Data driven

What students need to succeed in a rapidly changing business world

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Abstract

The world is changing around us—and fast. Every business is feeling the unprecedented impact of rapid demographic changes, economic shifts, increasing resource scarcity, urbanization, and technology breakthroughs. To keep up, leaders are urgently searching for the people who can help their organizations adapt to what is now the new reality.

So how can we best prepare students for the opportunities and challenges that lie ahead—and ready them for careers in professional services? At PwC, we believe data analytics should be integrated into accounting coursework.

In this paper, we offer specific accounting curriculum recommendations to strengthen technical foundations in data analytics and related skills, which are relevant for all students considering careers in business.

Our focus is not simply on skills for technical problem-solving, but also on problem-framing, so students learn to ask the right questions and think strategically.

We introduce this broader vision in our PwC Professional Framework, which emphasizes development beyond the technical, including business acumen, relationship skills, global acumen, and whole leadership.

Let's ask ourselves: Are today's students ready?

The changing business world

A world in flux

Students are now thrust into a world disrupted by five major forces of macroeconomic change, which we call *megatrends*. These trends have triggered events like the movement of consumer products companies into Africa, the development of self-driving cars, the booming demand for infrastructure projects in Asia and Latin America, and an increased focus on sustainability in nearly every organization.

1. **Demographic changes:** Between 2010 and 2050, the global number of people who are 100 years or older will have increased tenfold,[1] with at least 400,000 centenarians by 2050[2]. Some populations are rapidly aging, such as in Japan and in Western Europe, while others are becoming dramatically younger, such as in Africa and India. By the year 2050, 24 countries are projected to have populations with median ages under 25 years. [3] Some countries have also built more inclusive labor forces, with our estimates showing that 1 billion women will enter the workforce over the next decade.[4] These demographic shifts have significant implications for public policies like healthcare and tax, consumer and labor markets— and conflict among generations.

   For example, in 2013 PwC released one of the largest global generational studies ever conducted, in partnership with the London Business School and the University of Southern California. *NextGen: A global generational study* looked at Millennial employees (born between 1980 and 1995), and found that while there were many similarities among generations, Millennials have distinct views. They prioritize workplace flexibility, global opportunities, cohesive teams, supervisor support, and employer transparency.[5] Organizations like PwC are using these findings to improve how they hire and develop their people.

2. **Economic power shifts**: Seismic shifts are happening in global economic power, as we move beyond an era of Western dominance and into the economic emergence of other countries. Per PwC analysis, we've found that by 2050, the GDP of the E7 (China, India, Brazil, Russia, Indonesia, Mexico, and Turkey) will be collectively twice that of G7 nations (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States).[6] This power shift will create an expanded talent pool for organizations and geographically diverse career opportunities for students.

3. **Resource scarcity and climate change:** By the end of this century, the world will need to produce 2.5 times more food than was needed in the last 8,000 years,[7] all while the average global temperature rises at an average rate of 0.15° Fahrenheit per decade (which it has done since 1901).[8] Such scarcity will drive geopolitical conflict and risk. This trend will require companies to re-examine their sustainability strategies, and our future workforce will need to understand the environment's impact on business.

4. **Urbanization:** The movement of populations out of suburbs and rural areas and into cities is changing how people live and work. By 2050, the urban population of the world is expected to increase by 72%.[9] Businesses in these areas will find more opportunities as demand for infrastructure, healthcare, energy, and consumer markets expand—and create burgeoning economies that will need to sustain more people than ever, as the earth's population grows to over 9 billion by 2050.[10]

5. **Technological advancements:** The amount of information we have to manage is rapidly expanding. Data is generated from every action taken on every Internet-enabled device, and it's only going to grow. A full 90% of data in the world today is only 2 years old.[11]

At the same time, advances are happening in every technological area at never-before-seen speeds: in computing power, software, artificial intelligence, data analytics, cloud computing, networking capabilities, and the proliferation of mobile devices. While the largely digital-native Millennials have an advantage over previous generations, they are entering a workforce that is constantly transformed by technology. There is now a growing demand for fluency in areas like data analytics across entire companies and industries.

CEOs are bracing for change

We are certainly not alone in our view that future talent could benefit from new skills, especially when it comes to the ever-evolving technologies companies must keep up with.

We recently conducted our *18th Annual Global CEO Survey* to gain an updated perspective on where the business world is heading—and what challenges and opportunities CEOs see in the years ahead. This year's survey results include responses from over 1,300 CEOs in more than 60 countries and reveal six relevant themes:

- **CEOs are hiring, but with growing concern about widening skill gaps.** Fifty percent of CEOs plan to increase headcount over the next 12 months, although 73% of them are concerned about finding the key skills they need to support their growth (a 10% increase over last year). And 60% say that a skilled and adaptable workforce should be a top government priority (an increase of 19% from last year).

- **Seeking and developing new, broader skills in their people is a big focus.** Eight in 10 CEOs agree that they equip employees with new skills through continuous learning or mobility programs, and a similar number say they're looking for a much broader range of skills when hiring than they did in the past.

