ISO/TC 211
Geographic information/Geomatics

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Executive summary

A business view of the standardization of geographic information should include a description of the evolving use of such information in new and emerging environments. Evolving technology will set new standards and applications for merging geospatial data and services, and hence interoperability with other types of data. The result of this evolution will be further standards development work, with geodata being a central focus. This includes the embedding of geodata in specific applications of the future, developing a “system of systems” that are spatially enabled. ISO technical committee 211 standardization activities will help create this future interoperability.

Geospatial or location technology has been going mainstream for some years now. Maps, geographic information and related content are becoming more pervasive and embedded in everyday life. Continued major investments from large players like Google, Microsoft, Apple and Amazon are making consumer-based mapping, location-based service applications and image-based maps truly ubiquitous. As the consumerization of technology increases, the focus will be more on providing value and Return on Investment (ROI) to the users.

The scope of ISO/TC 211 is very wide, and the work targets several key segments:
- modelling and documentation of geographic information, traditionally important for major actors like the public sector;
- Spatial Data Infrastructures (SDIs) with emphasis on sharing and dissemination of geographic information through services;
- embedding of geographic information in everyday life – ubiquitous geographic information;
- some specific subject domains where geographic information is an important component and where multiple disciplines are involved.

The priority of ISO/TC 211 is geographic information and geomatics as an enabling technology within Information and Communications Technology, by providing value, ROI, and to make systems work. The standards developed by ISO/TC 211 actively contribute to authoritative, evidence-based decisions in any field involving geographic or location content.

The types of stakeholders to be addressed in this strategic business plan include:
- regulators;
- the management layer of organizations contributing to standardization;
- standards developers and standards developing organizations;
- users of standards;
- professional interest organizations;
- the interested public.
1 Introduction

1.1 ISO technical committees and business planning

The extension of formal business planning to ISO Technical Committees (ISO/TCs) is an important measure which forms part of a major review of business. The aim is to align the ISO work programme with expressed business environment needs and trends and to allow ISO/TCs to prioritize among different projects, to identify the benefits expected from the availability of International Standards, and to ensure adequate resources for projects throughout their development.

1.2 International standardization and the role of ISO

The foremost aim of international standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade.

Three bodies are responsible for the planning, development and adoption of International Standards: ISO (International Organization for Standardization) is responsible for all sectors excluding Electrotechnical, which is the responsibility of IEC (International Electrotechnical Committee), and most of the Telecommunications Technologies, which are largely the responsibility of ITU (International Telecommunication Union).

ISO is a legal association, the members of which are the National Standards Bodies (NSBs) of some 164 countries (organizations representing social and economic interests at the international level), supported by a Central Secretariat based in Geneva, Switzerland.

The principal deliverable of ISO is the International Standard.

An International Standard embodies the essential principles of global openness and transparency, consensus and technical coherence. These are safeguarded through its development in an ISO Technical Committee (ISO/TC), representative of all interested parties, supported by a public comment phase (the ISO Technical Enquiry). ISO and its Technical Committees are also able to offer the ISO Technical Specification (ISO/TS), the ISO Public Available Specification (ISO/PAS) and the ISO Technical Report (ISO/TR) as solutions to market needs. These ISO products represent lower levels of consensus and have therefore not the same status as an International Standard.

ISO offers also the International Workshop Agreement (IWA) as a deliverable which aims to bridge the gap between the activities of consortia and the formal process of standardization represented by ISO and its national members. An important distinction is that the IWA is developed by ISO workshops and fora, comprising only participants with direct interest, and so it is not accorded the status of an International Standard.
2 Business Environment of the ISO/TC

2.1 Description of the Business Environment

The following political, economic, technical, regulatory, legal and social dynamics describe the business environment of the industry sector, products, materials, disciplines or practices related to the scope of this ISO/TC, and they may significantly influence how the relevant standards development processes are conducted and the content of the resulting standards:

Introduction

Geographic information is used by government, industry, and individuals. For example, geographic information is used to plan disaster resilience, to support the delivery of goods, and to drive to a restaurant. Geographic information is captured and maintained by various organizations, in both the public and the private sector, and is generally accessible on the internet. The development of Spatial Data Infrastructure (SDIs) has widely contributed to this mainstream. National governments around the world have been coordinating national efforts to build their specific SDI and have contributed to international efforts especially the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) for the development of global approaches for the management, sharing, access and use of geographic information.

