The Analytics Movement: Implications for Operations Research

Matthew J. Liberatore
Department of Management and Operations, Villanova School of Business, Villanova University, Villanova, Pennsylvania 19085, matthew.liberatore@villanova.edu

Wenhong Luo
Department of Accounting and Information Systems, Villanova School of Business, Villanova University, Villanova, Pennsylvania 19085, wenhong.luo@villanova.edu

The movement toward the increased use of analytics in organizations has generated much discussion by academics and professionals about the impacts and opportunities that analytics offers. Although operations research (OR) has been a driving force in applying quantitative and analytical models for organizational decision making, it is less clear how we as OR practitioners can take advantage of the surging interest in analytics to promote the OR profession and expand its reach. In this paper, we discuss the drivers of the analytics movement, an example of an analytics project, and the opportunities and implications for OR, i.e., the problem scope, models and methods, implementation issues, organizational role, professional skills, and education.

Key words: analytics; professional; OR/MS implementation; OR/MS education; revenue management.

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The availability of voluminous, high-quality data has led to renewed interest in analytics, a discipline that is transforming how organizational decisions are being made and managed. Executives are no longer content with making decisions based only on intuition and instinct; they require data and facts to support recommended courses of action. Analytical executives, such as Harrah’s CEO Gary Loveman, have coined the mantra, “Do we think this is true? Or do we know?” (Davenport 2006, p. 100). Some firms conduct experiments to evaluate the effects of their promotional campaigns before launching them on a large scale. Others collect and analyze process data to gain insights about how decisions made at different stages of a process affect performance and to understand the interactions between these decisions. A recent Accenture survey of 254 managers in various functional areas at large corporations in the United States found the following: 60 percent of decisions were based on analytic input, most of these managers believe that they will need to increase their analytic resources, half predict additional requirements within 12 months, and high-performance businesses are 50 percent more likely to use analytics strategically (Accenture 2009, Information Management 2009). In another recent study (Coghlan et al. 2010), executives from 16 firms in various industries were interviewed about their use of analytics. All the executives indicated that analytics use and importance is increasing, and they expect these increases to continue. This survey identified marketing and operations as the heaviest users of analytics; research and development groups were also key users.

Recognizing the growing demand for analytics, information technology (IT) firms are quickly establishing positions in analytics and business intelligence (BI). IBM reorganized its consulting business and launched a new 4,000-person consulting organization focusing on analytics and optimization. It acquired Cognos and SPSS, two major players in the analytics and BI software market, to complement its consulting services (Bitterer et al. 2009). SAP and Oracle also expanded quickly into this market by purchasing Business Objects and Hyperion, respectively. The BI market will remain one of the fastest growing software markets despite the economic downturn; its
annual growth rate is expected to reach 8.1 percent by 2013 (Sallam et al. 2010).

The analytics movement has also generated discussion in various professional organizations about the impacts and opportunities it offers to these professions. In the 2009 Joint Statistics Meeting, the number of analytics presentations and the number of firms recruiting new statistics PhDs and offering them six-figure salaries was clear evidence of the movement (Lohr 2009). The demand for IT professionals who specialize in BI is growing as more organizations begin to implement BI software. In the operations research (OR) community, INFORMS has begun to publish Analytics, a new quarterly digital publication.

Although most OR professionals understand the general meaning of analytics and regard the nature of our work as primarily analytical, how they can take advantage of the surging interest in analytics to promote the OR profession and expand its reach is less obvious. To address this, we need to have a better understanding of the origins, scope, and drivers of the analytics movement. To that end, this paper provides a definition of analytics, identifies the key drivers of the movement, offers a case example to illustrate how to practice analytics, and discusses the potential implications of analytics for OR practice, the profession, and education. We argue that the new analytics movement takes a very different approach to addressing organizational problems and implementing analytical solutions than traditional OR does. The trend toward data-driven and analytical decision making presents tremendous opportunities for OR professionals because their optimization and modeling knowledge and analytical skills will be in high demand. However, to thrive and lead in this new environment, OR professionals must adapt and recalibrate their frame of reference, shifting from a focus of applying analytical methods to solve individual problems to a broader view of developing analytical solutions characterized by the integrated use of data, processes, and systems. Throughout this paper, we hope to start a dialog among OR professionals on how we can leverage analytics to promote OR as a profession, what new skills and knowledge we need, and how we should prepare future OR professionals.

