

Digital Transformation in Information Systems Curricula: A Keyword Analysis

Drew Hwang
dhwang@cpp.edu

Hui Shi
huishi@cpp.edu

Larisa Preiser-Houy
lpreiser@cpp.edu

Computer Information Systems
California State Polytechnic University, Pomona
Pomona, CA 91768, USA

Abstract

As modern digital technologies continue to advance and drive transformative changes, it is crucial for Information Systems (IS) educators to maintain up-to-date curricula to educate workforce-ready graduates for the digital economy. This study developed a knowledge pool of 121 common keywords in digital transformation through a literature review. It also examined how these keywords were used in the titles and descriptions of 4093 IS courses in 315 IS undergraduate programs in the United States. The results demonstrate how IS educators conceptualize the digital transformation phenomenon surrounding the IS discipline and how they integrate it into the curricula. The study's findings also provide insights to educators who plan to develop course content for digital transformation and update IS undergraduate curricula to meet workforce needs of modern enterprises competing in the digital transformation era.

Keywords: Digital Transformation, IS curricula, IS Course Design, IS Curriculum Development

1. INTRODUCTION

As businesses adopt new digital technologies, they need IS professionals who are competent in the design, development, and management of modern technologies. The IS educators continuously face a challenging task of assessing and updating their curricula to keep up with the demand for workforce-ready graduates.

A systematic literature review (Feng and Salmela, 2020) indicates that there has been no lack of rigor in IS curriculum study in the last decade. There are two lines of IS curriculum studies: normative and descriptive (Hwang et

al., 2015). The normative studies seek to determine factors affecting the IS curriculum design, while the descriptive studies intend to describe IS courses or programs. One of the common themes in the descriptive studies is the assessment of the state of the undergraduate IS curricula through a comprehensive survey of IS programs in countries like Canada, India, U.K. or U.S. or associated with an accreditation body like AACSB or ABET (Kung et. al, 2006; Stefanidis and Fitzgerald, 2010; Harrington & Larson, 2012; Yang, 2012; Bandi et al., 2014; Hwang et al., 2015; Karsten et al., 2015). These studies provided either a descriptive snapshot of the entire IS curricula or an overall mapping to a

model curricula such as IS 2010. This study takes the same approach to examine the undergraduate IS curricula in the United States, but with a focus on how its course content, defined as course title and course description, addresses digital transformation.

This paper is organized as follows: Section 2 discusses the digital transformation phenomenon. Section 3 explains the methodology used to build the keyword pool and the IS curricula dataset. Section 4 presents the analysis of results and discussion. Finally, Section 5 provides conclusions and recommendations for future research.

2. DIGITAL TRANSFORMATION

Businesses have been transformed by digital technologies characterized by the pervasiveness of social media, the proliferation of mobile devices and apps, the optimization of the data value through analytics, and the virtualization of computing resources in the cloud.

The convergence of social media computing, mobility computing, data analytics, and cloud computing is collectively referred to as the SMAC technology stack of the modern IT architecture. The SMAC technology stack has been labeled as the 3rd Platform of Computing by IDC (Gens, 2013), the Nexus of Forces by Gartner (Plummer et al., 2012), and the fifth wave of corporate IT by many technology futurists (Evans, 2013). In IDC's term (IDC, 2017), the 3rd platform evolution will be further fueled by the emerging innovation accelerators such as IoT, AI, robotics, AR/VR, 3D printing, blockchain, and others. Example applications include intelligent home appliances, self-driving cars, robots, wearables, and other applications.

The core concept of digital transformation is "digital" as the analog data is being digitized (digitization) into digital data, the business processes and models are being digitalized (digitalization), and the physical materialization is turning into digitalized materialization in the design of products and services. It is obvious nowadays that being "digital" is the key driver and crucial facilitator of the strategic planning and operating of modern organizations. In the sense of business being deliberately transformed, digital is a "mindset that seeks to leverage technology, data, and ways of working to establish new business and service models for the achievement of a higher purpose and value" (Tardieu et al, 2020).

The definitions of digital transformation vary

greatly. In an attempt to unify the definitions Gong and Ribiere (2020) defined digital transformation, at its highest level of abstract, as "a fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity and redefine its value proposition for its stakeholders". From a multidisciplinary perspective, the scope of digital transformation should at least include "information systems, strategic management, marketing, innovation, and operations management" (Verhoef et al., 2019). "Digital Transformation," "Business Transformation," and "Digital Business Transformation" are three terms used interchangeably.

