MaCuDE
Management Curriculum for the Digital Era

Information Systems Task Force

Phase I Interim Report of the MaCuDE project[1]

Interim Information Systems Curriculum Analysis

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Introduction

This interim report reports the key findings and the process of the collecting data by the IS Task Force of the AACSB MaCuDE project. The report provides information about the ongoing integration of big data and AI topics in the IS area.

Key activities of the project

A task force has been created jointly between AACSB (Kalle Lyytinen, MaCuDE IS Coordinator) and Association for Information Systems (AIS) Heikki Topi (AIS VP of Education). Jing Tang (Case PhD student) has acted as the key project coordinator. The task force has met frequently (at least biweekly). The task force effort has been integrated with new curriculum development by AIS / ACM. The role of this group is to focus on new competencies at different levels of IS curricula. Therefore, we will focus on the emergence of and need for new content related to big data and AI at the level of new competencies and offer examples of courses and delivery methods that can produce such competencies.

The project has established an Advisory Board consisting of many leading senior IS scholars who have either participated in curriculum work or are known for their work in Big data / Machine learning space. The Advisory Board currently consists of the following members:

- Jan vom Brocke, jan.vom.brocke@uni.li, University of Lichtenstein, Lichtenstein
- Ramesh Venkataraman, venkat@indiana.edu, University of Indiana, US
- Mary Tate, mary.tate@vuw.ac.nz, University of Wellington, NZ
- Joe Valacich, valacich@email.arizona.edu, University of Arizona, US
- Olivia Sheng, olivia.sheng@eccles.utah.edu, University of Utah, US
- Helmut Krcmar, helmut.krcmar@tum.de, Technical University of Munich, Germany

The task force has organized one advisory board meeting, with another one scheduled for the end of August to discuss the results of the data collection.

The task force also organized a workshop in Munich December 2019 (ICIS conference) jointly with AIS education committee. The meeting was attended by Gregory Prastacos from MaCuDE and about 40 faculty from all over the world.

A MaCuDE Survey was refined and developed in January and sent out in the end of March (Covid-19 significantly slowed down the survey process and made the data collection harder).

Current MaCuDE IS mailing list covers 36 school. This has been extended with about 25 members and their departments participating in the AIS Education Committee and AIS Council. Survey was also sent to top 20 ranked schools in the US and highly ranked 10 schools in German speaking area and 10 highly ranked schools in AIS Region 3 (Asia-Pacific). The response rate, however, through these data collection efforts has been very low.

We are in the process of obtaining and analyzing curriculum data also from other available sources, such as the Eduglopedia.com. This is an online repository of Information Systems program and course data developed by University of Lichtenstein in collaboration with AIS. This relatively large repository contains data for over 4000 courses across 400 universities globally. It has also historical data, and we hope to be able to collect trend data and analyze curriculum content changes over the last 5 years to determine if there are any significant changes occurring due the emergence of big data and AI.

Curriculum recommendations

Computing disciplines—including Information Systems—have a long tradition of curriculum recommendations developed by professional and academic societies (primarily ACM, IEEE-CS, AIS, and ISCAP EDSIG). In the Information Systems discipline, the first recommendations were developed about 50 years ago. The most recent approved undergraduate recommendation is IS 2010. There is an ongoing project to replace it with a new version (tentatively labeled IS 2020). At the graduate level, the most current recommendation is MSIS 2016. The need for change in some parts of the curriculum has been relatively constant due to fast change in underlying technologies, solutions and the expanding scope of technical and application topics that need to be covered in these programs. However, the center of these curricula over the last 50 years have focused on socio-technical issues related to managing and delivering IT based solutions that support organizational processes, decision-making and products and services. As such the need for such competencies over the time has not declined but been in the continued rise, even though the organizational forms associated with such activities have changed, because of outsourcing to large IT service providers and cloud computing.

The curricular recommendations are not intended to be normative. Instead, they provide a framework of goals, content and pedagogical methods that convey best current practices that can be adapted to various local conditions covering technologies, faculty skills and educational needs. This is particularly important now when these recommendations are being developed for a truly global audience.

Before reviewing the results of the Spring 2020 MaCuDE data collection, we will next provide a brief review of the core topics included in the most recent IS curriculum recommendations as a background. Table 1 includes the highest level categorization of core courses (MSIS 2006 and IS 2020) and related core competency areas (MSIS 2016 and IS 2020) for the last two versions of

graduate and undergraduate model curricula. The table is organized to also demonstrate similarities and differences between different versions.

