Revising the MSIS Curriculum: Initial Report for Public Comments and Feedback

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Executive Summary

ACM and AIS established a joint task force responsible for developing MSIS 2016, a revised version of the master of science model curriculum in Information Systems (IS), in fall 2014 based on a review and recommendation by a preliminary evaluation task force. The members of the joint task force are Sue Brown (University of Arizona; representing AIS), João Alvaro Carvalho (Universidade do Minho; AIS), Brian Donnellan (Maynooth University; ACM), Eija Karsten (Åbo Akademi University; AIS, co-chair), Jun Shen (University of Wollongong; ACM), Bernard Tan (National University of Ireland; AIS), Mark Thouin (University of Texas at Dallas; ACM), and Heikki Topi (Bentley University; ACM, co-chair). The task force started its work in January 2015, and it is planning to complete the MSIS 2016 revision by December 2016.

The MSIS 2016 curriculum recommendation will be a comprehensive revision built on the foundation of earlier MSIS curricula, specifically (Gorgone and Gray 2000) and (Gorgone et al. 2006). The key principles underlying this revision are as follows:

- The MSIS is a professional practice master's degree that always integrates computing with a specific domain of practice. An MSIS degree develops professional competences that prepare the graduates for work as an IS professional. In addition, an MSIS degree can provide a foundational preparation for academic research.
- An MSIS degree requires as its foundation a completed undergraduate degree in IS or in another computing discipline.
- The students without necessary background in computing can gain a sufficient prerequisite skill set by taking appropriate bridge courses (pre-program leveling courses).
- An MSIS degree requires foundational studies in its domain of practice as a condition for entry to the program. For students without a sufficient background, bridge courses can be used to provide it.
- A student entering an MSIS program requires at least one university level course in statistics or analytics.
- An MSIS degree program has no expectations regarding prior professional experience.
- An MSIS degree provides the students with competences in four areas, the relative emphasis of which varies depending on the program:
    - Domain of practice (such as business, health care, legal, government, education, etc.)
    - Computing/information technology
    - Management and organizational practices related to the structure and operation of computing/IT, and
    - Individual foundational competences (such as written and oral communication, critical thinking, ethical analysis, teamwork, leadership, etc.)
- An MSIS degree typically involves no less than eleven months of full-time study and requires at least 30 semester hours (USA) or 60 ECTS credits (Europe).
- In addition to the MSIS, it is easy to envision a large number of different types of post-experience master's degrees in IS. Providing curriculum guidance for all those program types would be a qualitatively different effort from developing the MSIS as specified here. Thus, it is not included in the scope of this project.

The MSIS 2016 will differ from MSIS 2006 in the following respects:

- MSIS 2016 specifies the MSIS explicitly as a degree that does not require professional experience. The document recognizes that there are also other types of master's degrees in IS (such as those focused on a single specialty and those targeted to students with significant professional experience), but it does not provide curriculum guidance for those program types. Particularly the post-experience programs are by definition highly diverse and are often designed to allow significant variation even at the individual level.
- The degree outcomes will be specified with competences categorizes into four areas: domain of practice, computing/IT, IS/IT management, and individual foundational competences.
- MSIS 2016 recognizes explicitly that business is not the only domain of practice.
- MSIS 2016 provides support for a variety of national and regional curriculum models around the world.
- MSIS 2016 articulates the expected graduate competences at a more detailed level than MSIS 2006 did and the proposed curriculum is more clearly based on the expected graduate competences.
- MSIS 2016 recognizes the significant changes that have taken place in the program delivery environments, particularly in the form of MOOCs and other on-line programs.

This document includes a summary of the task force's work in documenting global master's programs in IS. This summary describes significant regional, national, and university differences between typical master's programs. The programs vary in terms of the characteristics of the students entering the program, the length of the program, the amount of required student work, and the degree structures. The most striking differences are in the (nominal) amount of student work required to complete the degree: at the low end, many programs require about 1350 hours, whereas the ones with the highest requirements may need 3200 hours. This is, of course, also reflected in the length of the program: some MS programs can be completed in a year whereas others may require two years of full-time study. These differences cannot be only explained by differences in the prerequisite degree type.

A significant amount of space in this document is dedicated to a discussion on qualification and competence frameworks, such as the European Qualifications Framework, the European e-Competence Framework (e-CF), the Skills Framework for the Information Age (SFIA), and Occupational Information Network (O*NET). Because the curriculum of MSIS 2016, as stated above, will be largely driven by target graduate competences, it is essential to define these competences based on a well-defined framework. SFIA and e-CF are good candidates for being such a framework, but it is essential to introduce them carefully to the IS community because they have not been utilized in IS curriculum development work earlier. For example, the current version of e-CF introduces 39 competences categorized into five clusters: PLAN, BUILD, RUN, ENABLE, and MANAGE. In addition to the competence frameworks, it is essential to understand models of careers and career paths as a foundation for specifying the graduate competences.

At this stage, the task force provides only a brief description of one possible model that specifies expected MSIS graduate competences. Its components have been chosen from the 39 e-CF competences, which largely focus on the technical (computing/information technology) and IS management competence areas. In this analysis, competences belonging to the PLAN, MANAGE, and ENABLE clusters were identified to be the most important for MSIS. The most important e-CF competences were found to map well with the high-level IS competences identified in IS 2010.

The document concludes with a brief discussion regarding the possible characteristics of the MSIS 2016 curriculum itself and the next steps in the curriculum development process.

1 Introduction and Key Goals

ACM and AIS established a joint task force responsible for developing MSIS 2016, a revised version of the master of science model curriculum in Information Systems (IS), in fall 2014 based on a review and recommendation by a preliminary evaluation task force. The members of the joint task force are Sue Brown (University of Arizona; representing AIS), João Alvaro Carvalho (Universidade do Minho; AIS), Brian Donnellan (Maynooth University; ACM), Eija Karsten (Åbo Akademi University; AIS, co-chair), Jun Shen (University of Wollongong; ACM), Bernard Tan (National University of Ireland; AIS), Mark Thouin (University of Texas at Dallas; ACM), and Heikki Topi (Bentley University; ACM, co-chair).

The task force started its work in January 2015, and it is planning to complete the MSIS 2016 revision by December 2016. The MSIS 2016 project is based on the strong history and tradition of master's level curriculum recommendations in IS, including (Ashenhurst 1972), (Nunamaker, Couger, and Davis 1982), MSIS 2000 (Gorgone and Gray 2000) and MSIS 2006 (Gorgone et al. 2006).

This document is the task force's first deliverable made available for public review. It has four main goals:

1. It will inform the global IS and computing education communities of the task force's composition, history, goals and schedule (see Section 5.1 for the schedule).
2. It will outline the key elements of the direction in which the task force is currently moving with its work and state the principles that the task force has chosen as the foundation for revising the curriculum.
3. It will solicit feedback from the IS community regarding all aspects of the task force's work, with a specific focus on the key changes proposed to the underlying principles and architecture of the degree.
4. Together with the feedback that the community provides, this document will form a basis for the task force's future work.

The task force is acting on behalf of the Information Systems community, and one of its key responsibilities is to ensure that the richness of the voices of the global IS community is represented appropriately in the MSIS revision process. At the same time, the task force will be willing to make compromises and accept that not all views can be incorporated in the final curriculum simultaneously.

2 Why an MS in Information Systems?

There are multiple stakeholder groups for whom the existence and continued well-being of master's degrees in IS is important. Those groups include students, graduates/alumni, employers/recruiters, the departments and schools offering the degrees, and society as a whole. Students who are interested in developing professional competences beyond those provided by a bachelor's degree in IS or in another computing discipline benefit from a master's degree in IS as a well-defined credential that leads to a set of competences respected and valued by employers. MSIS graduates benefit if the image of their degree stays current and its identity strong. Employers benefit from graduate degrees in IS because these degrees produce graduates who are ready to join project teams addressing real organizational problems or opportunities immediately after graduation. For the organizational units offering MSIS (or equivalent) degrees, they are an

excellent mechanisms for giving students a highly valued set of professional capabilities and thus, providing value to both students and employers. At the societal level, graduate degrees in IS address the continuing shortage of professionals who are able to identify and implement the best connections between business problems and opportunities and the technology capabilities that can be used to address them.

The most important factor driving the value of graduate level programs in IS is, however, that human ability to produce computing-based technologies far exceeds human capability to apply these technologies to appropriate organizational and individual contexts in a way that leads to increased value. Master's programs in IS provide environments in which the students can gain the skills and knowledge that are needed to start a successful career in demanding IS roles of planning, enabling and managing of solutions that enable digital transformation. These roles require integration of in-depth domain knowledge with strong understanding of digital technologies.

