Gillon (ICAEW) moderated the panel and panelists were:

- Sinan Aral, MIT Sloan School of Management
- Ching-Yung Lin, IBM T. J. Watson Research Center
- Sunil Mithas, Robert H. Smith School of Business, University of Maryland
- Mark Zozulia, Deloitte Information Management Practice

Brief background statements can be found about each panelist at the end of this article.

Gillon opened the session by outlining the experience of ICAEW members (e.g. finance directors, finance controllers and auditors) with analytics and previous generations of decision-support technology. The session was then divided into two parts to address each question in turn. All panelists gave a brief response to the question, before the session was opened to the audience for questions and a general panel discussion.

Radical or incremental?

Before moving onto the detailed questions, however, panelists were challenged to give a one minute response to the question 'Business Analytics: Radical Shift or Incremental Change?' The responses were varied, with the academics focused on the new opportunities of analytics and the practitioners more mindful of the practical challenges of implementation:

- Aral was the strongest advocate for the idea that business analytics will lead to radical changes in the business environment and argued that the most successful businesses in future will be those with "science under the hood".
- Mithas suggested that we would see "incremental adoption of a potentially radical change" - while big data and business analytics promise radical possibilities, it will take a while for many organizations to catch up with the potential of what technology offers.
- Zozulia argued that the changes were incremental and highlighted some of the organizational challenges in adopting analytics, such as working out how to use all the data now being captured and maintaining appropriate control and governance.
- Lin also supported the view that it is incremental change and stressed the technical challenges of building systems to analyze big data, although he was optimistic about the chances of success.

Gillon took a straw poll of the audience and a clear majority took the view that the changes were incremental rather than radical.

II. VALUE AND COMPETITION

Introduction

The first half of the panel discussion focused on the external environment and the extent to which increasingly advanced analytics systems represent a qualitative change in opportunities to generate value and competitive advantage.

Businesses have made substantial investments in reporting technologies for many years, from Executive Information Systems to Customer Relationship Management Systems and Business Intelligence. However, it has often proved difficult to pinpoint tangible benefits generated by such systems and improved management information. This is reflected in a lack of research into the benefits of Business Intelligence systems [Jourdan, Rainer and Marshall, 2008].

While there is emerging research on the value of being a data-driven organization [Brynjolfsson, Hitt and Kim, 2011; Mithas, Ramasubbu and Sambamurthy, 2011], there is a real need for greater insight into the ways in which organizations should prioritize their data investments and resources.

As capabilities become more sophisticated, and the amount of data available increases, the opportunities for generating value and competitive advantage will grow. However, analytics capabilities to date have largely concerned incremental change - being embedded into operational processes to improve the management of supply chains and customer relationships and incorporated into risk management processes to enable them to be more proactive.

Are there more radical possibilities to reshape industries and competitive landscapes? Which industries are likely to see most disruption as these capabilities become more sophisticated? Are incumbents well positioned to take advantage of these capabilities? Or is there space for new players?

Panel views

The panel discussion focused on specific examples of business use of data and analytics.

Mithas started the discussion by outlining the ways that big data and analytics-based information management capabilities can generate economic value for an organization. He proposed the acronym ADROIT to understand the role of Information Technology (IT)-enabled information flows in creating competitive advantage, which parses the value created by IT into six components, namely:

- Adding volume and growth by leveraging current products and services, channels or customers or by developing new products and services, channels or customers
- Differentiating or increasing willingness-to-pay
- Reducing costs
- Optimizing risks and operations
- Improving industry structure, innovating with products and services and by generating and deploying knowledge and other resources and capabilities
- Transforming business models and business processes for continued relevance in a changing landscape

The ADROIT framework captures the role of IT in creating competitive advantage through five key drivers of sustainable economic value: volume, margins (through differentiating, reducing costs or improving industry attractiveness), optimizing uncertainty or risks in competitive environment, improving resources and capabilities of an organization, and continuous transformation to shape and respond to changing competitive landscape.