Analytics Defined

As a general term, analytics refers to the science of logical analysis. As such, it relates to the work of many professions and academic disciplines. At first glance many people, including OR professionals, feel that analytics is something they have been doing all along and wonder what is new about this movement. Davenport and Harris (2007, p. 7) define analytics as “the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, and fact-based management to drive decisions and actions.” Based on this definition, analytics is more than just analytical methodologies or techniques used in logical analysis. It is a process of transforming data into actions through analysis and insights in the context of organizational decision making and problem solving. Such a process can be initiated by the desire to address specific problems or the need to explore and learn from existing data.

Figure 1 shows that analytics begins with the collection, extraction, and manipulation of data. Organizations collect and store internal and external data for purposes such as record keeping and regulatory compliance. Therefore, most data are not gathered and organized in a format that can be readily used for analysis. Extraction and transformation are necessary to pull out the relevant data from various data sources and rearrange them in such a way that further analysis can be performed. Although it sounds easy, this is often the most time-consuming and arguably the most critical phase of the analytics process. Without the right data, further analytics is either impossible or would lead to erroneous conclusions.

In the analysis stage, an assortment of analytical approaches and techniques can be employed to
explore and evaluate the data. They generally fall into three categories. First, data may be presented and analyzed using interactive tables, charts, and dashboards. These data summarization and visualization tools can present multidimensional data and statistical results in an integrated graphical interface that allows data to be viewed from different perspectives and in different formats. These product features and capabilities are improving continuously in most BI software. Second, predictive modeling techniques try to estimate trends, validate relationships, and establish classifications based on a set of input data. They include many statistical methods (e.g., logistic and linear regressions, forecasting, and cluster analysis), OR models (e.g., stochastic and simulation models), and artificial intelligence (AI) techniques (e.g., neural networks). Finally, optimization models seek to find the optimal solution given a set of assumptions and constraints. Examples of such models include various mathematical programming models and AI heuristics, such as genetic algorithms.

The analytical approaches and techniques in each category can offer decision makers different types of insights. Visualization tools are often used to present information about what occurred in the past. They allow decision makers to compare key performance measures based on different dimensions, identify existing problems, and discover root causes to problems. Predictive modeling techniques focus on forecasting what would happen if a trend continues or certain conditions are satisfied. They allow decision makers to look into the future based on the past or similar events. The best solutions provided by optimization models suggest what should happen given a set of circumstances. They light a clear path for decision makers to follow. Although distinct in the kind of insights they offer, different analytical approaches and techniques can complement each other in generating and delivering insights to decision makers. The synergistic effects of combining multiple analytical approaches on the same set of facts make the new analytics so powerful.

Insights alone have limited value unless they can be translated into managerial actions, such as improving operational decisions, redesigning or changing existing processes, and formulating or adjusting strategies. At the operational level, insights can lead to improved decision quality and speed by frontline managers. For example, call center supervisors can dynamically adjust staffing levels based on insights from the analysis of actual and projected call volumes. At the tactical level, analytics can offer insights about the best customer service process configuration or bottlenecks in the current customer service process. As a result, the customer service process can be redesigned to optimize performance or reconfigured to address a bottleneck. At the strategic level, insights from customer analytics may reveal an untapped customer segment, leading to new product or pricing strategies.

Although Figure 1 describes the new analytics as a four-step process, most analytics projects will not follow the same sequence. It is conceivable that the conclusion of an analysis activity might call for more data collection. In addition, it can be argued that the analysis step is the engine and therefore the most important component of the analytics process. Although most organizations use visualization tools for data presentation and analysis and some are beginning to apply predictive modeling techniques, few organizations incorporate optimization models in their analytics efforts. Given that optimization models often offer strategic value to organizations, and decision optimization has long been the province of OR, we believe that OR professionals have tremendous opportunities to contribute to the analytics movement.

**Analytics Drivers**

Another way to understand the unique characteristics of analytics is to examine the driving forces behind the analytics movement. Our analysis points toward four driving factors (see Figure 2). Each has a strong independent effect; however, taken together and through their interactions, they are a powerful force leading to the growth of the analytic enterprise.