This web-based distribution of geographic information continues to evolve. Increasingly, sensors, the Internet of Things (IoT) and citizens are continuously connected and providing data. Connected devices and citizens wish to access data that is more detailed, is instantly accessible and is up to date.

Increasingly, geographic information is embedded within other domain systems, such as intelligent transport, construction, city management and national statistics.

_In this document, the terms geographic, geospatial, and spatial are used interchangeably._

Purpose of Geographic Standards

Geographic information standards are recognized as underpinning the realization of SDIs and providing a foundation for other domains which need to describe the world. They have since 1994, been developed to facilitate the sharing and the integration of geographic data across platforms. They facilitate the discovery, access, and appropriate use of geographic information, i.e. interoperability. As illustrated in Figure 1, geographic information standards rely on a significant IT and other standards that are not specifically geographic. Domain-specific standards then build on geographic standards. Together, they provide the pillars for interoperability.
Standards enable interoperability by consistent and interoperable definitions and structure for data and metadata (semantics), encoding (syntax), access (services), and processing (services). On the web, these “services” are increasingly known as Application Programming Interfaces (APIs). Standards support creating, reproducing, updating and maintaining geographic information that is needed by system integrators, application developers, researchers, industry, academia, decision makers in the public and private sectors, and for all people.

**Stakeholders**

Many communities have a direct or indirect interest in geographic information standards. This includes:

- regulators, such as the International Maritime Organization;
- the management layer of organizations contributing to standardization, such as national mapping agencies and software companies;
- standards developers and standard developing organizations, such as the Open Geospatial Consortium (OGC), Universal Postal Union (UPU), ISO, and ISO/TC 211;
- users of the standards, such as:
  - government at all levels;
  - academic communities;
  - large and small commercial data producers;
  - industry organizations, such as the International Association of Oil and Gas Producers;
  - software manufacturers, both those whose software manages and creates geographic information, and those whose software consumes it;
  - individual data users.
- professional interest organizations, such as the International Photogrammetry and Remote Sensing Society.

These groups have different perspectives and priorities, but all share a desire for geographic information to be easy to produce, disseminate, discover, and use. In many cases, the desire is that it should be as simple to use as non-geographic data.
Environment

There are a wide range of domains making use of geographic information, or which could benefit from using geographic information. Amongst others can be mentioned:

- improving sustainability of communities (Smart cities);
- enabling intelligent transport networks, and autonomous vehicles;
- administering land and land use, for reasons such as planning, funding, and taxation;
- enhancing digitalization in the construction industry;
- measuring progress towards the UN Sustainable Development Goals (SDG);
- measuring climate change;
- statistics measuring aspects of society;
- responding to disasters.

Management of complex spatial processes including traffic, air quality, climate conditions, public safety, energy transportation, water distribution etc. is increasingly supported by real time geospatial representations in so called Digital twins. Sensor web technology provides for real time monitoring and supports optimization of resources. Next steps are in applying algorithms for Artificial Intelligence and deep learning systems for operational management in Smart cities and other dynamic spatial data rich environments. GI-standardization will cope with these developments by for instance providing a spatial base on which integrated knowledge systems can be developed.

In all cases, data sharing is almost exclusively via the web. Increasingly, data with geospatial elements is created and published by individuals, organizations and devices with no background in geographic information. It is therefore important that this ISO/TC builds its work on existing standards for IT, ethics, privacy, usability and other standards. For example, the World Wide Web Consortium (W3C) standards cover most of the web environment; the Object Modeling Group (OMG) covers most of the data modeling aspect; ISO/IEC JTC 1/SC 32 covers standardization of database technology, which now includes geospatial aspects. OGC and ISO/TC 211 provide standards specific to geographic information, such as metadata, encoding web services, feature content, geospatial and temporal schema, coordinate reference systems, imagery, coverage and gridded data. However, many other issues need to be covered, for instance standards targeting domain-specific areas and where standardized application schemas and ontologies need to be developed.

