



Supersedes N 502
1998-09-16

Number of pages: 12

ISO/TC 211 Geographic Information/Geomatics

Title: Proposal for a New Work Item on Geographic information /Geomatics -
Qualifications and Certification of Personnel

Source: NB of Canada

Status: Document for ballot

Target date: 1998-12-16

Required Action: P-members are requested to complete and return the ballot form to the TC 211 secretariat no later than 1998-12-16

Reference: Resolution 60 Victoria

File name(s): 211n573c.doc, 211n5731.doc, 211n5732.doc, 211n573b.doc - 211n573.PDF,
211n573b.PDF

Distribution: P, O and L members
Chairman
WG Convenors
Mr. Keith Brannon, ISO CS
Mr. François Salgé, CEN/TC 287

ISO/TC 211 Secretariat



Norwegian Technology Standards Institution
Oscars gate 20
P.O. Box 7072 Majorstua
N-0306 Oslo, Norway

Telephone: + 47 22 59 67 16
Telefax: + 47 22 59 67 29

E-mail: Bjornhild.Saeteroy@nts.no
or: bjs@nts.no
URL: <http://www.statkart.no/isotc211/>



Date of presentation 1998-09-16	Reference number (to be given by secretariat)
Proposer SCC	ISO/TC 211 /SC N 573
Secretariat NSF	

A proposal for a new work item (including proposals for amendment or revision of an existing standard) **within the scope of an existing technical committee or subcommittee** shall be submitted to the secretariat of that technical committee or subcommittee with a copy to the Central Secretariat and, in the case of a sub-committee, a copy to the secretariat of the parent technical committee. The proposal will be circulated to the P-members of the technical committee or subcommittee for voting, and to the O-members for information. The proposer may be a member body of ISO, the secretariat itself, another technical committee or subcommittee, an organization in liaison, the Technical Management Board or one of the advisory groups, or the Secretary-General. Guidelines for proposing and justifying a new work item are given in the ISO/IEC Directives (part 1, annex Q) (see extract overleaf).

The proposal (to be completed by the proposer)

<p>Title of proposal (in the case of an amendment or revision, or a new part, of an existing standard, show the standard number)</p> <p>Geographic Information / Geomatics- Qualifications and Certification of personnel</p>
<p>Scope (as defined in 6.2.1 of part 3 of the ISO/IEC Directives)</p> <p>To develop a Type 3 report, which describes a system for the qualification and certification, by a central independent body, of personnel in the field of Geographic Information Science / Geomatics.</p> <p>To define the boundaries between Geographic Information Science/ Geomatics and other related disciplines and professions.</p> <p>To specify the technologies and tasks pertaining to Geographic Information Science / Geomatics.</p> <p>To establish skill sets and competency levels for technologists, professional staff and management in the field.</p> <p>To research the relationship between this initiative and other similar certification processes performed by existing professional associations.</p> <p>To develop a plan for the accreditation of candidate institutions and programs, for the certification of individuals in the workforce, and for collaboration with other professional bodies.</p>

Geomatics has evolved in Canada from the Surveying and Mapping profession (e.g. Canadian Institute for Surveying and Mapping (CISM) = Canadian Institute for Geomatics (CIG)). In the United States, Geographic Information Science stems from the technology, Geographic Information Systems (GIS) (e.g. University Consortium for Geographic Information Science UCGIS). Given the changing technology, changing problem definition (science), government and industry requires a set of standards for the certification of personnel. This task falls within the ISO/TC211 Geographic Information. The skills of technologists, professionals and managers have to be defined to meet the tasks within the new conceptual and technology context.

The purpose of the new work item is to reach agreement on the bounds of Geographic Information / Geomatics through collaboration with other professional associations and appropriate accredited standards bodies. For each broad work task, the background education and work experience will be identified for the individual to receive certification. This effort will be complemented by a survey of staff in existing government agencies and private industry who hold a position defined in terms of Geographic Information Science (GIS) / Geomatics. Part of the first phase will be a listing of all educational institutions which offer GIS/Geomatics education and training.