Pervasiveness of computing technologies is undeniable, and computing solutions are increasingly deeply embedded in products and services that have an impact on a wide variety of aspects of our lives. Transportation technologies, robotics in manufacturing, health care technologies, highly integrated computing and communication tools, commerce platforms that are available everywhere – the number of examples of technology solutions that are significantly changing human lives is increasing every day. Mastery of technology is not sufficient for fully understanding the potential and the risks of computing-based solutions. In addition to in-depth command of technology, it is essential that professionals responsible for digital technology solutions understand human behavior, organizational structures, business constraints and opportunities, ethical implications of technology applications, etc. A master's degree in IS prepares professionals who are able to deliver technology-based solutions addressing the most relevant problems and taking advantage of the most important opportunities.

Well-implemented master's degrees in IS with a shared identity also serve IS as an academic discipline and community. The professional contributions of the graduates of IS programs collectively form a significant component of what the discipline offers to its stakeholders (together, of course, with the impact of its research output over time). Educational output at the master's level is not inherently more valuable for the field than bachelor's degrees, but graduate degrees have the potential to be more effective in communicating the distinctive contributions of the field. This is particularly valuable in communicating the value and the identity of the IS discipline to prospective employees who might still not have a clear understanding of what IS graduates can offer. High-performing master's degree graduates and a well-defined integrated understanding of the key elements of a master's degree can be very effective in telling the story of IS.

One of the reasons a master's degree in IS can offer a very important additional qualification compared to a bachelor's degree is that many undergraduate degrees in IS (particularly those offered in business schools) are limited to a relatively small number of courses (such as six to eight) in the major. This type of an undergraduate degree does not make it possible to develop deep, specialized technical or managerial skills related to digital transformation. It does, however, form a good foundation on top of which a master's degree can build competences that demonstrate better what the IS discipline can offer than an undergraduate degree does.

The value of a graduate degree in IS can also be demonstrated by evaluating IS in the context of other computing degrees. As discussed, for example, in the CC2005 Overview Volume (Shackelford et al. 2006), IS as a discipline has a significantly stronger focus on organizational

level issues and the integration of domain expertise and computing than any other computing degree type (such as Computer Engineering (CE), Computer Science (CS), Information Technology (IT), or Software Engineering (SE)). CE and CS are clearly focused on computing only, SE introduces concerns of human behavior typically at a project level, and IT is primarily concerned about humans as users and sources of security threats. Although all disciplines recognize the importance of requirements specified by humans, IS degrees (particularly at the master's level) are specifically focused on supporting human goals at individual, organizational, and societal levels. Information Science is related to both IS and CS, and it shares areas of interest with both. It is, however, not one of the computing disciplines identified as such by, for example, CC2005.

Finally, it is also important to recognize that there is no one single model of a master's degree program in IS. As discussed in Section 6, the structure and content of these programs vary significantly depending on the region and the country. Still, many of the general reasons underlying the usefulness of these programs are the same: everywhere in the world, organizations and individuals are working to determine how to best use digital technology to advance their goals.

3 Assumptions Underlying the MSIS Degree

The revision of the MSIS model curriculum is based on the following assumptions regarding the MSIS degree:

1. MSIS is a **professional practice master's degree** that focuses on the development of specialized competences in IS. In addition, an MSIS degree can provide a foundational preparation for academic research; the programs choosing this emphasis typically require a research thesis. An MSIS degree focuses on the development of competences **that are aligned with a specific domain of practice** (such as business, health care, law, government, education, etc.).

3.1 Degree entry conditions and pre-program leveling experiences

2. An MSIS degree is **based on a completed undergraduate degree** that provides a foundation in the core IS topics, as defined in IS 2010. The length of the prior undergraduate degree in IS may vary depending on the national or regional educational system (for example, in many European countries an undergraduate degree can be three-year degree, leading to a two-year master's).
3. It is possible for those without an undergraduate degree as specified in #2 above to enter an MSIS degree program. This will, however, require additional coursework **that provides the equivalent of an undergraduate background in the IS topics specified below**. These courses are often called bridge courses, foundations courses, or pre-program leveling courses. The topic areas are as follows (together with the references to IS 2010):
    a. Foundations of Information Systems (IS 2010.1)
    b. Data and Information Management (IS 2010.2)
    c. IT Infrastructure (IS 2010.5)
    d. Systems Analysis & Design (IS 2010.6)
4. An MSIS degree **requires foundational studies in its specified domain of practice as a program prerequisite**.

The most common domain of practice is currently business, but the core concept of integration between technology understanding and domain expertise can be implemented in many other domains, too. Examples of such domains include government and public administration, non-governmental organizations, education, law, healthcare, banking and financial services, telecommunications, and services in general.

For example, if the domain of practice is business, a student entering the program is required to have prior coursework in core business disciplines. The specific combination may vary, but a typical combination consists of at least three courses covering topics such as accounting, finance, organizational behavior, strategy, marketing, operations management, and economics. In a health care focused MSIS program, incoming students would need to have an equivalent background covering relevant domain content. If an incoming student does not have a necessary background, the student will have to take appropriate bridge courses.

5. A student entering an MSIS degree program is required to have **at least one university level course in statistics or analytics**.
6. An MSIS degree program has **no expectations regarding prior professional experience**. Therefore, no outcome expectations for graduates can be built based on prior professional experience. It often is, however, valuable for students to have relevant professional experience as it could help overcome shortcomings in domain knowledge and/or an undergraduate degree (if, for example, the professional experience is in a computing field).

3.2 Key degree characteristics

7. An MSIS degree provides competences in four areas:
    a. computing/information technology (IT),
    b. domain of practice (see discussion above in #4),
    c. management and organizational practices related to the structure and operation of computing/IT, and
    d. individual foundational competences (such as written and oral communication, critical thinking, ethical analysis, teamwork, leadership, etc.)
8. The emphasis on or balance of these competences varies depending on the program. All of them should, however, be included in every MSIS degree program.
9. Universities around the world are offering an increasing number of highly specialized master's degrees in IS, focusing on a specific competence area, such as analytics and security. Whether or not such degrees can be considered MSIS degrees depends on the dominance of the specialized content. Any MSIS degree should support the development of competences in all of the four areas discussed above. **If the specialty dominates the degree so significantly that the core competence areas are not covered, a degree will not fit under the MSIS umbrella**.
10. An MSIS degree consists of **at least 30 semester hours (USA) / 60 ECTS credits (Europe) requiring at least eleven months of full-time study** (or an equivalent amount of part-time work). Possible bridge courses in IS and/or the domain of practice should not be included in this total.
11. When evaluating the required competences at the time when a student graduates from an MSIS program, it is essential to take into account not only the MSIS program components but also the graduates' competences accumulated before they enter the degree program. This sounds trivial, but is easy to ignore in practice.
12. When determining the expected graduate competences for an MSIS program, it will be very useful to utilize professional competence models developed during the recent years by multiple regional or national governmental organizations (such as the European e-CF

competence framework) or industry organizations (such as UK-based SFIA). Through conversations with the authoring organizations and users of these frameworks, the task force is planning to incorporate key elements of them into the outcome expectation model.

3.3 Post-Experience Degrees

There are many master's degree programs in IS that require students to have experience as IS professional before and/or during the graduate program and depend on this experience as an essential element of the program. These programs can be highly valuable and lead to excellent outcomes. Master's degree programs that are highly individualized, address just-in-time professional needs, and consist of components collected over a long period of time could become a very popular or even a dominant program model in the future. It would, however, be very difficult to build a curriculum recommendation for these programs, given the significant differences between students' backgrounds and program expectations regarding these backgrounds. Programs targeted primarily to pre-experience students may, naturally, let a student with relevant professional experience adjust her/his curriculum so that it better fits the student's existing competences. For example, an experienced network/systems administrator may have capabilities that allow her to take an advanced elective instead of an intermediate course in IT infrastructure.

It is likely that the IS community would benefit from a mechanism that allows IS professionals to acquire and collect educational experiences over their professional careers and build recognized credentials based on them. We do, however, recommend that this type of a degree be built separately with an identity that is different from that of an MSIS (it could, for example, be an executive master's consisting of multiple certificates). This type of separation would be likely to benefit both the pre-IS experience MSIS and the post-experience degree. The task force will articulate a way to separate a post-experience master's degree program, certificate programs, and commercial certifications. All of these are mechanisms through which IS professionals acquire new competences or strengthen existing ones as part of their lifelong learning process. Offering them can, however, be an important part of a university's mission, but it is clearer if a separate degree type is specified for them.