- **CEOs are more convinced by the power of technology and innovation than ever before.** A full 58% of CEOs said the speed of technological change was one of their top concerns—up from 47% last year.

  Their priorities line up with those concerns, too, with 86% saying they find it important as CEOs to champion digital technologies, and the same number emphasize a clear vision of using digital tech for competitive advantage.

- **They're fixated on using data analytics.** Eighty-five percent of CEOs say they put a high value on data analytics for their company, and 80% place data mining and analysis as the second-most important strategic technology for CEOs (just behind mobile tech). In fact, per *PwC's 6th Annual Digital IQ survey* of more than 1,400 leaders from digital businesses, the area of investment that tops CEOs' list of priorities is business analytics.[12,13]

- **Regulation—and compliance with it—is a growing concern.** Sixty-six percent of CEOs globally said changes in industry regulation are the biggest disruptor for their industry. Similarly, 77% said it is their top concern when it comes to their organization's growth prospects. It's clear that compliance and risk management will be a bigger priority than ever.

- **CEOs view the business world as increasingly volatile and complex.** While six in 10 CEOs see more growth opportunities than they did three years ago, a similar number see more threats to growth, too. Concern about issues like cyber threats and volatile energy costs were up across the board this year. Additionally, 61% of CEOs say the increase in the number of major competitors is one of the top disruptors for their industry, and a full 50% say that government-business collaboration is increasing the amount of cross-border data flows.

What does this mean for accounting students?

The insights from our CEO survey reveal that businesses are preparing for a future that's different from today. And they expect their talent to adapt. One implication of this rapidly changing business environment is clear—today's accounting curriculum should be updated to equip students with new skills, especially in technology and data analytics.

Business leaders often lament skill gaps, and we believe demand will continue to exceed the supply of candidates who have an analytical mindset, technical skills, *and* a foundation for leadership. So while skills in data analytics will be desired, we believe broader business acumen, global awareness, relationship skills, and leadership abilities will be just as coveted. This broad base will equip students to not only solve challenges, but also to frame these issues in a broader context, so they can ask the right questions—the ones that lead to root causes and solutions.

How data analytics disrupt business

One challenge in our increasingly connected society is the proliferation of data. Every company, regardless of size, is bursting with information—often more than it knows what to do with. This includes operational data (e.g. from sales figures, transactional information, delivery records, and revenue numbers), mechanical data (e.g. from medical devices, smartphones, cash registers, airplanes), and social data (e.g. from Facebook, Twitter, or blogs).

Some of this data is structured (amassed in one form within a database) but stuck in disconnected systems—much of which simply gets archived without deriving any real value. And much of business data is unstructured—coming in various forms, like documents, audio files, or image files, both online and offline. In other words, there is a lot of data to be reaped, yet little of it has been used to gain better insights.

In the accounting, tax, and consulting professions, we're in the epicenter of the data explosion, surrounded by information that exists quietly in disparate systems, often unused until it's pulled for an audit, engagement, or tax return. But if we turn reams of data into meaningful insights, organizations can use these findings to improve their businesses in many functions—and accounting professionals would add even greater value.

Many executives don't feel ready to tackle Big Data yet. Most companies struggle just to deal with "little data"—the traditional data found in their product-servicing and customer-management systems.[14]

Regardless of size, the real power of data comes from the more informed decisions it enables executives to make. Making big decisions better, faster, and cheaper is the next competitive advantage that organizations seek. In PwC's *2014 Global Data & Analytics Survey* of 1,135 senior executives across industries, we found that business leaders use a mix of intuition, advice from others, and data analytics to make major decisions. Nearly 90% said that Big Data has changed or will change decision making at their organization. One executive said, "We need to increase the amount of data that we collect; we need to discover the potential value of that data; and we need to use it as a reference for big decisions."[15] Company leaders told us the biggest barriers to using more data analytics in decision making include low data accuracy and quality; difficulties knowing what data is useful; and senior management lacking the skills needed to work with data.

Breaking down these barriers requires more investment in technology and advanced data analytics to add new insights into decision-making, business operations, and market understanding. For example, advertisers can target audiences more precisely than ever to create higher response rates. Healthcare companies can tap into real-time patient data from thousands of medical devices to improve care at a reduced cost. Retailers use data to better understand how their customers use their products and services. Banks use it to microsegment and customize their service offerings based on customer behaviors. In sum, every industry could use data to greater advantage.

How analytics enhance our work

Expectations for professional services firms like ours now often focus on three themes: better insight, greater efficiency, and improved coordination of risk and compliance activities. And data can play a role in each.

At firms like PwC, analytics are used regularly in just about every function, from audit to tax to consulting to the work our support staff does. Information that stood stagnant in paper files before can now be collected in seconds, freeing up our teams to do more strategic work. We now have the ability to analyze entire data sets, as opposed to smaller samples, and potentially make better decisions because of it. The work becomes less about reliance on technology to retrieve and report on data, and more about analyzing and gleaning insight.