As modern organizations adopt this new fusion of technologies, they need IT professionals who know how to help them with digital transformation. To address workforce demand, the IS educators are urged to design and develop their curricula by offering course content in digital transformation. By identifying and analyzing the keywords used in the course content, this study examined how the IS educators conceptualize the digital transformation phenomenon and how they integrate digital transformation into the IS undergraduate programs in the United States.

3. METHODOLOGY

This study developed a pool of digital transformation keywords to analyze the course content, title and description, of the undergraduate IS programs in the United States.

The Keyword Pool

Digital transformation is a relatively new field where a widely accepted and holistic framework is lacking (Kutzner et al., 2018; Lassnig & Klieber, 2022; Gao et. al, 2022). In the absence of such a framework for guidance, researchers (e.g., Henriette et al., 2015; Kutzner et al., 2018; Nadeem et al., 2018; Hausberg et al., 2019; Verhoef et al., 2019) commonly took an abstract approach through an independent literature review to identify a set of knowledge keywords, terms, or themes that can be used to validate the sensitization and conceptualization of digital transformation.

To develop a keyword pool for this study, a literature review was conducted on IS/IT articles, published between 2010 and 2022, which contained "Digital Transformation" in the title or abstract. As shown in Appendix A, the

study identified 121 keywords in fifteen knowledge subjects (*italicized below*) under four conceptual constructs (**highlighted in bold**) that can generally capture the nature, essence, and uniqueness of digital transformation.

In summary, digital transformation is driven by a **digital platform** that produce *digital generativity* in which new capabilities can be added after a product has been designed and produced. Such a platform supports a highly *heterogeneous* mix of social networks, mobile devices, and cloud infrastructures through real-time, anytime and anywhere *digital connectivity*. Adopting the modern practice of *digital software engineering*, **digital systems** in digital transformation employ *software-defined infrastructure*, implement *service-oriented computing*, embrace *digital user experience*, and enforce *digital security*. Digital transformation brings *digital effects* in which data is massively digitized, the physical materialization is turning to digital materialization in product design, and business processes and models are being digitalized. As a result, a tremendous amount of **digital data** is created and stored in the cloud with its value being maximized by *data analytics*. Successful digital transformation requires effective **digital management** that is guided by *transformational IT leadership*, develops *digital strategies*, executes *digital technology convergence*, creates *digital innovation*, and eventually turns an organization into a *software-driven enterprise or digital business*.

The IS Course Dataset

To be consistent, the study focused on the business and management schools as the typical educational contexts for IS undergraduate programs. These schools generally require students to take a set of pre-defined business courses along with either a fixed set of core courses or a set of common core courses followed by a number of electives in one or more of the specialization areas.

The study first compiled a comprehensive list of 771 business and management schools in the U.S., accredited or non-accredited, public or private, as listed in univsource.com, wikipedia.com, allBusinessSchools.com, as well as other resource websites. Among all the schools, 335 IS-related programs (e.g., Information Systems, Computer Information Systems, Business Information Systems, Management Information Systems, etc.) were identified. The study then performed a content review of each program's website and online

catalog to collect IS course data in the period from June to December of 2022. As a result, 4093 IS courses were found.

Each course's catalog number, title, and description were collected and entered into an Excel worksheet for the purpose of categorizing, analyzing, and summarizing. The worksheet was also converted into a MSSQL table for further course content analysis.

4. RESULTS AND DISCUSSION

In an attempt to understand how IS educators conceptualize the digital transformation phenomena surrounding the IS discipline and how they integrate it into the curriculum, the study calculated the number of occurrences of the 121 digital transformation keyword contained in the titles and descriptions of the 4093 IS courses. Grouped by the four digital transformation constructs, Appendix B shows the 75 keywords that appear at least once in the IS course titles and/or descriptions.