In addition, we recognize the existence of MBA concentrations in IS as a separate entity from master's degrees in IS. An MBA is a generalist degree designed to focus primarily on the development of managerial capabilities, and an MBA concentration seldom provides the type of technical depth expected from a specialized master's in IS.

4 Proposed Major MSIS 2016 Changes Compared to MSIS 2006

The MSIS 2016 Task Force is proposing the following key architectural changes compared to MSIS 2006:

1. **Specifying the MSIS as a pre-experience degree** targeted to either fresh graduates of undergraduate programs or career changes without IS/IT experience.
2. Explicitly articulating the expected graduate competences related to the four areas discussed above: **domain of practice, computing/IT, IS/IT management, and individual foundational competences.**
3. Recognizing that **business is not the only possible domain of practice.**

4. **Building support for a variety of national and regional curriculum models around the world**
    a. We need to design a curriculum structure that supports the required flexibility.
    b. It is particularly important to consider the fact that in many parts of the world a master's degree includes a significant research component (such as a master's thesis).
5. **Articulating the expected graduate competences at a more detailed level than in MSIS 2006.** Some of the changes will be based on the following external phenomena:
    a. Changes in computing technology and the environments to which it is applied
    b. Changing balance between management and technology
    c. Improved understanding of the general competence requirements for IS/IT professionals and the work on IT competences that has taken place around the world and particularly in Europe during the past few years.
6. **Addressing specific concerns and opportunities related to the highly specialized MSIS-style degrees, such as those focused on analytics and security.**
7. **Articulating post-experience degree programs and analyzing the opportunities they offer separate from the primarily pre-experience MSIS degree.**
8. Recognizing the need to address **delivery channel issues, such as**
    a. The impact of on-line delivery for graduate degrees
    b. MOOCs and other forms of ongoing just-in-time learning may require that particularly in post-experience degrees the components can be integrated into structures that can be certified as learning experiences.
    c. What is the relationship between commercial and academic providers?

5 What is a Model Curriculum?

5.1 Continuous Improvement

Model curricula and the corresponding development process provide a number of useful and important roles to the IS community. A model curriculum development process fosters collaboration, requires careful introspection on what constitutes the core knowledge and capabilities of the discipline, and assists in understanding content and delivery innovations affecting the future direction of the discipline. In addition, the tangible artifacts associated with the completed model curriculum reflect a consensus of the IS community, provide a mechanism to communicate to relevant stakeholders the core capabilities obtained in graduate IS education, and serves as a resource for benchmarking, comparison and innovation of existing IS programs.

When viewed as a process of continuous improvement, measurement and periodic revision of the model curriculum form a feedback loop whereby the needs of the IS community are continually being met. Figure 1 illustrates the process of continuous improvement used for the development of the 2016 IS model curriculum.

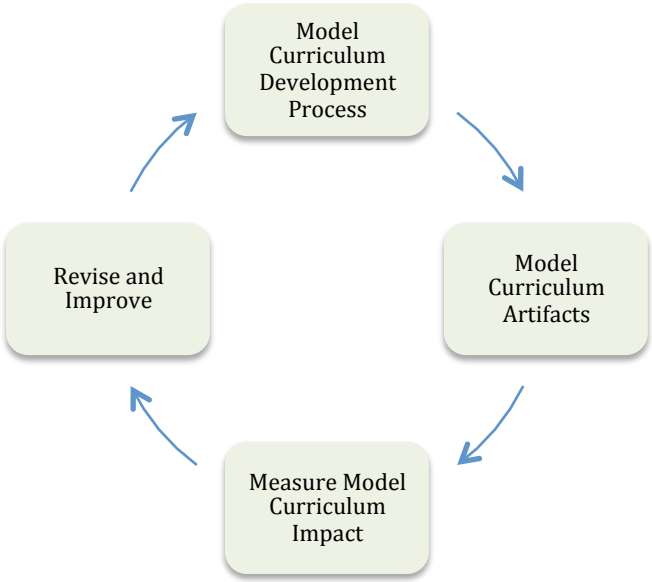


Figure 1. Continuous Improvement Process for IS Graduate Curriculum Development

Each component of the continuous improvement process for graduate IS curriculum development serves an important and vital role whose details are discussed below.

5.2 Role and Importance of the Model Curriculum Development Process

Development of a model curriculum is a complex process, involving a diverse group of stakeholders, and requiring a significant amount of time and effort. One purpose of the model curriculum development process is to assess and document the current state of IS graduate education. Accordingly, this effort documented characteristics regarding a large number of IS graduate programs (see later section). Attributes regarding entrance requirements, language of instruction, duration of the program, curriculum, and specific coursework are captured. The resulting repository provides a snapshot at a moment in time of the current state of graduate IS education worldwide enabling one to uncover similarities, differences, and potential gaps. The resulting repository serves as a major input to the completed MSIS 2016 curriculum.

The model curriculum development process also involves obtaining extensive feedback from the IS community. Panel discussions have been and will be held at major IS conferences (ECIS, PACIS, and AMCIS) to obtain feedback and guidance on the model curriculum. In addition, graduate IS program administrators were surveyed to obtain their feedback and input. The needs of industry partners were also incorporated via analysis and discussion of competence frameworks that document desired workforce skills of IS graduates (such as the European e-Competence Framework, the BCS SFIA Plus, and US DOL O*Net; see section 7). To foster collaboration and provide multiple opportunities for comment and feedback, two full drafts of the proposed MSIS 2016 model curriculum will be circulated to the IS community for comments and feedback prior to final publication (in addition to this document).

The realized/planned key milestones of the MSIS 2016 revision process are as follows:

- January 2015: Task force work started
- April 2015: First face-to-face meeting took place
- June 2015: First deliverable (a statement of principles and description of context; this document) was made available for public review
- August 2015: Review and comment period for the first deliverable ends
- December 2015: Second face-to-face meeting
- Mid-January 2016: First complete draft will be made available for public review
- Mid-February 2016: The comment period for the first complete draft closes
- Late May 2016: The second complete draft made available for public review
- End of June 2016: The comment period for the second complete draft closes
- August 2016: Third face-to-face meeting
- September 2016: Submitting the finalized product to AIS and ACM for approval
- December 2016: Launch of MSIS 2016 at ICIS 2016

The model curriculum development process will be transparent, comprehensive, and inclusive providing the entire global IS community with an opportunity to contribute and provide feedback on the development process as well as the final model curriculum artifacts. Accordingly, the resulting end product should be useful, impactful and possess a high degree of stakeholder concordance.

5.3 Role and Importance of the Model Curriculum and Model Curriculum Artifacts

The model curriculum contains recommendations regarding degree specific characteristics such as expected background knowledge prior to entering a program, recommended duration of a graduate program of study, required business coursework, required IS coursework, and a list of possible elective coursework. As a foundational element, the curriculum specifies the capabilities IS graduates are expected to have upon completion of an IS program of study. In addition, the model curriculum is designed to be flexible allowing customizations to meet unique regional and market demands. Furthermore, the model curriculum includes an IS course catalog consisting of exemplars of course descriptions.

The model curriculum and corresponding artifacts serve a number of important roles, such as providing a means to communicate the content and structure of IS graduate education to a broad audience. IS faculty, administrators, students and industry partners will have access to a model graduate IS curriculum, a detailed and comprehensive description of IS courses and an extensive list of expected capabilities of IS graduates. Communicating the model curriculum will lead to new ideas for faculty teaching courses, will help program administrators better understand and plan for the resources required to effectively implement a graduate program of study, will aid students in selecting a field of study, and help industry partners better understand the capabilities of IS graduates.

The model curriculum should also foster innovation and improvement in terms of program structure, content and delivery. Academic administrators will be able to use the model as a basis for benchmarking and comparison identifying similarities, differences and gaps. An understanding of the full range of options to consider when designing a graduate program of study will lead to better, more informed decisions regarding individual IS graduate program design.

Defining the expected competences for IS graduates will be significantly expanded in this edition of the model curriculum, which will provide a number of unique benefits. Industry partners will better understand the skills and abilities of graduates, thereby more efficiently placing students in correct jobs and reducing the amount of post-hiring training required before employees become fully engaged. In addition, the competence perspective allows students to know what to expect in terms of desired outcomes providing insight into course selection and career trajectories. The competence perspective is designed to bridge the gap between the knowledge acquisition focus of a typical graduate educational program to include a skills and capabilities focus desired by industry professionals in the workplace. Improved coordination between IS programs and industry partners should lead to more efficient hiring processes and better prepared students who can immediately contribute to the success of the corporate IT function.