**Data**

Increasing computing power, declining data storage costs, and advancing database technologies have led to an explosion in the amount of data organizations can collect, store, and process. Today, most organizations gather and maintain detailed transactional data about the activities associated with customers, suppliers, and other stakeholders from sources such as point-of-sale (POS) systems, corporate websites,
Data

People

Analytics

Software

Process

Figure 2: This diagram shows the four driving forces of the analytics movement.

and radio frequency identification (RFID) devices. The Internet and e-business have had a dramatic effect on the volumes of data generated. In addition to e-business-related transaction data, organizations track various types of online interactions with customers and suppliers, such as e-mail inquiries, website visits, and online product reviews.

To better manage business transactions and data, many organizations have implemented enterprise systems, such as enterprise resource planning (ERP), customer relationship management (CRM) and supply chain management systems, over the past two decades. A key objective is to run the organization based on “one version of the truth”—using a single database that all applications share—to ensure that each person in the organization sees the same value for a data item. To the extent that they are successful in helping the organization to achieve this objective, enterprise systems can generate and store large volumes of data and also ensure that the data are high-quality. At this juncture, organizations naturally begin to think of how they might leverage the availability of high-quality data to improve decision making, thus leading to the recent growth in analytics.

Analytical Software

The ability to use computer software to make sense of data has finally come of age. Vendors are offering analytic tools as part of their software suites. Analytical software ranges from the relatively simple statistical and optimization tools in spreadsheets (e.g., Microsoft Excel) to statistical software packages (e.g., Minitab), complex BI suites (e.g., SAS, Cognos, Business Objects), predictive industry applications (e.g., Fair Isaac), and finally to the reporting and analytical modules of major enterprise systems (e.g., SAP and Oracle).

Increased product offerings and competition in the analytical software market have helped to drive the use of analytics within organizations. First, most analytical software has made it easier to extract and integrate large data sets from a variety of data sources and formats. Second, analytical software has become more versatile because many analytical methods and approaches are included in one suite. Finally, the graphical user interface has made analytical software easier to learn and use.

Process

Since the early 1990s, many firms have adopted a process orientation to better understand the tasks that comprise their businesses. This development led to the reengineering movement (also called business process redesign) that sought to make fundamental changes in business processes to increase performance by focusing on value-added activities through better process design (Hammer 1990). This approach was supported by the implementation of ERP systems, because the various system modules are organized around processes and often provide the necessary data to evaluate them.

The adoption of Six Sigma programs (Eckes 2001, Pande et al. 2000) by many organizations supports the use of analytical thinking and tools for decision making. Using the DMAIC (define, measure, analyze, improve, control) process, organizations focus on improving a process metric that is important to customers and analyze data to measure performance before and after any process changes.

Many firms use the balanced scorecard (Kaplan and Norton 1992, 1996, 2000), which consists of a number of metrics that can drive firm performance. These metrics are based on data often available from the ERP system. Although balanced scorecards and other sets of performance metrics are typically reporting...
mechanisms and are often viewed as part of BI, they are leading firms to think about predicting these metrics and modeling performance, thus leading them to analytics.

People
A new generation of technology-literate executives—the first generation to grow up with computers—has moved into upper-management positions. Many of these executives have used analytical software, such as spreadsheets and statistical packages, earlier in their careers; therefore, they are comfortable with using systems and software and are likely to expect their subordinates to do the same. In some cases, top executives have strong technical backgrounds in the quantitative disciplines, although this is not widespread.

The combined effects of the four driving forces have resulted in a number of unique characteristics of the analytics movement. First, analytics is more data-driven. In the past, because data were expensive to obtain and validate, many analytical approaches assumed small data samples. This is now less of a constraint. The availability of high-quality data is often the motivation for analytics. Second, analytics is not limited to any single methodology or discipline. Instead, analytical software supports using a variety of methods and approaches to address a problem. Thus, the power of analytics lies with the synergistic effects resulting from this best-of-breed approach. Third, the focus on processes in many organizations has shifted demand for decision support and problem solving away from human decision makers to processes. Analytics is performed to improve the overall process or the decisions associated with process roles, preventing potential suboptimal decisions. Fourth, many decisions and insights obtained from analytics are implemented through changes within enterprise systems. Insights and decision rules are retained within these systems, providing needed continuity even if the decision makers move to other positions.

