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AACSB MaCuDE Task Force Phase III Report

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MaCuDE IS Task Force Phase III Report Outline

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Organization

1. Task and Setting
2. Issues and Deliverables of MaCuDE/IS Task Force
3. State of the Art in BDA/AI education in IS Field
4. Emerging BDA/AI Skills and Competencies by Roles
5. Key Competencies for BDA/AI IS Education
6. Resources, Governance and Implementation of Curriculum Development

1. Task and Setting

- MaCuDE IS Task Force goals
  - Provide an overview of the status of IS education, identify emerging industry needs and articulate recommendations for future curriculum work
  - Determine the impact of new IT capabilities associated with Big Data and AI (including machine learning) in IS curricula (especially in business schools)
  - Identify directions for IS education in business schools given the increased focus on digital technology across most business disciplines
  - Review how IS faculty and units within business schools can collaborate with other groups in this new environment?
- Context
  - AIS and ACM jointly developed multiple IS curricula over the past three decades—The project draws on these recommendations as a baseline, identifies gaps, and provides input for future initiatives
  - Collaboration between the AACSB MaCuDE IS Task Force and AIS Education Committee
- Generate a framework of aspired/expected high-level competencies for different degree types and education contexts related to BDA/AI in IS education

2. Issues in Current State of IS Education

- 1. Undergraduate level
  - Programs cover BDA/AI at a relatively modest level except for specialized analytics-focused programs
  - IS education focus on specialized programs, instead of general IS education
  - A few programs emphasize design thinking
- 2. Graduate level
  - Specialized analytics programs becoming common
  - Analytics topics gaining real estate in general IS programs
  - Other specialized programs with a IS thematic focus (e.g., digital innovation/ cybersecurity) emerging
  - Programs typically acknowledge the importance of AI topics but cover them at the awareness level.
- 3. Emerging challenges of IS Education
  - Digital transformation poses new opportunities and needs for IS education
  - How to establish a viable and distinct role of IS in delivering BDA/AI education within business schools
  - Increased variation in the content and scope related to BDA/AI technologies in IS programs based on local needs and environment

2. Issues in Industry Needs

1. **Dimensions of Digital Transformation**
    Capability improvement and transformation
    Decision-making strategies and tactics
    Changes in operations or products

2. **Three classes of competencies to meet the industry needs:** Fundamental environmental competencies; Data, information, and content management; System design

3. **Competency gaps in industry needs:** foundations (e.g., domain competencies), data management, and design

4. **Emerging needs** in security/continuity, deep technical/ analytical, and business development and design and execution

5. **Universities main BDA/AI competency providers** because of the weaknesses in training in companies

6. **The industry needs of BDA/AI** should be carefully considered in the future **departmental recruiting**

2. Deliverables Related to BDA/AI Competencies

1. **Key contribution of IS graduates**: harnessing the transformative power of information technologies to organizational needs and opportunities while appreciating the implications of the transformation for all stakeholders

2. **IS community needs to develop new curricula recommendations for the MBA concentration, specialized versions of undergraduate majors and master's programs (such as business analytics, cybersecurity, AI, etc.)**

3. **Specify competency levels for each program type / competency area pair**
   - Program types: General education (all/business), General IS, Specialized degrees, Non-degree
   - Competency levels: Awareness, Novice, Intermediate, Advanced, Proficient
   - IS Competency Areas: Data and Information Management; Digital Transformation/Innovation/Systems Analysis & Design; IT Infrastructure; Secure Computing; Application Development/Programming; Ethics; IS Management & Strategy; Artificial Intelligence
   - Available here

2. Deliverables Related to BDA/AI Competencies

1. **Core IS competencies in data management, systems analysis & design, IT infrastructure, and IT management critical**
2. **Additional BDA/AI areas** of competency development
   1) **BDA and AI systems development and deployment** (often based on packaged solutions)
   2) **Effective integration of AI-based IT capabilities**, advanced analytical solutions, and other emerging technologies **into large-scale organizational systems**
   3) **Cloud-based infrastructure** and non-relational data management technologies
   4) **Stronger analytics competencies**: statistical analysis and inferences, storytelling, visualization
   5) **New life cycle models** of data management and data science
   6) **Ethical decision-making** to understand the implications and to maintain fairness and equity of algorithmic decisions

2. Deliverables Related to BDA/AI Competencies

1. IS competencies are not sufficient alone—Integrated development of **Individual Foundational Competencies and Domain Competencies remain essential**

2. **Re-introduce systems thinking and meta-learning** (and experience-based engagement)
   - Competencies to cope with future, still unknown, challenges—increased importance of meta-learning

3. **Develop understanding of software/systems design and related organizational/process design** → a flexible design mindset

2. BDA/AI Curriculum Implementation

1.   Offering and executing BDA/AI curriculum content demands **competent technical faculty** which calls for **flexibility in hiring and tenure decisions**

2.   Offering BDA/AI curriculum content calls for **new and different types of technical environments and resources** demanding significant investments and collaboration

3.   Offering and executing BDA/AI curriculum calls for **changes in how degrees are regulated and what is necessary common content**. Calls also for collaboration with AIS/ACM and INFORMS.