Figure 2 depicts the role and importance of the IS model curriculum.

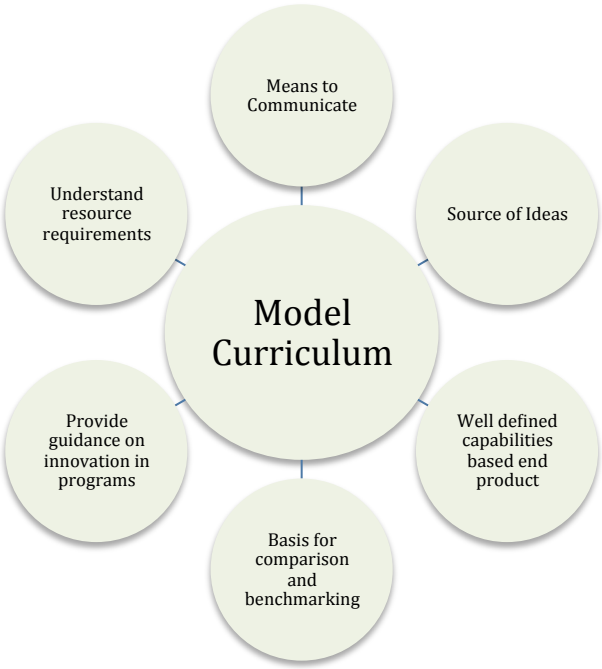


Figure 2. Model Curriculum Role and Importance

6 Current Status – Review of Global IS Master's Program Practices by Region

The earlier MSIS model curricula have focused mainly on degrees in business schools in the U.S. However, the work of the preliminary review task force (Topi et al. 2013) and an increasingly strong global orientation of AIS and ACM incentivized both organizations to include a global perspective in the revision task. Therefore, the members of the task force represent all three AIS regions: Region 1, the Americas; Region 2, Europe, the Middle East, and Africa; and Region 3, Asia and the Pacific.

As an initial exercise, the group described the MS program(s) in IS at their home universities. This lead quickly to the realization that the programs differed fundamentally based on the following factors:

- How much and what topics have students studied before entering the master's program?
- What, how much, and in what ways do the students study for an IS master's degree?
- What is the structure of the IS master's degree, specified as a balance between elements such as courses, industry projects, thesis, exchange periods abroad, and others?
- Do the students continue directly to master's studies after a bachelor's degree or are they expected to have work experience before?

Consequently, the task force launched a process to gather detailed information of programs around the world. In the United States, Germany and Australia this was relatively easy as there was previous work carried out for this purpose. At the time of writing this report, we have gathered data about 260 master's degree programs in IS, offered by over by over 230 universities in 33 countries. The countries covered include Australia and New Zealand, several Asian countries, almost all European countries, and the United States. Our aim is to cover all programs on all continents. To this end, we will also be utilizing the AIS Education Survey database.

6.1 Students Entering the Programs

In general, entering a master's program requires a bachelor's degree. Some programs are designed to enable a university's own undergraduates to continue on to complete a master's degree. These integrated programs were very prevalent in Europe before the Bologna process and in some countries in Asia, and they are becoming more common in the U.S.

In Europe, a typical IS master's entry requirement is to have at least 90 ECTS credits in IS or a closely related field in the three-year bachelor's degree. The degree can also be obtained at a University of Applied Sciences. Significant work experience in IS (for more than seven years) is also considered qualifying in some countries such as UK and Ireland. These two options may necessitate bridge studies.

In Asia, most programs have specified a bachelor's degree in IS or a related discipline as an entry requirement. These programs are also flexible in considering candidates who lack such qualifications but have relevant experience. This supports the buildup of the ICT professions, which is much needed because most Asian economies face ICT personnel constraints.

In Australia and New Zealand, entering a master's degree in IS requires an equivalent three-year bachelor's degree, which may not necessarily be in IS/IT or a shorter sub-degree plus substantial work experience in IS/IT. Because of IS/IT personnel constraints, Australia recruits students with a bachelor's degree from Asian countries and therefore, it has been supportive of intermediate degrees and bridge studies.

Students who enter master's degree programs in North America are all required to have a four-year bachelor's degree but they come from a variety of disciplinary backgrounds. That is, the entering students are not required to have any kind of background in IS or related subjects, although in many cases some bridge courses extending the undergraduate experience are needed.

In sum, in countries where there are sufficient numbers of applicants with bachelor's degrees, the universities focus on the nature of the degree and the qualifications of the applicant. In countries building up the ICT work force, the entry requirements tend to be more flexible.

6.2 Length of Program and Amount of Student Work

Typically IS master's programs require one or two years of full-time study, suggesting significant differences between program requirements. Some schools also offer part-time options for working professionals. In addition to the on-site study, distance education appears often as an option.

Doing comparisons based on the amount of student work was challenging. However, in Europe, the introduction of ECTS credits gives considerable comparability. A typical European two-year master's degree is 120 ECTS credits corresponding to 3200 hours student work, with one-year degree half of that. Also three-semester degrees exist. In France, the MIAGE degrees emphasize three possible modes of attendance: (1) full time followed by internship after the academic year; (2) apprenticeship, where periods at university are combined with periods in industry; and (3) continuous, where students work for a company and attend courses during their free time.

In Asia, programs are typically between one to two years in duration for full-time students and twice as long for part-time students. There are plenty of programs taught in the evenings and during weekends. The workload required for one credit varies. For example, in Singapore one credit is 32.5 hours but in reality, students spend about 50% more time. While the calculated workload is 1400 hours, the real requirement can be even 2800 hours.

The length of degrees in Australia and New Zealand (ANZ) is either 1.5 or two years, where two years is more popular as it aligns better with migration requirements. Regarding student working hours, New Zealand universities follow a standard model in which a typical student workload per year is 1200 hours. However, among Australian universities, the credit system varies significantly. The workload for Australian master's degree students may range from 900 hours to 1600 hours, where 1200 hours of workload is most common.

In North America, one credit hour is most often equivalent to 15 classroom contact hours, with the assumption that students will work externally for two hours for each hour in the classroom (leading to a total work requirement of 45 hours per one credit hour). The credit hour requirements for programs range from 30 to 53, which equates to 1350 to 2385 hours of total student work; most programs are between 30 and 36 credit hours. This range of credit and associated work hours is represented in programs lasting 12 to 24 months for full-time students.

If we take into consideration the amount of IS studies prior to entering the program and add to that the workload of the program, the potential for variation in terms of IS knowledge and skills by a master's degree holder is considerable.

6.3 Degree Structures

A master's degree in IS consists usually of a number of core courses in IS and some electives in the domain of practice. In North America and in Asia, the degrees are usually course-based.

In Australia, ACS mandates that the master's degrees in IS/IT should include a cornerstone project unit, which is often a practical component rather than a research thesis. The project often requires supervision and liaison with industry or real problems. In France, the MIAGE degree emphasizes professional training, including always internships and possibly projects with industry. In Germany, several programs include a 6 or 12 ECTS project in addition to the thesis. The Bologna process has significant increased the popularity of exchange periods in Europe, as the credits can be included in the degree. Employers also appreciate international experience.

In North America and Asia, a thesis is an option for students interested in a research career. In Europe, the thesis is an essential part of the degree, usually worth 30 ECTS credits. To support the independent work required, usually a course in research methods and a seminar is required. In the seminar, each student presents the research carried out so far.

7 Using Competence-Based Approach to Understanding and Specifying Curricula

7.1 Degree Profiles, Competences and Learning Outcomes

In all continents[1][2][3], there is much ongoing work related to curriculum development. The general trend appears to be moving from traditional content-based curricula – where a Body of Knowledge is the main guiding tool and available resources set the constraints – to competence-based approaches where the degree programs should be organized in view of their results.

> "Competences represent a dynamic combination of cognitive and metacognitive skills, demonstration of knowledge and understanding, interpersonal, intellectual and practical skills, and ethical values." (Lockoff et al. 2010, p. 21)

Instead of *competence*, Bowden (Bowden 2004) uses the term *knowledge capability* that he defines as

> "the ability: to work out what are the key aspects to be dealt with in each new situation; to relate those aspects to the knowledge already acquired and/or to knowledge the graduate knows to have access; to determine what the underlying task or problem in that situation might be; to design a process or solution to deal with the situation; and then to have the ability to follow through and complete the task to solve the problem, either alone or with others."

