- **Leadership and collaboration.** IS students will perform in various collaborative and leadership roles during their careers. IS programs should prepare graduates to be effective collaborators and inspiring leaders. This topic should cover leadership and project management skills, collaboration techniques and team work etiquette, and the use of technology to support team work collaboration and coordination.

- **Communication.** IS professionals work closely with colleagues within and outside their own professional domain. Therefore, IS students cannot become effective IS professionals without being competent in oral and written communication. This topic should cover general and technical writing, oral communication, presentations, and listening skills.

- **Negotiation.** IS professionals regularly serve as a link between different stakeholders that hold different interests. Such stakeholders include, but are not limited to, end users, external IS service providers, managers, and other IS professionals within the organization. Therefore, IS students need to understand and learn how to manage different, sometimes competing, interests. This topics should cover stakeholder analysis, how to balance resources and desired outcomes, and fundamental negotiation skills and techniques.

- **Analytical and critical thinking, including creativity and ethical analysis.** Every IS professional must have strong analytical and critical thinking skills. Fundamentally, IS students need to master problem solving and systems thinking skills to analyze, design, develop, and evaluate IS systems and situations. This topic should cover basic problem solving approaches and techniques, using quantitative and qualitative analysis techniques, understanding different perspectives regarding IS artifacts and situations such as ethical and legal issues, creativity techniques and approaches, and the competitive global environment.

- **Mathematical foundations.** IS professionals should be versed in core mathematical concepts, including but not limited to probability, statistics, mathematical or symbolic logic, calculus, and discrete mathematics.

- **Functional areas of an organization**. Students should be exposed to the principles of economics and functional areas of the organization such as accounting, finance, human resources, marketing, logistics, and operations. They should also be introduced to the essentials of non-profit, governmental, and international business organizations.

# 10. OUTCOME EXPECTATIONS FOR INFORMATION SYSTEMS GRADUATES

### Overall Structure of Basic Concepts

The restructuring of the Model Curriculum is clearly driven by changes in high-level organizational needs and graduate capabilities. The work underlying the curriculum specification first identified the high-level capabilities needed by IS graduates. These overall capabilities, in turn, are based on knowledge and skills that have been categorized as IS-specific Knowledge and Skills, Foundational Knowledge and Skills, and Domain Fundamentals. By doing so, the revised Model Curriculum links curriculum content and structure to graduate capabilities in a well-

defined and transparent way. Figure 3 shows how the high-level IS capabilities are extrapolated to the final curriculum topics delivered through courses.

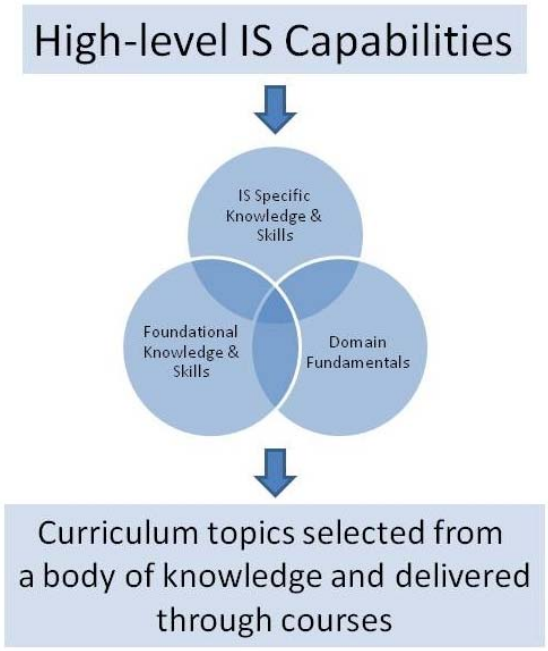


**Figure 3: Overall Structure of the Basic Concepts.**

**High Level IS Capabilities**

The new curriculum will be based on a significantly revised set of degree outcome expectations, that is, expectations regarding the capabilities of graduating IS students when entering the full-time workforce. The new capability set recognizes the change in the nature of the jobs IS graduates are likely to have by focusing on business analysis, organizational processes, enterprise architecture, sourcing options, and security/risk management. The curriculum acknowledges explicitly the contribution that the Information Systems discipline can make to domains outside business (such as governments, non-profits, health care, etc.) and, therefore, the high-level capabilities are not limited to a specific domain. They are, however, driven by organizational needs and more abstract and stable than knowledge and skills. The following will give a more detailed description of each capability.