Digital Transformation as a Keyword

The study first observed how the three forms of digital transformation keywords, "Digital Transformation", "Business Transformation", or "Digital Business Transformation", are used in the course content. Despite the calls to teach Digital Transformation as a standalone course in higher education (Moreira et al., 2017; Dang & Vartiainen, 2022), there are only two courses found in the entire IS curricula: *Digital Business Transformation* and *Technology-Enabled Business Transformation*. As listed in the Appendix C, these two courses recognizes the importance of "the alignment of process, people, and technology" to "support and innovate business strategies", and teach students "a managerial understanding of applications, emerging technologies, skills sets, business concepts, and strategic opportunities that organizations need to master in order to plan, manage, and lead companies through the process of digital business transformation". Although these two courses do not cover all aspects of Digital Transformation, they are indeed courses that teach Digital Transformation.

Even though the three digital transformation keywords are only used in two course titles, they appear in the description of six other courses: *Management of Technology and Innovation*, *Business Dynamics*, *Enterprise & Supply Chain Management Systems*, *Management of Information Systems*, *Business Process*

Automation, and Design Thinking. Reviewing course descriptions, all these courses acknowledge the fact that businesses today are running in a fast-changing and extremely competitive environment driven by the transformative technologies. Thus, the courses appear to address the challenges from a particular perspective of digital transformation:

- The *Strategic Management of Technology and Innovation* course recognizes the innovative nature of digital technologies and teaches students how to apply the technologies to create innovative digital experiences, products, and services.
- Knowing the impact of the digital technologies on business processes, the *Business Process Automation* course shows the students how mapping and automating business processes can improve digital transformation.
- The *Management of Information Systems* course seems to be a traditional MIS foundation course but with a focus on the role of IS managers in digital transformation.
- In the *Design Thinking* course, students learn how to design or re-design existing products, services, and business models for digital transformation.
- The *Business Dynamics* course introduces the “systems thinking” approach to master the complexity in Digital Transformation.
- Emphasizing the importance of process integration within an enterprise, the *Enterprise & Supply Chain Management Systems* course focuses on digital transformation occurring within the firm and across the firm's supply chain.

Transformation as a Keyword

Attention was also given to “Transformation” as a standalone keyword with a broader scope to understand if Digital Transformation is being conceptualized differently in this IS curricula dataset. The result showed that this keyword appears in one course title: *Enterprise Strategies and Transformations* (see Appendix C). Though the course emphasizes the “integrative strategies spanning all business functions” for evolving enterprises, the concept of digital transformation is not explicitly stated in the description.

At the same time, the keyword “Transformation” appears 22 times in the description of courses other than those discussed above. A review of the course descriptions reveals that “Transformation” is mostly used in the context of data warehousing where “transformation” is an

element of the data extraction, transformation, and loading (ETL) process. Others use the keyword to illustrate the process of raw data being “transformed” to information for data analytics in subjects such as Data Management and Business Intelligence. The usage does not principally refer to digital transformation.

However, two courses are found to teach digital transformation but use the sole keyword “Transformation” instead in the course description. One of the courses, *E-Commerce*, teaches “the transformation of businesses to be technologically competitive in the 21st century” using “major software systems like customer relationship management, supply chain management, big data, cloud technologies, and the Internet of all things”. Another course, *IT Strategy: Disrupting Norms*, emphasizes the “managerial and industry issues with a focus on the transformations of business models” as a result of technological disruption.

Digital as a Keyword

The core concept of digital transformation is “Digital”. The origins of the word “digital” date back to late 15th century (Holden, 2023), but its usage became more widespread as a direct result of modern computing in the twenty-first century. Today, the word “Digital” is used in conjunction with many other words to convey a concept or subject using binary digits (Digital, 2023). As shown in Table 1, the study found that the keyword “Digital” is associated with 16 other words in 34 course titles. A review of these course descriptions reveals the following facts:

Digital Enterprise	Digital Commerce
Digital Business	Digital Economy
Digital Entrepreneurship	Digital Marketing
Digital Innovation	Digital Market
Digital Services	Digital Security
Digital Product Management	Digital Forensics
Digital Business Design	Digital Analytics
Digital Solutions	Digital Media

Table 1: The Keyword “Digital” in the Course Titles

- Several courses recognize the fact that businesses in the digital transformation era are operating in the digital environment such as the digital market (e.g., *Data-Driven Decisions in Digital Markets*), the digital commerce (i.e., *Digital Commerce and IoT Analytics*), or the digital economy (i.e., *Analytics and the Digital Economy*).
- A few courses refer to businesses that leverage digital technologies as digital business (e.g., *Global Perspectives on Digital*

Business) or digital enterprise (e.g., *Foundations of the Digital Enterprise*).