For example, junior consultants in professional services firms typically spend a large amount of time reviewing research reports, internal documents, spreadsheets, and presentations to synthesize market trends, competitive drivers, customer behaviors, and operational procedures. Accounting, finance, and compliance personnel are often asked to pull manual bills of lading, create new spreadsheets of financial data, or produce hard copy documentation. But in the future, most of these activities will likely be partially or fully automated, allowing consultants to more easily obtain the data they need and focus on using their expertise for client problem-solving.

One Fortune 50 executive recently told us, "The status quo of asking our company to provide information and pull documentation to our provider has to change and be automated to use all of the company data already available." More than ever, executives are asking professional services firms to use corporate investments in technology and more sophisticated analytic tools.

While learning how to use data is valuable, it is just as important to know how to communicate the value of that data. Data visualizations can help clients understand the story the data is telling, through graphics, charts, interactive data models, and other illustrations.

But that's just the beginning.

How data makes a difference

Evolving to a data-driven audit

Data analytics are altering the way the audit process is done at both the transaction and general-ledger levels. Auditors have new tools to extract and visualize data, allowing them to dig into larger, non-traditional data sets and perform more intricate analysis.

These data sources aren't necessarily numbers. Non-traditional data, like images or words, can be found in different forms and pulled from varied sources, so the ability to analyze all of it leads to better insight. Accounting professionals can also use data visualization tools to help others better understand what the data is telling them, such as depicting the ebb and flow of online conversations around a particular topic, or using an interactive chart to allow a user to change inputs and see a new view automatically. This is all leading to unprecedented levels of insight into an organization's transactions and records.

As the AICPA (American Institute of CPAs) noted, "Today, many audit processes are essentially unchanged from those performed decades ago, even though newer technology may be used to perform them more efficiently."[16] There is a great opportunity to change this. The benefits?

- **Better experience for the clients.** From a client's perspective, a lot of time and effort goes into pulling supporting documentation for testing, whether on paper or electronically. And it often comes at an already busy time of year. While they don't eliminate the need for supporting documentation, automated testing and data validation performed by tapping into massive data troves can save time and effort, since much of the data will have already been coded for audit purposes. With the data easier to access, clients can get the payoff of more focus on data discovery and analysis.

- **Better experience for the auditors.** By shifting substantive and controls testing away from a manual process and toward an automated data discovery and validation system, audit professionals can focus more on the logic and rationale behind data queries and less on getting the data in the first place. They can concentrate on business processes and outliers in testing, which increases their technical knowledge over time. Having the necessary data at the ready and not needing to pull data at the client site also gives the staff the flexibility to work from anywhere at any time—which is what Millennials want.[17]

- **More valuable insights.** Analyzing client data more strategically leads to insights that can increase the value we add to a client's broader operations. So not only does the audit yield important findings from a financial perspective, but also information that can help companies refine processes, improve efficiency, and anticipate future problems. For example, during an internal audit, a client could use data-derived insights related to customer profitability or loss prevention to potentially improve earnings. So our future accountants should have a clear understanding of how regulatory needs will affect accounting needs. Any underlying data, process, and visualization skill sets should bridge the gaps between the technology advances, regulatory changes, and accounting principles (like GAAP).

A case in point

A manufacturing company has a policy that all its journal entries must be officially approved.

With data analytics, the auditors can examine nearly all journal entries processed for the entire year and measure policy compliance.

They can also use data visualizations to depict their insights—a step that's easy to take and doesn't require a major investment, once all the journal data is pulled together. This allows them to perform a more exact analysis and display their findings in a simple, visual way that the client can easily understand.

Seeing the bigger picture when managing risk

Data analytics have also improved an accountant's ability to discern risk more efficiently, accurately, and transparently. As megatrends add complexity to the business world, companies face risk in everything from potential IT security breaches to possible supply chain weaknesses, intensifying the focus on mitigating risk and preparing for what's around the corner. Our risk assurance group looks at our clients' processes, policies, systems, and controls with fresh eyes, helping them keep risk under control and make more confident decisions in the face of changing regulations. With data analytics involved, our capabilities expand enormously in services like testing for fraudulent transactions and automating compliance monitoring activities.

For instance, data discovery and visualization tools can transform information into more easily understood, multi-dimensional images that help us better communicate insights, whether they take the form of a graph, chart, or interactive visual. This can help our professionals identify patterns that are not as evident through traditional spreadsheet analysis.

As manual processes become more automated, analysts can save hours of time that used to be spent on data gathering and reviewing by extracting only the information they need. One emerging area includes unstructured text analytics, which offer the ability to examine large amounts of text to detect word patterns. By overlaying algorithms atop large sets of unstructured text data, analysts can make conclusions about the nature of an entire range of words and look for risk indicators.

As analytics play a larger role in solving business problems, risk assurance professionals will need to understand how to effectively work with data.

A case in point

A major investment bank wants to monitor its key risk areas (in regulatory, compliance, and technology) in real-time and with transparency.

With data analytics, the bank can work with risk and analytics professionals to develop a library of key risk indicators and key performance indicators that are statistically weighted to generate a risk score in each area.