*Improving Organizational Processes*

The new curriculum assumes that understanding and improving organizational processes is one of the key capabilities of all IS graduates. This requires the graduates to be functional in:

- Understanding the fundamental concepts related to organizational processes
- Understanding general principles of process analysis in order to apply them to specific situations
- Analyzing existing processes based on interviewing, observation, documentation analysis, and other similar methods

- Understanding how the very large amounts of data collected by modern organizations can be used to review, redesign, and improve processes
- Identifying and capturing the essential findings from the large amount of data produced by the analysis process
- Researching and applying industry reference models and best practices in order to improve process designs
- Using the analysis results as a basis for designing revised processes based on the graduates' strong understanding of both organizations and information technology
- Simulating a proposed process and revising it as necessary
- Negotiating a solution that satisfies the political requirements for the new process
- Leading the implementation of new processes.

The specification of high-level IS capabilities does not include a particular set of process improvement methods or techniques, but the graduates are expected to be aware of and benefit from at least one such method.

*Exploiting Opportunities Created by Technology Innovations*

Graduates of Information Systems programs are experts in seeing how organizations can benefit from technology capabilities, converting opportunities created by information technology innovations into sustainable organizational value through systematic processes. An essential element of this high-level capability is the ability to understand both information technology and the needs of an organization within a specific domain at such a deep level that IS graduates see new opportunities to create value faster and with greater clarity during various analysis processes than their non-IS counterparts. Achieving a high level of performance related to this capability requires in-depth knowledge of technology and the domain, skills in analyzing problems and designing solution alternatives, ability to analyze the strengths and weaknesses of various alternatives as well as demonstrable skills in sourcing, designing, and implementing technology solutions.

*Understanding and Addressing Information Requirements*

Another key capability of all IS graduates is the ability to analyze and document organizational information requirements at various levels, starting from those of individual knowledge workers responsible for specific tasks and ending with very high level institutional requirements. IS graduates are experts in analyzing the information needs of an individual, organizational unit, or an organization in order to determine how information technology-based solutions can best be designed to support these information needs. Increasingly, the core capabilities in this area are related to effective utilization and integration of data that is generated in a rich variety of organizational systems and includes multiple types and formats.

*Designing and Managing Enterprise Architecture*

Information Systems graduates are experts in high level design and management of IT capabilities that are fully aligned with general organizational goals. Currently, these capabilities are typically organized and presented as an enterprise architecture, consisting of high-level internally compatible representations of organizational business models, data, applications, and information technology infrastructure. The capabilities of the graduates of undergraduate IS programs are typically at a level suitable for focusing on the component architectures. One of the knowledge and skill areas that is directly derived from this high-level IS capability is related to IT

infrastructure, including networking technology, data centers, and so on. This high-level capability also requires an understanding of the IT management and control frameworks, such as ITIL and COBIT.

*Identifying and Evaluating Solution and Sourcing Alternatives*

Graduates of IS programs are capable of producing high-level design alternatives for various organizational IT-based solutions. There are always a large number of ways to achieve a specific set of organizational capabilities using information technology, but not all of approaches are feasible in a specific context. An essential high-level capability that IS graduates have is an ability to identify a small subset of realistic, financially and technically feasible solution alternatives and the mechanisms through which an organization can acquire these technology resources. Most projects require reusing or building on the existing components (such as modules, reusable objects, databases, information architectures, etc.) used in the current systems, and therefore, it is essential that graduates have the capability to understand a variety of technologies and their integration.

In particular, the globalization of the IS/IT supply chain has made the traditional "buy vs. build" questions significantly more complex to answer, but the core issues are still the same: once an IT capability need has been identified, what is its high-level design and how should an organization acquire this capability?

*Securing Data and Infrastructure*

It has been increasingly important for organizations to ensure that their data and IT infrastructure resources are protected from a variety of security threats, which can potentially create significant financial liabilities as well as damage the organizational image. Understanding these threats and identifying high-level solutions to protecting the organization are essential capabilities of all graduates of Information Systems degree programs.

*Understanding, Managing and Controlling IT Risks*

IS graduates should have strong capabilities in understanding, managing, and controlling organizational risks that are associated with the use of IT-based solutions (e.g., security, disaster recovery, obsolescence, etc.). At the undergraduate level, the emphasis should be on in-depth understanding of a variety of risks. Because IT solutions are so closely integrated with all aspects of a modern organization, it has become essential to manage the risks related to their use in a highly systematic and comprehensive way.