A second phase, if accepted, would be an accreditation process for those institutions who wish their graduates to be eligible for certification.

A number of national (international) organizations are independently working towards certification e.g. URISA, AGI, ACSM, ASPRS, UCGIS. ISO/TC211 can provide a co-ordination function.

Target date (indicate the date by which the availability of the International Standard is considered to be necessary) 2001-09

Relevant documents to be considered

ISO documentation on certification for other technologies and disciplines. Certification documents for related disciplines e.g. Forestry, Planning, Public Administration. Draft GI/Geomatics certification from professional associations e.g. CIG, URISA, AGI, ACSM, ASPRS, UCGIS

Relationship of project to activities of other international bodies

Coordination with ISO/TC 211 Class A liaison members.

Liaison organizations

ISO/TC 211 Class A liaison members

Need for coordination within ISO and IEC

Preparatory work

- A draft is attached
- An outline is attached and it will be possible to supply a draft by (date)
- Proposed project leader (name and address): **Dr. Robert Maher, Bio Geographics International
4545 Sarah Owen Place, Victoria BC V8X 3X1 Canada.**

Concerns known patented items

(see part 2 of the ISO/IEC Directives)

- yes
- no

If YES, provide full information as annex

Signature of the proposer

**Doug Langlotz, Senior Program
Officer, SCC**

(signature on file)

Date of circulation

1998-09-16

Closing date for voting

1998-12-16

Signature of the TC or SC secretary

Bjørnhild Sæterøy

(signature on file)

Comments with respect to the proposal in general, and recommendation thereon

(Indicate any issues to be brought to the notice of committee members. For instance, refer to any associated vote on form 5 regarding adoption of any attached draft for direct progression to CD or DIS.)

Elements to be clarified when proposing a new work item (new standard)**Title**

Indicate the subject matter of the proposed new standard.

Scope

Give a clear indication of the coverage of the proposed new work item and, if necessary for clarity, exclusions.

Purpose and justification

Give details based on a critical study of the following elements wherever practicable.

- a) The specific aims and reason for the standardization activity, with particular emphasis on the aspects of standardization to be covered, the problems it is expected to solve or the difficulties it is intended to overcome.
- b) The main interests that might benefit from or be affected by the activity, such as industry, consumers, trade, governments, distributors.
- c) Feasibility of the activity: Are there factors that could hinder the successful establishment or general application of the standard?
- d) Timeliness of the standard to be produced: Is the technology reasonably stabilized? If not, how much time is likely to be available before advances in technology may render the proposed standard outdated? Is the proposed standard required as a basis for the future development of the technology in question?
- e) Urgency of the activity, considering the needs of other fields or organizations. Indicate target date and, when a series of standards is proposed, suggest priorities.
- f) The benefits to be gained by the implementation of the proposed standard; alternatively, the loss or disadvantage(s) if no standard is established within a reasonable time. Data such as product volume or value of trade should be included and quantified.
- g) If the standardization activity is, or is likely to be, the subject of regulations or to require the harmonization of existing regulations, this should be indicated.

If a series of new work items is proposed, the purpose and the justification of which is common, a common proposal may be drafted including all elements to be clarified and enumerating the titles and scopes of each individual item.

Relevant documents

List any known relevant documents (such as standards and regulations), regardless of their source. When the proposer considers that an existing well-established document may be acceptable as a standard (with or without amendments) indicate this with appropriate justification and attach a copy to the proposal.

Cooperation and liaison

List relevant organizations or bodies with which cooperation and liaison should exist.

Preparatory work

Indicate whether the proposer or the proposer's organization is prepared to undertake the preparatory work required for the new work item.