These observations about the four drivers and their implications lead to some thoughts about the relationship between OR and analytics. Ackoff (1987) argues that OR was originally market-driven in the sense that it focused on addressing the changing needs and problems faced by the users whom it supports. Because OR teams were interdisciplinary, they applied ideas and methods from a wide range of pure and applied sciences, and they therefore were not limited to a defined set of either problems or tools. OR was a practice-oriented field, and OR professionals were united by their application of the scientific method for problem solving (Ackoff 1962). Interestingly, organizations involved in analytics today seem to subscribe to the market-driven concept. They build analytics teams with people from the statistics, industrial engineering, computer science, data analysis, finance, and OR fields, and they leverage generalists with industry knowledge (Saxena 2010), reminiscent of the early OR interdisciplinary teams.

In contrast, as OR has matured as a discipline, it has tended to become associated with a defined set of methods, techniques, and problems. The rise of the analytics movement should be viewed as a motivation for OR to reassess its evolution and to refocus its attention on developing and applying a broader range of scientific and technological approaches for solving significant problems for organizations. Otherwise, analytics will increasingly become a challenger and even a competitor of OR; it addresses many of the high-profile, challenging problems and issues organizations face today and which they might consider the province of OR. Some would argue that analytics has in a sense already subsumed OR because OR practitioners tend to be either on an analytics team or on a team that complements one (Saxena 2010). As a result, the OR profession and INFORMS should take the lead in evolving OR so that it incorporates the essential elements of the analytics movement. This might lead to INFORMS becoming the “home base” for analytics professionals (Saxena 2010), with OR professionals and educators actively participating in and leading the design of analytics training and degree programs. We now consider a case example to highlight the unique characteristics of the analytics movement and how they relate to the four driving forces and OR.

Analytics in Action: Revenue Management at Harrah’s Entertainment
Harrah’s Entertainment is recognized as a leading analytics competitor because of its innovative use of analytics (Davenport and Harris 2007). The practice of revenue management analytics at Harrah’s (RMAH)
has been a subject of several academic articles and case studies, e.g., Metters et al. (2008) and Agrawal et al. (2009). RMAH increased revenue by 15 percent per room (Underwood 2003). RMAH is a good illustration of how new analytics programs differ from traditional OR projects.

Revenue management involves selling the right resources to the right customer at the right price to maximize revenue or profit from a fixed, perishable inventory (Smith et al. 1992). Over the years, sophisticated mathematical models have been developed to optimize pricing and resource allocation decisions in revenue management. Such models have been widely deployed in industries such as airlines, hotels, rental cars, and gaming (Talluri and van Ryzin 2004).

Revenue management in casino hotels differs from that in other hospitality companies because casino hotels view hotel rooms as incentives or rewards to support casino gaming activities and revenues, not as revenue-maximizing assets. Therefore, RMAH’s objective is to set room rates and accept reservations to maximize the expected gaming profits from customers. Figure 3 depicts the RMAH process.

RMAH begins with the collection and tracking of customers’ gaming activities using Harrah’s “Total Rewards” card program, a customer loyalty program that provides tiered awards to customers based on the amount of money and time they spend at Harrah’s. The IT systems supporting the Total Rewards program can track gaming activities in slot machines as well as table games across all Harrah’s properties. Because the program’s benefits are explicitly defined and transparent, customers are willing to use a loyalty card during their play to earn awards. Consequently, the program collects accurate behavioral data, which Harrah’s uses to segment customers into more than 20 groups based on their expected gaming activities.

For each customer segment, it forecasts demand for hotel rooms by arrival date and length of stay using time-series models with Holt-Winters exponential smoothing (Metters et al. 2008). The results are then entered into a linear program-based bid-price optimization model, which is the core of the booking-recommendation system. The bid-price model is dynamically recalibrated when 24 hours have passed or five rooms have been reserved since the last optimization. If necessary, managers can also manually recalibrate the model.

Although RMAH’s demand-forecasting and bid-price models have some interesting variations to address issues specific to the gaming industry, the models are similar to those found in other revenue management applications. JDA, the consulting firm that developed Harrah’s initial revenue management solution, also developed revenue management solutions for companies such as National Car Rental, Continental Airlines, and Hilton. RMAH’s unique characteristic is how the models are embedded in a system that is integrated into business processes and an analytically oriented business environment. This is typical of analytics applications.

