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SERVICES FOR SCIENCE AND EDUCATION

A Study of Employee Digital Supply Chain Skill Needs and Business School Executive Education Program Coverage of These Skills

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ABSTRACT

Digital technologies are being widely adopted to bring visibility and efficiency to supply chains, but employees often lack the technology skills needed to use them effectively. This situation presents significant opportunities for business school executive education programs to access new pools of students and remain relevant as a source of employee technology training, even as they face stiff competition from a myriad of online training providers. This study examined business school executive education websites to determine the extent to which they are meeting the digital supply chain training needs of corporate employees. Findings indicate that, although employee format preferences for short, online, customized, flexible courses have been built into executive education programs, a number of critical digital supply chain topics are covered by only a few businesses school programs or not at all.

Keywords: Supply chain, digital technology, eLearning, executive education

Supply chain transparency, visibility, control, efficiency, and supplier and customer relationships, which were key make-or-break issues even before Covid-19, are even more important in the post-pandemic world [1] [2] [3]. MIT's David Autor referred to the pandemic as an "automation-forcing event", because companies rushed to adopt digital technologies that would enable them to remain engaged and connected remotely with their many stakeholders" [4, 2]. However, recent surveys of supply chain managers and employees have revealed that digitalization efforts are still very much a work in progress in the overwhelming number of cases. An MHI & Deloitte study found that 80% of companies estimate that only 5% of companies currently have "autonomous, connected, intelligent, and agile" digital supply chains; although they do also predict that digital supply chains will be the norm by 2027 [5, 28]. The MHI & Deloitte study [5] also found that 54% of companies had supply chain disruptions and 52% out-of-stock situations over the past year [5] and a COUPA survey [6] found that close to 80% of companies reported at least one significant supply chain disruption. Disruption causes included regional wars, climate disasters, inflationary conditions, cybersecurity attacks, sourcing strategies updates, and changes in governmental regulations [5] [6] [7]. [7] found that approximately 30% of survey respondents reported less than 50% visibility into the operation of mobile assets in their supply chains, while 45% of Alicke al.'s [8] survey respondents reported having either no upstream visibility into their supply chains or visibility limited to first-tier suppliers. This research [8] also revealed the sober estimation that if a supply chain disruption lasts a month or longer, it can cost 45% of a company's yearly profits over ten years.

INTRODUCTION

To prepare for future disruptions, companies are increasing investment in technology innovations, with an 87% increase in such investment since 2021 [5]. Ninety percent of Alicke et al.'s study [8] respondents plan large investments in technology; and average corporate technology spending is expected to range from $1 million to $50 million [5] [6] [7].

Adopting and implementing new technologies requires employees who have the necessary skills to use them effectively [7] [9] [10]. Serous shortages in digitally trained supply chain talent are preventing many companies from adopting and implementing digital supply chain systems. Indeed, companies in MHI & Deloitte's study [5] reported that their top supply chain challenges continue to revolve around labor issues, with 57% of companies reporting difficulties in hiring and retraining qualified workers and 56% reporting talent shortages. An Ivanti Wavelink study [7] found similar percentages, with labor shortages in 57% of companies surveyed, worker efficiency issues reported by 55% of companies, challenges with time to train workforce by 52%, and high employee turnover by 50%. A Coupa [6] study found that after material shortages (38%), labor shortages (36%), were the second highest challenges over the past year. This study examines the extent to which colleges of business across the country are taking measures that will enable them to continue to be relevant as sources of technology training for employees around the country. Fortunately, as stated above, increasing numbers of companies are investing in reskilling and upskilling, with 41% of companies concentrating on technology skill training [5]. High expected investment in employee technology training presents opportunities for colleges of business to help close employee technology skill gaps. Indeed, college of business executive education programs are struggling to remain relevant to employers and employees seeking technology training [11] [12] [13] [14], while at the same time finding themselves in an atmosphere of challenging competition from a myriad of third-party online training providers [13] [15]. At this point in time and into the future, the continued viability of business school executive education depends on the ability to provide the format flexibility and technology content which are now expected by both supply chain employees and their employers [13].

In particular, the study seeks answers to the following questions:

1. What is the specific supply chain digital technology training needs and expectations of today's companies and employees?
2. To what extent have colleges of business made or begun to make the changes necessary to serve the digital supply technology training needs of today's companies and their employees?

The paper begins with a discussion of technologies recognized as transformative for supply chains, the need for digital technology training, the changing landscape of eLearning, and insights from survey studies; followed by the research methodology, results, discussion, limitations, conclusions, and future research directions.

LITERATURE REVIEW

Digital Technologies That Are Transforming Supply Chains

Digital transformation has the impact of connecting a company in real-time with its stakeholders--both internal stakeholders like employees and external stake holders like

suppliers and customers [8] [16]. With a digital platform, order taking, order processing, and data storage can be automated and streamlined. Important documents like contracts and legal documents can be secured through cryptography in Blockchain. Customer information can be gathered and used to predict consumer behavior and assist in customizing services and other types of customer engagement [16]. The pivotal role played by data in digital transformation cannot be underestimated. In 2006, mathematician/data scientist Clive Humby characterized data as follows: "Data is the new oil. It's valuable, but if unrefined it cannot really be used. It has to be changed into gas, plastic, chemicals, etc. to create a valuable entity that drives profitable activity; so, data must be broken down, analyzed for it to have value" [17, 26]. Digital transformation meets this challenge to derive value from data by changing the way data is collected, stored, analyzed, and proactively used. Data now has strategic value and can be available in real-time to all stakeholders in a company, thus increasing transparency with partners and trust among stakeholders [18].

From order taking to fulfillment, supply chains have been impacted by digital transformation. Starting with planning and visibility, control towers provide real-time optimization for planning; advanced analytics provide accurate forecasting; and inventory management systems use mathematical algorithms to determine the most probable excess stock and shortage levels and enable demand forecasting and planning [19] [20]. Sales and customer service are enhanced by sensor-driven goods replenishment, demand-driven supply chain operations, and user-friendly customer platforms. After-sale benefits from predictive supply/demand diagnostics, remote servicing, and predictive spare-parts management. The procurement process supports supplier collaboration through supplier platforms and spend analytics programs [22]. Production is enhanced by connectivity with suppliers, employees, and customers, with many routine jobs now being completed by robots, drones, driverless machines, and/or by employees using wearable devices that capture data that is available in real-time to stakeholders [16]. Logistics is enhanced by dynamic network optimization tools, which use mathematical models to reduce network complexities and optimize asset locations across the supply chain [20] [23]. As shipments leave the factory or warehouse (sometimes in driverless vehicles) smart inventory alerts enable employees and customers to know exactly where a shipment is. Throughout the supply chain operation, performance management that used to be performed weekly or monthly is now done in real-time, enabling performance issues to be solved quickly [20].

For the past several years, MHI & Deloitte Annual Industry Reports [21] [22] [44] [53] have followed the adoption of digital supply chain technologies and their potential to disrupt or create competitive advantage for supply chains. Looking ahead to adoptions/predicted use of supply chain technologies within the next five years, companies surveyed indicated that inventory and network optimization , Internet of Things, and AI rank first at 85%, followed by the following technologies, which are ranked in descending order—sensors and automatic ID (83%), robotics and automation (83%), clouding computing and storage (81%), Additive technology (3D printing) (81%), Data Analytics (78%), blockchain (77%), autonomous veicles and drones (76%), and wearable and mobile technology (75%) [21].

The specific roles of these technologies in digital supply chains are as follows.