As discussed earlier, competences that a master's level IS degree program develops can be divided into four categories. The subject area competences are associated with either computing/IT or management and organizational practices related to computing/IT. The competences associated with the degree's domain of practice are the third category. The fourth category includes individual foundational competences. Throughout a degree program, competence development proceeds in an integrated and cyclical manner.

To understand what kind of competences are expected of a MS, one view is given in the Framework of Qualifications for the European Higher Education Area (www.ehea.info). According to it, qualifications that signify completion of the second cycle (i.e., master's level) are awarded to students who:

> • have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle (i.e. bachelor's level), and that provides a

[1] In Europe, the Bologna Process
[2] See, for example, https://www.insidehighered.com/news/2015/06/17/new-letters-us-and-accreditors-provide-framework-approval-competency-based-degrees
[3] In Asia, we are aware of work in Japan and India regarding IS and computing degrees, and regarding e-commerce in China.

basis or opportunity for originality in developing and/or applying ideas, often within a research context;

• can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;

• have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments;

• can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously;

• have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

These are also called the Dublin Descriptors[4]. In degree programs, these are turned also into specific, subject-area related competences.

The North American DQP – Degree Qualifications Profile (Adelman et al. 2014) includes a Specialized Knowledge category to cover specific proficiencies (competences) and four other generic categories: (1) Broad and Integrative Knowledge; (2) Intellectual Skills; (3) Applied and Collaborative Learning; and (4) Civic and Global Learning.

Constructing a model curriculum is formulating a degree profile with describing the competences and learning outcomes of the program in a concise way. One way to do this is given in the *Tuning Guide* (Lockoff et al. 2010). The distinction between *Competences* and *Learning Outcomes* established in the *Tuning Guide* is the following:

> "A **competence** […] is a quality, ability, capacity or skill that is developed by and that belongs to the student. A **learning outcome** is a measurable result of a learning experience which allows us to ascertain to which extent / level / standard a competence has been formed or enhanced. Learning outcomes are not properties unique to each student, but statements which allow higher education institutions to measure whether students have developed their competences to the required level." (Lockoff et al. 2010, p. 21)

DQP uses the term proficiency instead of competence. It is understood that a proficiency "reflects the DQP's emphasis on summative learning for the degree as a whole, while the term "competence" usefully points to formative objectives within a specific course or learning experience" (Adelman et al. 2014, p. 33). Furthermore, DQP does not distinguish between proficiency and learning outcomes.

7.2 Competences in Computing Professions

Depending on the perspective on the IS field, the search for specific competences to associate with an MSIS degree will vary. One possible perspective – shared by the MSIS 2016 task force – is that the IS field should be viewed as a professional field. In other words, the IS field is directly associated with a range of professional practices carried out in settings where IT serves human and social affairs.

[4] e.g., http://ecahe.eu/w/index.php/Dublin_Descriptors

The professional perspective leads immediately to a search for competences that are sufficient for entry to the profession and meet labor market needs and expectations. These needs and expectations, sometimes driven by very short-term demands, have to, of course, be balanced with the needs for building a foundation for the graduates' entire career.

Computing professions in general, and IS in particular, are not as mature as other professions, such as medicine or law. Thus, it is not surprising that they are not very organized nor they are easily recognized either by the public or within the labor market. Nevertheless, the task force has identified several initiatives that aim at specifying the competences associated with computing professions. These are important sources for understanding not just specific competences for IS graduates but also common generic competences. These initiatives aim at identifying frameworks for competences or skills and relating them to professional profiles.

Table 1. Some additional known competence frameworks and professional profiles.	
Iceberg Model of Competences	Spencer & Spencer 1993; IT architects: Ho and Frampton 2010
AITTS job role profiles (Germany)	http://www.kibnet.org/english/en.aitts/content.en.aitts.2/content.content.en.aitts.2.2/index.html
CIGREF (France)	http://www.cigref.fr/c/english
Skills Standards for IT Professionals (Japan)	http://www.ipa.go.jp/english/humandev/forth.html
Nasscom job roles (India)	http://www.sscnasscom.com/ssc-projects/job-roles-and-qualification-packs/
e-skills UK, now tech partnerships	https://www.thetechpartnership.com/
National Infocomm Competency Framework (Singapore	http://www.nicf.sg

We will discuss below only three competence frameworks and related professional profiles, even though we are aware of several more (see Table 1). These three are the European e-Competence Framework (e-CF) with the European ICT Professional Profiles (CEN 2014), the Skills Framework for Information Age (SFIA) with related Career Framework for IT Professionals (SFIA Foundation 2011), and the Occupational Information Network program in the U.S. with related occupation profiles.

7.2.1 The European e-Competence Framework (e-CF), version 3.0

The European e-Competence Framework was initiated by the European Commission with a broad group of related stakeholders, with the objective of providing a "common, shared, European tool to support organizations and training institutions in recruitment, assessment, competence needs analysis, learning programs, career path design and development"[5] as well as supporting policy makers in the definition of policies related to e-Skills development. Members of earlier teams that had developed competence frameworks (AITTS and CIGREF) participated in the process.

Prior to starting work on the e-CF and related frameworks, there was no common agreement on how to express ICT competences/skills requirements and gaps on a European level. As a consequence, many leading European firms were expending enormous costs and effort in establishing and maintaining internally developed ICT competence catalogues for HR planning,

[5] Building the e-CF – methodology documentation, e-CF 2.0 CWA Part III, 09/2010 www.ecompetences.eu

training and development, or were confronted with the prospect of adopting a distinct national level framework for each of the countries in which they operated. For this reason, the notion of a collectively produced frameworks represented a potentially major cost-saving opportunity. Moreover, at a European level, the frameworks represented an opportunity to improve the efficiency of an ICT-enabled European economy.

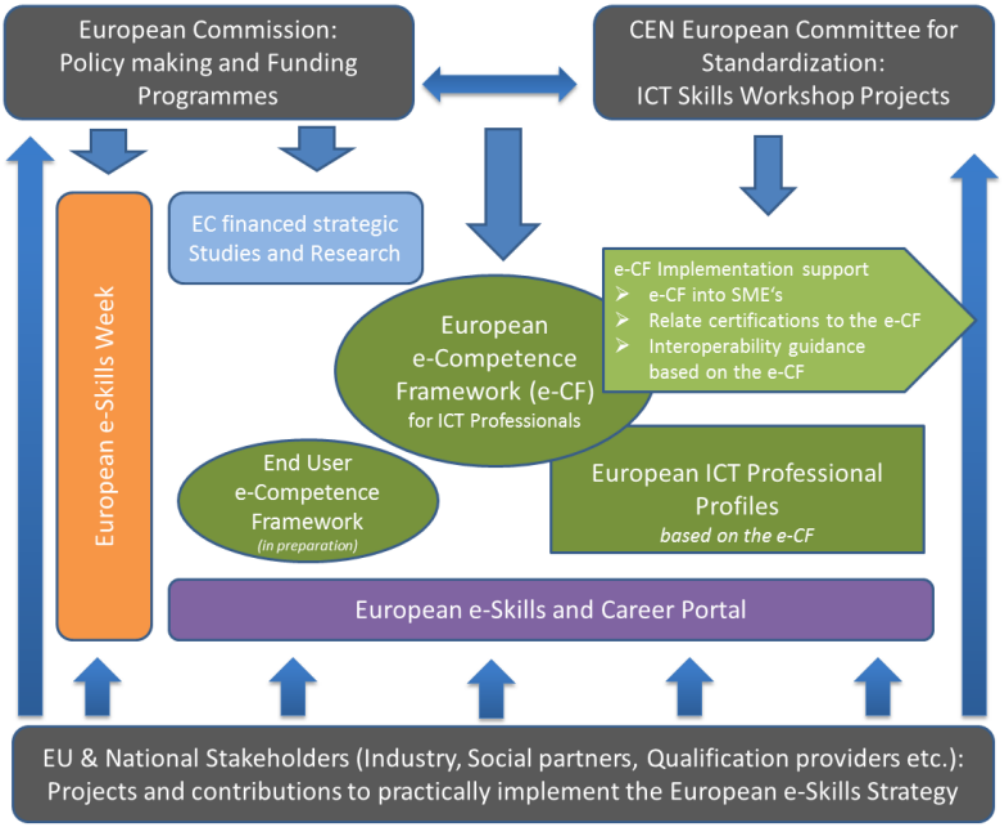


Figure 3. European e-Skills for the 21st Century -- Key players, communication structures and multistakeholder achievements.

