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.

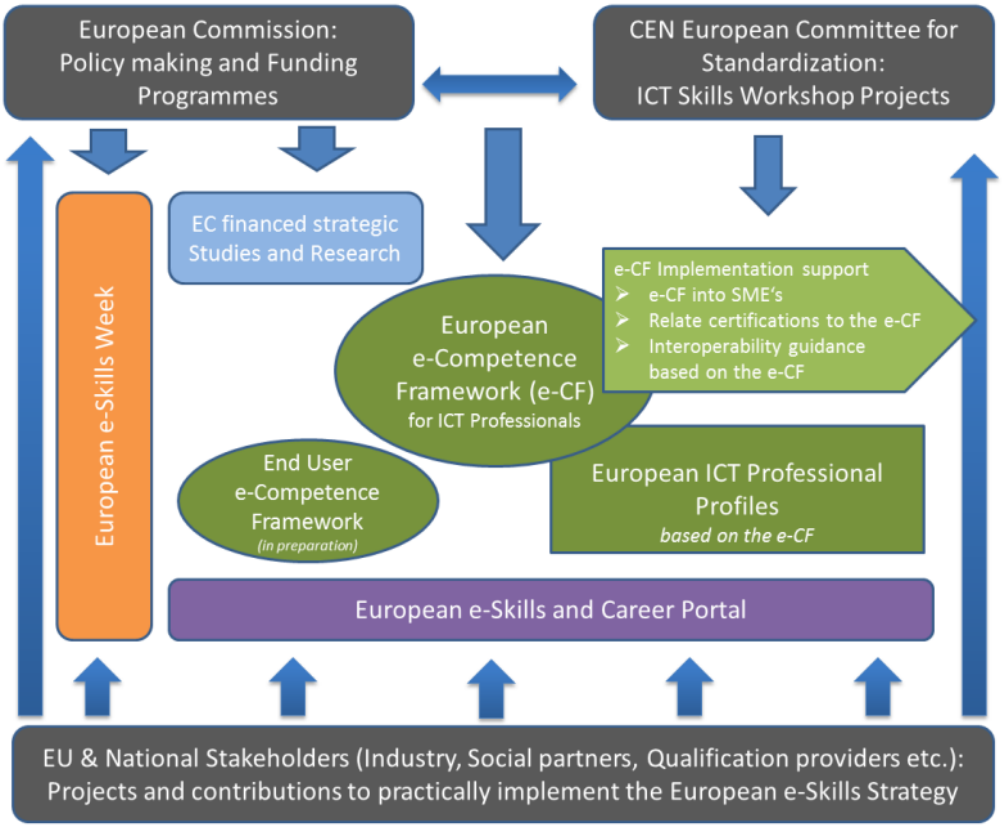


Figure 3. European e-Skills for the 21st Century -- Key players, communication structures and multistakeholder achievements.

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.

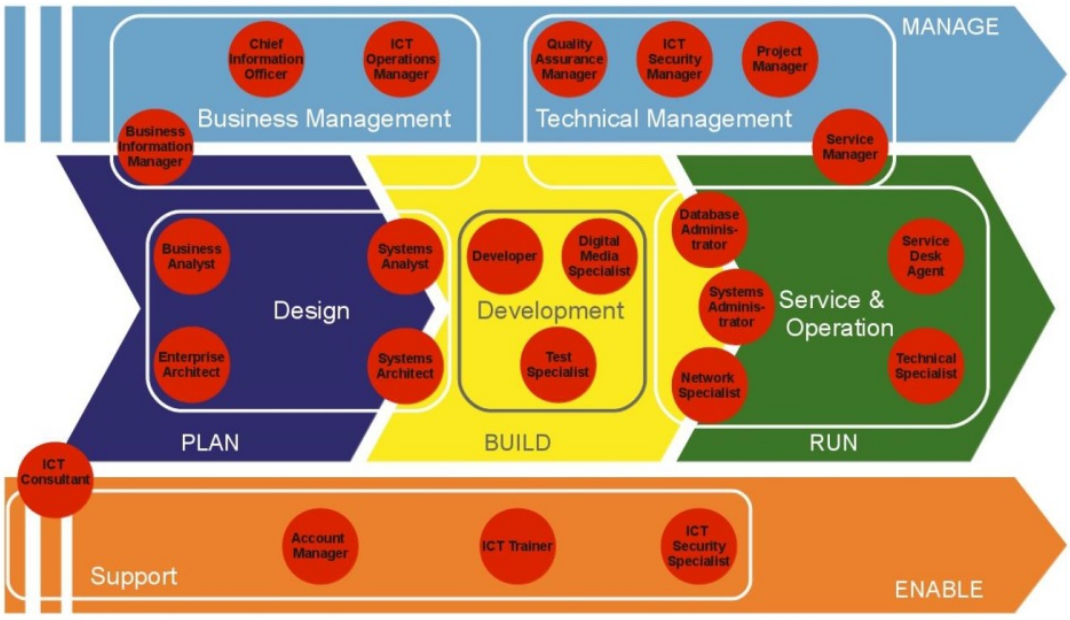


Figure 4. The 23 profiles mapped on the five areas of e-CF (CEN Workshop Agreement 2012)