The UN, in establishing its Committee of Experts on Global Geospatial Information Management (UN-GGIM) play an increasing role in setting the agenda for the development of global geospatial information and to promote its use to address key global challenges. ISO/TC 211 has contributed to the development of the standards aspect within the work programme of UN-GGIM, and the committee produces a yearly report in collaboration with the Open Geospatial Consortium (OGC) and the International Hydrographic Organization (IHO).

The UN-GGIM document “A Guide to the Role of Standards in Geospatial Information Management” and its Companion document (shortly referred to as the Standards Guide), prepared cooperatively by the OGC, ISO/TC 211 and the IHO, introduces a maturity model for the development of SDI, and suggests appropriate standards at different levels, or tiers of maturity (Reference 1).

The first tier is about sharing maps over the web using Web Mapping Services – WMS/ISO 19128). The second tier describes the discovery, access and use of geographic information from multiple sources. The third tier focuses on the availability and access of framework data and applications for use on multiple platforms (desktop, mobile, or others). Finally, the last tier describes a geographic knowledge ecosystem, bringing SDI into the web of data. In this way,
the web can be used to host a global geographic information database from which data from different sources are connected, providing additional value to the existing data.

Spatial data is increasingly important in the transformation towards digital government or e-Government, as illustrated in Figure 2. Location is not sector specific but generic. Most public administration data has (or could have) a location.

The potential pitfall in e-Government is to start immediately with database implementation and not follow a standardized approach for modelling, applying a conceptual modelling language, as defined in the package of standards developed in ISO/TC 211.

Moving from SDI and the “professional” marked to location enablement and location intelligence in e-Government brings location to new user groups who are not familiar with the geographic dimension and the geospatial data management dimension, the spatial literacy. A spatial literate person thinks spatially, practices spatial thinking in an informed way and can adopt a critical stance to spatial information. International geospatial standards are important in the transformation towards digital government, not only for geospatial public administrations, but for public administrations in general.

Re-use of open geospatial data fosters innovation and creation of new or improved products and services.

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**Figure 2 - Location Data underpins transformation towards digital government**

![Figure 2](Reference 2)

### 2.2 Quantitative Indicators of the Business Environment

The following list of quantitative indicators describes the business environment in order to provide adequate information to support actions of the ISO/TC:
Implementation of standards and compliance with standards

ISO/TC 211 does not keep track of statistics on implementation and compliance with the standards. However, any device or product that makes use of location coordinates derived from a GNSS device is likely to follow ISO 6709:2008, Geographic information -- Standard representation of geographic point location by coordinates. Many, if not most, geospatial products are based on ISO 19107, Geographic information -- Spatial schema, a conceptual schema describing the spatial characteristics of geographic features and operations on them. Similarly, most object-relational databases have implemented ISO 19125-2:2004, Geographic information -- Simple feature access -- Part 2: SQL option, which has now been integrated into the ISO/IEC 13249 series of standards on database languages for SQL multimedia.

EuroGeographics is an organization of national mapping and cadastral agencies in Europe. Surveys distributed to its members, in 2004, 2011, and 2017 with respect to the use of ISO/TC 211’s Data Quality and Metadata standards and found that the majority of the 28 organizations use one or more ISO/TC 211 standards to help manage the quality of their data. This use increased from 2011 to 2017. Almost all of the national mapping and cadastral agencies use the ISO/TC 211 metadata standard, amongst others, because this standard was adopted by INSPIRE, where ISO 19115/19139 compliant metadata records power the INSPIRE GeoPortal, at http://inspire-geoportal.ec.europa.eu/. The portal contains approx. 240,000 ISO 19115:2003 records describing geographic information datasets or services. It also has a machine-readable interface. Similarly INSPIRE implemented and widely spread the use of the ISO/TC 211 standards for information modelling (ISO 19103/19109).

The United Nations and World Bank have encouraged the use of ISO 19152 Geographic information - Land Administration Domain Model, in many developing countries. It has also been used in the maritime domain by the IHO.