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In Inventory Optimization (85%), mathematical algorithms determine the most probable excess stock level and shortage level, helping a company achieve multi-echelon inventory optimization, cost-effective postponement strategies, stock keeping unit rationalization, optimization of inventory components, enhanced supplier intelligence, demand forecasting and planning, and Just-in- Time (JIT) strategies [19] [20] [24].

In Network Optimization (85%), mathematical modeling reduces supply chain network complexities and optimizes asset locations across the supply chain. Enterprise priorities and supply chain competencies in all areas of the supply chain network (sourcing, inventory, transportation, warehousing) are identified, prioritized, and mapped [20] [23] [25] [26].

The Internet of Things (85%) refers to physical devices, vehicles, home appliances, and other items that are embedded with electronics, software, sensors, actuators, and network connectivity that enable them to connect and exchange data [27]. IoT makes it possible to access or control remotely located objects across the supply chain, and facilitates real-time analytics, customer/market insights, customer and/or supplier collaboration, quality control, streamlined production, AI and machine learning, and temperature/humidity monitoring [22] [28] [29].

Artificial intelligence (85%) combines several types of other technologies in the simulation of human intelligence and the rapid solution of complex problems: machine and deep learning, reasoning, voice recognition, augmented reality, cognitive computing, natural language processing, and translation. AI systems adapt and learn as information, goals, and requirements evolve; and interact easily with other processors, devices, and cloud services [30] [31] [32] [33].

Machine Learning is a subset of AI that can provide insights about supply chain management performance that is not accessible from previous technologies [16]. Machine learning can identify key factors that affect supply chain performance by using algorithms to discover new patterns in supply chain data with little or no manual interference. Machine learning can detect excesses and shortages of stocks and analyze customer behavior. Machine learning also analyzes existing routes for quicker delivery of products and uses data from IoT and other sensors to identify inaccuracies and evaluate risk factors/opportunities along the supply chain [34] [35].

Automatic sensory and identification technologies (83%) enable robots and other sensor-equipped equipment to greatly improve operations and order processing by using RFIDS, barcodes, and optimal character recognition to sense, identify, and react to, other devices and access data from SKUS [27] [37] [38] [39]

Robotics and automation (83%) are used to relieve workers from routine, manual tasks such as picking, packing, inspecting, classifying, and sorting orders; loading, unloading, and stacking; receiving and put-away; assembly operations; and processing such as welding, painting, and cutting. In turn, workers are responsible for monitoring robots' performance and making needed adjustments [37] [40].

Cloud computing and storage (81%) use a network of remote servers to access shared resources like data servers, storage, applications, and other services. Users can store and process data in a

privately-owned cloud or a third-party server, making data readily accessible from anywhere. Supply chain data stored on a cloud is available to anyone inside the company, as well as to distributors and suppliers, so that all of the stakeholders can access the same accurate, real-time information [41] [42].

In additive manufacturing (3D printing) (81%), special CAD software relays messages to a printer, which prints the desired shape in thin layers that are repeatedly printed on top of each other and fused together until the shape is complete [43]. Additive manufacturing reduces material inputs for manufacturing, as well as the cost of production processes, and enables faster reaction to demand changes [44] [45] [46].

Data Analytics (78%) provides information that contributes to a company's business intelligence and enhances planning, strategic decision making, and customer service. Data analytics techniques analyze data sets of large, real-time data from IoT and other sensors, unstructured social media, news feeds, weather, and blockchain-enabled networks [47] [48] [49] [50]. Descriptive analytics can reveal where a company is currently and what has happened in the past; diagnostic analytics examines why things happened the way they did; predictive analytics can predict the future more accurately, and prescriptive analytics helps determine the optimally desired outcome. By providing real-time and near real-time data, data analytics supports and enhances nearly every aspect of supply chain--inventory management, transportation management, risk management, sustainability, increased efficiency, improved visibility-all of which enable better decision making [50].

Blockchain (77%) is a continuously growing list of digital records that are linked, secured through cryptography, and continuously updated. Blockchain can be used for transaction processing, records management, and other data-driven tasks. For supply chain clouds, blockchains can provide continuously updated and verified information from data inputs in shared ledgers that are available 24/7 to all enterprise stakeholders [22] [51] [52].

Autonomous, self-driving vehicles (76%) equipped with sensors can provide data about the environment around them, work together to complete tasks, and provide visibility along the supply chain (MHI & Deloitte [5] [21] [22] [44] [53] [54] [55] [56]. Smart warehousing systems direct trucks to the correct inventory bay, where they are unloaded by robot forklifts, with flying drones inspecting and verifying the load. [57] [58]. Global Positioning Systems (GSPs) receive signals from GPS satellites that enable calculations of an object's position and time, enabling the identification of the exact location of sensor-tagged items. Real-Time Locating Systems (RTLS) can identify and track the location of objects within a building or other enclosure, track products and supplies through an assembly line, locate pallets in a warehouse, track temperature and humidity, and send them to the supply chain cloud [36] [56].

Wearable technologies (75%) are application-enabled computing devices, worn or attached to the body, that accept and process input from the Internet or other devices. Workers equipped with wearable technology do not need to input information and can capture, hands-free, leads and sales updates via voice messages. Smart glasses guide staff through the warehouse by virtual reality, and SmartWatches enable managers to receive 24/7 emails, voice mails, text message, and notifications (Herhold, 2020). Mobile devices eliminate wasted "travel" time within a

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warehouse by enabling employees to input/update data and create and print labels wherever they are [59] [60].

Metaverse was also included in the list of supply chain digital skills in this study, because it is expected to have a powerful impact on supply chains [61]. Metaverse brings together multiple technologies—including extended reality, blockchain, artificial intelligence, digital twins, smart objects, edge computing, and much more powerful computers—which connect groups, collaborators, and data/information in virtual spaces where they can collaborate and make decisions. Smart products can trigger automatic replenishment/routing and shape demand; and AI-generated data can optimize processes, forecasts, and inventory management. Metaverse will also enable enhanced customer experiences, collaboration, and employee training [62] [63].

The Critical Need for Supply Chain Employee Training

Many of today's supply chains have become global and "specialized, multi-tiered, and fragile" [64, 1]. In order to meet consumer demands for customization, products are outsourced to external suppliers that are often far flung across the globe. Fragmented and increasingly complex supply chains with multiple tiers of partners are difficult to monitor and control. As digital technologies like the ones described above address these issues, employee expertise in mastering and using them is becoming more crucial than ever. In fact, employee digital dexterity is being increasingly valued more than tenure and experience [65]. As predicted by Toffler in 1971, "The Illiterate of the twenty-first century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn" [66, 414]. With the half-life of technical skills now about 5 years and steadily decreasing, continuous, lifetime learning and corporate support for it will be necessary for employees to succeed in the challenging and evolving work environment of the future [7] [9] [10] [67]. Predictions are that 85 million workers will be replaced by automation by 2025 ([68]; the good news is that by the same year, 149 million new technology jobs are expected to be available (Smith, 2020).

The 2020 MHI & Deloitte Annual Industry Report [44] emphasized the importance of providing ongoing opportunities for employees to develop digital skills, by tying career growth to employee participation in training, by using younger digital-savvy employees to mentor older employees and assist in facilitating digital transformation, and by establishing partnerships with STEM programs in colleges of business that encourage the training of future employees with the skills companies need. Eighty-seven percent of employers in a CarringtonCrisp & LinkedIn survey indicated that they plan to develop a formal lifelong learning strategy for upskilling and reskilling employees that allows them to develop skills flexibly, informally, and online [70]. This sentiment was echoed in the World Economic Report 2020, which wrote that 95% of employers plan to retrain their employees [68]. The need for lifelong learning is recognized by employees themselves. According to a Pew Research Report, the majority of employees recognize the need for upskilling and consider themselves to be lifelong learners [71]. Recognizing the lifelong learning message, Walmart has offered to pay 100% of tuition and textbook cost for any of its associates [72]; and other companies offer learning opportunities to employees [73]. "Investment in continuous learning—and making learning an everyday habit—can reduce the impact of chronic talent shortages and an aging population, improve worker equality, promote inter-generational learning, and help create a more resilient

workforce" [5, 22].