Other related projects running at European level, building on the e-CF, include:
- ICT Certification in Europe (linking certification offerings to e-CF)
- e-CF application in SMEs
- Euromed: Digital job profiles for the Mediterranean Union in coherence with e-CF

The e-CF is structured along four dimensions:
- Dimension 1 comprises five e-Competence Areas, derived from the ICT business processes PLAN-BUILD-RUN-ENABLE-MANAGE
- Dimension 2 defines competences
- Dimension 3 provides proficiency level assignments that are relevant to each competence
- Dimension 4 provides short sample specifications of knowledge and skills (but is not intended in any way to be exhaustive)

It is also important to note that the five e-competence levels specified in e-CF relate to levels 3-8 of the European Qualifications Framework (EQF). This is an important relationship, as it is likely to encourage education and training providers to map their offerings to the e-CF. The reason for this is that mapping certifications to the e-CF is currently a relatively straightforward peer review

process, as opposed to the much more rigorous and time-consuming process required to achieve EQF parity.

To date, e-CF has been applied by companies, trade unions, qualification & certification providers in France, Germany, Italy, Estonia, Hungary, Bulgaria, Netherland, Canada, Malta and at the EU level, with interest expressed from several countries outside of Europe. The framework is being translated into several languages. Importantly, the e-CF does not look to replace any existing national models. Instead, the approach taken is based on national bodies wanting to adopt the e-CF, in parallel with existing national competence models, where desired.

7.2.2 Professional Profiles based on e-CF

As a response to the huge number of ICT Profile Frameworks and Profile descriptions used today in European ICT Business and Qualification systems, it was decided to create a number of representative ICT Profiles covering, at their level of granularity, the full ICT Business process. The professional profiles built on the e-CF are called the *European ICT Professional Profiles*[6]. The 23 Profiles combined with e-competences from the e-CF, provide a "gene pool" for the development of tailored profiles in specific contexts and with higher levels of granularity.

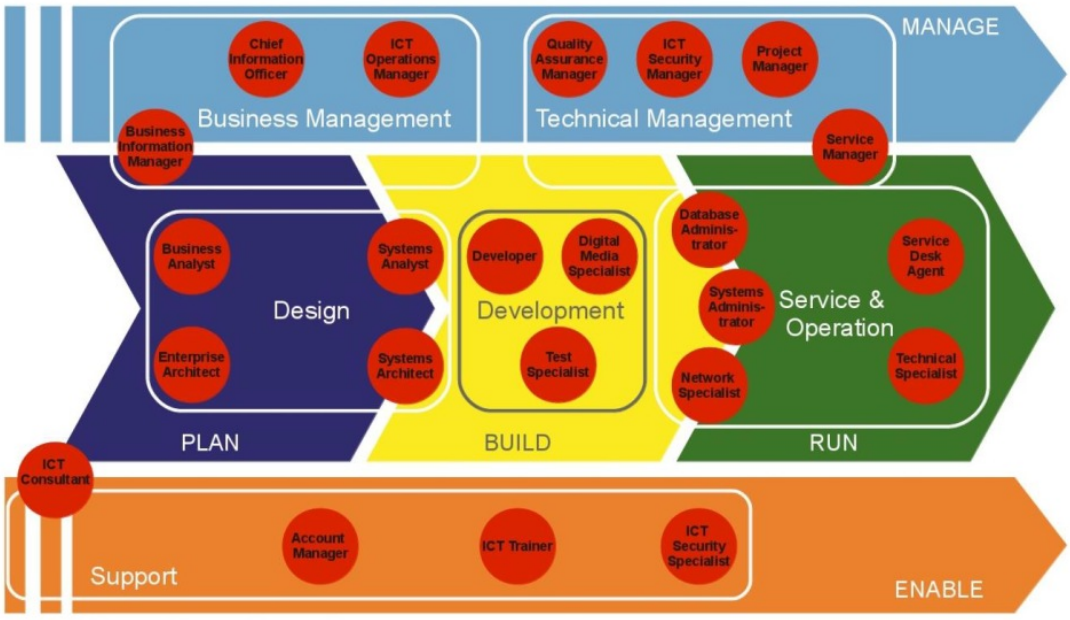


Figure 4. The 23 profiles mapped on the five areas of e-CF (CEN Workshop Agreement 2012)

7.2.3 The Skills Framework for the Information Age (SFIA)

The purpose of SFIA is to provide a standardized view of the wide range of professional skills needed by people working in Information Technology. As such, SFIA contains definitions of recognizable IT skills so that they can, for example, be incorporated in the job descriptions or role

[6] http://relaunch.ecompetences.eu/wp-content/uploads/2013/12/EU_ICT_Professional_Profiles_CWA_updated_by_e_CF_3.0.pdf

profiles used by an organization. The SFIA claims to be the "world's most popular definition of IT skills."

Although originating in the UK under the leadership of the British Computing Society, SFIA has since acquired partners in Australia (including Australian Computing Society), Belgium, Chile, Italy, Japan, New Zealand and Ireland. Notably, the International Professional Practice Partnership (IP3), a global initiative sponsored by the International Federation for Information Processing (IFIP), has adopted SFIA as the skills and competence reference for the international professional standard - the IP3P[7].

The SFIA Foundation in the UK is a not-for-profit collaborative initiative between e-skills UK, British Computer Society, Institution of Engineering and Technology (IET), IT Service Management Forum (itSMF), and Institute for the Management of Information Systems (IMIS). The Foundation works to further develop SFIA (version 6 will be released soon) and encourage and support its use within organizations using information systems. The SFIA Council provides input to help shape strategic direction.

SFIA is constructed as a simple two-dimensional matrix. One axis shows the skills in categories and subcategories; the other shows a more specific definition at each of the levels (theoretically up to seven) at which the skill is recognized. The definitions (or "descriptors") used are intentionally only defined in terms of the capability required (e.g. database design) rather than being tied to specific technological domains (such as knowledge of a particular database type). The skill categories are:

- Strategy and Architecture
- Business Change
- Solution Development and Implementation
- Service Management
- Procurement and Management Support
- Client Interface

The seven levels of responsibility, as defined by SFIA are:

- 7 Set Strategy, Inspire, Mobilize
- 6 Initiate, Influence
- 5 Ensure, Advise
- 4 Enable
- 3 Apply
- 2 Assist
- 1 Follow

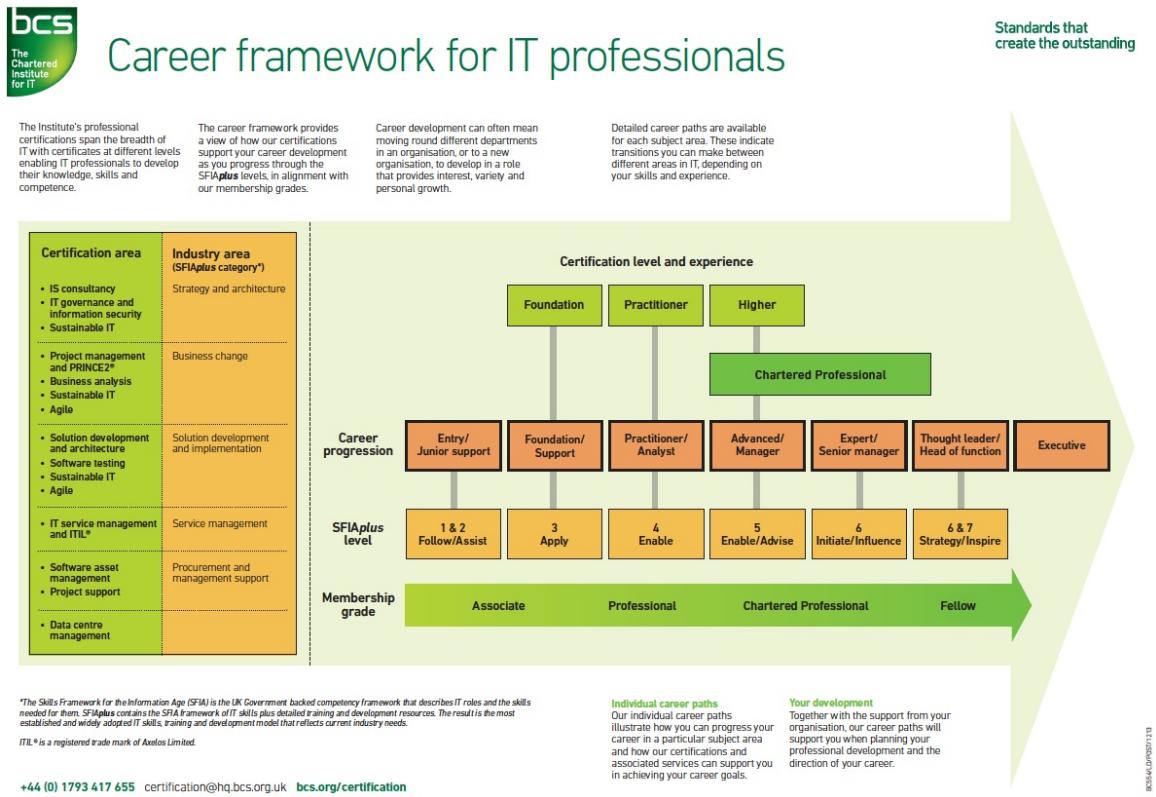
7.2.4 Professional profiles based on SFIA

Organizations can use SFIA to produce job profiles and descriptions by combining the SFIA skills with information about behavioral competences and relevant technologies and products. As with other competence frameworks, these can subsequently be used to support the management and deployment of IT capability as a whole.