Compliance statistics are available for standards that have been developed and/or published in collaboration with OGC (www.opengeospatial.org) and the Universal Postal Union (UPU) (www.upu.int). Currently, 297 products comply with an OGC specification and more than 900 products implement OGC specifications but have not been subjected to compliance certification. Some OGC specifications are also ISO standards, for example, the OGC Web Map Service (WMS) Implementation Specification (1.3.0) is identical to ISO 19128:2005; Geographic information -- Web map server interface; 157 products comply with the standard and 359 products implement the standard (Source: http://www.opengeospatial.org/resource/products/stats). ISO 19160-4:2017, Addressing -- Part 4: International postal address components and template language, was jointly developed with the UPU. Currently, 58 countries have UPU S42 templates complying with this standard (Source: http://www.upu.int/en/activities/addressing/s42-standard/compliant-countries.html).

Geospatial industry

The Global Geospatial Industry Outlook (2019), published by Geospatial Media and Communications, valued the global geospatial industry at an estimated US$ 339.0 billion in 2018. The cumulative geospatial industry is projected to reach US$ 439.2 billion by 2020, growing at a compound annual growth rate of 13.8%. This growth acceleration can be accredited to continuous technology advancements in the industry, democratization of geospatial information riding on integration with advancements in digital technologies and resultant innovative business models. Adopting open standards¹ is considered to be important for the way forward and for realizing the full potential of geospatial technologies.

¹ See section 1.2 on principles of global openness and transparency, consensus and technical coherence. See also https://en.wikipedia.org/wiki/Open_standard. ISO standards are generally considered to be open
Benefits through the implementation of ISO/TC 211 standards
In the Standards Guide (Reference 1), the benefits and value of geospatial standards are described. The Companion document includes hyperlinks to many examples of implementations of the ISO/TC 211 and OGC standards.

Estimates of government adoption of ISO/TC 211 standards
The majority of the 50 countries evaluated in the Global Outlook Report (2017) had an open data initiative and a national data catalogue providing access to datasets available for reuse, which allow diverse data sources, applications and systems to operate with each other. On the country geospatial readiness index in the 2017 report, developed nations are ahead, especially regarding standards implementation. Spatial data sharing in emerging economies is conservative and restricted. Data dissemination is limited to mostly traditional methods, and the importance of data standards is yet to be realized. European countries follow the INSPIRE directive, which clearly defines data policies, built on ISO/TC 211 standards. According to the 2019 Global Outlook Report, the common standards that are followed and implemented in almost all countries are those published by the ISO and the OGC.
3 Benefits expected from the work of the ISO/TC

ISO/TC 211 develops International Standards that:

- support the understanding and usage of geographic information;
- increase the availability, access, integration, and sharing of geographic information, enable interoperability of geospatially enabled computer systems;
- contribute to a unified approach to addressing global ecological and humanitarian problems;
- ease the establishment of geospatial infrastructures on local, regional and global level;
- contribute to sustainable development;
- enable interoperability of geospatially enabled computer systems.

The ultimate benefit of standardization is based on the use of widely recognized and accepted international standards developed to the highest technical level by an open consensus process that includes all those affected. This benefit occurs at four levels, those relating to the general benefit of standardization, those relating to the standardization of geographic information at the general level, those relating to specific areas dealt with by ISO/TC 211, and finally, those that implement ISO/TC 211 standards in other standards.

The general benefits are those common to all areas of standardization, particularly in areas of information systems and technology. They include:

- reduced development costs of systems and applications, through following established procedures, e.g. ISO 19135-1 specifies procedures to be followed in establishing, maintaining, and publishing registers of unique, unambiguous, and permanent identifiers and meanings that are assigned to items of geographic information. Once a register is implemented, it can be used for many kinds of identifiers;
- improved reliability of systems through reuse of mature components, e.g. different mashups can be created from mature implementations of a Web Map Service (ISO 19128) and a Web Feature Service (ISO 19142);
- reduced lock-in to individual proprietary suppliers, e.g. the geography markup language (GML) (ISO 19136) is a software vendor neutral XML encoding for transferring and storing geographic information.