**Knowledge and Skills of IS Graduates**

Graduates of Information Systems undergraduate degree programs need a wide variety of specific skills and knowledge as a foundation for the high-level IS capabilities specified earlier. The high-level capabilities typically encompass skills and knowledge from various areas. For example, in order to determine and address information requirements, an IS graduate needs to understand and apply data management technologies, have excellent interpersonal, analytical, and problem solving skills as well as have a strong command of the organizational domain for which the information requirements are specified. The knowledge and skills that graduates in Information Systems are expected to have can be divided into three categories:

1. Information Systems Specific Knowledge and Skills

2. Foundational Knowledge and Skills
3. Knowledge and Skills Related to Domain Fundamentals

The category "Information Systems Specific Knowledge and Skills" includes elements that are in the core of the IS discipline. These knowledge and skills would not be developed by other types of educational programs; they are specific to Information Systems as a discipline. "Foundational Knowledge and Skills" are shared by many disciplines that educate knowledge professionals, and they include broad categories such as leadership and collaboration, communication, and analytical and critical thinking. Finally, "Domain Fundamentals" covers skills and knowledge related to the domain to which a specific Information Systems program applies computing. For most IS programs the domain is general business, but it could focus on a specific business specialty (e.g., finance), industry (e.g., health care), organization type (e.g., government, non-profit), and so on. As discussed above, undergraduate IS programs will develop knowledge and skills in each of these three categories. When combined over the course of a student's studies, they will lead to the high-level IS capabilities.

*Information Systems Specific Knowledge and Skills*

Information Systems specific knowledge and skills are divided into four main categories (and subcategories), as follows:

1. **Identifying and designing opportunities for IT-enabled organizational improvement.** The integrating theme of this category is the focus on an organization and the ways it can develop its capabilities using information technology. In many ways, the specific items in this category are related to requirements analysis and specification at a high level of abstraction, including strategic alignment, the analysis of information needs, and the evaluation of user experience.
   These include:
   a. Ensuring alignment between IT strategy and organizational strategy
   b. Improving organizational processes with information technology solutions
   c. Understanding and designing the role of information systems in managing organizational risks and establishing controls
   d. Identifying and exploiting opportunities created by emerging technology innovations
   e. Understanding and documenting information requirements
   f. Improving various stakeholders' experience in interacting with the organization, including issues in human-computer interaction.

2. **Analyzing trade-offs.** One of the most important knowledge and skill categories for Information Systems graduates is the ability to design and compare solution and sourcing alternatives in a way that takes into account various sources of risks and dimensions of feasibility, including technology characteristics, availability of and organizational ability to utilize human resources, scheduling, organizational politics, regulatory issues, and return on investment. A particular strength of Information Systems graduates is the ability to integrate a variety of these perspectives and avoid analysis that narrowly focuses on only technology or business requirements. A key element of this capability is to be able to evaluate sourcing alternatives. Subcategories include:

   a. Identifying and designing high-level solution and sourcing options
   b. Analyzing and documenting the feasibility of various options
   c. Comparing solution options using multiple decision criteria

d. Capital budgeting for IT-intensive projects; creating a financial justification for choosing between alternatives

3. **Designing and implementing information systems solutions.** Although the knowledge and skills that IS graduates need have recently moved significantly in the direction toward higher levels of abstraction, individual skills related to design and implementation are still essential for IS graduates. Those who can demonstrate the ability to integrate high performance in design and implementation, along with strong business capabilities, are typically the most highly sought after graduation. This category of knowledge and skills also includes the management of people and organizations that are used to develop IS/IT capabilities, whether internal or external, regardless of their geographic location. Knowledge and skills related to specific issues of IS project management are in this category. The specific subcategories include:

    a. Designing enterprise architectures
    b. Identifying, evaluating, and procuring detailed solution and sourcing options; configuring and integrating organizational solutions using packaged solutions
    c. Designing and implementing solutions that provide a high-quality user experience
    d. Designing secure systems and data infrastructures
    e. Designing and implementing applications, application architectures and integrated systems
    f. Managing and exploiting organizational data and information; designing data and information models
    g. Managing information systems development/procurement resources
    h. Managing information systems projects.

4. **Managing ongoing information technology operations.** IS graduates need knowledge and skills related to the management of the ongoing information systems operations within the organization, including the management, operation, and securing of the IT infrastructure. This can include:
    a. Managing the use of enterprise technology resources
    b. Managing application performance and scalability
    c. Maintaining existing information systems
    d. Managing relationships with technology service providers
    e. Securing data and systems infrastructure
    f. Ensuring business continuance

*Foundational Knowledge and Skills*

Foundational knowledge and skills are not unique to Information Systems as a discipline. Instead, most programs that educate knowledge professionals intend to develop some or all of these skills and capabilities. Still, they are very important for Information Systems programs because it is impossible for IS graduates to exhibit the required high-level IS capabilities without these foundational knowledge and skills. Individual IS programs typically implement educational experiences that develop these areas in an IS specific context.