The Changing eLearning Landscapes

Over the last several years, the landscape of corporate learning has expanded and diversified as a result of the increasing digitalization of supply chains and the globalization of business. Concurrently, colleges of business are struggling to maintain currency in their curricula and to address the ever-evolving technology skills which industry demands of its employees [13]. Colleges of business are dealing with declining enrollments and the necessity of developing new pathways to serve the needs of today's learners, which now include a new, expanded group of non-traditional students, many already in the workforce and eager to upskill to meet the technical demands of their jobs [13].

More and more colleges of business are now offering short-term executive education training for employees that is customized to specific organizational needs, addresses the requirement for lifelong learning, and recognizes training completion with digital recognitions [74].

The increased popularity of eLearning has created competition from a myriad of eLearning corporate training providers [13]--online education providers like Coursera for Business, Udemy, Skillshare, MasterClass, EdX, Udacity, Khan Academy, KnowledgeCity and PluralInsight; social platforms like LinkedIn Learning, Twitter, YouTube, Instagram, Facebook; consultants like The McKinsey Academy, Accenture, the Supply Chain Academy; non-profit professional organizations like Association for Supply Chain Management, the Council of Supply Chain Management Professionals, and the Institute for Supply Management® 2021); and publishers like Pearson and O'Reilly [13] [15]. In many cases, universities have developed revenue sharing relationships with third-party training providers like the ones listed above. Partnerships with online training platforms can include assistance in developing and offering a school's own online courses, offering and marketing already packaged courses (from educational platforms) on university websites, and marketing and featuring existing university courses on the partner's platform, in order to make them accessible to learners. Universities who partner with third-party training providers are highly supportive of this additional channel for reaching new students and testify to the savings in revenue which they realize with such partnerships [75].

Colleges of business also face the challenge of competing with immersive, engaging learning modalities that are offered by an increasing number of alternative eLearning providers--from the more familiar virtual reality and augmented reality holograph technology; to AI programs like Microsoft's FLEXA, which can customize learning according to the specific needs of individual learners; to metaverse, which extends virtual reality by using avatars of learners and supporting interactive, real-life scenarios, and both face-to-face and hands-on learning [13].

In order to remain relevant and sought-after by employers and employees in the competitive eLearning marketplace, colleges of business must reach out to business and industry to determine what their employee training needs are and how to provide training in a way that is most effective and appealing to them. This relationship-building process can be enhanced and facilitated by surveying the specific needs of companies, as well as by consulting previous research findings. Establishing closer partnerships with companies can develop information sharing between a school of business and the company that builds confidence and familiarity

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with the college's offerings, as well as the business' employee training needs.

Insights From Survey Studies About Employer and Employee Training Attitudes and Preferences

A 2023 learning and development study by Coursera made the interesting insight that in the past, when companies faced uncertain, changing market environments, investments in learning and development were usually the first expenses to be cut or eliminated. In contrast, in the unique, ever-evolving digital-dominated environment facing today's companies, reskilling employees for digital work is recognized as a crucial effort that is absolutely necessary for a company to support, if it is to survive [76]. Such efforts are evidenced in the 5%-10% increase in learning and development reported by many companies, and more than 10% planned by 45% of companies [76].

Several survey studies point out the evolving nature of the skills students need for success in today's digital business environment and the high talent shortage which companies are facing. Indeed, projections are that up to 97 million new hi-tech jobs will be created while 85 million existing jobs will be eliminated by 2025 [14]; and that furthermore, more than 60% of employees globally will need upskilling/reskilling by 2027 [68]. Meanwhile, four out of five companies are facing serious talent shortages [14], and many companies even doubt that, given rapid advancements and adoption of AI, students are actually building the skills they need to fill growing company needs [14]. In a 2024 World Economic Forum session, Education Meets AI, Code.org Founder and CEO, Hadi Partovi, emphasized that there is less risk for worker job loss due to AI than there is to job loss to someone else who is AI-trained [77]. Emphasis on the need for reskilling/upskilling is being experienced globally, as witnessed by ongoing efforts of the World Economic Forum's Reskilling Revolution to "provide one billion people with better education, skills, and economic opportunity by 2030" [77] [83]. At the same time, 97% of employers report the intention to move to skills-based hiring and that they are more likely to hire job candidates that have industry micro-credentials than those who do not [78]. Colleges and universities are now addressing the demand by both students and employers for industry micro-credentials [79].

CarringtonCrisp & LinkedIn [70] surveyed attitudes of employers on specific aspects of corporate training. Only 35% of employers reported using college of business corporate training programs for employee learning, because they find that other learning providers better meet their needs (24%), and that colleges of business are too expensive (24%), too theoretical, and sometimes outdated (20%). However, employers indicated that they would like to develop a closer relationship with colleges of business to co-create relevant content (79%) and short-term flexible employee training that facilitates and supports lifelong learning (76%). Eighty-one percent agreed that their organization plans to create long-term relationships with learning providers to build understanding of their business and to maximize the impact from learning; and 83% indicated that measuring the impact of learning and development will become key when selecting a learning provider.

In the employee portion of CarringtonCrisp & LinkedIn's [70] study, employees surveyed wanted to update skills on an ongoing basis—with flexibility as to when, where, and how they learn. They preferred online, short-term/module format, low-cost training that earns them

valued recognitions, accelerates their career prospects, supports lifelong learning (69%) and has flexibility that suits their lifestyle, career, and commitments (71%). Employees wanted to update skills on an ongoing basis (67%), take training during work hours (41%), expected employers to fund the training, wanted more guidance from employers about skills they need to develop (70%), and thought that employers should value informal learning when making hiring decisions (69%). They also indicated that college of business programs are often too expensive (52%) and do not always impact career growth (44%). More than half (58%) of employees agreed that the availability of so many eLearning options beyond higher education has made them less sure of the value of formal university programs. Regarding degrees they plan to seek, employees indicated interest in industry-recognized qualifications (e.g.CPA, CFA, ACCA, CIM, CMI, ETC) (21%), a traditional or microcredential MBA that prepares them for the workplace of the future (77%), and a degree they can earn in a series of modules over an extended time period (34%).

Insights about employee training format/content preferences were also provided by an earlier Coursera for Business survey study [80]. Employees preferred content that is relevant and applicable (49%), offered in a format that fits their schedule (32%), is valued by colleagues (28%), includes opportunity to earn a valuable credential (23%), and is provided by the employer (20%). Preferred training time commitments for training sessions included, in descending order: 1) 45 minutes of less in length, 2) 45-minutes to 2 hours, or 3) a half-day or longer. Preferred learning formats were online courses (50%), in-class training (49%), training materials to study (45%), attending conferences (39%) and webinars (39%), and consulting friends, co-workers, and mentors (34%).