- Three courses, *Digital Entrepreneurship*, *Digital Entrepreneurship and Innovation*, and *Managing Digital Services and Innovation*, bring together the state-of-the-art knowledge in digital business practices using innovative digital technologies.
- Several courses refer to the agile methodology for digital transformation - the *Digital Product Management* course teaches project management for digital projects, the *Analysis and Design of Digital Solutions* course focuses on the development of digital solutions, and the *Digital Solutions with AI* course further discusses the solutions with the use of AI.
- Based on its description, the *Digital Business Design* course teaches digital transformation to a large extent in that the students “bring together knowledge of digital technologies and their skills in business design and development to create innovative, leading-edge processes, products, and services for today’s modern organizations”.
- Among the 264 courses that contains the word Security or Cybersecurity in this curricula dataset, there is only one course titled *Digital Security*. The description of such course, however, does not explicitly address the new and higher level of security risks created by digital transformation (Shahim, 2021).
- Even though the terms Computer Forensics and Digital Forensics are often used interchangeably, the *Digital Forensics* courses cover a broader range of examination and analysis of not only computers but also mobile devices and digital networks that expand security surface in digital transformation.

Keywords in the Four Constructs

As shown in Appendix B, most of the keywords with the highest number of occurrences appear in the Digital Data construct (56.7%), followed by the Digital Systems (27.8%), Digital Platform (11.1%), and Digital Management (4.4%). This indicates that a large amount of digital transformation context in the IS curricula covers the Analytics pillar of the SMAC technology stack. This also corresponds to the most common pattern of the SMAC convergence (Meegan et al., 2013; Niu, et al., 2021). That is, the conversion in which the mobile devices serve as the front-end platform, the social networks add a layer of rich information, the cloud services provide the underlying infrastructure, and most importantly, the data analytics enables

the business to reach its ultimate goal of making intelligent data-informed decisions.

Digital Platform

In the Digital Platform construct, the Social, Mobile, and Cloud technologies of the SMAC stack receive a lot of attentions in the course context. Among them, the Cloud keywords (i.e., *Cloud Computing*, *Cloud Service*, *Software as a Service*, *Cloud Security*, *Cloud Technology*, *Cloud Deployment*, *Infrastructure as a Service*, *Platform as a Service*, *Software-Defined Network*) appear the most. Thus, the IS educators might also recognize the fact that the efficacy of the three digital transformation drivers, the social solutions (email and social media), the Big Data solutions (data backup and storage), and the mobile apps, are all heavily dependent on the cloud provisions (Gens, 2013).

Digital Data

Digital data and analytics receives the most attention from the IS educators. In the Digital Data construct, the three common keywords of Business Analytics, Business Intelligence, and Data Analytics, are generally used interchangeably. The analysis of course data shows that these keywords are typically used in the title of the survey courses including (the number of occurrences in parenthesis) Business Analytics (95), Business Intelligence (89), and Data Analytics (47). Keywords in the more specialized areas, such as Big Data (33), Machine Learning (14), Social Media Analytics (4), and Text Mining (3), also appear in a number of course titles. Although the origin of Data Mining (51) and Data Warehousing (23) dates to the late 1980s, it is the recent digital transformation movement that appears to amplify its importance and popularity because of the more open, flexible, and cost-effective technologies, such as IoT and AI, that employ more advanced statistical algorithms.

Digital Systems

There are some interesting findings in the Digital Systems construct. First, Web APIs and Web Services are found, not surprisingly, to be taught in the IS programs to meet the two major implementation demands of the Service-Oriented Architecture (SOA) which is being recognized as one of the key enablers of digital transformation (Kumar & Prasad, 2016; Fischer et al., 2020). However, in this curricula dataset, the emerging Microservices have not yet been explicitly integrated into any IS course.

Second, software engineers in the digital transformation era face the challenge of being

more agile and responsive (Rigby et al., 2016; Paterek, 2018). As found in 10 course titles, Agile Methodology is now being taught not as a module in the traditional System Analysis and Design course but solely in standalone courses including, for example, *Software Development with Agile Methodologies*, *Agile Web Design & Development*, *Agile Project Management*, *Agile Application Development*, and *Agile Principles of Software*.