He went onto highlight evidence that organizations which have better information management capabilities achieve improved performance in many different ways [Mithas, Ramasubbu and Sambamurthy, 2011; Mithas, Tafti, Bardhan and Goh, 2012]. Firms will have to evaluate big data and business analytics to answer the question whether these technologies represent a sustaining or a disruptive change and what their strategic posture should be. One key question in this context is the extent to which business analytics might enable firms to pursue ambidextrous strategies (e.g., pursuit of revenue growth and cost reduction at the same time). Although prior work suggests that IT-enabled revenue growth is a stronger driver of firm profitability, these findings do not focus specifically on analytics capabilities. They emphasize the importance of information to a business and suggest the potential value of effective use of analytics.

Aral focused on the specific opportunities presented by the massive increase in data which is being captured. While he accepted that volume in itself is not important, he suggested that nano-data on human behavior, such as mobile and location data, has the potential to generate tremendous economic value. The consistency and veracity of this data, combined with the ability to experiment in real time, will help businesses to understand the causal relationships between human behavior and economic value more clearly. This new insight can inform business decisions. It also improves consumer welfare, with less deadweight in the economy and a stronger match between supply and demand.

Zozulia was more cautious about the potential value in the area. However, he did feel that the degree of investment being made in the area by companies such as Deloitte and IBM emphasizes the industry's firm belief that building strong capabilities in analytics is essential for future business success.

He maintained that there was a wide disparity between different industries and that broad generalizations about the field should be avoided. Financial services and retail, for example, already have vast amounts of structured data. In

contrast, sectors such as government, media and healthcare cope with vast amounts of unstructured data. In both of these cases, new data and analytics technologies will mean experimenting with different types of data and figuring out how to marry structured and unstructured data. Therefore, the results are likely to be incremental rather than radical.

A company such as Google sits at the leading edge of big data and analytics and therefore is likely to be at the forefront of radical changes.

In other industries, companies may have to make radical changes to compete more effectively in the marketplace. Aral outlined two examples of businesses using analytics to shift their business models radically:

- Nike historically based its business success on brand and sourcing. Now, by gathering data from many new sources, it has built a digital platform offering innovative fitness services, leading to a radically different business model and new competitors.
- The New York Times is a traditional print newspaper struggling to survive in a digital environment. As a result, it has established a research and development lab to experiment with data and learn new ways of engaging with readers and making money in this radically different environment.

Lin also gave an example of how advanced analytics can bring value to an organization by improving internal processes. IBM's Small Blue system links together IBM employees from around the world into a single network, and includes information about expertise, publications, blogs and other connections. It has been used to improve knowledge sharing and efficiency around the organization.

However, all panelists agreed that exploiting analytics technologies and big data is still a long way off for the majority of companies. Indeed, many companies are still fixing problems in the traditional information management space, and face many challenges before they can achieve significant value from analytics technologies.

Lin raised particular concerns, echoed by the audience, about the ability of smaller businesses to get to grips with this area. The examples given through the session, and in industry and academic literature, primarily concern large companies, especially in the technology industry. It appears that only companies with substantial resources currently have the capabilities to exploit these systems. It was suggested that managed analytics services and subscription type models may help smaller businesses to build capabilities in the future.

III ORGANIZATIONAL BARRIERS

Introduction

There is often an underlying assumption that improved information and tools will lead to better decisions by managers. In turn, better decisions will lead to improved organizational performance. As a result, the focus of research and practice has typically been on improving the quality of data and tools.

However, the presence of more or better information does not necessarily lead to better decisions. Even if managers can make better decisions, that may not translate into improved organizational performance. As a result, understanding and improving tools and data can only provide part of the picture and there is a need to build better understanding of how businesses actually use these systems in practice and the complementary resources needed to exploit them [Shanks, Sharma, Seddon and Reynolds, 2010].