A more recent study by Flynn [81] provided insights about strong employee interest in training as well as benefits employers know they can reap from supporting the reskilling/upskilling of their employees. Interest in training: 87% of employees surveyed responded that professional development is important to them, 58% that it makes them feel more satisfied with their job, 59% that it enhances their job performance, 69% that they consider skill development to be most their employer's important policy, and 74% that when professional development is not available, they cannot reach their career potential. Only 41% of employees report formal training, 52% report a week or less of training, and 59% have never been formally trained. Impact of training on employee retention: 40% of employees quit after one year, with 34% citing the lack of training opportunities as the reason why. At the same time, 94% of employees said they will not quit if training opportunities are available, companies that support training show 30%-50% better retention than those that don't, and 55% value career growth as more important than salary. Popular employee training program formats: 91% of employees want training that is personalized to their specific skill needs, and 93% want training to be convenient--online, video, one-on-one, skill-specific, flexible in terms of when and where it can be taken. Employee views on training: 68% of employees would like to learn on the job, and only 29% of employees feel very satisfied with the training opportunities they currently have. Benefits to companies with strong training/development programs: 218% higher income and 24% higher profit margins per trained employee, as well as 17% higher productivity. Globally, corporate investment in training amounts to $345.56 billion, and it could reach close to $500 billion by 2028.

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All of the above employee survey results indicate that employees recognize the importance of maintaining current through professional development; consider formal training programs to be even more important than salary; and want job-specific training that is offered via video, online and is flexible regarding when and where they can take it. At the same time, the lack of training opportunities still remains an issue in need of more attention from many companies, who are missing out on productivity and profit gains to be reaped through employee skill development.

METHODOLOGY

This study examined the extent to which college of business executive education programs are offering courses that cover the skills identified as crucial technology training areas for supply chain employees. The first step was to locate a list of highly ranked business schools in the United States through an Internet search. *U.S. News and World Report's 2023-2024 Best Business Schools* [82] was chosen as a source of this information.

The final list, shown in Table 1 (See Appendix 1), included executive education programs at 113 universities in the United States, with a mixture of private, public, and technical-focused institutions represented. The websites of these business schools were examined for executive education courses and certificate programs that cover supply chain and the crucial technical skills identified above. A wide variety was found in the presentation and terminology used to feature programs/courses for working professionals, making it necessary in many instances to examine various website pages in order to get the full picture of programs available. For example, relevant information was found under headings such as Professional Development and Continuing Education, Career Advancement and Executive Education, Open Enrollment Courses, Courses for Individuals and Courses for Organizations, Non-Degree Courses, Office of Continuing Studies, Bootcamps. Workshops, Continuing Education, Career Advancement and Executive Education, Outreach and Corporate Learning, Extended Studies, Center for Workforce Development Needs, Office of Professional Advancement, and Center for Corporate Learning. The business school executive education programs identified were examined on the following criteria, which were based on the skills identified in this paper and on the training needs and preferences identified in prior surveys of employers and employees:

- **Short-term time length**: Does the duration of executive education courses reflect the need to build specific skills in a short period of time for corporate leaners?
- **Flexible delivery modes**: Are executive education courses offered in a variety of delivery modes, such as live online, asynchronous online, face-to-face on campus, face-to-face on company's site, and on-demand?
- **Customized content**: Are executive education programs and courses customized to fit the training needs of companies and their employees?
- **Completion recognition**: Are participants given recognitions to honor their completion of training, such as certificates, digital badges, or mini-MBAs?
- **Cost**: Is a range of costs available to suit the budgets of individuals and organization seeking training?
- **Partnerships**: Do any universities partner with online technology training partners?
- **Relevant content**: Does executive education reflect coverage of the crucial skills in this study?

RESULTS

Results for Course Length

All programs examined offer short term options (1-2 days to several months) and staggered start/finish for courses through the year to fit the busy schedules of working individuals.

Results for Flexibility of Delivery Mode

All programs offer a mixture of face-to-face at the business school, live online, asynchronous online, on-demand, on campus, or on site at the workplace.

Results for Customized Content

Readiness to address the particular training needs of companies and their employees with customized training is offered by all of the executive education programs examined. Some programs break their executive education programs/courses into those for individuals and those for organizational groups (Georgia Institute of Technology, University of California-Berkeley, and Harvard University). For others, open enrollment in existing programs is offered to both individuals and to organizational groups (University of California-Berkeley, Georgetown University, Pepperdine University). Columbia University and Georgetown University offer organizations the opportunity to enroll their employees in any of their MBA courses.

Additionally, non-degree courses are featured for corporate learners (American University, Michigan State University, Ohio State University, Rutgers University, Texas Christian University, University of Michigan, University of Southern Carolina, and University of Tennessee-Knoxville). Another trend is for some technical and business courses to be housed in continuing education, workforce education, or professional education departments. Harvard University Extension School, Berkeley Extension School, and Yale University Extension School, for instance, are well known for offering non-credit professional education courses.

Results for Content Reflective of Supply Chain and Digital Technologies

Table 2 (See Appendix 2) shows coverage of digital supply chain skills, in courses and/or in certificates, across each of 113 corporate learning programs in the study. Programs that offer courses in a digital skill were given a score of 1, and those that offer certificates in the same skill were also given a score of 2 points, with 3 points (1 for offering courses and 2 for offering certificates) the maximum possible score for each digital skill. The schools were ranked from highest to lowest totals, with MIT the top ranked university, with 22 points, and nine universities with no coverage of digital skills, who received a score of 0.

Fig. 1 shows the number of schools that offer courses or certificates in the digital skills of interest.

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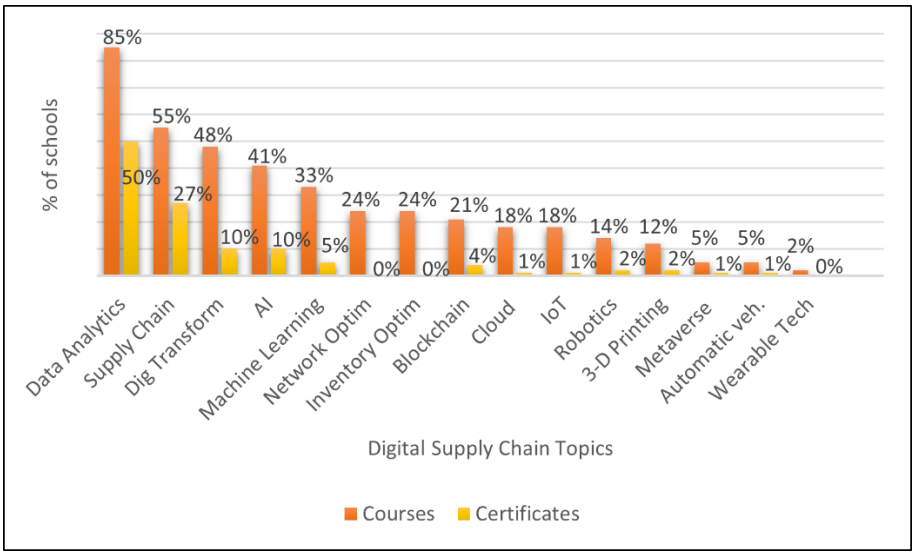


Fig. 1: Number of executive education programs offering courses/certificates in digital supply chain skills

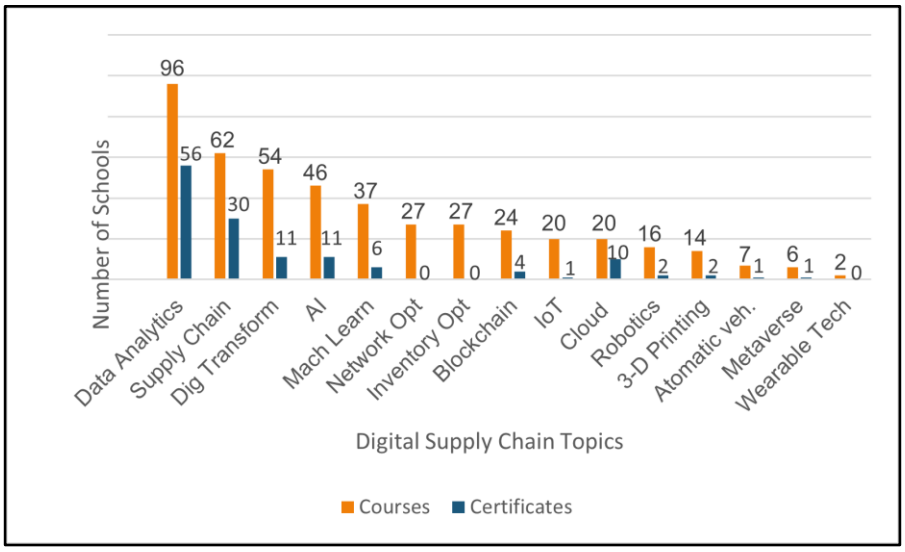


Fig. 2: Percentages of schools that offer courses/certificates in digital supply chain skills