MSIS 2006 Core courses	IS 2010 Core courses	MSIS 2016 Core Competency Areas	IS 2020 Core Competency Areas
	Foundations of Information Systems		Foundations of Information Systems
		Business Continuity and Information Assurance	Secure Computing
	Data and Information Management	**Data, Information, and Content Management**	**Data and Information Management**
Emerging Technologies and Issues			
Enterprise Models	**Enterprise Architecture**	**Enterprise Architecture**	
Implications of Digitalization or HCI		**Ethics, Impacts, and Sustainability**	**Ethics, use, and implications for society**
Integrated Capstone			
Strategy and Policy	**IS Strategy, Management and Acquisition**	**IS Strategy and Governance**	**IS Management and Strategy**
		IS Management and Operations	
Project and Change Management	**IS Project Management**		**IS Project Management**
IT Infrastructure	**IT Infrastructure**	**IT Infrastructure**	**IT Infrastructure**
Analysis, Modeling, and Design	**Systems Analysis & Design**	**Innovation, Organizational Change, and Entrepreneurship**	**Systems Analysis & Design**
		Systems Development and Deployment	Application Development / Programming

The bolded rows indicate core topic areas that have shown significant stability across different recommendations. These core areas are not surprising. They are easily recognizable as key areas of expected competencies for graduates of IS programs, if these graduates are expected to manage and deliver IT based solutions for organizations. From the standpoint of this report, a few observations are warranted in light of the ongoing change toward big data and AI/machine learning topic:

- The current high-level structure hides currently topics and competencies related specifically to big data/data science/analytics within the Data and Information Management area. However, recently revised courses and textbooks in this area pay a lot of attention to data management challenges and technologies related to the explosion of analytics as shown also in the analysis of the reported course content below
- Artificial intelligence and machine learning is not included as a separate topic in any of the high-level lists. Yet, questions related to AI are, in all likelihood, included in many of the included categories, such as Data and Information Management, Ethics and Impacts, Systems Analysis and Design, IS Management and Strategy and even IT Infrastructure. One essential competency for all IS graduates is to have the ability to build new and emerging technology capabilities into organizational systems, preferably so that the systems have capabilities to learn from their own behavior.
- Inclusion of Security and Programming/Application Development have brought back to the model curricula detailed technical content and strength that was largely missing from them in the previous iterations. One reason for this change was the realization that graduates without at least a foundational understanding of programming and principles of secure systems, would have difficulty to address competently questions regarding how to deliver and manage many organizational applications and implications. This

pendulum movement between organizational and technical competencies is likely continue when big data and AI topics need to be integrated into the model curricula[1]
- Ethical issues and implications was a significant addition to MSIS 2016 curriculum. It is likely that it will continue in IS 2020. Given the complexity of ethical issues raised by both analytics and AI (and many other new technologies such as blockchain), it is essential that graduates will have effective models and frameworks to analyze the implications and potential ethical and moral consequences of emerging technologies.

Spring 2020 MaCuDE IS task force data collection for Big Data and AI content

As part of the MaCuDE IS task force data collection effort, we received responses from a total of 22 universities. They covered 17 undergraduate programs, 37 graduate programs, two executive programs, and one PhD program. Of the graduate programs, 16 were degree programs in Information Systems, 8 in Analytics, and 4 in other focused specialties of IS. The rest were in disciplines outside the scope of the survey (Management, Marketing, Strategy, and Accounting). Of the undergraduate programs, 10 were degree programs in Information Systems and four in Analytics. The responding universities were located in Finland, Germany, Ireland, Italy, New Zealand, Singapore, Switzerland, and the United States.

As is typical in reviews of curriculum data from a globally distributed sample, it is difficult to perform detailed quantitative analyses, because fundamental program structures, course lengths, and terminologies vary significantly. Therefore, our findings are primarily based on a detailed qualitative program level review which was augmented with data from a separate analysis of course topics.

At the **undergraduate** level, our main observations are based on the 14 Information Systems and Analytics programs. They are as follows:
- The core of most of the programs is built around a basic IS curriculum model aligned with the undergraduate model curriculum (IS 2010). They include core courses in a subset of the following area: Fundamentals of IS, data and information management, systems analysis and design, IT infrastructure, application development, enterprise architecture, and project management.
- Cybersecurity is emerging as a new topic.
- Only the specialized analytics programs in the sample included courses directly focused on big data/data science/analytics. A separate course level review (possible only for only a smaller number of programs) below indicated that these topics are covered mostly at awareness level in other courses with a separate primary focus.
- No programs had core courses directly focused with AI/machine learning, and there were few undergraduate electives in this area. AI/ML were, however, introduced

[1] Our observation from our own schools and discussions with many colleagues in other disciplines is that also in fields like operations, accounting, finance and even in marketing basic programming skills related mostly to Python and R are now becoming standard content.

primarily at the awareness level in general courses such as Digital Business: Technology and Transformation or Management Information Systems.