In particular, organizations are likely to need a wide range of skills to exploit business analytics systems, including technical skills, data skills, analytical skills and business skills. While IT departments have some of these skills, they may not have the analytical skills in particular which will be required to exploit systems. Is this a matter of concern?

In the light of these questions, how should IT departments work with other areas of the organization to build capabilities and a data-orientated culture throughout the business? And what should IS and business students be taught to help them be successful in this environment [Mithas, 2013]?

Panelists outlined a wide variety of challenges facing organizations in their exploitation of analytics systems and big data. These fall into three broad areas.

- Technology
- Management and governance
- Skills and human capital

Technology

While the technology may have improved substantially, the panelists highlighted significant technology challenges. Lin stated that there have been big improvements in storage and processing in particular, but other areas such as data mining are still problematic. This leads to a perception of what Zozulia described as a "Wild West" of tools, where it is difficult to tell what is hype and what is a proven product or service. Lin also raised concerns that, in many cases, what is being promised is not likely to work.

Zozulia outlined what he called the "Holy Grail" of integrating structured and unstructured data. In many cases, businesses have worked hard to conquer structured data and are now trying to figure out whether and how to integrate new pieces of unstructured data into this environment. Many banks, for example, have innovation labs running tools for big data, such as Apache Hadoop. However, this remains in very early stages for most businesses.

Management and governance

All panelists highlighted the depth of management challenges that organizations need to overcome in order to exploit analytics systems. Aral suggested that the number and variety of challenges support the argument that this is indeed radical change. If the change was just incremental and minor, organizations could simply continue doing what they currently do.

Mithas focused on the challenges to management and governance structures from analytics projects. Many of these stem from the cross-departmental nature of such projects, as well as the fact that most businesses are in the early stages of building capabilities in this area. He summarized some key questions that businesses need to consider when establishing management and governance structures around analytics using a 4D framework:

- Decision rights – who will have the decision rights for leading and sponsoring the big data and business analytics projects? To what extent should these decisions be made by business or technology executives and how centralized or decentralized should they be? How should IS, marketing, finance and business executives collaborate on such decisions?
- Department Role and Configuration – what is the role of IT department in developing analytics skills and implementing and exploiting systems? How does it interface with other business units and how are its services charged back to business units?
- Dollars – how much to spend and where should resources be focused? Where is the long-term advantage likely to be?
- Delivery – should businesses recruit and build in-house capabilities for business analytics, retrain existing staff or outsource to specialist providers?

Zozulia picked up on the role of the IT department and how responsibilities are split between IT and the wider business. He has seen a variety of models in practice and did not believe that a preferred solution had yet been established.

A question from the audience concerned the importance of leadership and panelists agreed that strong leadership was essential to success. Aral described this shift as one from a culture of Highest-Paid Person's Opinion ('HiPPO') to a data-driven decision-making culture.

In many cases, though, senior management do not have sufficient understanding of data to give this leadership. Mithas suggested that more pressure may be needed from sources such as the stock markets to drive change. For example, if institutional and retail investors demand more information from firms and punish or reward them for how they are preparing for big data and business analytics, that can prompt firms to pay more attention to a more prudent approach to their information technology-based assets and capabilities. Aral went further and suggested that it may be necessary to bring in new leaders from outside the organization who do have greater experience and understanding of the importance of data and analytics.

Aral also highlighted the growing importance of managing privacy policies, advocacy and regulation. As businesses gather and exploit more and more personal data, there will be a need to manage customer expectations and compliance obligations.

Skills and human capital

A particular concern raised by panelists and the audience was skills. As Lin described it, the IT has become cheaper over the years, but the human capital has become more expensive. This is reflected in many predictions about the dire shortfall expected in data scientists in the next few years [Manyika et al, 2011].

Two particular aspects were highlighted. First, graduates need to have sufficient technical skills to undertake predictive modeling, understand the statistical techniques and manipulate the tools available. Concerns were expressed about the strength of technical skills in students. Second, the interdisciplinary nature of working with data was emphasized.