The customer gaming behavioral data generated by the Total Rewards program are critical to RMAH. The availability of relatively clean, accurate, and up-to-date information about customers’ gaming habits enables RMAH to classify customer segments and forecast room demands more accurately. By using historical customer information and real-time inventory data, RMAH can recommend better room allocations. Although other casinos have similar customer loyalty programs, none actually uses the data in its revenue management applications (Metters et al. 2008). RMAH’s value will increase when it incorporates real-time customer information in its recommendations (Agrawal et al. 2009).

Figure 3: This diagram depicts the five steps that comprise the revenue management process at Harrah’s Entertainment (RMAH) (adapted from Metters et al. 2008).
RMAH is not a stand-alone decision support application; it is an integral part of the room reservation process. For each room request, RMAH generates a specific price quote for the inquiring customer. Although managers are still responsible for VIP customers and hotel suites, most hotel rooms are allocated and reserved through the room reservation process. RMAH is also closely integrated with Harrah’s marketing processes. For example, if RMAH has identified low-occupancy rates for specific dates, the marketing group might use that information in its customer-relationship effort by sending promotional offers to specific customer segments.

Implementing RMAH would be impossible without IT systems. First, IT systems are indispensible for data storage and movement. They enable Harrah’s to properly recognize and serve any Total Rewards customer who shows up at any Harrah’s property. Second, Harrah’s implements RMAH as part of its enterprise systems. Although the RMAH systems are managed by an external firm, the Rainmaker Group, Harrah’s staff can easily access and use the application from various Harrah’s properties and offices. By including RMAH in an IT system, Harrah’s can better manage the system’s life cycle; for example, it can easily collect usage information, analyze it, and evaluate RMAH’s effectiveness. Harrah’s uses a revenue-opportunity index to monitor RMAH’s performance.

RMAH’s success can also be attributed to Harrah’s analytically oriented business environment. Its CEO, Gary Loveman, has been an advocate and promoter of analytics since he arrived at Harrah’s. He strived to change the culture by hiring analytically oriented managers and expecting all managers and executives to make fact-based decisions. For this principal reason, managers and executive throughout the organization embrace RMAH and view it as an asset that enables innovation and new capabilities.

**OR Implications**

As evident from the discussion above, the analytics movement has profound implications for OR professionals and their practice. Often regarded as a group closely associated with analytics, OR professionals are indispensible to the analytics movement and are sometimes called upon to lead analytics initiatives within organizations. However, analytics solutions often differ from traditional OR applications. Unless OR professionals realize and embrace such differences, they will be unable to take full advantage of analytics and the synergistic effects that its driving forces offer. Figure 4 represents the implications of analytics for OR.

**Problem Scope**

Many traditional OR applications focus on identifying, formulating, and solving a specific problem that is relevant to a few decision makers. In contrast, analytics solutions tend to focus on an entire business process with many connected problems and decisions that span functional boundaries. The analytics solution is relevant to a broad group of managers and often affects the decisions made by a variety of users. The solution is often imbedded within the IT infrastructure, and decisions can be fully or partially automated. The process orientation and scope of an analytics solution tend to make it much more valuable than single applications to organizations. However, it also increases a project’s complexity because
it often requires the integration of a variety of data capture, processing, and analytical methods.

Models and Methods
Optimization and simulation models and methods are often regarded as the core of OR applications. In the new analytics environment, these models and methods are only part of the analytics tool kit; they will likely be employed with other kinds of analytical models and methods, such as statistical and artificial intelligence models. Integration of various types of analytical models to address an expanded problem scope is the key to a successful analytics project.

Implementation
As we mention above, instead of a one-time transfer of ownership from OR professionals to users, analytics solutions are often implemented within enterprise systems to support ongoing business processes. Therefore, analytics implementations are likely to require that OR professionals collaborate closely with IT professionals and users to build and embed analytics solutions within enterprise systems. Although such an approach may take a longer time and (or) be more expensive to implement than traditional OR solutions, it improves the chance of success and ongoing usage; it also offers distinct advantages for OR professionals.