Third, Python for its versatility is heavily used in the industry not only for website and software development but also for data analytics, data visualization, and software-defined networks. Python as a keyword appears 116 times with 10 occurrences in the course titles. In contrast R, as another programming language for statistical calculation and data visualization, appears only in one course title as "Introduction to R for Analytics". Interestingly, neither Python nor R have taken over the de facto Java which appears 154 times in the course content with 88 occurrences in the course titles.

Finally, Artificial Intelligence, once a sub-discipline in Computer Science but now a crucial technology enabler for digital transformation, appears 33 times in the course content with 5 in the course titles such as *Artificial Intelligence Application in Business*, *Business analytics & AI*, *Artificial Intelligence in Business*, *Topics in Information Systems: Digital Solutions with AI*, and *Artificial Intelligence Business Strategies and Applications*.

Digital Management

Because successful digital transformation requires the development of new software, every business could become a digital business largely controlled by software (Holmes, 2019). From the literature review conducted in this study, the business engaging with digital transformation is commonly called Digital Business or Digital Enterprise. In this course dataset, Digital Business or Digital Enterprise appears 14 times in the course context with 6 in course titles such as *Global Perspectives on Digital Business*, *Digital Business Technologies*, *Digital Business Transformation*, *Digital Business Design*, *Digital Business Lab Design*, and *Foundations of the Digital Enterprise*.

The keyword Digital Technology was also found in use 10 times in course description and 3 times in the course titles including *Digital Technology*, *Digital Technologies for Business*, and *Digital Technologies: Strategy and Use*. The digital technologies being employed in digital

transformation would be described more accurately as "digital" rather than "informational". Whether the use of Information Technology as an umbrella term in IS curricula (Leidig & Salmela, 2022) would be largely replaced by Digital Technology remains to be seen.

In digital transformation, digital technologies expand its digital capabilities beyond internal dimensions from redefining products and services to reengineering business process and models to create disruptive innovations (Ciriello et al., 2018). Digital Innovation appears in thirteen course titles including *Digital Innovation*, *Global Digital Innovation*, *Management of Digital Innovation*, *Digital Entrepreneurship and Innovation*, *Managing Digital Services*, *IS Innovation and New Technologies*, and other titles.

The keywords in the Digital Management construct appear the least. Thus, the course content in this curricula dataset reflects that IS educators may perceive digital management as less critical than the digital technology itself. In a long run, however, mismanaged digital transformation might contribute to the failure of digital transformation (Baskin, 2018; Tardieu et al., 2020; Ramesh & Delen, 2021).

5. CONCLUSIONS AND RECOMMENDATIONS

With proliferation of innovative digital technologies, modern organizations are increasingly embedding technology across their business processes and integrating them into products and services to drive fundamental change for organizational improvements and redefining their "value" proposition. To address the demand for IT professionals with competencies needed to facilitate digital transformation of organizations, the educators are urged to update their curricula with course content on digital transformation.

To explore the coverage of digital transformation content in IS curricula, this study developed a knowledge domain (or pool) of 121 common keywords on digital transformation and used the keywords domain as a lens for a descriptive analysis of titles and course descriptions of 4,093 Information Systems undergraduate courses in 315 Information Systems undergraduate programs in the United States. The results provide a broad snapshot on how IS educators conceptualize digital transformation phenomenon in the IS discipline and integrate it in the curricula. General conclusions are listed in the following

subsections, followed by recommendations for future research. The study's findings help inform efforts of educators on updating IS curricula to address the workforce needs of modern enterprises.

Conceptualization of Digital Transformation in the IS discipline

The study's findings on how IS educators conceptualize digital transformation in the curriculum reveal an interesting trend in the use of "digital transformation", "transformation" and "digital" keywords in course content, title and description. More specifically, despite the calls to teach Digital Transformation as a standalone course, very few courses analyzed across the entire IS curricula dataset use the term "digital transformation" (i.e., two courses) or a variation of the terms "digital transformation", "business transformation" or "digital business transformation" (6 courses) in the course title.