[7] http://www.sfia.org.uk/cgi-bin/wms.pl/928

The SFIA Foundation proposes a framework for IT professional profiles that takes into consideration two dimensions: style of work (management, technical, administrative), and the context in which the work is done (business, development or service provision).

Figure 6 describes the BCS perspective for the evolution of computing professionals in the UK. It considers seven levels of career progression – entry, foundation, practitioner, advanced, expert, thought leader, executive – and combines them with the levels within the SFIAplus competences framework and with BCS membership grades.



7.2.5 O*NET

O*NET[8] (Occupational Information Network) is a national program in the U.S. promoted by the U.S. Department of Labor/Employment and Training Administration. The O*NET online site provides access to information standardized and occupation-specific descriptors. Occupations are organized in families and can be searched through several criteria. No single criterion or short combination of criteria is available to select Computer/IT or IS related occupations.

[8] http://www.onetonline.org/

For each occupation a characterization is provided that includes information such as tasks, tools & technology, knowledge, skills, abilities, work activities, work context. The characterization of occupations makes use of concepts that include[9]:

- *Abilities* - enduring attributes of the individual that influence performance;
- *Basic skills* - developed capacities that facilitate learning or the more rapid acquisition of knowledge;
- *Cross-functional skills* - developed capacities that facilitate performance of activities that occur across jobs;
- *Knowledge* - organized sets of principles and facts applying in general domains;
- *Work styles* - personal characteristics that can affect how well someone performs a job;
- *Tasks* - occupation-specific tasks.

7.2.6 Occupations identified

The U.S. Bureau of Labor Statistics of the U.S. Department of Labor makes available an Occupation Outlook Handbook[10] that characterizes a set of occupations. Occupations related to IS and IT include:

- *Group of computer and information technology occupations*[11]:
  - Computer and Information Research Scientists, Computer Network Architects, Computer Programmers, Computer Support Specialists, Computer Systems Analysts, Database Administrators, Information Security Analysts, Network and Computer Systems Administrators, Software Developers, Web Developers
- *Group of management occupations*:[12]
- Computer and Information Systems Managers

Figure 5. BCS Career Framework for IT Professionals.

For each occupation the Occupation Outlook Handbook provides information such as: what they do, work environment, how to become one, pay, job outlook. The section *what they do* provides a list of duties that can be used to derive competences.

7.3 Continuous Professional Development

In established professions, there are steps during the career where new competences are acquired, existing competences are tested against a set of criteria, or the professional has matured to take on a different kind of a role.

Some mature professions have highly developed frameworks of professional competences, responsibilities and activities. A good example is the medical profession. For example, the CanMEDS framework[13], developed and maintained by the Royal College of Physicians and

[9] http://www.onetcenter.org/content.html
[10] http://www.bls.gov/ooh/home.htm
[11] http://www.bls.gov/ooh/computer-and-information-technology/home.htm
[12] http://www.bls.gov/ooh/management/home.htm
[13] http://www.royalcollege.ca/portal/page/portal/rc/canmeds

Surgeons of Canada, is widely used throughout the world as a basis for establishing medical education and continuing professional development.

One important aspect of a professional's career addresses a natural progression of proficiency/ mastery/ maturity in the performance of professional activities. This progression is inherently associated to different titles assigned by professional bodies that might be associated to the profession and the attention given to this progression depends on the maturity of the profession and its accreditation/evaluation bodies. For instance, figure below illustrates a view of the medical career within the CanMEDS framework.

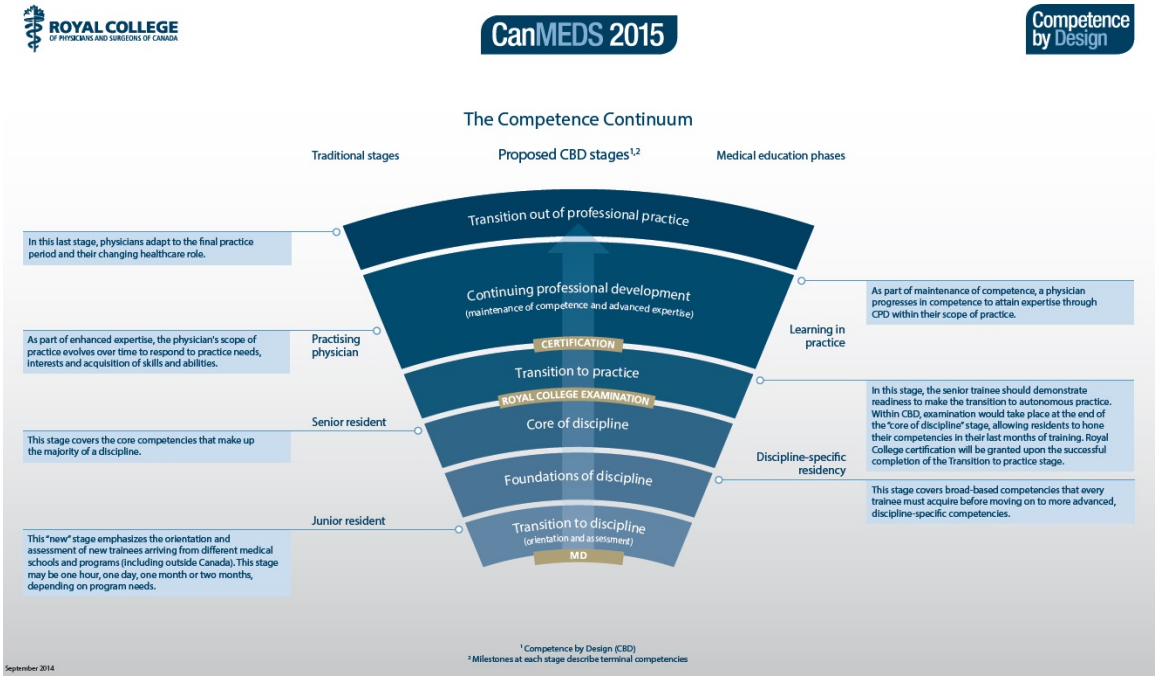


Figure 6. CanMEDS 2015 Competence Continuum.

8 Expected Graduate Competences

Identifying expected graduate competences for MSIS graduates forms an essential foundational element underlying the entire model curriculum. This is based on a strong conceptual foundation (Bowden 2004), and it builds an important link between this curriculum recommendation and the emerging competence frameworks developed for the IS/IT profession discussed above in the section on the competence-based approach to building curricula. The degree-level expected competences will be the basis for learning unit (course, seminar, etc.) level learning objectives and, ultimately, the entire curriculum (including topics and pedagogy). They will be communicated to various stakeholders, including forthcoming students, program/degree directors, teaching professors, course administrators, course accreditation agencies, student recruiters and university marketing staff, as well as future employers who are hiring IS/IT graduates. The expected competences will define the foundational characteristics of the degree programs and reflect the entire identity of the field of IS.

What competences graduates can be expected to have depends significantly on the positioning of the MSIS degree. As discussed above in the section on "Principles Underlying the MSIS Degree,"

the task force proposes that this curriculum recommendation is specifically targeted at pre-experience MSIS degree programs, intended for students with little or no IS/IT related work experience (including those continuing directly from their undergraduate degree and career changes without IS/IT-related work experience).