First, it increases the impact of analytics solutions because it supports many users across an organization instead of a few application sponsors. Because of its enterprise nature, analytics solutions might integrate with other analytics solutions within the organization. For example, staff members from Harrah’s marketing department, not originally intended as users of RMAH, might use it as a solution to support their pricing and promotion efforts. Second, it allows an organization to continuously monitor and improve solutions; the effort invested in a specific analytics solution can be sustainable and ongoing. Over the long run, organizations will realize greater savings from the continuous improvement and reuse.

Third, it allows organizations to acquire analytical capabilities and use them in an efficient manner. By thoroughly documenting past and present analytics solutions, they can easily identify relevant analytical resources for future endeavors.

Professional Skills
Hiring the best people is increasingly being recognized as key to an organization’s successful analytics deployment (Davenport et al. 2010). To that end, organizations are adjusting their hiring practices and looking for candidates with a well-balanced mix of technical and managerial skills. In analyzing more than 1,000 OR job advertisements, Sodhi and Son (2008) find that employers value strong technical skills but also seek an array of soft skills. The most consistently requested technical skills include modeling, statistics, programming, spreadsheet and database, operations management, and basic IT skills. The requested soft skills include communication, project management, leadership, team, and general analytical skills; these include the ability to perform quantitative and qualitative analysis, to pay attention to details and work independently, and to solve problems. The importance of soft skills, such as oral and written communication, is a recurring theme addressed by Woolsey (1979, 1981) and others. The need for OR professionals to develop their soft skills is supported by professional training, such as workshops offered at the INFORMS Conference on O.R. Practice (INFORMS 2010).

Sodhi and Son (2008) also identify modeling, statistics, programming, and general analytical skills as the four core OR-specific skills regardless of section, function, and degree type. The implications of these findings for OR professionals and academics are significant. Few new or even fairly experienced OR professionals have all these skill requirements; therefore, OR professionals must acquire or strengthen their capabilities and knowledge to be successful in the new analytical environment. The ongoing discussion of credentialing future OR professionals should consider the acquisition of these skills (Nestler and Leong 2009).

Organization
OR professionals and groups can and should play a leading role in directing the analytics movement within organizations. OR must reposition itself, and OR professionals must move from the role of consulting to that of analytics solution providers. Instead of focusing on discrete problems and being “hired-to-be-fired” troubleshooters, OR professionals should be
responsible for the organization’s analytics strategy and solutions. Analytics solutions should be viewed and managed as organizational assets and part of its knowledge base, as opposed to being part of an individual manager’s toolkit. Although user sponsorship remains critical to the success of analytics solutions, OR organizations must maintain a certain level of ownership after the solution is in production.

Education
The most profound implication of the analytics movement is its potential impact on education. This impact is not limited to OR; it is applicable to other quant-oriented disciplines, such as statistics, industrial engineering, management information systems, and computer science, and to subject-area disciplines, such as accounting and finance, supply chain management, and marketing. Realizing the opportunities, some universities have started developing degree programs and courses for analytics, as the following examples illustrate.

- With support from the SAS Institute, North Carolina State University has established the Institute for Advanced Analytics and launched an interdisciplinary Master of Science in Analytics (MSA) degree program, which has a heavy emphasis on analytical applications and practicums while including soft skills.
- The Warwick Business School in the United Kingdom offers a Master of Science (MSc) in Business Analytics and Consulting, which is led by its Operational Research and Management Sciences group. Industry experts contribute to the program by giving seminars and presenting real-life consultancy projects.
- The University of Tennessee is launching a Master’s degree program in Business Analytics to replace its Master’s degree in Management Science. The new program, which is led by the statistics, operations, and management science department, offers specializations in applied statistics, process optimization, and BI and data mining.
- The University of Southampton in the United Kingdom offers an MSc in Business Analytics and Consulting that replaces its MSc in Management Sciences. It is linked to the MSc in Operational Research offered by the School of Mathematics in that all the optional courses are shared; the new program includes systems thinking and soft skills along with technical and application courses.
- Other schools are also adding a minor or courses in business analytics or BI to their existing programs (Sircar 2009).

These initiatives are valuable, and many other universities are expected to join the effort to define an analytics curriculum. However, we argue that it is time for industry and the academic community to start a serious dialog about how the OR profession can be evolved into a new analytics profession and what kind of academic degree programs are needed to support the profession. Together, they must develop a vision for the analytics profession; identify the skills and knowledge required for the profession; and design courses, curricula, and degree programs for future analytics professionals.