- Mithas argued that all business students must have what he called "digital intelligence" competencies to make sense of technical and business issues related to technology [Mithas, 2013].
- Aral argued that data scientists need to combine technical skills with an understanding of human behavior, commonly developed in economics, psychology or anthropology classes.
- Lin strongly agreed with this point and emphasized that he always tries to recruit people from other backgrounds as it is very beneficial to have diverse knowledge and experience, although this is not always easy.
- Zozulia highlighted how universities are rapidly developing their curriculum to address the field of business analytics and how much Deloitte values graduates with these skills across all parts of the firm. Deloitte are partnering with several universities on developing their business analytics curriculum, sitting on their business analytics advisory boards and creating custom training programs for staff. As an example, they are working very closely with Indiana University(IU) and their Institute for Business Analytics (IBA). They also created a custom Business Analytics Certificate program with IU to train people from across Deloitte.

If sophisticated analytics capabilities are to become available to a broad range of companies, and not just the biggest and richest companies, serious attention needs to be given to building more skills in this area.

IV CONCLUSIONS

At the end of the session, panelists were asked to give one key takeaway from the discussion and these provided a useful summary to close the discussion.

- Zozulia concluded that the "Holy Grail" of the area is to marry structured and unstructured data.
- Lin suggested that more people from different backgrounds are needed to bring together the diverse skills and experience needed to make the most of analytics.
- Mithas acknowledged the potential of analytics but felt that organizations would need to do a lot of things to make it work, and this provided many opportunities for academics to help through their research and teaching activities.
- Aral described analytics as a moment of transformation for businesses but they would need "science under the hood" in order to win in the marketplace in future.

As a result, the broad conclusions of the panelists were that business analytics and big data provide radical opportunities to reshape businesses, at least in some industries, but organizational capabilities are relatively low in all but the biggest companies. This is resulting in many management and implementation challenges and slowing the adoption of tools in practice. These conclusions reflected the concerns from the audience about skills and leadership in particular, as well as a healthy skepticism about the radical nature of analytics. However, the range of questions from the audience emphasized the high degree of research interest in the subject and the need for further debate about teaching in this area.

In order to take this debate further, we see several opportunities for future research where practitioners and academics can collaborate. First, although big data and business analytics have significant potential, they also have significant limitations and dark side, much like their predecessor technologies. For example, easy availability and manipulation of digital data raises significant privacy concerns for citizens to protect from ill-intentioned or inadvertent misuse of data about them by governments or organizations. To the extent that laws and governance processes are often found lagging or lacking sufficient protection, there is a role for practitioners and academics to come together to inform public discourse in this area and craft prudent policies that protect individual privacy while fostering innovation.

It is also important to note in this context that sheer availability of data and analytics tools does not guarantee that we will suddenly be able to predict everything correctly as the hype would suggest. The case of Massachusetts Institute of Technology (MIT) failing to predict how many students will actually enroll after receiving an admission offer [Korn, 2012], and the inability of scientists to predict earthquake incidents in Italy [Moloney and Wang, 2012] are some sobering reminders. Examples such as these should spur further research on boundary conditions for success of business analytics efforts. Good data or tools alone will not guarantee that we reach better decisions unless we also equip scientists and managers to pose good questions in the first place or interpret the outputs of data analysis with their deep domain knowledge and judgment that often comes with years of experience [Shah, Horne and Capella, 2012].

From a governance perspective, big data and business analytics will require rethinking the role of the Chief Information Officer (CIO) and IT department because other functional areas and disciplines (e.g., marketing, operations management, computer science and finance) are likely to lay claims in this growing area [Davenport, Barth, and Bean, 2012]. This will also require revisiting some issues such as centralization versus decentralization. Although we already see a significant amount of new faculty hiring for business analytics positions across business schools, there is a sense that often what was covered under a different label is being relabeled as "business analytics". This may change as academics and practitioners collaborate and gain a better understanding of the promise and limitations of underlying technologies and tools. Regardless of whether business analytics comes to be a "radical shift" or "incremental change", if the new energy that it has unleashed results in better curriculum, research, governance processes and ultimately decisions, those will be favorable outcomes that everyone can agree upon.