At the **graduate** level, we made the following observations:

- Many IS departments offer now a master's degree program in analytics. The curricula of these programs vary significantly, and their main focus and variations are difficult to analyze without detailed review of all course contents (some examples of course titles are Data Science for Business I and II or Data Analysis I and II). Common courses—in addition to foundations courses such as the ones listed above—are programming for analytics (with Python or R), data warehousing, data visualization, data mining, and business intelligence. Of the degree titles of the analytics programs MS in Business Analytics is the most frequently used; some variants include Data Science with a specialty in Business Analytics, Master of IT in Business (Analytics).
- In addition to the specialized analytics programs, five of the 16 (about 30%) of the Information Systems programs included at least one core course in an analytics topic (such as general business analytics or data visualization).
- In addition to analytics, the sample had four other programs that concentrated on a specialty area of IS: Master in Business Innovation, Automotive and Mobility Management, Marketing and Supply Chain Management, Strategy and Governance of Cyber Risk. Typically, these programs do not include courses that develop competencies in all the traditional core areas of Master's degree programs in Information Systems but might have content related to analytics or AI.
- There are few programs in the sample that provide entire courses focusing on applications of AI. One program offered a course in machine learning and another in AI techniques and applications. Based on the course level data provided, many programs identified AI topics at the awareness level in courses that had their primary focus on another area.
- Three graduate programs used the word digital or its derivative in their titles- so there is also a change from using IT to connote the field as digital: Governance of Digitalization, Digital Business and Digital Innovation. In some cases, "digital" was also added to other course titles, such as "Digital ISM challenge," "Digital Work Practices," "Digital Business Transformation," "Digital Information Infrastructure," and "Digital Business Models."

Below we offer a short summary on the digital topics and technologies covered in courses reported to us based on the detailed course level analysis. The table summarizes main characteristics of each course, and aggregates it also at the program level. This also shows significant variation in the content and scope of topics covered related to big data and AI technologies. "Y" in the table denotes that the program covers the topics or technologies, leaving it blank means the topics or technologies are not covered in the course. "Y" in bold means the specific topic or technology is included in a high percentage in all the courses of this program (at varying levels of intensity), and "Y" in green color means the specific topic or technology is included in a low percentage of all the courses of this program.

Table 1. Summary of the digital topics and technologies covered in the course at the program level

Undergraduate Programs

No.	Institution/University Name	Program	Course level										
		Program Name	Big data/ data science	AI/Machine Learning	Automation /Algorithms	Blockchain	Design thinking	Python, R, SQL	Tableau, SAP, Splunk	JAVA, C, C#, C++	SAS, SPSS, EXCEL	ERP, CRM, SCM	OTHER
1	University of Illinois Springfield	Management Information Systems	**Y**		**Y**			Y					
2	University of Illinois Springfield	Business Administration	**Y**					Y			**Y**		
3	University of St.Gallen	Bachelor of Business Administration	Y	Y	**Y**			Y					
4	Singapore Management University	MaCuDE IS Task Force	**Y**	Y	Y	Y							Y
5	Baylor University	BBA in Management Information Systems	**Y**	Y	**Y**	Y		**Y**	**Y**	Y	Y		Y
6	Technische Hochschule Ingolstadt	Digital Business		Y	**Y**	Y		Y					**Y (vary)**
7	National University of Singapore	Bachelor of Science (Business Analytics)											
8	National University of Singapore	Master of Computing (Information Systems)											
9	Victoria University of Wellington, New Zealand	Cybersecurity Engineering			Y								

Graduate Programs

No.	Institution/University Name	Program	Course level										
		Program Name	Big data/ data science	AI/Machine Learning	Automation /Algorithms	Blockchain	Design thinking	Python, R, SQL	Tableau, SAP, Splunk	JAVA, C, C#, C++	SAS, SPSS, EXCEL	ERP, CRM, SCM	OTHER
1	SDA Bocconi School of Management	The Blockchain Journey	Y	Y	Y	Y		NA					
2	University of Illinois Springfield	Management Information Systems	**Y**	Y	**Y**	Y		Y		Y	Y	Y	Y
3	University of Illinois Springfield	Master of Business Administration, MBA	**Y**	Y	Y								Y
4	Baylor University	Management of Science in Information Syste	Y	Y	Y						Y		
5	Technische Hochschule Ingolstadt	Automotive and Mobility Management			Y								Y
6	University of Turku University of Turku, Passau University, Tilburg	Marketing and Supply Chain Management			Y								Y
7	University, Central China Normal University	Global IT Management											Y
8	Maynooth University	MSc Business Analytics	Y	Y	Y								Y
9	Victoria University of Wellington, New Zealand	Master of Professional Business Analysis	Y	Y	Y		Y						Y
10	Victoria University of Wellington, New Zealand	Master of Information Management					Y						
11	SDA Boconi School of Management	Strategy and Governance for Cyber Risk	**Y**	**Y**	**Y**	Y							Y (vary)