Given the abstract rather than concrete nature of these terms, the courses that use them in the title address the challenges of the digital transformation phenomenon from several specific, yet different, perspectives. These perspectives relate to strategy and innovation, business processes, supply chain design, systems thinking, and IS management. Furthermore, the keyword "transformation" is rarely used in course title (one course) or course description (22 times), and the usage does not appear to refer to digital transformation. Only two courses with the keyword "transformation" in the course description are found to teach digital transformation as it relates to E-commerce and IT Strategy.

On the other hand, the analysis results show that the keyword "digital", used in association with 16 other words, appears in 34 course titles, ranging from "Digital Business" to "Digital Forensics". The relative prevalence in the use of "digital" keyword in the course titles across the IS curricula dataset, as compared to the use of "Digital Transformation" or "Transformation" keywords, could be because of the term's utility to conceptualize more concretely the digital transformation phenomenon grounded in binary digits.

Integration of Digital Transformation in the IS Curricula

The findings on the integration of digital transformation in the IS curricula were grounded in the analysis of 121 keywords contained in the titles and descriptions of 4,093 courses. The keywords were organized across four conceptual

constructs that drive digital transformation in organizations - Digital Platform, Digital Systems, Digital Data, and Digital Management. The results show that more than half of the keyword is in Digital Data construct (56.7%), with Business Intelligence and Business Analytics as most prevalent within the IS keywords dataset. The other keyword occurrences are in Digital Systems (27.8%), Digital Platform (11.1%), and Digital Management (4.4%).

The keyword distribution reveals the prevalence of digital transformation content in the Analytics pillar of the SMAC technology stack. This demonstrates the importance that educators place on data analytics as an enabler of intelligent, data-driven decisions with the organization. There is also curricular emphasis on digital systems (e.g., programming, methodologies, applications, etc.), as well as the digital platform (e.g., cloud computing, social media, etc.), both of which correspond to the most common pattern of SMAC conversion. From that perspective, mobile devices, social networks, and cloud services provide the underlining infrastructure for digital transformation.

For Digital Systems (27.8%), the use of Python, with 116 occurrences in course content, demonstrates the importance educators place on integrating it into the IS curricula. The Web API, Web Services and Agile methods are also considered by educators as important to IS work in the digital transformation era. Additionally, for Digital Platform (11.1%), the Cloud Computing and Social Media appear to be prevalent in the IS curricula. Finally, the study's results point to a paucity of keyword occurrences in Digital Management (4.4%). This demonstrates that educators consider digital management to be less critical than digital technology in delivering undergraduate curricular content in digital transformation.

Recommendations for Future Research

Digital transformation is a relatively new field of research with only a few studies focusing on IS curricula. One area of future research is to examine digital transformation in IS curricula through the lens of the new IS2020 Model Curricula. The new competency based IS2020 curriculum guidelines define 10 required and 9 optional competency areas, for a total of 19 areas of competency for IS education (Leidig & Salmela, 2022). Future studies could examine the occurrences of digital transformation keywords across required and optional competency domains to provide insights for

curricular updates in the context of the IS2020 Model Curricula.

Another avenue for future research is to examine the digital transformation phenomenon in the curricula of AACSB accredited vs not AACSB accredited schools. AACSB accreditation, a rigorous, external peer-review process, ascertains curricular and programmatic quality of business schools. With the new 2020 AACSB standard for Learner Success (Standard 4. Curriculum), business schools are expected to deliver curricular content that is current, relevant, forward-looking, and aligned with program competency goals (AACSB, 2022). More specifically, Standard 4 addresses the need for learners to be agile with current technologies and possess technological agility for workforce readiness in a digital transformation era. A comparative study of the digital transformation phenomenon in IS curricula across AACSB accredited vs. non AACSB accredited schools could provide insights for educators in updating the curriculum for alignment with the AACSB standards.

Finally, the study of keyword analysis on digital transformation may be replicated to examine the keyword prevalence in Master's Programs in Information Systems and MBA programs. With more and more business becoming digital and developing strategies to survive, grow and thrive in the digital economy, specialized IS graduate programs and MBA programs have an opportunity to educate the next generation of business leaders who could lead digital transformation to accelerate change for business impact. With educators considering ways to update their curricula for currency and relevancy to modern organizations operating in digital economy, the study on the digital transformation phenomenon may provide valuable insights to educators interested in updating the course content and curricula of their graduate programs.