4.   Offering BDA/AI educational programs requires **flexible and new governance** solutions across the university

5.   Offering and executing BDA/AI curricula in IS requires the **integration of design thinking** as a dominant principle

6.   Offering and executing BDA/AI curricula needs to be founded on **experiential and problem-focused learning** to advance system thinking and meta-learning skills

3. State of the Art in BDA and AI Education

BDA and AI topics and tools covered in programs (Lyytinen et al., 2021)

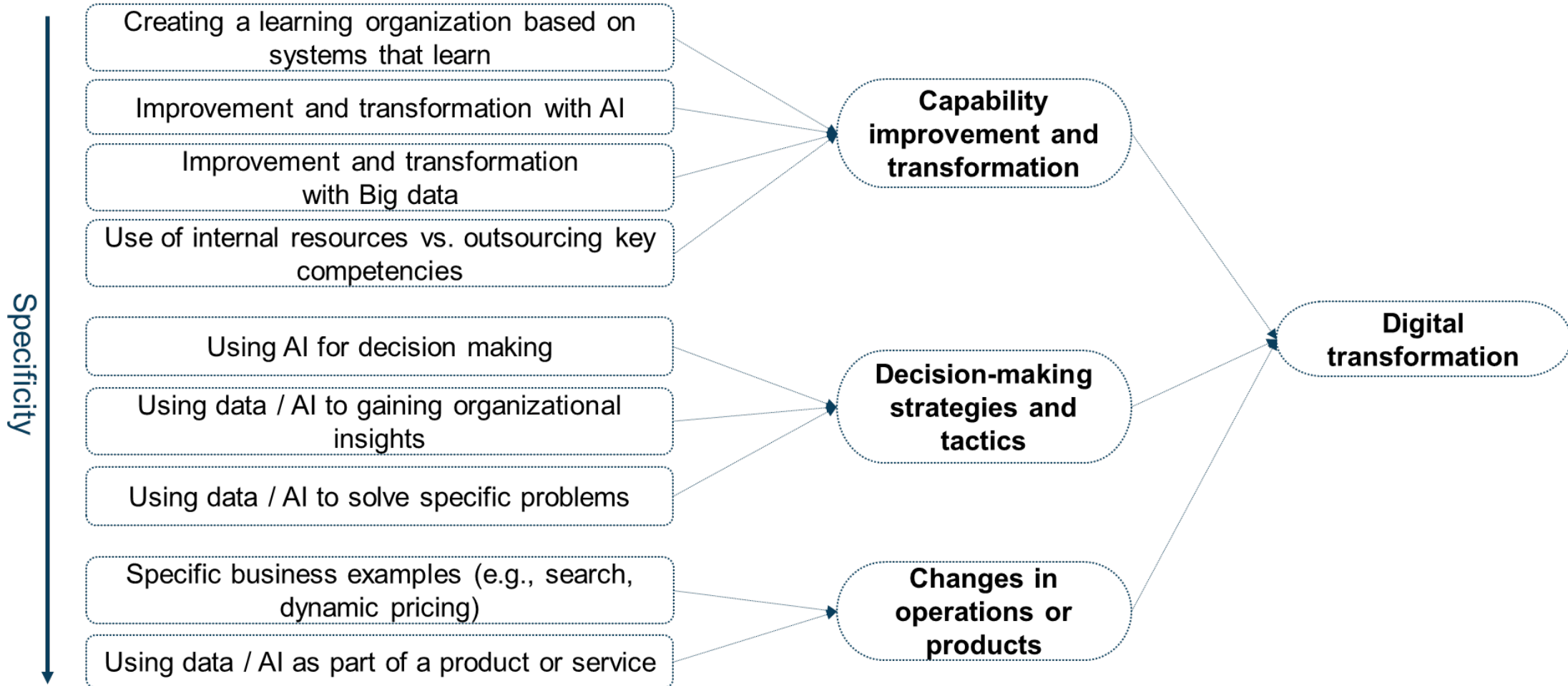| Undergraduate level	Graduate level
1. At their core, most programs implement key components of IS curriculum model that aligns with the past undergraduate model curriculum (IS 2010).	1. Common courses include programming for analytics (using Python or R), data warehousing, data visualization, data mining, and business intelligence.
2. Cybersecurity has recently emerged as a new topic.	2. In addition to dedicated analytics programs, 5 out of the 16 (about 30%) of the reported IS programs include at least one course on analytics (significant *increase* in the past years).
3. In data analytics, only specialized analytics programs include courses in this area.	
4. No evidence that core courses solely focused on AI or any of its subareas, such as machine learning are common at undergraduate level.	3. Some programs concentrate on specialty IS topics such as BPM but have content related to BDA or AI in some courses.
	4. Few programs provide full courses focused on AI/ML applications.