The expected graduate competences would be very different for an MSIS degree targeted at experienced IS/IT professionals seeking a degree that would allow the graduates to move to more senior technical IS roles or to a high(er) level managerial IS/IT role. The task force has specifically decided to not consider these types of degrees as part of this curriculum recommendation. In addition, this document will not provide guidance for MBA concentrations or Executive Master's degrees that have the explicit goal of preparing the students for high-level senior IT management roles. Specifying shared expected graduate competences for all of these degree types would simply not be possible.

Finally, the task force also recognizes that there is an increasing number of master's degrees offered by IS and related departments that are highly specialized, such as, for example, Master of Science in Business Analytics or Master of Science in Cybersecurity. These are important degree types that serve their graduates and the employers recruiting the graduates very well, but we are forced to consider them to reside outside the scope of this document. The reason is, again, the same: their expected graduate competences would be very different from those specified for the MSIS.

8.1 Tentative List of Core Expected Graduate Competences

When identifying the expected graduate competences, we have to consider the following factors:

- We are expecting the incoming students to have or develop a foundation in IS (or another computing discipline) and in the domain of practice (as specified above in the section on Principles) prior to the degree program.
- The competences should be at a materially higher level than those offered by an undergraduate degree in Information Systems (such as IS 2010).
- The competences will be built on the significant earlier work on IS/IT/e-competences, such as e-CF and SFIA.
- The competences should cover the four dimensions of the MSIS degree outlined above in the Principles section:
    - computing/information technology (IT),
    - domain of practice (such as business, health care, legal, government, or education),
    - management and organizational practices related to the organization and operation of computing/IT, and
    - individual foundational competences (such as written and oral communication, critical thinking, ethical analysis, teamwork, leadership, etc.)

To be used only as an example and a foundation for comments, this section describes the results of the task force's own initial internal analysis of the expected graduate competences using the e-competences specified in the e-CF framework. Based on this evaluation, the competences included in Table 2a were deemed to be included in the first priority group for MSIS graduates. They include capabilities from three of the five e-CF e-competence areas: PLAN, ENABLE, and MANAGE.

Table 2a. Most important expected MSIS graduate competences	
PLAN	A.1. IS and Business Strategy Alignment
	A.2. Service Level Management
	A.5. Architecture Design
	A.9. Innovating
ENABLE	D.1. Information Security Strategy Development
	D.10. Information and Knowledge Management
	D.11. Needs Identification
MANAGE	E.2. Project and Portfolio Management
	E.3. Risk Management
	E.5. Process Improvement
	E.8. Information Security Management
	E.9. IS Governance

It is interesting to see how well these match to the high-level IS capabilities that were identified in IS 2010 (Topi et al. 2010):

- Improving Organizational Processes (E.5. above)
- Exploiting Opportunities Created by Technology Innovations (A.1. and A.9. above)
- Understanding and Addressing Information Requirements (D.10. above)
- Designing and Managing Enterprise Architecture (A.5. above)
- Identifying and Evaluating Solution and Sourcing Alternatives (partially A.2. above)
- Securing Data and Infrastructure (D.1. and E.8. above)
- Understanding, Managing, and Controlling IT Risks (E.3. above)

The second group of high-level competences included in Table 2b was considered important but not as critical those included in Table 2a. The same three e-Competence areas continued to be dominant.

In addition, the high-level competences presented in Table 2c were also considered essential but they should be gained during pre-program studies (undergraduate degree or bridge courses). Interestingly, several of these belong to the BUILD e-competence area.

It is obvious that these labels alone are not sufficient for understanding and specifying what the required competences are. The e-CF document includes a generic description and detailed knowledge and skills examples for each of the e-Competences. In addition, building on the European Qualifications Framework for Lifelong Learning (EQF), e-CF explicitly acknowledges that there are different proficiency levels associated with each of the competences. Specifying appropriate proficiency levels for each of the competences has to be done before they can be used for developing characteristics of educational experiences.

Table 2b. Second group of expected MSIS graduate competences.	
PLAN	A.3. Business Plan Development
	A.4. Product / Service Planning
	A.7. Technology Trend Monitoring
ENABLE	D.2. ICT Quality Strategy Development
	D.4. Purchasing
	D.8. Contract Management
	D.9. Personnel Development
MANAGE	E.4. Relationship Management
	E.6. ICT Quality Management
	E.7. Business Change Management

Table 2c. Competences Required for MSIS Program Entry	
PLAN	A.6. Application Design
BUILD	B.1. Application Development
	B.2. Component Integration
	B.3. Testing

9 Initial Thoughts Regarding the Curriculum Direction

Although past ACM/AIS curriculum development efforts have largely adopted a content-driven approach using important and emerging topics as a starting point, the current curriculum development effort adopts a competence-driven approach where identified competences will guide the choice of topics to be included and pedagogies to be used. This approach is enabled by the availability of rigorously development competence frameworks in recent years (e.g., the European e-Competence Framework, the CEPIS e-Competence Benchmark, and comparable frameworks from the British Computer Society and the Australian Computer Society). Choosing topics and pedagogies based on the identified competences can help to ensure that graduates would have skills that are truly valued by their prospective employers. In addition, this approach is fully compatible with the model(s) adopted by accreditor(s) in many parts of the world (such as AACSB and ABET based in the U.S. but operating globally and many national or regional accreditors). To facilitate implementation, courses can be provided as exemplars to illustrate how topics and pedagogies may be combined to bring about learning outcomes that are aligned with the identified competences.

The newest version of the MSIS curriculum will have to recognize that the range of possible master's degrees under the Information Systems umbrella has become significantly broader. Therefore, MSIS 2016 will be specifically defined as a pre-experience curriculum, building directly on suitable undergraduate-level educational background. Applicants without the standard pre-requisite of a bachelor's degree from a related discipline can also be admitted with appropriate bridge courses. The scope of MSIS 2016 does not, however, include advanced post-

experience programs targeting experienced IS professionals. Neither does it cover executive master's programs or MBA concentrations. Both degree types will be described, but not specified at a detailed level.

Moving forward, core and elective topics in the curriculum may be determined based on the importance of the associated competences within the competence framework. Collection of elective topics that correspond to specific career tracks can be identified and made known to students. Such arrangements have to be reviewed periodically to keep updated with changing competences (reflecting changing needs of the industry). To craft an international curriculum, national/regional differences would have to be accounted for. For example, the competences needed in developing countries tend to be more technical and less business in nature.

Core topics in the curriculum will need to be determined carefully. While past curriculum development efforts have typically included traditional core topics (e.g., systems analysis and design, data management, infrastructure management, project management, IT strategy etc.) without question, this effort will have to re-evaluate such traditional core topics in light of the identified competences. It may be necessary to accommodate different core topics so as to account for national/regional differences.

Future IT professionals will need to constantly upgrade themselves to keep up-to-date with emerging needs of the industry (i.e., new competences will emerge from time to time). They will not have the luxury to take time off from work every now and then to upgrade themselves. Therefore, they are likely to have to upgrade themselves through various forms of on-line learning. There have been reports which conjecture that an increasing number of IT professionals may opt for "just in time" upgrading (i.e., pursue flipped classes or MOOCs to acquire specific competences needed for their jobs) rather than enroll in master's programs (i.e., pursue master's program to acquire a broad set of competences, some of which may not be immediately needed). Therefore, in the longer term, it may be necessary to develop an accreditation arrangement where students can accumulate course credits to get competence certificates and then accumulate competence certificates to get masters degrees.

The next steps in the MSIS 2016 curriculum development process are as follows:

1. Using various forms of data collection (including surveys, interviews, and panel presentations) to determine a much deeper understanding of the expected competences of the MSIS graduates, including the relative importance and level of each of the expected competences.
2. Identifying relevant inventories of possible curriculum topics (including prior curriculum documents, various competence specifications described earlier in this document, and bodies of knowledge specified in other computing curricula).
3. Creating a mapping between the expected competences and high-level curriculum topics.
4. Using the mapping developed in #3 to determine the high-level curriculum topics to be included in MSIS 2016.
5. Expanding the high-level curriculum topics into more detailed topic specifications building on #2 above.
6. Organizing the curriculum topics into a coherent conceptual curriculum structure.
7. Writing/inviting others to write/provide course exemplars that fit with the proposed curriculum structure.

Throughout this process, various stakeholders of the IS community will be invited to provide feedback to the task force. We would encourage the readers of this document to visit msis2016.org, provide comments regarding this document, and take a MSIS stakeholder survey.

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