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Appendix A
List of Digital Transformation Constructs, Subjects, and Keywords

Digital Transformation Constructs and Subjects			
Digital Platform Digital Heterogeneity Digital Connectivity Generative Technology	Digital Systems Digital Security Digital Software Engineering Digital User Experience Service-Oriented Computing Software-defined Infrastructure	Digital Data Data Analytics Digital Effect	Digital Management Digital Business Digital Strategy Digital Technology Convergence Digital Innovation Transformational IT Leadership Software-driven Enterprise
Digital Transformation Keywords in Alphabetical Order			
Agile methodology Agile project management Agile software development Amazon Web Services Application as a Service Web API Artificial Intelligence Augmented Reality Big Data Blockchain Bring Your Own Device Business Analytics Business Intelligence Business Process Automation Business Process Reengineering Change management Citizen developer Citizen Development Cloud Computing Cloud data platform Cloud deployment Cloud security Cloud services Cloud technology Cloud transformation Collective intimacy Consumerization of IT Customer centric Customer intelligence Data Analytics Data Lake	Data Mining Data Science Data Warehouse Data Warehousing Democratization of technology DevOps Digital age Digital application Digital business Digital Business Transformation Digital company Digital connectivity Digital convergence Digital data Digital devices Disruptive Technology Digital economy Digital ecosystem Digital effect Digital engineering digital environment Digital generation Digital generativity Digital Heterogeneity Digital infrastructure Digital innovation Digital marketing channels Digital maturity Digital mobility Digital modernization Digital platform	Digital process automation Digital security Digital Software Engineering Digital strategy Digital system Digital technology Digital Transformation Digital user experience Digital velocity Digital veracity Digital volatility Digitalization Digitization Disruptive innovation Enterprise application services Enterprise Data Architecture Generation D Generative technology Infrastructure as a Service Innovative business model Innovative business process Internet of Things Internetification Low-code Development Machine Learning Master Data Management Materialization Microservices Mobile Computing Mobile security Mobile technology Natural Language Processing	Network effect No-Code development Platform as a Service Process automation Process mining Python R Rapid Application Development Service broker Service-Oriented Architecture Service-Oriented Computing Social Computing Social media analytics Social network Social network monitoring Social network security Software as a Service Software-Defined Infrastructure Software-Defined Network Software-Defined Storage Software-driven enterprise Software-driven service Text mining Transformational IT leadership Transformational leadership Transformation management Virtual Reality Web Services

Appendix B
Keyword Occurrences by Keyword Constructs

Digital Platform	A¹	T²	Digital Data	A	T	Digital Systems	A	T	Digital Management	A	T
Cloud Computing	73	21	Business	203	89	Python	116	31	Change management	14	
Social Media	52	14	Intelligence	187	95	Application	92		Digital Technology	13	5
Blockchain	26	10	Business Analytics	181	51	Programming			Digital Business	11	3
Social Network	20		Data Mining	137	23	Interface	91		Digital Solution	6	
Cloud Service	8		Data Warehousing	132	47	Mobile App	60	10	Digital	6	3
Mobile Computing	7		Data Analytics	105	33	Agile Methodology	46		Transformation	5	2
Software as a Service	7		Big Data	59	14	Amazon Web Service	34	4	Digital Innovation	5	2
Cloud Security	4		Machine Learning	34	13	Artificial Intelligence	32		Business	4	
Mobile Technology	3		Data Science	22		Web Service	20	1	Transformation	4	1
Cloud Technology	2		Neural network	19	3	R Language	16		Business Process		
Digital Device	2		Text Mining	9	4	Internet of Things	11	1	Engineering	3	
Digital Platform	2		Social Media	3		Rapid Application			Process	3	
Digital Security	2		Analytics	2		Development	5		Automation	2	
Cloud Deployment	1		Digital Data	2		Service-Oriented			Digital Enterprise		
Infrastructure as a Service	1		Digitization			Architecture	4		Digital Economy	2	
Mobile Security	1		Master Data	2		DeveOps			Business Process	2	
Platform as a Service	1		Management	1		Natural Language	3		Automation	1	
Social Computing	1		Google Analytics	1		Processing	3		Digital Strategy	1	
Software-Defined Network	1		Data Lake			Low-code development			Digital age	1	1
Digital network	1		Digitalization			Digital Product	1		Customer Centric	1	
						Management	1		Network Effect	1	
						Augmented Reality	1		Process Mining	1	
						Digital Application	1		Bring Your Own Device		
						Virtual Reality			Process Mining		
									Digital Business		
									Transformation		
215 (11.1%)			1099 (56.7%)			584 (27.8%)			86 (4.4%)		