Geographic Information / Geomatics -

Qualifications and Certification of Personnel

1. Introduction

Geographic Information, because of its large data volume and temporal nature, about the two dimensional representation of its land and water surface (maps and charts) and also the three dimensional atmosphere, ocean and sub-surface, has been dramatically impacted by digital technologies. Map - making and surveying traditions are now part of Geographic Information Science / Geomatics. Data collection processes are often done in real time, with the results being shared and distributed across computer networks. This permits more complex analysis and synthesis. The challenges of certification are to monitor a rapidly changing skill set, achieve recognition for the diversity of applications and yet meet the growing need for an in-depth understanding of fundamental geographic and information system concepts.

2. Scope

Geographic Information / Geomatics can be defined from at least two viewpoints: technology and tasks. The technology view identifies a suite of tools for information management and analysis:

- (i) digital survey instruments
- (ii) global positioning system (GPS)
- (iii) remote sensing (including photogrammetry)
- (iv) geographic information systems
- (v) spatial systems engineering tools
- (vi) spatial database management
- (vii) automated cartography
- (viii) visualization
- (ix) modeling
- (x) spatial analysis

The task view recognizes a sequence of operations which deploy multiple technologies:

- (i) sample design and systems architecture
- (ii) data collection (location and attributes)
- (iii) quality assurance and validation
- (iv) information management (spatial DBMS)
- (v) analysis/synthesis (GIS, image processing)
- (vi) dissemination (transfer of graphic files and applications across the network)

Each of these tasks can be undertaken by a technologist, a scientist or an engineer, and under the direction of a manager. The respective roles of the three groups is depicted in Figure 1 adapted from (Christman 1997).

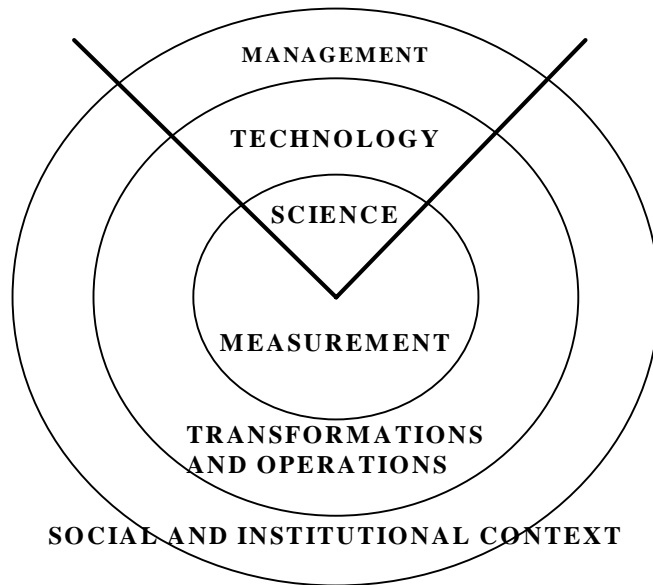


Figure 1: Measurement-centric view of Geographic Information Systems (Chrisman 1997)

3. Normative References

The following standards contain provisions that, through reference in this text, constitute provisions to this proposed International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10011-2:1991(E), *Guidelines for auditing quality systems — Part 2: Qualification criteria for quality systems auditors.*

ISO 9712:1992(E), *Non-destructive testing — Qualification and certification of personnel.*

ISO 14012:1996(E), *Guidelines for environmental auditing — Qualification criteria for environmental auditors.*

4. Definitions

Geographic Information

(ref: ISO/TC211/WG1 N119)

- knowledge obtained as the result of the synthesis, analysis or integration of geographic data;
- information concerning phenomena implicitly or explicitly associated with a location relative to the Earth.

Geographic Information Services

(ref: ISO/TC211/WG1 40.6)

- services that transform, manage or present geographic information to users.

Geographic Information Technologies

(ref: Goodchild 1997)

- technologies for collecting and dealing with geographic information;
- they include at least three broad categories: GIS, Remote Sensing (including Photogrammetry) and GPS

Geographic Information Science

(ref: Goodchild 1997)

- the science behind the technology;
- multidisciplinary field;
- geographic: two dimensional surface representation; three dimensional atmosphere, oceans, and sub-surface.