In this paper, we begin such a discussion by synthesizing the implications of the analytics movement, classifying different types of analytics work, and envisioning the roles and responsibilities that analytics professionals play in organizations. The process view of analytics we describe above suggests that the use of analytics in organizations today would differ greatly from traditional applications of OR models. To make the distinction clear, it is perhaps instructive to think of analytics as a product or service and analytics professionals as participants of an enterprise or ecosystem engaged in the design, construction, application, and use of analytical products and services. As such, we should focus on the research and development of analytics and pay attention to the application and use of analytics in the working environment. As in many other industries, a clear division of labor among analytics professionals is necessary if analytics is to gain wide acceptance. The automobile would not have enjoyed its popularity and success if the auto industry required all drivers to learn to repair an engine or to understand the effects of aerodynamics. Similarly, we should not expect all analytics users to develop
analytical models. Based on this assumption, we identify three important activities and their corresponding analytics professionals from the analytics value chain (see Table 1).

Research analysts are engaged in the fundamental research and development of analytical methods, models, and practices. Their research efforts tend to address a broader application area or a problem domain so that many organizations can apply their results. To that end, they are also involved in the development of software tools that will embed their new discoveries. Most research analysts hold a PhD degree and work as professors, scientists, or principals in universities, software companies, and consulting firms.

Application analysts are responsible for the design, implementation, and maintenance of analytical solutions for specific problems. Although application analysts often rely on existing analytical models and methods, their knowledge and expertise about the problem domain and the organizational processes, systems, and people are crucial to the success of analytics. As more organizations adopt an overall analytics strategy, dedicated roles and career paths may be established for application analysts, who are likely to form the core of the analytics profession. Most application analysts hold a master’s or bachelor’s degree in analytics.

User analysts are responsible for providing input into analytical solutions, interpreting analytical results, and making decisions or taking actions based on the results. User analysts may not know how an analytics solution is built; however, they understand the values, assumptions, and limitations of the solution. More importantly, they have the ability to incorporate and integrate the analytics solution into the decision-making process. User analysts could be either the decision makers or their supporting staff. Most decision makers probably would not require formal training in analytics models. They should, however, have on-the-job training for specific solutions; their supporting staff might be individuals with a bachelor’s degree or MBA degree in analytics.

To advance this enterprise of analytics, the academic community must make significant changes to its curricula at various academic levels. Instead of teaching the same subjects with varying degrees of sophistication and difficulty, each program level should prepare different types of analysts. At the undergraduate level, analytics programs should focus on preparing students in general analytical skills and on giving them the ability to manipulate data, interpret analytical results, and incorporate analytical results into various decision-making environments such as finance, marketing, and supply chain management. The master-level analytics programs should
be application-driven. Sample curricula may include foundation courses that survey existing analytics models and methods, analytical software tools and applications, business process management, project management, and soft skills. Beyond the common body of knowledge, students could specialize in analytics for a particular industry, a problem domain, or a business process. An applied capstone project would complete the degree program. Individuals interested in analytics research and development might pursue a doctoral degree. Ideal candidates for a PhD program should have some industry experience as application analysts.

The suggested curricula changes will not come without challenges, especially when interdisciplinary efforts are required to break down existing walls between disciplines and departments. However, we believe that the changes are feasible and necessary; the analytics movement provides us with the opportunity and incentive to participate in the making of a new profession.

Conclusions

Analytics is having an increasing impact on decision making and performance management within many organizations, and it is sometimes viewed as a source of competitive advantage. The analytics movement is being driven by technically literate executives who make fact-based decisions, the availability of good data, a process orientation to running an enterprise, and improved software for data capture, processing, and analysis. Analytics has much in common with OR; however, analytics tends to focus on problems that span organizational functions and address the needs of multiple users, employs an expanded analytical tool kit, and often provides solutions that are integrated into the IT infrastructure. OR professionals must acquire or strengthen their technical and managerial skills to succeed in the new analytics environment, moving from being “one-and-done” problem solvers to solution providers. Industry and the academic community must start a serious dialog about how the OR profession can be evolved into a new analytics profession and what kind of academic degree programs are needed to support the profession. An understanding of this changing landscape can help OR professionals participate more fully in the analytics movement and become its leaders.

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