Results for Partnerships with Other Online Education Providers

Table 3 (See Appendix 3) shows universities that have developed partnerships with online technology training platforms. Some universities partner with online training providers to select, design and deliver online short courses such as web development, data analytics, cybersecurity, digital marketing, and technology project management. Examples of these training providers include Trilogy and GetSmarter, each of which is used by 10 of the universities in the study.

Some online training providers offer their own technology programs/bootcamps on university websites.

- FullStack bootcamps, which are offered at 16 of the universities included in this study.
- QuickStart is used at three universities.

- Flatiron is used for bootcamps by two universities.
- Podium is used by one university, and BISK is also used by one university.

Platforms like Coursera, edX, and Emeritus market existing university technology programs on their platforms, making them accessible to learners worldwide. Examples include Coursera, used by 41 universities in the study; edX, used by 34 universities; 2U, used by 36 universities; and Emeritus, used by 12 universities.

Results for Completion Recognitions

Table 4 provides examples of universities that offer professional certificates, mini-MBAs, and digital badges. Digital badges offered by three of the examined programs can be included in resumes and on social media. Mini-MBAs, offered by several institutions, encapsulate the main subject areas covered in MBA programs into short-term, modules which can be completed in a few days or weeks. Two Mini-MBA programs have a data analytics focus--University of Houston offers a Mini-MBA in Data Analytics, and Rutgers University offers Mini-MBAs in several areas, including Digital Supply Chain, Business Essentials, Digital Marketing, Data-Driven Management, Driving Innovative Business Solutions, and Artificial Intelligence. Additionally, Clemson University offers mini-MBAs in Data Analytics and Visualization and in Marketing Trends and Digital Transformation.

Table 4: Executive Education Program Mini-MBAs and Digital Badges

Institution	Professional Certificates, Mini-MBAs, Digital Badges
Clemson U. Powers College of Business	Mini MBA, including in Data Analytics and Visualization, and Marketing Trends and Digital Transformation (each one 6 4-hour sessions.
Case Western Reserve U. Weatherhead School of MNGT	Digital Badges: Innovation and Design (including digital transformation and Tech innovation)
Miami U. Farmer School of Business	*Beyond Ready for the Future* Mini-MBA, online, self-paced
Rutgers Business School	Mini-MBAs, including Digital Supply Chain, Business Essentials, Digital Marketing, Data-Driven Management, Driving Innovative Business Solutions, AI. Online self-paced, 12 wks., Digital badge upon completion.
U. of Buffalo School of Management	Mini-MBA online, self-paced, includes IT and Inventory Management (Doable in 4-6 months)
U. of California San Diego, Rady School of Management	Mini-MBA, online via Zoom, 7 weeks, (includes business analytics)
U. of Houston- Bauer College of Business	Mini-MBA in Data Analytics, in-person, 5 days

Results for Cost

Table 5 presents a few examples of fees for various executive education programs/courses.

Table 5: Sample of Course/Program Fees

University	Course/Program and Fees
American U. Kogod School of Business	Graduate Certificate in Analytics, $1,800 per credit hour x 12 = $21,000

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Carnegie Mellon U. Tepper School of Management	Analytics and Decision-Making: Unlock the Power of Data, online, 3 days, $4,100
Columbia U. School of Business	Digital Marketing Strategy-in-person, 3 days, $6,650
MIT Sloan School of Management	Technology and Operations- self-paced online, 6 weeks,6-8 hrs/wk, $2,800
Michigan State U. Broad College of Business	Business Analytics: $4,613 for 2 courses, each 8 wks.
New York U. Stern School of Business	Digital Marketing and Social Media Strategy: Leveraging Analytics and AI, live online, 5 days, 9:30 a.m.-2 p.m., $5,400.00.
Temple U. Fox School of Business	Executive Approach to AI/Machine Learning, 3 hrs. Zoom meetings, $2,000 per company login (up to four participants)
U. of Chicago Booth School of Business	Digital Innovation Strategy and Management—live-online, 4 days, $2,500
U. of Michigan Ross School of Business	Digital Transformation and Innovation, online synchronous/unsynchronous, 5-wks, $2,000

As shown in Table 5, fees for executive education programs/courses vary greatly, depending on the university at which they are offered and the delivery mode and length of the program/course.

DISCUSSION

This study of executive education programs at schools of business in the United States focused specifically on skill development opportunities for corporate employees in supply chain management and the digital skills which are crucial for employees who are to use digitally transformed supply chains. The purpose was to gauge the extent to which these topics are being covered in executive education programs, as well as the extent to which the expressed preferences of employers and employees regarding customized content, length, delivery flexibility, completion recognition, and cost are being met by these programs. The insights into the coverage of supply chain and digital technologies in the study, are, admittedly, not generalizable to the many other institutions of higher education in the country. This study represented a one-time sample of training that is being offered to employers and their employees at a particular point in time in topics that are crucial for the survival and competitiveness of today's business and industry.

Executive Education Formats are Flexible and Address Employee Schedule Needs

A positive outcome of this study is the discovery that all of the executive education programs examined offer customized programs that can fill skill gaps quickly. Their websites feature short-term courses, with flexible start and finish times. Executive education programs are addressing employee needs and preferences regarding learning mode and are providing multiple modes of content delivery—live online, asynchronous/on-demand online, or face-to-face on campus or at the employer's location, often with more than one delivery mode offered for the same course. Executive education programs offer the option of customizable programs developed with the employer to fit skill needs, as well as open enrollment courses that are available to individual employees or groups of employees. A modest number of programs offer certificates and digital badges to mark completion of a program, and several universities offer mini-MBAs that focus on specific digital technology areas. The cost of executive education

programs/courses varies greatly across universities. As a recognition of the factor of cost, many universities offer discounts to organizations for their custom programs if the organizations become university partners. Also offered are discounts to individual learners, veterans, alumni, and groups of learners for open enrollment courses.

Digital Supply Chain Content Coverage is Deficient in the 113 Schools Studied

However, beyond course format issues, the results for the coverage of the digital skills of interest in this study are concerning. As shown in Table 6, while the study found that data analytics is offered in 85% of programs studied and AI in 41%, coverage of all of the remaining topics was below 25%, which is significantly deficient. Digital skill coverage found in this study is particularly alarming when compared to the adoption/predicted use of supply chain technologies within the next five years reported in [21] which were discussed earlier (See Table 6).