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

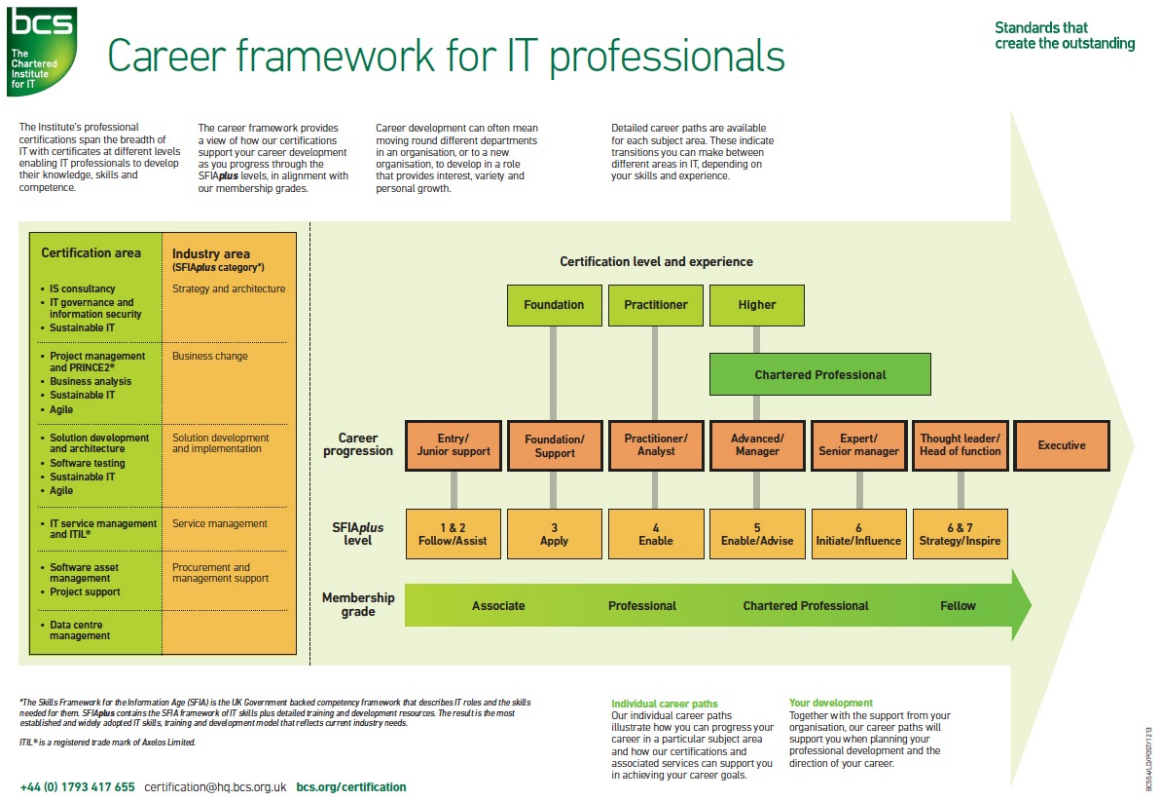
7.2.4 Professional profiles based on SFIA

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.

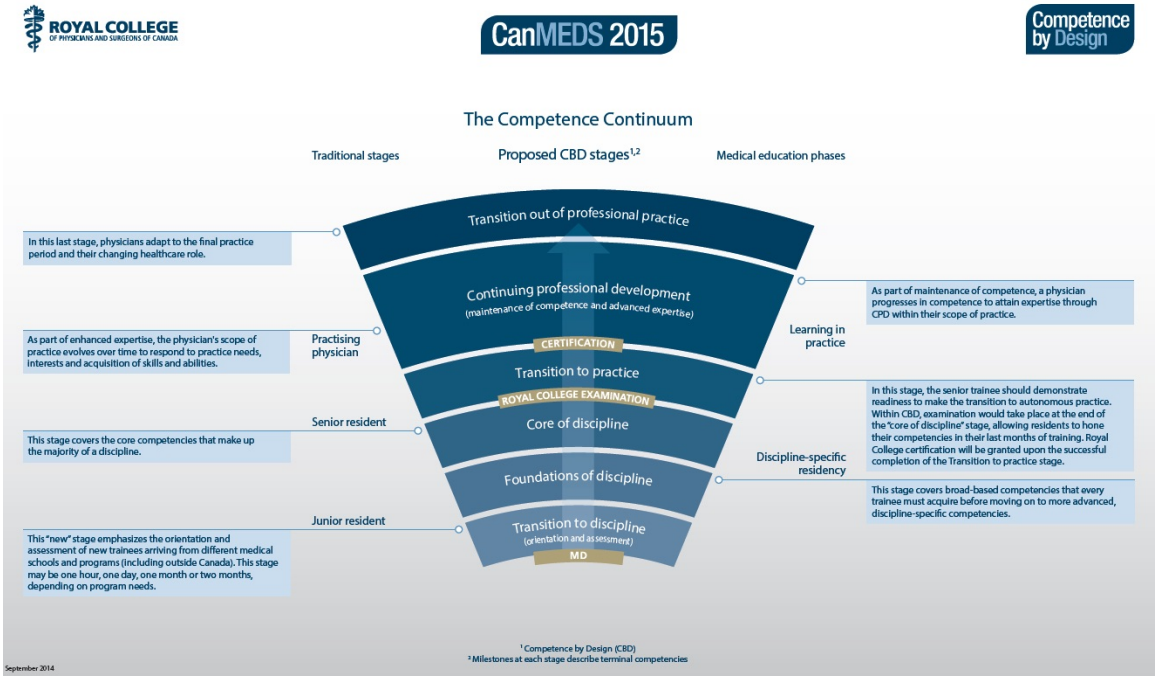


Figure 6. CanMEDS 2015 Competence Continuum.

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,"