1. **Leadership and collaboration.** The graduates of Information Systems programs will be required to act in various collaborative roles during their professional careers, and it is likely that most of them will be assuming leadership positions at various levels. Increasingly, these roles are performed in a genuinely global context. It is essential

that programs prepare their graduates to be effective collaborators and inspiring leaders. Capabilities should include:

a. Leading cross-functional global teams
b. Managing globally distributed projects
c. Working effectively in diverse teams
d. Structuring organizations effectively

2. **Communication.** It is impossible for an IS professional to perform effectively in any organizational role without excellent oral and written communication skills. IS professionals work closely with colleagues in a variety of different organizational roles, and invariably, their job performance is partially dependent on their ability to communicate. Capabilities should include:

   a. Listening, observing, interviewing, and analyzing archival materials
   b. Writing memos, reports, and documentation
   c. Using global collaboration tools (such as wikis, blogs, shared collaboration spaces, etc.)
   d. Giving effective presentations

3. **Negotiation.** Related to the previous category, negotiation skills are also very important for IS professionals. In their organizational roles, they have to navigate carefully between different, competing interests within the organization. In these situations, excellent negotiation skills are essential. Finally, IS professionals increasingly play a role in the negotiations with external IT service providers and other vendors. Capabilities should include:

   a. Negotiating with users about funding, resources of time, staff, and features
   b. Negotiating with providers about service levels
   c. Negotiating with providers about quality and performance of deliverables
   d. Facilitating negotiations between competing internal interests.

4. **Analytical and critical thinking, including creativity and ethical analysis.** Strong analytical and critical thinking skills are a foundation for everything IS professionals do – it is essential that they are able to systematically analyze complex systems and situations, break them down into manageable components, understand deep connections within systems, and create solutions based on the results of a systematic analysis. Problem solving is also omnipresent in the life of IS professionals. Capabilities should include:

   a. Analyzing the ethical and legal implications of complex situations
   b. Analyzing the risks associated with complex systems
   c. Solving complex problems
   d. Using quantitative analysis techniques appropriately and effectively
   e. Enhancing innovation and creativity in oneself and others

5. **Mathematical foundations**. Even though IS professionals do not need the same level of mathematical depth as many other computing professionals, there are, however, some core elements that are very important for IS professionals (of course, these needs will vary depending on an individual's specialty). To support in-depth analysis of data, IS professionals should have a strong background in statistics and

probability. For those who are interested in building a strong skills set in algorithmic thinking, discrete mathematics is important.

*Knowledge and Skills Related to Domain Fundamentals*

Domain Fundamentals is the third category of knowledge and skills. It is equally important as the other two, but different because its contents vary significantly depending on the domain that together with the other two categories forms the outcome expectations for an Information Systems degree. The most common domain for Information Systems is business in general, but many other domains are possible components, including business specialties (such as accounting or finance), government, health care, the legal profession and non-governmental organizations. Within each domain, it is typically possible to identify at least three subcategories of domain knowledge:

- General models of the domain. This subcategory refers to the general foundational material that provides an overall understanding of the domain at the level that is needed to both understand the general concepts within the area and form a basis for studying the key specializations within the domain.
- Key specializations within the domain. Within each domain, there is a core set of the most important specializations that are essential for understanding the domain and operating within it. It is, obviously, typical that with the domains there is vigorous discussion regarding what these specializations are, but, for example, within business it appears that few experts would dispute the need to include finance, accounting, marketing, and management (both organizational behavior and strategy).
- Evaluation of performance within the domain. Within many domains, issues related to performance analysis and evaluation are essential for understanding the domain fully, and, therefore, we include it as a separate subcategory. Performance evaluation also reveals important aspects of the philosophy of a domain. For example, both general models and key specializations might be essentially the same for businesses and non-profit organizations, but their key performance metrics could differ quite significantly.

Examples of these three subcategories within the general business domain are as follows:

General models of business
- Business models
- Business process design and management
- Organizational theory
- Business strategy

Key business specializations
- Finance
- Accounting
- Marketing
- Operations management; service science and management
- Organizational behavior
- Business law

Evaluation of business performance
- Analysis of organizational performance
- Analysis of individual and team performance
- Business analytics
- Business intelligence