Because entire data sets were available and coded appropriately, data analytics played a big role in developing an aggregated risk score for the entire global enterprise, and more specific scores for each risk area.

These scores were presented in a user-friendly interface using a variety of data visualization tools, with dashboards that present data in a digestible way: pie charts, bar charts, and detailed maps and interactive visuals that allow the user to change the output view with just a click or tap. Such software can display important historical trends and highlight outliers, and allow users to zero in on high-risk areas and continually monitor them. If the client wanted to test a scenario, they could change the threshold levels and point out any resulting deviations.

Ultimately, the bank successfully worked with risk and analytics professionals to better manage its risk profile.

Tax, technology, and transformation

Tax has historically lagged the rest of the finance organization in technology, but is now experiencing transformative change. To add efficiency, tax functions are replacing manual spreadsheets with modern database technologies based on those used by other parts of the business.

With this upgraded technology, teams can standardize and structure data inputs and outputs, retrieve the data they need to analyze the tax efficiency of different business units, and pinpoint tax-planning opportunities and emerging trends.

The industry will continue to raise the bar away from process-oriented tasks (gathering and managing data) and toward value-focused tasks (analyzing the data to drive planning decisions). As our clients' businesses change through acquisitions, revised tax laws, and expansion into new jurisdictions, integrating and analyzing larger data sets is more important than ever. It all leads to better insights that we previously wouldn't have been able to easily derive —and help firms like ours retain talent that wants to spend more of their workday strategically.

For example, tax accountants are collaborating with the finance and IT functions to explore new ways to analyze financial activity and exploit their enterprise resource planning systems (ERPs) before tax departments begin their work. This can lead to more thorough, real-time data analysis during transactions or in compliance season, and pave the way for what-if analysis and modeling.

As the global business environment and its regulations evolve, tax-sensitive data will come from a large number of disparate sources and varieties of data (called "multivariates"). Those who explore careers in tax will be asked to understand where critical tax data resides (e.g., in ERPs or payroll systems) and be able to standardize and map that data by legal entity into a tax-structured database,

with tax rules consistently applied across every data set to meet recurring reporting requirements.

A case in point

With data analytics, tax accountants can not only help a company assess its tax situation in real time for opportunities and exposures, but they can integrate data from the whole company. The tax function can now be essential to the enterprise, and not just the area that calculates the after-effects of a decision.

For example, let's say a retailer with a global footprint is trying to decide on the optimal countries in which to set up its distribution network.

Historically, only the supply chain and finance functions would have input into this decision. But with the ability to add live tax data and use analytical tools, a better solution can be derived at the product transfer-pricing level. So analysis can now be ongoing, with a real-time understanding of the tax implications of a transfer-pricing framework. This allows the organization to adjust quickly as needed. With tax data playing an integral role, better decisions can be made.

Of course, in real life the data is more complex, so aligning with operations can be difficult. But by using the data from regular operating activities, tax accountants can overlay tax analytics to gain a clearer perspective into ongoing business operations and advise a company appropriately.

Advancing insights in consulting

In consulting and advisory services, we see organizations in every industry racing to recruit and create data-savvy people—employees who can give them competitive edge by drawing meaning from large volumes of data. As startups use data analytics' insights to disrupt larger, more established businesses, data has become more valuable than ever.

This demand to compete with and disrupt industries is leading to a transformation of the consulting industry. We now often ask consultants to not only possess the standard skills expected today (to develop business strategies and models, trigger innovations, create value propositions, use proprietary data analytics platforms, etc.), but also to have proficiency with data analytics. We will look for their ability to gather data from many places, analyze what they see, and use those insights to solve client problems.

Future consultants would also benefit from knowing how to use analytic platforms and take both structured and unstructured data to draw conclusions—about changing trends, competitive forces, and customer behavior. Similarly, consultants will also be called upon to help companies focus on asking the right questions to lead to the answers that ultimately help the business improve its performance.

This will lead to a fundamental shift in the way consulting services will be created, sold, and delivered to clients. Consultants will be asked to:

- Collect external data about markets, customers, distributors, and companies

- Combine it with their own experience and intuition on the industry's future

- Build analytical platforms that can layer these insights with proprietary client data for new solutions

Information management skills will be significant here. And in some cases, implementing or offering those services to the client may happen exclusively through the cloud.

As professional services organizations build these analytic solutions for clients, they'll also have the opportunity to become more automated themselves. Using similar applications, firms can automate their own data collection tasks and focus instead on strategic analysis and problem solving. This all means future consultants should prepare for a career where

their creative thinking and analysis skills will be at the forefront.

A case in point

A large insurer with a substantial variable annuity book wanted to understand how policyholder behavior has changed since the financial crisis. Traditional actuarial analysis and predictive analytics can't answer how policyholder lapses and withdrawals have changed since the crisis. And these models cannot project how changing policyholder behavior will affect the insurer's balance sheet and cash flow under different economic conditions.

The insurer turns to the consulting organization's platform that uses behavioral simulation—an advanced analytics method that goes beyond predictive modeling—to answer their questions. The platform uses both the client's proprietary and publicly available data to create a synthetic household-level balance sheet and income statement for a representative set of the US population. It also simulates the financial decision-making of individual consumers and households over an entire lifetime.