Table 6: Coverage of Technologies to be Adopted in the Next Five Years

Digital Technology	Predicted adoption by companies surveyed	% of executive education courses/certificates coverage revealed in this study
Inventory and Network Optimization	85%	24% courses 0% certificates
Cloud Computing	81%	18% courses 0% certificates
Data Analytics	78%	85% courses 50% certificates
Wearable Technology	75%	2% courses 0% certificates
Robotics/Automation	83%	14% courses 2% certificates
3D Printing	81%	12% courses 2% certificates
AI	85%	41% courses 10% certificates
Internet of Things/Sensors	85%/83%	18% courses 1% certificates
Blockchain	77%	21% courses 4% certificates
Driverless Vehicles/Drones	76%	5% courses 1% certificates

Data Analytics Coverage

The results for coverage of data analytics (85% courses, 50% certificates) are encouraging, since the ability to analyze and make predictions with data from multiple sources and channels within the supply chain is paramount to successful digital transformation [84]. Adopting data analytics is a first step in developing a data-driven culture that sets supply chain managers and employees up for implementing other technologies and for achieving data-driven decision making.

Supply Chain Coverage

It is concerning that, despite widely discussed recognition of the importance of supply chains, 51 of the 113 schools studied do not include supply chain in their executive education curricula. Nine schools do not offer either supply chain management or any of the digital skills of interest. However, 42 of the 51 schools that do not cover supply chain do cover one or more of the digital skills necessary for digital supply chains.

Digital Transformation Coverage

Another surprising result is that of the 113 schools in this study, 57 do not offer courses or

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certificates in digital transformation; and 12 schools do not offer either digital transformation or any of the digital skills of interest in this study. However, similar to supply chain, 45 of the 57 schools that do not cover digital transformation do cover one or more of the digital supply chain skills.

Third-Party Training Provider Collaboration

Either because of a lack of faculty expertise to teach tech courses or because of the financial burden of developing and staffing new programs, many schools of business, even at some of the most prominent universities, have turned to collaboration with third-party training providers to provide technology training. It could be argued that this trend is consistent with suggestions made by educational experts that business schools provide multiple pathways to learners in order to remain viable, relevant, and easily accessible to them [11] [13]. The danger is that, with technology courses offered online by third parties often at greatly reduced cost, students may find it easier in terms of application/acceptance and cost-effectiveness, to take courses available through third-party providers. Ultimately, this could potentially diminish the value and viability of business school degrees.

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

With information readily available about today's employees' learning needs and preferences, as well as increased investment in employee training, colleges of business executive education programs are missing out on significant opportunities for new pools of students and will continue to do so unless they address needed changes in curricula and course content to prepare employees for success in the ever-evolving demands of the digital workplace. In the end, this is the only way for business schools to compete and survive in the crowded eLearning marketplace. "With the world still dealing with the COVID-19 pandemic, a school that continues with the same offer it had before the crisis will have misjudged the potential uncertainty and change facing employers. Instead, listening to employers and learning with them about the 'new normal' is a must-do activity to develop relevant programs for the future" [70, 22).

Future research will continue to gauge the ability of business schools to remain valid and sought-after for employee executive education. It would be interesting to measure the impact of wider adoption of content that addresses minority and gender inclusion as well as environmental stewardship and sustainability, on the popularity of business school executive education programs; as well as to undertake another review of business school executive education programs that directly compares their programs to what is offered by alternative sources of digital eLearning for employees. Another area for future research is the use of inter-disciplinary collaboration on corporate learning programs that blend business knowledge with other disciplines, share costs and joint benefits, and expose students to multiple disciplines. Finally, the success and challenges of collaborations between schools of business and other training providers within the university, such as continuing education and professional development, are also interesting areas for research.

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Appendix 1

Table 1: Schools of business included in this study

American University Kogod School of Business
Arizona State University Carey School of Business/Thunderbird School of MNGT
Auburn University Harbert College of Business
Babson College Olin College of Business
Baruch College Zicklin School of Business
Baylor University Hankamer School of Business
Boston College Carroll School of MNGT
Boston University Questrom School of Business
Brigham Young University Marriott School of Business
Carnegie Mellon University Tepper School of Business
Case West Reserve University Weatherhead School of Business
Chapman College Argyros School of Business & Economics
Clemson.University Powers College of Business
College of Charleston School of Business
College of William and Mary Mason School of Business
Columbia University Business School
Cornell University Johnson College of Business
Creighton University Heider College of Business
Dartmouth University Tuck School of Business
Duke University Fuqua School of Business
Emory University Goizueta Business School
Fairfield University Dolan School of Business
Fordham University Gabelli School of Business
George Washington University School of Business
Georgetown University School of Business
Georgia Institute of Technology Scheller College of Business
Harvard University Business School
Howard University School of Business
Indiana University Kelley School of Business
Iowa State University Ivy College of Business
Le Moyne College Madden School of Business
Louisiana State University Ourso College of Business
Louisiana Tech University College of Business
Loyola Marymount University College of Business Administration
Loyola University Maryland Sellinger School of Business and MNGT
Massachusetts Institute of Technology Sloan School of MNGT
Michigan State University Broad College of Business
New York University Stern School of Business
North Carolina State University Poole College of MNGT
North Carolina A & T State University
Northeastern University D'Amore-McKim School of Business
Northwestern University Kellogg School of MNGT
Ohio State University Fisher College of Business
Oklahoma State University Spears School of Business
Penn State University Smeal College of Business
Pepperdine University Graziadio Business School
Purdue University Daniels School of Business
Rice University Jones Graduate School of Business
Rockhurst University Helzberg School of MNGT

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Rutgers University Business School
Saint Joseph's University Haub School of Business
Saint Louis University Chaifetz School of Business
Santa Clara University Leavey School of Business
Seattle University Albers School of Business and Economics
Southern Methodist University Cox School of Business
Stanford University Graduate School of Business
Stevens Institute of Technology School of Business
Syracuse University Whitman School of MNGT
Temple University Fox School of Business
Texas A & M University Mays Business School
Texas Christian University Neeley School of Business
Tulane University Freeman School of Business
University of Alabama Culverhouse College of Business
University of Arizona Eller College of MNGT
University of Arkansas Walton College of Business
University of Buffalo School of MNGT
University of California -Berkely Haas School of Business
University of California- Davis Graduate School of MNGT
University of California- Irvine Merage School of Business
University of California- Los Angeles Anderson School of MNGT
University of California- Riverside School of Business
University of California-San Diego Rady School of MNGT
University of Chicago Booth School of Business
University of Cincinnati Lindner College of Business
University of Colorado Leeds School of Business
University of Connecticut School of Business
University of Delaware Lerner College of Business and Economics
University of Denver Daniels College of Business
University of Florida Warrington College of Business
University of Georgia Terry College of Business
University of Hawaii Shidler College of Business
University of Houston Bauer College of Business
University of Kansas School of Business
University of Kentucky Gatton College of Business and Economics
University of Maryland Smith School of Business
University of Massachusetts Isenberg College of MNGT
University of Miami Herbert Business School
University of Michigan Ross School of Business
University of Minnesota Carlson School of MNGT
University of Mississippi School of Business Administration
University of North Carolina-Chapel Hill Kenan-Flagler Business School
University of Notre Dame Mendoza College of Business
University of Oklahoma Price College of Business
University of Oregon Lundquist College of Business
University of Pennsylvania Wharton School of Business
University of Pittsburgh Katz Graduate College of Business
University of Rochester Simon Business School
University of San Diego Knauss School of Business
University of San Francisco Masagung Graduate School of MNGT
University of Scranton Kania School of MNGT

University of Southern California Marshall School of Business
University of South Carolina Moore School of Business
University of Tennessee-Knoxville Haslam College of Business
University of Texas (Austin) McCombs School of Business
University of Texas (Dallas) Jindal School of Business
University of Utah Eccles School of Business
Vanderbilt University Owen Graduate School of MNGT
University of Virginia School of Business
University of Washington Foster School of Business
University of Wisconsin-Madison School of Business
Washington University- St. Louis Olin Business School
Xavier University Williams College of Business
Yale University School of MNGT

Appendix 2

Note: The following abbreviations were used in the table, due to space constraints.