The benefits relating to the standardization of geographic information at the general level relate to:

- ability to interoperate between systems through use of common schemas and interfaces;
- increased understanding of data, through common terminology and standardized data definitions;
- ability to integrate locational data through use of standardized geospatial referencing systems;
- ability to discover data resources through standardized metadata;
- improved data quality, through use of standardized quality measures;
- formalizing standards produced by industry bodies, such as OGC;
- provision of models in a central repository to assist systems and applications developers.

The specific application communities addressed by the TC, where benefits are achieved include:

- location based services;
- observation and measurement;
- imagery sensor technology;
• land administration and information systems, e.g. the Land Administration Domain Model (LADM), described in ISO 19152, is a comprehensive conceptual model. Land information systems or cadasters can be implemented based on a simplification or extension of this model;
• land cover, e.g. the Land Cover Meta Language (ISO 19144-2) makes it possible to integrate land cover data from different sources;
• addressing, e.g. templates specified according to ISO 19160-4 may be used to exchange information about address rendering rules on international cross-border mail and domestic mail.

ISO/TC 211 standards also works to support the implementation of other International Standards, such as for:
• indoor mapping;
• self-driving cars;
• building information modeling (BIM);
• disaster relief and disaster management;
• indicators measuring progress on the UN SDGs.

SDI are the computerized environment for handling data that relates to a position on or relative to the earth, from the local up to the global level. SDIs such as INSPIRE in Europe, enable broadly-based environmental applications to be set up, so that data can be collected on a national basis and used on a pan-European basis. All the INSPIRE regulations and technical specifications are underpinned by ISO/TC 211 standards.
4 Representation and participation in the ISO/TC

4.1 Membership

Countries/ISO member bodies that are P and O members of the ISO/TC 211.  
[https://www.iso.org/committee/54904.html?view=participation](https://www.iso.org/committee/54904.html?view=participation)

4.2 Analysis of the participation

Figure 3 shows the participation in ISO/TC 211.

![Figure 3 - The ISO/TC 211 world map (source: ISO web October 2019)](image)

ISO/TC 211 has participation from all continents, with particularly good participation from Europe, Asia and North-America. The technical committee would like to increase participation from Africa and Latin-America.

The imbalance in participation is mostly caused by lack of financial resources, but also, to some extent, human resources.

The imbalance is partially reduced by having regional organizations, like the UN Economic Commission for Africa (UNECA), the Regional Committee of the UN Global Geospatial Information Management Americas (UN-GGIM Americas), and the Regional Committee of the United Nations Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP), participating as Category A liaisons.

The external liaisons to ISO/TC 211 include stakeholders such as professional associations, international and regional institutions, of which belong to, or are affiliated with, the UN, industry consortia, etc. Some of these external liaisons are contributing extensively to the technical committee by proposing and/or leading projects, submitting their own specifications to ISO to be developed into International Standards, etc.

As an effort to improve participation in the committee, ISO/TC 211 is specifically focusing on collaborating with the UN in a broad sense and continuing the good cooperation with other standards developing bodies.
5 Objectives of the ISO/TC and strategies for their achievement

5.1 Defined objectives of the ISO/TC

ISO/TC 211 develops a package of International Standards, linked to the committee’s work with the major trends and markets addressed in section 2 of this document. Standards developed by the committee has numbers between 19100 and 19199, with a few exceptions.

The committee has since its inception, prioritized establishing a suite of basic geographic information technology standards providing a conceptual framework for SDIs. The work is based on appropriate IT standards for information technology. The scope for the committee (section 7) also implies to provide a framework for the development of domain-specific applications using geographic data, which is illustrated in Figure 1.

Next to domain-specific standards the increased use of sensors and digitalization will also increase the demands for developing and using sensor web enabled standards.

Since geographic information is used in various applications, it is of great importance to cooperate with other domains and organizations.

The committee will initiate, and in some examples, already has initiated, good cooperation with several important domains, which are:

- geographic information standards in Smart cities;
- geographic information standards in Intelligent Transport Systems (Joint ISO/TC 211 - ISO/TC 204 WG: GIS-ITS);
- geographic information standards in the construction industry (Joint ISO/TC 59/SC 13 - ISO/TC 211 WG: GIS-BIM interoperability);
- geographic information standards in land administration;
- geographic information standards in statistics.