A model like this lets the insurer have a thorough look at how its policyholders' behaviors have changed— and what that might imply for the future. In addition, the consulting organization trained the insurers' data scientists on the new approach so they could tailor the platform to their specific needs.

This example speaks to the differentiators that consulting organizations can bring to their more traditional clients. Sector expertise and strategic problem-solving skills will always be at the core, but consultants should also know how to layer on client's proprietary data with their own analytics platforms.

Building integrity into information analytics

As organizations rely more heavily on analytics, requests will shift from ad-hoc to more ongoing trend analysis. And with it, a bigger question will emerge: "How do I *really* know these numbers are reliable?"

Using the case above, for example, how will management know that the household-level balance sheet and income statements generated over successive periods used the same model and consistent data sources? Would management benefit from generating risk information year-over-year for its annual reporting?

As that transition occurs, and as data complexity increases, the risk of inaccurate outcomes can go up, too. As such, controls need to be nimble and adapt as data sources change. Companies will start to look for risk and control processes with the needed rigor and structure.

As a result, another increasingly valuable skill for future talent will be understanding how to apply controls and frameworks to these new operations and reporting processes, such as the COSO *Internal Control–Integrated Framework* and *Enterprise Risk Management–Integrated Framework*. While often viewed just through the financial reporting lens, a framework like COSO can be applied to new operations and reporting practices to reduce risk to management. These frameworks can help an organization in having effective, efficient controls. Professional services organizations thus look for people who know how to problem-frame and understand how data reporting accuracy is sustained over time with these frameworks.

Improving corporate compliance

Recently, increased regulations have led businesses to invest more in their compliance functions. The result? Large corporations receive more compliance reporting requests from boards, executives, and regulatory bodies that need to make sure these processes are actively, accurately monitored. At the same time, chief compliance officers have become more common, and their focus is on accuracy.

Accordingly, more companies are asking their professional service providers to assist with compliance activities. For example, many large financial institutions ask for continuous data monitoring for investment trades or flow of funds in order to report suspicious activity. This may involve access to reams of data sets to comb for abnormalities and identify out-of-compliance transactions. Companies are also asking professional services firms to take subsets of the data they already collect and use them for other purposes, like financial and risk analysis.

And now, more than ever, regulators demand greater transparency. Professionals who help clients with compliance engagements must work in an increasingly intense environment that demands ever growing data sets—and while still maintaining accuracy.
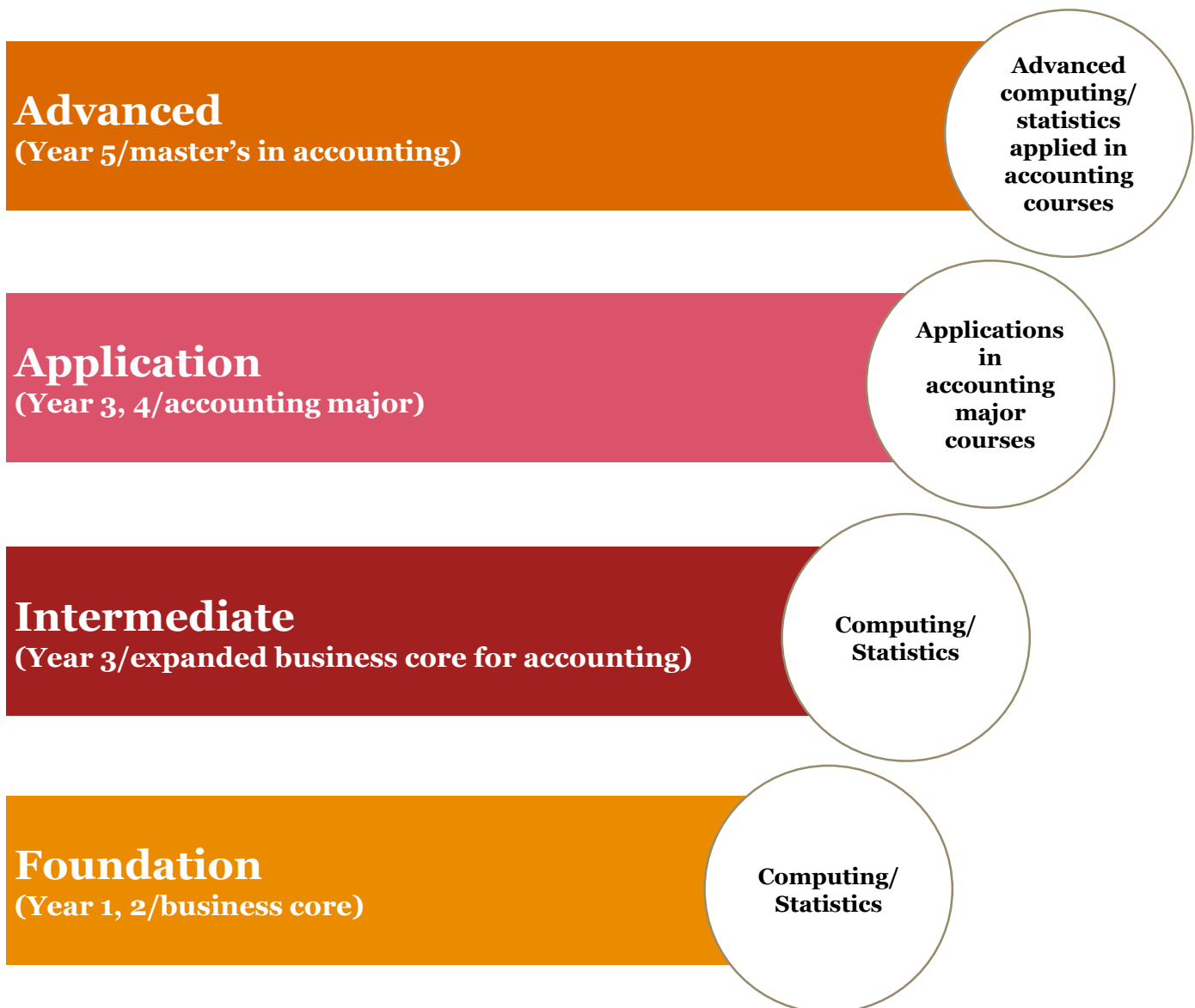
Our recommendations for evolving skill sets