¹ Total number of occurrences in both course title and course description ² Total number of occurrences in course title

Appendix C

Courses with Digital Transformation in the Description

Digital Business Transformation: Recent advances in computers, information and communication technologies have created new global electronic trading and communication infrastructure that affects organizational strategies, market structures, and industrial organization around the world. Managers need deep understanding of twenty-first century business models and how to align new technology with changing business processes and new ways of organizing businesses in the digital age. This course provides a managerial understanding of applications, emerging technologies, skills sets, business concepts, and strategic opportunities that organizations need to master in order to plan, manage, and lead companies through the process of digital business transformation.

Technology-Enabled Business Transformation: It does not matter it's what you do with it! Business in the 21st century runs on it. However, competitive advantage seldom comes from having exclusive or proprietary access to a technology. Rather, it comes from more effectively utilizing technologies to which everyone - including the competition - has access. The implications of this reality are many. First, it is necessary to understand what technologies are available in the marketplace and their capabilities. Next, and far more challenging, it is necessary to understand how these capabilities may positively (or negatively) interact with business strategy. Business transformation is the alignment of process, people, and technology such that it can both support and innovate business strategies. Given that technologies evolve and develop at a rapid pace, it is necessary for managers to understand what technologies can do (both established and new) and how it can be leveraged to create real value.

Strategic Management of Technology and Innovation: Provide students with concepts and frameworks for identifying, assessing, creating, and managing technology-enabled innovation in organizations. Include innovation process, the framework to identify, assess, create, and implement innovation in organizations, digital transformation of organizations, managing changes, and tools for prototyping. Through projects, learn how to apply technologies to create innovative digital experiences, products, and services.

Business Process Automation: Students map current business processes and identify areas for software automation utilizing Excel VBA; how mapping and automating business processes can improve an organization by providing for simplified workflow, digital transformation of existing processes, increased service quality, improved service delivery, or reduced costs.

Management of Information Systems: Roles of information systems managers and executives in digital transformation for business processes and outcomes. Strategy and techniques in development and deployment of information systems for sustainable competitive advantage. Ethical, organizational, social opportunities and challenges inherent in information systems management.

Business Dynamics: Managers and business leaders need to make sense of a complex and fast-changing business landscape. They need to map, analyze, and manage complexity to achieve superior performance. This course introduces systems thinking, as well as associated modeling methods, techniques, and software tools that are essential to master complexity and drive business performance. The course explores models, model-based thinking, complex system dynamics, network dynamics, and other computational modeling approaches. These skills can be used to understand system structure and dynamic behavior across a variety of business domains and applications, including business transformation, digital transformation, business model design, and sustainability. Case studies across a variety of industries and a group project add to the student learning experience.

Design Thinking: Design thinking refers to a transformation and problem-solving approach that emphasizes strong user orientation and agile iterations with multidisciplinary teams. Aiming to create ideas and solutions that are emotionally meaningful, functional, and economically viable, "design thinking integrates the needs of people, the possibilities of technology, and the requirements for business success ." Design thinking is applicable to both start-ups and mature organizations to design new offerings or re-design existing teams, products, services, business models, or platform ecosystems. Adopting a hands-on and experience-based learning approach, this course introduces design thinking to business undergraduate students. Through lectures and case discussions students

will learn about the design thinking process and the applications of design thinking for digital transformation across a variety of industries. Students will also work in teams to participate in a design challenge project.

Enterprise & Supply Chain Management Systems: This course emphasizes the importance of integration of processes within an enterprises and across enterprises in a supply chain and the systems used to support these processes. Enterprise systems support the internal logistics chain within a firm integrating processes across all functions. Students will learn about the digital transformation taking place within the firm and across the firm's supply chain. The course will introduce students to processes and systems that firms use to harness the capabilities of their supply chain partners and supply networks.

Enterprise Strategies and Transformations: Organizational transformations are critical for continued market success in an increasingly complex and dynamic global environment. Emphasizes integrative strategies spanning all business functions which are needed by evolving and established enterprises.