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ABOUT THE AUTHORS

Sinan Aral is a leading expert on Social Networks, Social Media and Digital Strategy. He is the David Austin Professor of Management and an Associate Professor of IT and Marketing at the MIT Sloan School of Management. His research focuses on social contagion, product virality and measuring and managing how information diffusion in massive social networks such as Twitter and Facebook affects information worker productivity, consumer demand and viral marketing. Sinan has been a Fulbright Scholar, served as Chief Scientist and on the board of directors of SocialAmp, a social commerce company that enables targeting and peer referral in social media networks (which was sold to Merkle in January 2012). He is currently Chief Scientist at Humin and an organizer of the Workshop on Information in Networks.

Kirstin Gillon is responsible for the *Making Information Systems Work* thought leadership program of ICAEW, a leading professional body with 140,000 members and founded in 1880 as the Institute of Chartered Accountants in England and Wales. She is lead author of the ICIS panel reports "Creating, Capturing and Measuring Value from IT Investments - Could We Do Better?", "Information Security and Privacy: Rethinking Governance Models" and "IT Innovation in China: Industry and Business Capabilities" in *the Communications of the Association of Information Systems*. She joined the ICAEW IT Faculty from PricewaterhouseCoopers, where she was a Senior Consultant in its IT consultancy practice. She has a Masters degree in international law from McGill University, Montreal.

Ching-Yung Lin is a Research Scientist at the IBM T. J. Watson Research Center and the IBM Lead of the Social and Cognitive Network Research Center. He received his Ph.D. from Columbia University in 2000 and M.S. and B.S. from National Taiwan University in 1993 and 1991, respectively, all in electrical engineering. His research interest is mainly focused on fundamental research of multimodality signal analysis, complex network analysis, and computational social and cognitive sciences. Since 2011, he has been leading a team of more than 35 Ph.D. researchers in IBM Watson Research Center to advance fundamental researches of network science and people analytics, as well as applied researches on collaboration, security, and commerce. He is the Principal Investigator of IBM Research's major funded social network analytics projects.

Sunil Mithas is an associate professor at the Robert H. Smith School of Business at the University of Maryland and the author of the book *Digital Intelligence: What Every Smart Manager Must Have for Success in an Information Age*. He was identified as a 2011 MSI Young Scholar by the Marketing Science Institute. Sunil's research focuses on strategic management and the impact of information technology resources and has appeared in journals that include *Management Science, Information Systems Research, MIS Quarterly, Marketing Science, Journal of Marketing* and *Production and Operations Management*. His papers have won the best paper awards and best paper nominations and featured in practice oriented publications such as *Harvard Business Review, MIT Sloan Management Review, Bloomberg, CIO.com, Computerworld*, and *InformationWeek*.

Mark Zozulia is a Deloitte Consulting Principal based in Chicago with over 25 years of experience. He has successfully structured, delivered and operated complex enterprise information management programs for numerous companies in Financial Services, Health Care, Hi-Tech, Manufacturing, State Government and Telecom. His teams have assisted these organizations in developing business strategies for increasing the competitive value of their information assets. He has delivered process and organizational transformation efforts in financial management, customer analytics, performance measurement, external customer and regulatory reporting, case

management, risk management and eDiscovery. Mark is a leader in the National Information Management (IM) practice at Deloitte and also leads the National Business Technology Analyst (BTA) program which includes campus hiring of more than 400 BTAs annually. He is an adjunct professor at Indiana University (IU) and was instrumental in developing Deloitte's Global Certificate in Business Analytics training program in conjunction with the Kelley School of Business at IU.