Business specialty	Core skills	New skills likely to be needed
Audit	An understanding of the fundamentals of accounting, including financial accounting, managerial accounting, taxation, and financial reporting systems Knowledge of generally accepted accounting principles, policies, procedures, and auditing standards How to tie accounting needs back to regulatory needs	How to: 1. Research and identify anomalies and risk factors in underlying data 2. Mine new sources of data (must possess a base level of programming knowledge) and use insights to bring new value to the business 3. Understand databases that are relational (a data structure that allows linking information from different types of data buckets) and non-relational (data stored without structured mechanisms to link data from different buckets to one another) 4. Use exploratory multivariate statistics, inferential statistics, visualization tools, optimization methods, machine learning, and predictive analysis tools 5. Process-mine using new data analysis techniques and algorithms, to isolate and investigate specific processes that might have led to changes to the data/accounting ledgers
Tax	The ability to recall specific accounting or tax rules and knowing how they apply to various business transactions; for example, applying a rules-based analysis to a transaction to determine how it should be reported on a tax return The ability to use a similar analysis to evaluate a proposed transaction's impact	How to: 1. Gather a large amount of data in many forms and use it to help make tax department business decisions 2. Consider after-tax performance insights in decision-making 3. Visualize accounting data, like credits, debits, and tax thresholds 4. Use technology to verify that remedial actions or calculations introduced are within regulations and compliance limits 5. Help minimize accounting pitfalls using new data software and visualizations (much like tax planning software has revolutionized income tax filing)

Business specialty	Core skills	New skills likely to be needed
Risk management	An understanding of data science, business domain, and analytical techniques Third-party assurance and vendor risk management knowledge, which entails understanding how companies can mitigate risk that is introduced when an organization contracts work with outside vendors	How to: 1. Use simple vendor risk dashboards and filters to minimize inefficiencies and human error 2. Perform data and process mapping from a regulatory and risk-assurance view 3. Understand and apply advanced query languages; programming languages like R, SQL, and SAS; and data discovery and visualizations techniques
Consulting	Strategic analysis and problem-solving skills coupled with expertise in a particular industry, along with the ability to use data analytics for new insights and new solutions	How to: 1. Identify and frame key business decisions and their related metrics to make these solutions more effectively and efficiently 2. Extract the right data from different sources, then select and run the most appropriate analytics solution to generate insights 3. Visualize and translate insights into concrete actions that businesses can take 4. Communicate the decisions and actions needed in a way that highlights the business value to the client 5. Create proprietary analytics solutions that capture the unique data analytics that the consulting organization builds over time

The new curriculum: What we recommend

Four levels of focus

Advanced
(Year 5/master's in accounting)

Advanced computing/ statistics applied in accounting courses

Application
(Year 3, 4/accounting major)

Applications in accounting major courses

Intermediate
(Year 3/expanded business core for accounting)

Computing/ Statistics

Foundation
(Year 1, 2/business core)

Computing/ Statistics

A set of recommended courses that can build the new technical skills that companies demand.
Source: PwC, 2014

As Erik Brynjolfsson and Andrew McAfee put it in their book *The Second Machine Age,* "Acquiring an education is the best way to not be left behind as technology races ahead."[18]

With both universities and employers dedicated to lifelong development, we're all responsible for preparing students for this new world. But before students enter the workforce, there are base skills that will be important to incorporate in curriculum to position students for success.

Our specific recommendations build on the foundation included in the work of the Pathways Commission and the Association to Advance Collegiate Schools of Business (AACSB) International. AACSB 2013 Standard A7, in particular, emphasizes the need for increased attention to technology and business analytics to prepare future professional accountants. Similarly, the Pathways Commission, co-sponsored by the American Institute of CPAs and the American Accounting Association, has addressed ways accounting education can be improved in light of new technologies.