- DA = Data Analytics
- ATV = Automatic Vehicles/Drones
- SC = Supply Chain
- BC = Blockchain
- DT = Digital Transformation
- 3D = 3-D Printing (Additive Manufacturing)
- AI = Artificial Intelligence
- CLD = Cloud Computing
- ML = Machine Learning
- MET = Metaverse
- ROB = Robotics/Automation
- NOP = Networking Optimization
- IoT = Internet of Things/Sensors
- IOP = Inventory Optimization
- WT = Wearable Technology

Table 2: Rankings of schools of business according to their coverage of digital supply chain skills (#1 = highest ranked, #20 = lowest ranked)

Rank	Total CRS CRT	University	DA	SC	DT	AI	ML	ROB	IoT	WT	ATV	BC	3D	CL	MET	NOP	IOP
#1	22	MIT Sloan School of MNGT	CRS CRT	CRS	CRS	CRS	CRS	CRS CRT	CRS		CRS	CRS CRT	CRS CRT	CRS	CRS	CRS	CRS
#2	20	U. Cal-San Diego Rady School of MNGT	CRS	CRS CRT	CRS CRT	CRS CRT	CRS CRT				CRS		CRS	CRS CRT		CRS	CRS
#3	19	Arizona State U. Carey School of Business & Thunderbird School of MNGT	CRS CRT	CRS CRT	CRS CRT	CRS CRT	CRS CRT	CRS					CRS			CRS	CRS
#3	19	Loyola U. Maryland Sellinger School of Business & MNGT	CRS CRT	CRS CRT	CRS CRT	CRS CRT		CRS				CRS		CRS CRT		CRS	CRS
#3	19	U. Texas (Austin) McCombs School of Business	CRS CRT	CRS CRT	CRS	CRS CRT	CRSCRT						CRS	CRS CRT		CRS	CRS
#4	18	Carnegie Mellon U. Tepper School of Business	CRS	CRS	CRS CRT	CRS	CRS	CRS CRT	CRS			CRS	CRS CRT	CRS		CRS	CRS
#4	18	Clemson U. Powers College of Business	CRS CRT	CRS	CRS CRT	CRS		CRS			CRS CRT	CRS		CRS CRT		CRS	CRS
#4	18	Cornell U Johnson College of Business	CRS CRT	CRS CRT	CRS CRT	CRS CRT	CRS CRT					CRS CRT					
#5	17	Indiana U. Kelley School of Business	CRS CRT	CRS CRT	CRS	CRS	CRS	CRS	CRS			CRS		CRS CRT		CRS	CRS
#6	15	Harvard U. Business School	CRS CRT	CRS	CRS CRT	CRS CRT	CRS	CRS		CRS	CRS		CRS				

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#6	15	George Washington U. School of Business	CRS CRT		CRS CRT	CRS CRT	CRS		CRS				CRS	CRS CRT			
#7	14	Northwestern U. Kellogg School of MNGT	CRS CRT	CRS CRT	CRS CRT	CRS CRT	CRS	CRS									
#8	13	Rutgers U. Business School	CRS CRT	CRS CRT	CRS		CRS	CRS	CRS						CRS	CRS	CRS
#8	13	Georgetown U. School of Business	CRS CRT	CRS CRT		CRS CRT	CRS		CRS			CRS		CRS			
#8	13	Georgia Institute of Technology Scheller College of Business	CRS CRT	CRS CRT	CRS	CRS	CRS		CRS				CRS			CRS	CRS
#9	12	Fairfield U. Dolan School of Business	CRS CRT	CRS CRT	CRS	CRS		CRS				CRS				CRS	CRS
#9	12	Michigan State U. Broad College of Business	CRS CRT	CRS CRT	CRS	CRS	CRS	CRS	CRS					CRS			
#9	12	Stevens Institute of Technology School of Business	CRS CRT	CRS CRT		CRS CRT	CRS CRT										
#9	12	U. Miami Herbert Business School	CRS CRT			CRS CRT	CRS CRT		CRS CRT								
#10	11	Penn State U. Smeal College of Business	CRS CRT	CRS CRT	CRS CRT											CRS	CRS
#10	11	Washington U.-St. Louis Olin Business School	CRS CRT	CRS CRT	CRS	CRS	CRS	CRS	CRS								
#10	11	Baylor U. Hankamer School of Business	CRS CRT	CRS CRT		CRS	CRS							CRS CRT			
#11	9	American U. Kogod School of Business	CRS CRT		CRS	CRS	CRS					CRS				CRS	CRS
#11	9	Case West Reserve U. Weatherhead School of Business	CRS CRT	CRS	CRS	CRS	CRS		CRS			CRS					
#11	9	Columbia U. Business School	CRS CRT		CRS CRT			CRS	CRS			CRS					
#11	9	U. Buffalo School of MNGT	CRS CRT	CRS CRT	CRS											CRS	CRS
#11	9	U. Cal.-Berkely Haas School of Business	CRS	CRS	CRS	CRS	CRS		CRS			CRS CRT					
#11	9	U. Houston Bauer College of Business	CRS CRT	CRS	CRS	CRS	CRS									CRS	CRS
#11	9	U. Pennsylvania Wharton School of Business	CRS	CRS	CRS	CRS		CRS		CRS					CRS CRT		
#11	9	Auburn U. Harbert College of Business	CRS CRT	CRS CRT	CRS											CRS	CRS
#11	9	U. Colorado Leeds School of Business	CRS CRT	CRS CRT			CRS									CRS	CRS
#11	9	U. Connecticut School of Business	CRS CRT	CRS CRT										CRS		CRS	CRS
#11	9	U. Mississippi School of Business Administration	CRS CRT	CRS CRT										CRS CRT			
#12	8	U. Michigan Ross School of Business	CRS	CRS	CRS	CRS		CRS	CRS		CRS		CRS				
#12	8	Louisiana State U. Ourso College of Business	CRS CRT			CRS	CRS							CRS CRT			
#12	8	Oklahoma State U. Spears School of Business	CRS CRT	CRS CRT												CRS	CRS
#12	8	Saint Louis U. Chaifetz School of Business	CRS CRT	CRS CRT												CRS	CRS
#12	8	Southern Methodist U. Cox School of Business	CRS CRT	CRS CRT												CRS	CRS
#12	8	Syracuse U. Whitman School of Management	CRS CRT	CRS CRT												CRS	CRS
#12	8	Texas Christian U. Neeley School of Business	CRS CRT	CRS CRT												CRS	CRS
#12	8	U. Arizona Eller College of MNGT	CRS CRT		CRS	CRS								CRS CRT			
#12	8	U. San Diego Knauss School of Business	CRS	CRS CRT		CRS			CRS			CRS		CRS			
#12	8	Santa Clara U. Leavey School of Business	CRS	CRS	CRS			CRS	CRS		CRS		CRS	CRS			
#13	7	Stanford U. Graduate School of Business	CRS	CRS	CRS	CRS	CRS							CRS	CRS		
#13	7	Temple U. Fox School of Business	CRS CRT		CRS	CRS	CRS					CRS					