Survey sample: In total, 31 universities responded to the survey at the program level. Altogether, they provided data regarding 34 undergraduate programs, 59 graduate programs, two executive programs, and one doctorate program. The graduate programs included 33 in information systems, 13 in analytics, and four in other focused IS specialties.

3. Status of BDA/AI Education

- Currently driven by school or university level initiatives, faculty interest, and access to resources (little community level interest)
- Most activity at the graduate level—the number of analytics courses and programs have increased since early 2010s
- No systematic and standardized approach to cover BDA and AI topics in IS programs exists
- Need to address systematically current gaps in the BDA/AI education and increase awareness about IS contributions to these topics in business schools

4. Emerging BDA/AI Skills and Competencies by Roles

4. Industry Needs in Digital Transformation

Specificity

Creating a learning organization based on systems that learn

Improvement and transformation with AI

Improvement and transformation with Big data

Use of internal resources vs. outsourcing key competencies

→ **Capability improvement and transformation**

Using AI for decision making

Using data / AI to gaining organizational insights

Using data / AI to solve specific problems

→ **Decision-making strategies and tactics**

Specific business examples (e.g., search, dynamic pricing)

Using data / AI as part of a product or service

→ **Changes in operations or products**

→ **Digital transformation**

4. Industry Needs— Individual Competencies

Fundamental environmental competencies

- **Individual foundational competencies**
  - Team work skills and communication skills
  - Critical thinking and meta-learning skills
  - Problem solving and systems thinking
- **Business domain competencies**
  - Integrating business and technology competencies
  - Aligning business with IT
  - Identifying business value
  - Understanding the business domain

Data, information, and content management

- **Database**
  - Foundational database competencies
  - Online analytical processing (OLAP)
  - Structured query language (SQL)
- **Data analytics**
  - Extract, transform, load (ETL))
  - Executing analytics
  - Storytelling
  - Visualization
- **Data management**
  - Data and modelling requirements (data architecture and management)
  - Data science life cycle
  - End-to-end management of data life cycle
- **Business continuity and information assurance**
  - Model and data security
  - Privacy and security (Ethics)

Systems design competencies

- **Individual analytics and programming skills**
  - Programming
  - Statistics
- **IT infrastructure**
  - Machine learning, various subareas of AI
  - Managing cloud resources
- **Systems architecture**
  - Architecting for cloud
  - Open source
  - Understanding data structures, architectures, and governance
- **Systems development and deployment**
  - Machine learning, building and managing ML models
  - Machine learning, technical foundations of ML
  - UIUX
  - Using platform tools
- **IS management and operations**
  - Project management

5. Key Competencies for BDA/AI IS Education

5. Key Competencies for BDA/AI IS Education

Proposing to organize the demands for BDA/AI competencies around the following areas:

- General education
  - All university students
  - All undergraduate business students
- General IS programs
  - Undergraduate IS majors and general IS master's degrees
  - Minors (undergraduate) and concentrations (MBA/MBA tech)
- Specialized MS degrees
  - E.g., Analytics and Applied AI
- Non-degree programs

Each has specialized education needs by the level and domain of competency

5. Proposed Competency Specification

Competency is defined by:

1. Knowledge: technical and genera problem solving knowledge

2. Skills: Practical skills to identify, design, implement and coordinate BDA/AI development and use

3. Disposition(s): attitude, behavior, social skills, emotional capabilities

Competency = [Knowledge x Skills x Dispositions] in addressing specific task

- Level of competency:
  - E.g., in MSIS 2016: Awareness, Novice, Supporting, Independent, Proficient