The plan for the coming two years includes to deliver:

- standards in the area of geodesy such as the International Terrestrial Reference System (ITRS), that meet needs for general use of geographic information and contributes to the Global Geodetic Reference Frame (GGRF) within the UN-GGIM work (WG 4, WG 9);
- a long-term maintenance environment for the ISO geodetic registry, an authoritative database with quality assured geodetic information (Geodetic Control Body);
- revision of the standard for linear referencing, which is applicable to transportation, utilities, location-based services and other applications which define locations relative to linear objects (WG 10);
- in total between 10 and 15 geographic information technology standards that have undergone revision.

Furthermore, the plan is to initiate:

- work on standards for land cover and land use, land administration, and addressing. This is a part of the committee support to UN and FAO in achieving Sustainable Development Goals (WG 7);
- work on calibration and validation of remote sensing data and derived products, which e.g. will help government design data quality policy and regulation to achieve high quality data and products (WG 6);
- work on framework for ontology, i.e. semantic interoperability of geographic information, which will define a high-level model of the components required to handle semantics in the ISO geographic information standards with the use of ontologies (WG 7).
More information on the work programme and the projects is found in section 7.

5.2 Identified strategies to achieve the ISO/TC’s defined objectives

There are four areas of strategy, and these are described in this subsection:

- collaboration;
- standards projects;
- harmonization and maintenance;
- outreach.

Collaboration

The strategy, besides the important work to maintain the already developed standards, is to work more closely with liaison organizations and other ISO technical committees to support specific application domains, since geographic information is used in various applications. Since most subjects are directly or indirectly associated with a location, geographic information and geomatics are linked to many other areas. It is natural for ISO/TC 211 to have a coordinating role for all standards in the scope of geographic information/geomatics. There are 36 external liaisons and approximately 25 internal ISO liaison committees to and/or from ISO/TC 211.

Collaboration with other standardization organizations is an important part of the ISO/TC 211 work. ISO/TC advises other committees and standards bodies, by liaison, on how to successfully embed geographic information in their work in a way that is compatible across the domains. Thus ISO/TC may at times, need to amend its set of standards, which may require collaborating with other TCs and standards groups to produce domain-specific standards and/or publishing Technical Reports concerning the use of geographic information standards for specific domains.

Standards have been developed in cooperation with several international organizations, e.g. the Open Geospatial Consortium (OGC)^2^, the Universal Postal Union (UPU)^3^, the International Hydrographic Organization (IHO)^4^, Food and Agriculture Organization of the United Nations (FAO)^5^, The Defence Geospatial Information Working Group (DGIWG)^6^ and the International Federation of Surveyors (FIG)^7^ All are category A liaisons of ISO/TC 211.

OGC ([www.opengeospatial.org](http://www.opengeospatial.org)) is a voluntary consensus standards organization. Its focus is to define, document and test implementation standards for use with geospatial content and services. Many of these implementation standards are based on the conceptual (or abstract) models defined by ISO/TC 211 or in cooperation between OGC and ISO/TC 211. The collaboration between ISO/TC 211 and OGC has proven to be one of the most important liaisons, and it is formalized by the Cooperative agreement, with the overall purpose of aligning the working processes of the two organizations. A Terms of Reference for the Joint Advisory Group (JAG) between ISO/TC 211 and OGC refines the relationship.

The cooperation between IHO ([www.iho.int](http://www.iho.int)) and ISO/TC 211 has been driven by the development of standards for digital hydrographic information and products. Both organizations

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^2^ OGC  
^3^ UPU  
^4^ IHO  
^5^ FAO  
^6^ DGIWG  
^7^ FIG
agreed to formalize their cooperation through a Memorandum of Understanding to strengthen the joint development of International Standards and to avoid duplication of work on standards related to hydrography and nautical charting and related data, products and services. Reports on the work of IHO are given at each relevant ISO/TC 211 plenary or working group meeting; reciprocally, and conversely, reports on the work of ISO/TC 211 are given at each relevant IHO meeting.