Geomatics

(ref: ISO/TC211/WG1 N119)

- discipline concerned with the collection, distribution, storage, analysis, processing, presentation of geographic data or geographic information.

Geographic Information Scientist

- expert in the conceptual framework of Geographic Information and possessing an in-depth knowledge of an application domain and its geo-temporal context.

Geomatics Engineer

- expert in the conceptual framework of Geographic Information and possessing an in-depth knowledge of spatial systems engineering tools.

Geomatics Technologist

- knowledgeable in the application of GIS and related technologies for the purposes of land, water, air or environmental (including people) management.

5. The Knowledge Domain of the Geographic Information Science / Geomatics

GIS/Geomatics staff can be assigned to one of three groups: technologist, scientist or engineer, and management. Each group may contain two or three levels. In broad terms, the technologist has responsibility for the proper use of IT tools for geo-temporal applications. The scientist and engineer may bring a deeper conceptual appreciation of the task, combined with a better understanding of the application content or systems engineering. The management group may understand best the issues of business planning and overall project management. The Venn diagram (Figure 2) illustrates three dimensions of work in the Geographic Information Science / Geomatics domain.

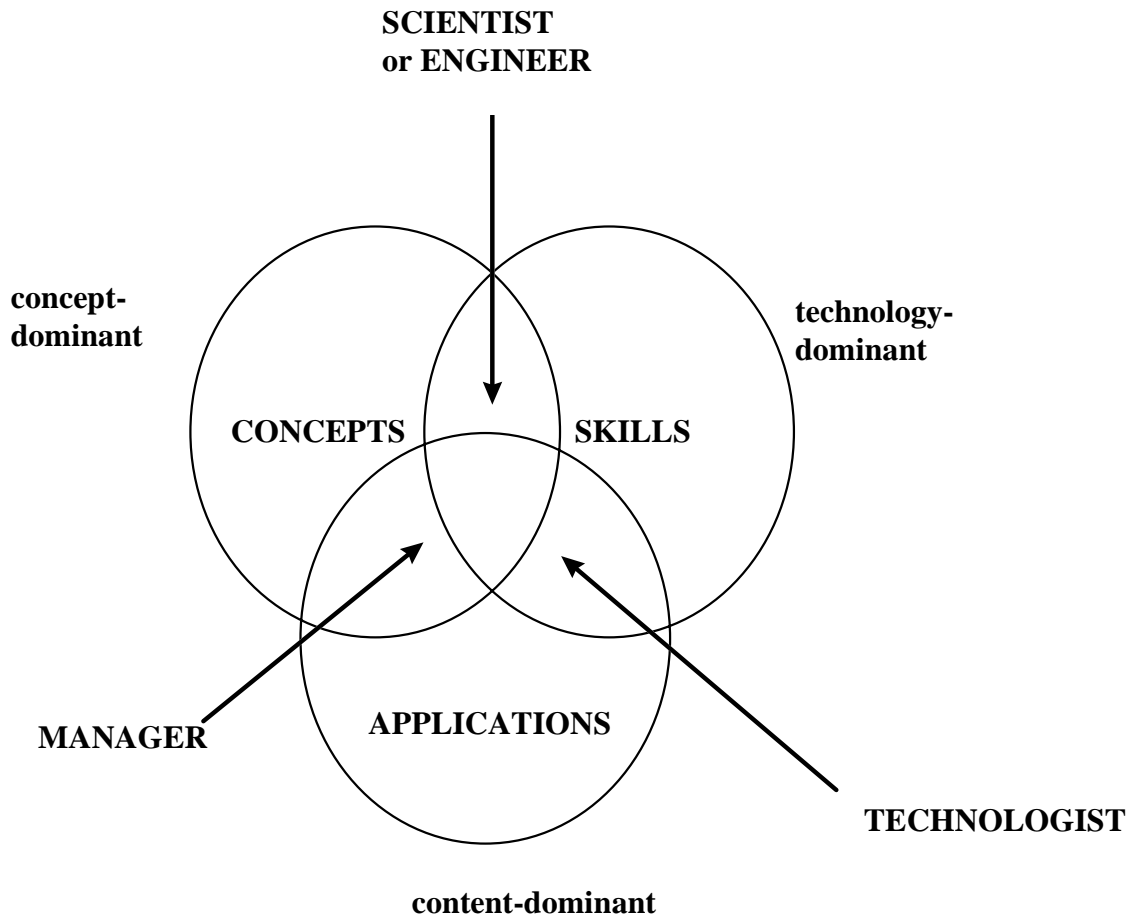


Figure 2 Overlapping areas of expertise in the fields of Geomatics and Geographical information Science

Certain disciplines are primarily interested in objects and processes operating in the landscape (content). Other disciplines are more concerned with abstract space and time (context).

6. Tasks and levels of competency

Within the knowledge domain, work can be divided into six tasks: sample design and systems architecture, data collection, quality assurance and validation, information management, synthesis and analysis, and dissemination. Each of these six tasks can be mapped into a competency grouping (Figure 3).

Task \ Profession	Technologist	Scientist	Engineer	Manager
Sample Design and Systems Architecture	→			
Data Collection	↓	↘		
Quality Assurance and Validation				
Information Management				
Synthesis/Analysis				
Dissemination				

→ pathways from entry position

Figure 3: Task / Profession Matrix

Employees can work for government agencies, the consulting industry, sectoral industry, technology vendors or educational institutions. They may have responsibility for the design and development of the technology, the underlying science behind the technology or the application of the tools for problem solving, or overall project management.

7. Qualifications and the Certification process

7.1 Definitions

qualification: A demonstration of the knowledge, skill, training and experience required to properly perform GIS/Geomatics tasks.

certification: The procedure leading to a written testimony of the qualification of an individual's competence in GIS/Geomatics.