Source: CC 2020; IS 2020; MSIS 2016

5. Proposed Competency Specification

- Definitions of Competency Levels; Levels based on MSIS2016 (Topi et al., 2017):
  - **At the Awareness level,** a graduate knows that the competency category exists and is aware of the reasons why it is important for the domain of practice and individual organizations that use information systems to achieve their goals. Graduates at this level have not yet reached SFIA level of responsibility 1 (SFIA, 2022).
  - **At the Novice level,** a graduate can effectively communicate regarding matters related to the competency, perform component activities under supervision, and develop on-the-job experience related to the competency. This level corresponds closely to SFIA level of responsibility 1.
  - **At the Intermediate** (Supporting in MSIS2016) level, a graduate has achieved a level of competence that allows them to collaborate effectively in a supporting role with colleagues who have achieved a higher level of the competency to produce the desired outcomes. This level corresponds closely to SFIA levels of responsibilities 2 and 3.
  - **At the Advanced** (Independent Contributor in MSIS2016) level, a graduate has achieved a level of competence that allows them to perform without continuous support/supervision the tasks required to produce the desired competency outcomes. This level corresponds closely to SFIA level of responsibility 4.
  - **At the Proficient level,** a graduate has achieved a level of knowledge and skills that allows them to perform in demanding leadership roles both as an independent expert and a leader of a team. This level corresponds closely to SFIA levels of responsibility 5 and 6.

SFIA 2022 available at https://sfia-online.org/en/sfia-8/responsibilities

5. IS Competencies per Program Type: Tentative Classification—General Education

IS Competencies			All undergraduate	All business ug
Data and Information Management	Big Data		Awareness	Awareness
	Database		Novice	Novice
	Data Analytics		Novice	Intermediate
	Data Management		Awareness	Novice
Digital Transformation / Innovation Systems Analysis and Design	Organizational Transformation		Awareness	Novice
	System Requirements Specification			Novice
	Systems Project Planning and Mgmt		Awareness	
	Systems Design			
IT Infrastructure	IT Infrastructure		Awareness	Awareness
	Systems Architecture			
Secure Computing	Business Continuity and Info Assurance		Awareness	Novice
Application Development/Programming	Systems Development and Deployment		Novice	Novice
	Individual Analytics/Programming Skills		Novice	Intermediate
Ethics	Ethics, Use and Implications for Society		Awareness	Novice
IS Management & Strategy	IS Management and Operations			Awareness
	IS Strategy and Governance			Awareness
	Enterprise Architecture			Awareness
Artificial Intelligence	Artificial Intelligence		Awareness	Awareness

5. IS Competencies per Program Type: Tentative Classification—General IS

IS Competencies		IS minor	IS ug	MBA Tech	General IS master's
Data and Information Management	Big Data	Awareness	Novice	Intermediate	Intermediate
	Database	Intermediate	Advanced	Novice	Proficient
	Data Analytics	Intermediate	Intermediate	Intermediate	Intermediate
	Data Management	Novice	Intermediate	Intermediate	Advanced
Digital Transformation / Innovation Systems Analysis and Design	Organizational Transformation	Awareness	Intermediate	Advanced	Advanced
	System Requirements Specification	Intermediate	Advanced	Advanced	Proficient
	Systems Project Planning and Mgmt	Intermediate	Intermediate	Proficient	Proficient
	Systems Design	Awareness	Novice	Intermediate	Advanced
IT Infrastructure	IT Infrastructure	Awareness	Novice	Novice	Advanced
	Systems Architecture	Awareness	Awareness	Awareness	Intermediate
Secure Computing	Business Continuity and Info Assurance	Novice	Intermediate	Intermediate	Intermediate
Application Development/Programming	Systems Development and Deployment	Intermediate	Intermediate	Novice	Advanced
	Individual Analytics/Programming Skills	Novice	Advanced	Novice	Proficient
Ethics	Ethics, Use and Implications for Society	Intermediate	Intermediate	Advanced	Advanced
IS Management & Strategy	IS Management and Operations	Awareness	Novice	Advanced	Advanced
	IS Strategy and Governance	Awareness	Novice	Proficient	Intermediate
	Enterprise Architecture	Awareness	Novice	Intermediate	Intermediate
Artificial Intelligence	Artificial Intelligence	Novice	Novice	Novice	Novice