ISO/TC 211 has worked with FAO on the development of standards for land cover and is now conducting a study with the FAO on the revision of the two existing standards currently published and the addition of a standard to address land use. This work directly supports the FAO work on the UN SDG 2 to “End hunger, achieve food security and improved nutrition and promote sustainable agriculture”.

ISO/TC 211 is continuing to work with both DGIWG and IHO on standards for portrayal.

Another organization that contribute to the development of ISO/TC 211 standards, is the International Federation of Surveyors (FIG). FIG activities include cadastre and valuation and in 2012 submitted to ISO/TC 211 a proposal for a standard to cover land administration. This proposal became ISO 19152 Land Administration Domain Model (LADM) and has since being used worldwide, assisting countries to improve their management and integration of land administration with other fundmental geospatial data information. With the success of LADM a new version is being proposed to further improve its information, with possible inclusions like modules for taxation and validation, enhance 3D and 4D support, land management support and fit for purpose concepts and volunteered land administration and crowdsourcing

ISO/TC 211, OGC, and IHO jointly provide standards input to UN-GGIM, for example preparing the Standards Guide (Reference 1). Further contributions to UN-GGIM are viewed as a strategic activity for ISO/TC 211. The plan for the next two years includes to deliver:

- the document Strategic Pathway 6 as part of the UN-GGIM Integrated Geospatial Information Framework (IGIF). This high-level document aims to address all aspects of global, regional and national approaches to make administrative, scientific and commercial geoinformation productive according to UN-GGIM aspirations;

**Standards projects**

ISO/TC 211 encourages stage zero projects to formulate standardization requirements and to ensure involvement of relevant stakeholders in new areas of work before accepting NWIPs. The review summary report on ontologies (N 2705), ubiquitous public access (N 2862) and addressing (N 3188) are examples. These have been particularly useful where more than one International Standard is eventually developed.

For individual standards, ISO/TC 211 requests that the proposer of an NWIP submit their responses to comments received on the draft NWIP, so that they can be circulated to the TC at the same time the NWIP is circulated for balloting (Resolution 434, Responses to comments on draft New Work Item Proposals). The aim is to clarify how the comments to the draft NWIP have been handled in the formal submission for ballot.

The work with standard projects is organized in Working Groups:

- **WG 4** Geospatial Services;
- **WG 6** Imagery;
- **WG 7** Information Communities;
- **WG 9** Information Management;
- **WG 10** Ubiquitous public access;
• JWG 11 Joint ISO/TC 211 - ISO/TC 204 WG: GIS-ITS;

Harmonization and Maintenance
The maintenance groups in ISO/TC 211 coordinate harmonization among ISO/TC 211 standards, as well as with the geographic information community at large.

• The Programme Maintenance Group (PMG) monitors ISO/TC 211 standards, specifications and reports to ensure harmonization and consistency. It also monitors changing requirements and technological developments for alignment with the ISO/TC 211 programme of work.
• The Resources groups collaborate to ensure the maintenance and harmonization of terms, models, schemas, and ontologies for standards development projects within the TC. These groups are:
  o Terminology Maintenance Group (TMG) maintains the ISO/TC 211 terminology records and administers, coordinates, maintains and publishes a multi-lingual register of the terminology;
  o Harmonized Model Maintenance Group (HMMG) maintains the harmonized model to ensure that the UML models of ISO/TC 211 projects and standards and specifications are harmonized and conformant to requirements for UML modelling. HMMG also has the overall responsibility for management of resources for implementation;
  o XML Maintenance Group (XMG) ensures the development, maintenance and accessibility of XML implementation schemas from ISO/TC 211 standards and specifications;
  o Group on Ontology Maintenance (GOM) ensures the development, maintenance and accessibility on the Web of ontologies from ISO/TC 211 standards and specifications.
• ISO/TC 211 and OGC Joint Advisory Group (JAG) coordinates activities between the two standards developing organizations, The JAG meets at least twice a year, once associated with ISO/TC 211 plenary, once with OGC technical meetings;
• Control body for the ISO Geodetic Registry. ISO/TC 211 is responsible for establishing an international geodetic register according to ISO 19127. The Control body for the ISO Geodetic Registry was established by ISO/TC 211 and consists of a group of geodetic experts that decide on the acceptability of proposals for changes to the content of the register.