certifying body: The agency that administers procedures for certification of GIS/Geomatics personnel in accordance with requirements of this International Standard.

qualifying body: A competent organization, independent of the employer or responsible agency, authorized by the certifying body to prepare and administer examinations to qualify GIS/Geomatics personnel.

candidate: The individual seeking certification under the qualification and certification scheme.

employer or responsible agency: The organization for which the candidate works on a regular basis.
NOTE: Candidates may be self-employed.

basic education: The minimum formal education required for qualification.
NOTE: It may be used to determine duration and level of training and experience required prior to qualification.

training: A process of instruction in the theory and practice in the GIS/Geomatics tasks which may take the form of training courses to an approved syllabus in addition to periods of practical work under qualified supervision.

experience: The period during which the candidate performed GIS/Geomatics tasks under qualified supervision.

qualification examination: An examination administered by the certifying body or by an authorized qualifying body for each level of competence.

8. Grouping of competence

An individual certified in accordance with this International Standard shall be classified in one of three groups depending upon the individual's respective level of competence.

GIS/Geomatics technologist (group 1)

An individual certified as GIS/Geomatics technologist is qualified to undertake the specified tasks under the supervision of group 2 or group 3 personnel.

GI Scientist/Geomatics Engineer (group 2)

An individual certified as GI Scientist/Geomatics Engineer is qualified to determine the appropriate technology for solving a problem; to interpret and evaluate the results; to carry out all the duties for which a group 1 individual is qualified and to check that they are properly executed. The individual shall be familiar with the scope and limitations of the current technology and be able to exercise responsibility for on-the-job training of group 1 personnel.

GIS/Geomatics manager (group 3)

An individual certified as GIS/Geomatics manager shall be capable of assuming full responsibility for the facility and staff; establishing business practices and procedures. The individual shall have the competence to interpret and evaluate the results within the context of information management policies; and have the ability to define professional development for group 1 and group 2 personnel.

9. General principles of certification

9.1 Administration

The certification activity that includes all procedures adopted to demonstrate the qualification of an individual to carry out tasks in GIS/Geomatics and leads to written testimony of his/her competence shall be administered in each country by the certifying body, with the assistance, where necessary, of duly authorized qualifying bodies.