Like the AACSB states in its September 2014 white paper, *Information Technology Skills and Knowledge for Accounting Graduates: An Interpretation*, the growing conversations around challenges and opportunities of IT, Big Data, and data analytics for accounting professionals reaffirms how timely their Standard A7 is.[19]

We know their and our recommendations will require significant planning to enact change. Current accounting faculty must prepare to deliver new curriculum and build on current collaborations with faculty who possess expertise in information systems, statistics, and computing. There is no single approach to this. But these proposed changes offer opportunities for programs to innovate in both curriculum design and delivery.

With that said, we believe there are three primary ways that universities can ready students for this new business world. We developed the following recommendations with input from university accounting instructors and program leaders.

I. Technical skills in undergraduate accounting programs

Universities should infuse analytical exercises into existing curriculum to help students develop data analytics proficiency on top of their core accounting skills.

Most schools currently require a class on computing and one or two statistics courses early in the curriculum. But if reformed, these classes could provide *all* business students with a base level of sophistication around data analytics. Whether accounting students or not, everyone could benefit, as analytics will continue to grow in importance in every business discipline.

We also forecast a significant increase in demand for students with double majors in accounting and information systems. Academic programs that support these double concentrations will be increasingly attractive to both employers and students.

Deep dives into statistics theory are not the primary point. Instead, we suggest the following courses as a tentative outline for providing students a new set of skills.

a. *Basic computing course: The core competencies should include:*

 - Basic programming skills using a contemporary coding language such as Python or Java

 - Core skills in the legacy technologies (Microsoft Excel and Access), especially in teaching the complex power of spreadsheet software

- Core skills with both structured and unstructured databases (SQL, MongoDB, Hadoop, etc.)

b. *First statistics course:*

- Introduction to programming with R (a common programming language designed specifically for data analysis)

- Basic skills around obtaining and cleaning data, using R, the legacy technologies, and the programming language delivered in the basic computing course

- Introduction to data visualization using tools like Tableau, SpotFire, or Qlikview

- Other core skills in exploratory data analysis (descriptive statistics, basic exploratory multivariate statistics)

c. *Second statistics course:*

- Documenting analysis with R

- Use of GitHub for collaborative work (an online platform where code work is openly shared)

- Introduction to more advanced topics: statistical inference, dealing with missing data or design issues, univariate and multivariate regression and the General Linear Model, logistic regression, machine learning, and predictive tools

We recognize that favored software and other technology will evolve over time, so universities may explore which options work best for them and remain flexible. Some may consider using open-source tools because of the low cost to both schools and students.

We also propose incorporating a series of case problems throughout the accounting coursework that require hands-on use of analytics tools. We suggest introducing real-world concepts that students will need to understand as they enter the workplace, such as how data analytics can add value to business, as well as a grasp of processes and how data flows through an organization, so that they know the right questions to ask clients. This can be taught in a class dedicated to scenarios, in which, for example, students look at mocked-up data to determine *what* is wrong and *why* it is so (technical accounting skills); how they would test it (auditing skills); and how they would communicate it to others (communication and business writing skills).

II. Technical skills in graduate accounting programs

Most accounting graduate programs allow students to pursue a sequence of non-accounting coursework, in addition to a core set of accounting course requirements.

We suggest that accounting departments consider adding an analytics specialty to the curriculum, or replace existing elective sequences with an analytics requirement. The sequence would continue to build on the undergraduate skill set developed above and would include at least three classes:

a. *Statistical analytics course:* providing students with an arsenal of tools in multivariate statistical analysis, including conjoint, cluster, discriminant function, and factor analysis

b. *Computational analytics course, addressing:*

- An introduction to using Python or Java for text mining and HTML scraping

- Optimization

- Advanced topics in predictive analysis and machine learning

- Advanced database and data handling methods

c. *A data analytics practicum, allowing students to solve real or instructor-developed business issues using data analytics. A primary focus would be on communicating the results of analysis in an understandable way, such as through data visualizations.*

III. Building leaders who will build the future

While so far we've focused on the increasing need for deeper expertise in data analytics, the changes in the global business environment have much broader implications. We have a larger vision for what is needed to prepare students.

We describe this point of view as the "PwC Professional"—a framework we use to align our talent management and development activities across our firm, from hiring to career planning. So while we acknowledge the trend toward greater specialization, we also emphasize broader, complementary skills that are more relevant than ever. The following framework serves as our roadmap for career progression in a rapidly changing world.

Our career progression framework

The five areas of development that we focus on for our future and current people.

Source: PwC, 2014

Whole leadership: *"I lead myself and others to make a difference and deliver results in a responsible, authentic, resilient, inclusive, and passionate manner."*

Leadership development includes emotional and social intelligence, starting with self-awareness and empathy for others. What does being self-aware mean in this context? It's about being clear on personal values, understanding both strengths and weaknesses, and being cognizant of one's impact on others. We stress the importance of taking personal responsibility for soliciting on-the-job feedback from others, as well as the ability to manage reactions to the feedback received, whether it's negative or positive.