5. IS Competencies per Program Type: Tentative Classification—Specialized Programs

IS Competencies			Business Analytics ug	Applied AI ug	Business Analytics master's	Applied AI master's
Data and Information Management	Big Data		Intermediate	Intermediate	Advanced	Advanced
	Database		Intermediate	Intermediate	Advanced	Advanced
	Data Analytics		Advanced	Intermediate	Proficient	Intermediate
	Data Management		Intermediate	Intermediate	Intermediate	Intermediate
Digital Transformation / Innovation	Organizational Transformation		Novice	Intermediate	Intermediate	Advanced
Systems Analysis and Design	System Requirements Specification		Intermediate	Intermediate	Intermediate	Advanced
	Systems Project Planning and Mgmt		Novice	Novice	Intermediate	Intermediate
	Systems Design		Novice	Novice	Intermediate	Intermediate
IT Infrastructure	IT Infrastructure		Novice	Novice	Intermediate	Intermediate
	Systems Architecture		Awareness	Awareness	Intermediate	Intermediate
Secure Computing	Business Continuity and Info Assurance		Intermediate	Intermediate	Intermediate	Intermediate
Application Development/Programming	Systems Development and Deployment		Novice	Intermediate	Intermediate	Advanced
	Individual Analytics/Programming Skills		Advanced	Advanced	Proficient	Proficient
Ethics	Ethics, Use and Implications for Society		Intermediate	Intermediate	Advanced	Advanced
IS Management & Strategy	IS Management and Operations		Novice	Novice	Intermediate	Intermediate
	IS Strategy and Governance		Novice	Novice	Novice	Novice
	Enterprise Architecture		Novice	Novice	Novice	Novice
Artificial Intelligence	Artificial Intelligence		Intermediate	Advanced	Advanced	Proficient

5. IS Competencies per Program Type: Tentative Classification — Notes

- Color coding: green (all ug); light blue (all business ug); yellow (general IS degree); beige (analytics); red (applied AI); and gray (minor/concentration)

- Applied Artificial Intelligence has been included as a currently emerging but primarily future-focused degree

- None of the major sources of this work (curriculum recommendations or the MaCuDE studies) offer guidance regarding key AI competency areas—as often is the case, it takes time and experimentation by innovative programs a commonly accepted core curriculum emerges

- Five competency levels: Awareness, Novice, Intermediate, Advanced, and Proficient

- Note: IS competencies are not all that is needed—Individual Foundational Competencies and Domain Competencies are essential, too

6. Resources, Governance and Implementation of Curriculum Development

A portfolio of options and ideas

6. Implementation Issues

Resourcing

- New curriculum requirements pose demands for novel technical content. Demands resources for
  a) **Competent technical faculty**: schools need to be flexible and find alternative solutions to this issue, hiring, training, collaboration, and related incentives
  b) **New IT resources**, with access to cloud, large data sets and technical experience in using them. Call for collaborations with industry, locally with firms, AIS role in developing common resource pools

Regulation

- Challenges **current regulation of degrees and their content (all content required cannot be included): creates the need to soften regulatory demands, especially for AACSB common content**. Future curricula in business schools should allow for more variation and flexibility locally to serve specific needs of specific programs

- Need more **common frameworks and assessment criteria for technical technical/ business skills and related competencies** (AIS/ACM)

Organization

- **Organizing for educational programs and their governance and accreditation can vary significantly locally;** can also involve university wide collaboration with CS departments and/or Information Schools and other fields such as statistics

6. Implementation Issues - Role of IS

Competitive or complementary position of IS related to other disciplines

Competitive	Complementary
1. Where are the boundaries: business, IS, CS (who owns the turf for specific competencies)?	1. There is a need for a diversity of faculty (more technical, CS, Engineering, etc.)
2. Who owns the domains of technology and analytics?	2. IS needs collaboration and education involves integration between the different disciplinary viewpoints
3. Competition on number of courses offered or the level of topic integration within courses? E.g., integrate CS, business.	3. Interdisciplinary program need guidance/ guidelines from business school and related governance.

- Business schools need to hire increasingly faculty with high levels of technical and analytics capabilities.
- IS can—with its application and system management focus—serve as a bridge of CS, engineering, statistics and other business disciplines.

6. Policy Issues and Implementation

- Need for detailed curriculum development within AIS and ACM to advance and expand the curricula development both for undergraduate and master's/ MBA content

- Must to conduct bi-annually shorter evaluation of the status of the area with new recommendations, starting 2024-25 (AIS Education Committee)

- Review the AACSB accreditation criteria for analytics/ technical content across all programs (Lobby for AACSB)
    - Few references in the current criteria

6. Curriculum Regulation and Related Needs

- How to allocate credit for different areas?
- Role of AIS and ACM/Informs?
- Role of AACSB?