9.2 Certifying body

The certifying body may be a non-profit organization which has no direct involvement in the training and education of GIS/Geomatics personnel and which has been recognized by the ISO member body of the country concerned (see 9.3 and 9.4 for Composition and Responsibilities)

9.3 Composition

The certifying body (CB) shall be supported by an administrative committee, which shall include eminent representatives of GIS/Geomatics societies, committees, users, suppliers, government departments and other interested parties as appropriate. The CB shall establish, in writing, the number of members of this committee, their qualifications (including education, training and experience), the means and extent of documentation of their qualifications, and their tenure.

9.4 Responsibilities

The certifying body

- a) shall initiate, maintain and promote the certification scheme as specified in this International Standard;
- b) shall administer the procedures and operations for certification in accordance with national documents meeting the minimum requirements of this International Standard, and a stringent code of ethics, including sanctions, which shall apply to committee members and certificate holders;
- c) may delegate, under direct responsibility, the detailed administration of the certificate procedure to other organizations which will act as qualifying bodies and which could represent industrial sectors;
- d) shall take the ultimate responsibility for the certification scheme, including technical and administrative requirements;
- e) shall approve, either directly or through a qualifying body, properly staffed and equipped examination centres which it shall monitor on a periodic basis and
- f) shall keep all appropriate records and issue, or delegate the issuing of written testimonies.

10. Pre-requisite qualifications

Technologist: college diploma or degree from accredited institution (see Annex 1); 1 -3 years work experience.

Scientist or Engineer: degree or post-graduate degree from accredited institution (see Annex 1); 2 - 4 years work experience.

Manager: Group 1 or Group 2 qualifications; management qualifications from accredited institution (see Annex 1); > 5 years project management experience.

11. Articulation agreement with other professional organizations

ISO/TC211 should investigate the structure and procedures of other professional associations where there is subject matter overlap. Candidate organizations at the national and international level would include URISA, AGI, ICA, FIG, GIAC, CIG, ACSM, ISPRS, UCGIS. There should also be a concerted effort to ensure adequate linkages to the Information Systems organizations.

ISO/TC211 should investigate the structure and procedures of other professional associations which use GIS/Geomatics technology within their disciplines (e.g., Forestry, Planning, Business, Geology, Health Sciences)

12. Annex 1: Individual certification and Institutional accreditation

Bennion et al 1997 describe the interdependency of individual certification, institutional accreditation and professional development. Certification of individuals may depend upon the completion of an accredited program plus additional work experience. Professional development through upgrading courses, is essential for the Geographic Information Science / Geomatics professional to stay current with new technological and conceptual advances.

Individual certification

The British Computer Society (BCS) set standards and quality control for professional development of practitioners in an employer environment. This approach has significant central management costs associated with the scheme and the maintenance of the standards. The standards for a professional within the BCS framework include a clear Code of Conduct, National Vocational Qualifications (NVQ) and standards for professional development.

Institutional accreditation

To enter the Geographic Information Science / Geomatics profession, employees will require either a community college diploma or a university degree. The challenge will be to establish criteria for inclusion in a database of accredited institutions. An independent body would undertake the following tasks:

- a) define learner outcomes;
- b) assess the core courses in the program;
- c) identify the availability of professional development courses

Each learner would be required to demonstrate a balance between formal study and practical work experience. The independent body would set the criteria for the evaluation of individual courses and also complete programs.

References

Bennion, F., B Capper and D.Unwin. 1997 Professional Development for the Geographic Information industry. A publication of the Information and Education Committee of the Association for Geographic Information. Draft.

Chrisman, N. R. 1997. Exploring Geographic Information Systems. John Wiley & Sons. New Jersey.

Goodchild, Michael F. "What is Geographic Information Science ?", NCGIA Core Curriculum in GIScience, <http://www.ncgia.ucsb.edu/giscc/units/u002/u002.html>, posted October 7, 1997.