#13	7	U. Cal.- Irvine Merage School of Business	CRS CRT	CRS		CRS										CRS	CRS
#13	7	U. Chicago Booth School of Business	CRS	CRS	CRS	CRS						CRS				CRS	CRS
#13	7	U. Cal.- Riverside School of Business	CRS	CRS	CRS				CRS			CRS CRT					
#13	7	Northeastern U. D'Amore-McKim School of Business	CRS CRT	CRS CRT		CRS											
#14	6	U. Minnesota Carlson School of MNGT	CRS	CRS	CRS	CRS	CRS							CRS			
#14	6	North Carolina State U. Poole College of MNGT	CRS CRT	CRS CRT													
#14	6	North Carolina A & T State U.	CRS CRT	CRS CRT													
#14	6	U. Oklahoma Price College of Business	CRS	CRS	CRS	CRS			CRS				CRS				
#15	5	New York U. Stern School of Business	CRS CRT		CRS	CRS											
#15	5	Ohio State U. Fisher College of Business	CRS	CRS	CRS		CRS						CRS				
#15	5	U. Utah Eccles School of Business	CRS		CRS	CRS			CRS			CRS					
#15	5	Baruch College Zicklin School of Business	CRS		CRS	CRS	CRS					CRS					
#15	5	Purdue U. Daniels School of Business	CRS CRT		CRS		CRS										
#15	5	U. Tennessee-Knoxville Haslam College of Business	CRS	CRS	CRS											CRS	CRS
#15	5	Le Moyne College Madden School of Business	CRS	CRS	CRS											CRS	CRS
#15	5	Seattle U. Albers School of Business and Economics	CRS CRT	CRS			CRS										
#16	4	U. Maryland Smith School of Business	CRS		CRS	CRS	CRS					CRS					
#16	4	U. Wisconsin-Madison School of Business	CRS CRT		CRS												
#16	4	U. Cal.- Los Angeles Anderson School of Management	CRS		CRS	CRS	CRS										
#16	4	Babson College Olin College of Business	CRS CRT			CRS											
#16	4	Boston U. Questrom School of Business	CRS		CRS CRT												
#16	4	Creighton U. Heider College of Business	CRS CRT										CRS				
#16	4	Dartmouth U. Tuck School of Business	CRS		CRS	CRS						CRS					
#16	4	U. Cincinnati Lindner College of Business	CRS CRT											CRS			
#16	4	U. Georgia Terry College of Business	CRS CRT		CRS												
#16	4	U. South Carolina Moore School of Business	CRS CRT			CRS											
#16	4	U. Washington Foster School of Business	CRS	CRS			CRS								CRS		
#16	4	Emory U. Goizueta Business School	CRS	CRS		CRS	CRS										
#16	4	U. Delaware Lerner College of Business and Economics	CRS CRT								CRS						
#17	3	U. North Carolina-Chapel Hill Kenan-Flagler Business School	CRS		CRS							CRS					
#17	3	U. Pittsburgh Katz Graduate College of Business	CRS		CRS				CRS						CRS		
#17	3	College of William and Mary Mason School of Business	CRS CRT														
#17	3	Fordham U. Gabelli School of Business	CRS CRT														
#17	3	U. Alabama Culverhouse College of Business	CRS CRT														

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#17	3	U. Denver Daniels College of Business	CRS	CRS	CRS												
#17	3	U. Massachusetts Isenberg College of MNGT	CRS CRT														
#17	3	U. San Francisco Masagung Graduate School of MNGT	CRS CRT														
#17	3	U. Texas (Dallas) Jindal School of Business		CRS CRT													
#17	3	U. Virginia School of Business	CRS		CRS	CRS											
#18	2	Loyola Marymount U. College of Business Administration	CRS									CRS					
#18	2	Pepperdine U. Graziadio Business School	CRS									CRS					
#18	2	Rice U. Jones Graduate School of Business										CRS	CRS				
#18	2	U. Cal.- Davis Graduate School of MNGT	CRS				CRS										
#18	2	Duke U. Fuqua School of Business	CRS	CRS													
#18	2	Iowa State U. Ivy College of Business	CRS	CRS													
#18	2	Saint Joseph's U. Haub School of Business	CRS				CRS										
#18	2	Boston College Carroll School of MNGT	CRS	CRS													
#18	2	Louisiana Tech U. College of Business	CRS	CRS													
#18	2	U. Kentucky Gatton College of Business and Economics	CRS	CRS													
#19	1	U. Southern. Calif, Marshall School of Business			CRS												
#19	1	Chapman College Argyros School of Business & Economics	CRS														
#19	1	College of Charleston School of Business		CRS													
#19	1	Howard U. School of Business		CRS													
#19	1	U. Arkansas Walton College of Business		CRS													
#19	1	U. Florida Warrington College of Business	CRS														
#19	1	U. Oregon Lundquist College of Business	CRS														
#19	1	Vanderbilt U. Owen Graduate School of MNGT	CRS														
#19	1	Yale U. School of MNGT			CRS												
#19	1	U. Kansas School of Business	CRS														
#20	0	Texas A & M U. Mays Business School															
#20	0	Brigham Young U. Marriott School of Business															
#20	0	Tulane U. Freeman School of Business															
#20	0	U. Hawaii Shidler College of Business															
#20	0	U. Notre Dame Mendoza College of Business															
#20	0	U. Rochester Simon Business School															
#20	0	U. Scranton Kania School of MNGT															
#20	0	Xavier U. Williams College of Business															
#20	0	Rockhurst U. Helzberg School of MNGT															
		# Courses # Certificates	96 56	62 30	54 11	46 11	37 6	16 2	20 1	2 0	7 1	24 4	14 2	20 10	6 1	27 0	20 7

Appendix 3

Table 3: School of business third-party partnerships on technology training

University	COURSERA	edX	2U	Trilogy	Get Smarter	Full Stack	Emeritus
American University			X				
Arizona State University	X	X	X			X	
Babson College		X					
Baruch College	X						
Baylor University				X			
Boston University		X					
Carnegie Mellon University	X	X					X
Case Western Reserve University	X	X	X	X		X	
Columbia University	X	X	X	X		X	X
Cornell University		X					
Dartmouth University	X	X					
Duke University	X						
Emory University	X		X				X
Fordham							
George Washington University	X		X		X	X	
Georgetown University	X	X	X				
Georgia Institute of Technology	X	X	X			X	
Harvard University		X	X		X		X
Howard University			X				
Indiana University		X					
Massachusetts Institute of Technology		X	X		X		X
Michigan State University	X		X				
New York University	X	X	X				
Northeastern University	X						
Northwestern University	X		X	X	X	X	X
Ohio State University			X				
Pennsylvania State University	X						
Pepperdine			X				
Purdue University		X					
Rice University	X	X			X		X
Rochester University			X				
Rutgers University	X	X	X	X		X	
Southern Methodist University						X	X
Stanford University	X	X	X		X		X
Syracuse University					X		
University of Arizona	X					X	
University of California-Berkeley		X	X	X	X	X	X
University of California-Davis	X	X			X		
University of California-Irvine	X					X	X
University of California-Los Angeles						X	
University of California-Riverside		X					
University of California-San Diego	X	X	X				
University of Chicago	X	X					
University of Colorado-Boulder	X	X					
University of Denver						X	
University of Florida	X						
University of Georgia	X						

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University of Houston	X						
University of Kentucky	X						
University of Maryland System		X	X				
University of Miami			X			X	
University of Michigan	X	X	X				
University of Minnesota	X		X				
University of N. Carolina-Chapel Hill	X		X	X			
University of Notre Dame	X	X					
University of Pennsylvania	X	X	X	X			X
University of Pittsburgh	X						
University of Rochester	X						
University of San Diego	X	X					
University of San Francisco							
University of S. California			X				
University of Texas-Austin		X	X	X		X	
University of Texas-Dallas		X	X				
University of Utah			X				
University of Virginia	X						
University of Washington		X	X				
University of Wisconsin		X	X				
Vanderbilt University	X		X			X	
Washington University-St. Louis	X	X	X	X			
Yale University	X		X		X		
Totals	41	34	36	10	10	16	12