Leading others means contributing to a team, serving as a coach for other team members, providing others with feedback, and supporting performance improvement. Essential skills include learning how to strengthen the larger brand, how to drive innovation and change, and how to lead by example by maintaining the highest ethical standards.

Technical capabilities: *"I apply a range of technical capabilities to deliver quality and value for clients and PwC."*

In addition to building a solid foundation of technical expertise, it's equally important to build a mindset that takes personal responsibility for lifelong learning. Ongoing development requires personal discipline, as well as curiosity and open-mindedness. Students ought to understand that building a personal brand and reputation is a long-term project, and that a dedication to continuous learning is a part of building expertise.

Conducting research and taking advantage of their network is another essential, as is staying abreast of thought leadership. Technical aptitude also entails the ability to *produce* thought leadership—by forming clear and thoughtful points of view based on hard research and evidence, then communicating and sharing the insights more widely.

Other related skills that fall under technical acumen include professional skepticism and a focus on quality. We expect talent to understand how to validate data and analysis for accuracy and completeness, especially when it's passed along to other team members.

Business acumen: *"I bring business knowledge, innovation, and insights to create distinctive value for clients and PwC."*

As students begin their business careers, we believe it's crucial they understand the influence of macroeconomic factors on the economy, such as the megatrends we previously referenced.

We also expect students to build a basic understanding of areas like emerging economies, business strategy and profitability levers, organizational models and structures and their impact on performance and risk, financial reporting, corporate governance structures, and regulatory organizations. These topics are all part of a foundation of business knowledge that should be developed early on in one's career.

Analytical abilities play into this characteristic, too. Our people should be able to use data analytics to help our clients learn from the insights and resolve the challenges they face. It's not simply a matter of technical skills, but also the ability to think critically using data.

Global acumen: *"I operate and collaborate effectively with a mindset that transcends geographic and cultural boundaries."*

Global acumen means being a student of how the world works—economically, socially, culturally, and technologically, and also understanding the many dependencies among different countries. It means exhibiting curiosity about the world and actively seeking out opportunities to learn about other cultures, businesses, and current events, whether that entails reading, observing, or experiencing new world views.

This attribute is defined by a mindset of curiosity and openness, along with recognition that we all have potential blind spots. Those with global acumen also demonstrate comfort working across geographic boundaries and working productively with virtual team members. Finally, they have the self-motivation to continue to build cultural dexterity by consciously working with diverse teams and seeking to understand perspectives that are different from their own.

Relationships: *"I build relationships of high value which are genuine and rooted in trust."*

As technology continues to disrupt direct social interaction, and globalization increasingly requires working across cultures and languages, the skills required to build deep and trusting relationships have risen in importance, too.

Listening and empathizing, communicating clearly and persuasively, collaborating fluidly with others, and actively building a broader network of skills are needed capabilities. So, too, is the ability to embrace diverse perspectives and welcome opposing and conflicting ideas.

What universities can do

How can we support students' development beyond technical skills? Classroom curriculum can embed a variety of experiences that develop these attributes by design, such as creating a feedback-rich environment. Team projects can incorporate exercises around giving and receiving constructive feedback, resolving conflicts, and communication and presentation skills whenever possible.

Using flipped course design can also accelerate skills development. "Flipping" courses means reversing how the typical classroom works: Students view online lectures on their own time outside of the classroom, then spend in-person classroom time for application exercises and small group work. Additionally, case studies and research projects can incorporate the global megatrends and build the judgment required to problem frame, not simply problem solve.

Some programs are also adding courses or development experiences that focus explicitly on leadership, relationship, and communication skills. Universities can encourage students' global acumen by supporting international study experiences and foreign language studies, continuing to enroll diverse student populations, and drawing upon this diversity of perspectives in the classroom.

These kinds of experiences will add depth to all five dimensions we emphasize, which aren't exclusive to PwC's needs. According to *The Wall Street Journal,* many companies report that today's entry-level roles increasingly require more abstract thinking and advanced skills like collaboration and problem-solving.[20] Students who leave their universities with this mindset will have a significant advantage.

Conclusion

We know there is a lot of work ahead to prepare students for success in the rapidly changing business world they'll be entering. The global megatrends and data analytics are transforming the workplace, and the skills students need should correspondingly transform. At universities, accounting curriculum should be refreshed to satisfy the demands of the business world.

We've developed our curriculum recommendations based on what professional services firms like ours increasingly look for in candidates, and what our clients ask of us. We are also focused on the full professional growth of our people, including technical, relationship, and leadership skills, as well as business and global acumen. The PwC Professional framework is our vision for development of a whole leader.

Today, we recognize skills in data analytics, information management, and programming languages as more valuable than ever, along with the leadership skills that enable students to effectively lead, communicate, and collaborate.

Tomorrow, we can only imagine how technology will continue to transform our work and the workplace. It is on us, as educators and employers, to make certain that our students are not the ones being disrupted—but rather, the ones driving innovation and leading change.

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