Outreach
As the objective of outreach is to increase the uptake of standards, and to attract participation, a strategy of ISO/TC 211 is to carry out conscious outreach work, targeted to the stakeholders. The committee work and outreach activities should have impact on the quantitative indicators described in section 2.2 concerning adoption, referencing, and implementation of standards, although it could be a great challenge to measure these effects.

The plan for the coming few years is to assure that the communication with the liaisons of ISO/TC 211 is active and relevant, and to assure that experts participating in the working groups have essential information about participating in ISO and ISO/TC 211 work.
6 Factors affecting completion and implementation of the ISO/TC work programme

There is a general lack of resources that impacts the work programme.

This often results in delays in the development of the project deliverable, and difficulties in meeting the expected milestones.

The lack of resources also impacts the capability to meet societal and business needs in the sense that important standards projects cannot be initiated. This is especially true for resources to lead the projects, project leaders and editors.

With such a comprehensive list of published standards, ISO/TC 211 faces a great challenge in the maintenance programme. Standards that should be revised for technical and business reasons, cannot move forward due to a lack of the resources to lead and participate in the work.

The strategic business plan addresses this factor in several ways: the global imbalance in participation is discussed in section 4, and the strategy section in 2.1 describes efforts in collaboration and building strategic alliances, as well as outreach. The means of addressing this factor needs to be further developed to meet the challenges of attracting participation to committee work.
7 Structure, current projects and publications of the ISO/TC

The defined scope of ISO/TC 211 is “standardization in the field of digital geographic information and geomatics. This work aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting and transferring such data in digital/electronic form between different users, systems and locations. The work links to appropriate standards for information technology and data where possible and provides a framework for the development of sector-specific applications using geographic data.”

ISO/TC 211 has a longstanding cooperation with CEN/TC 287. The work is now concentrated within ISO/TC 211, but standards are encouraged to be developed within the Vienna Agreement.

The committee website https://committee.iso.org/home/tc211 publishes detailed information about the committee work.

Information on ISO online

The link below is to the TC’s page on ISO’s website: https://www.iso.org/committee/54904.html

Click on the tabs and links on this page to find the following information:
- About (Secretariat, Committee Manager, Chair, Date of creation, Scope, etc.)
- Contact details
- Structure (Subcommittees and working groups)
- Liaisons
- Meetings
- Tools
- Work programme (published standards and standards under development)

Reference information

Glossary of terms and abbreviations used in ISO/TC Business Plans

General information on the principles of ISO’s technical work

References in this document

(2) European Location Interoperability Solutions for E-Government (ELISE), an action within Interoperability solutions for public administrations, businesses and citizens (ISA2).
Acronyms used in this document

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>BIM</td>
<td>Building Information Model (Modeling)</td>
</tr>
<tr>
<td>DGIWG</td>
<td>Defence Geospatial Information Working Group</td>
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<tr>
<td>ELISE</td>
<td>European Location Interoperability Solutions for E-Government</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FAO</td>
<td>UN Food and Agriculture Organization</td>
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<tr>
<td>FIG</td>
<td>International Federation of Surveyors</td>
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<tr>
<td>GGRF</td>
<td>Global Geodetic Reference Frame</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
</tr>
<tr>
<td>GML</td>
<td>Geography Markup Language (OGC)</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite System</td>
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<tr>
<td>GOM</td>
<td>Group for Ontology Maintenance (ISO/TC 211)</td>
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<tr>
<td>HMMG</td>
<td>Harmonized Model Maintenance Group (ISO/TC 211)</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
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<tr>
<td>IGIF</td>
<td>Integrated Geospatial Information Framework</td>
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<tr>
<td>IHO</td>
<td>International Hydrographic Organization</td>
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<tr>
<td>INSPIRE</td>
<td>Infrastructure for Spatial Information in Europe</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>ISA²</td>
<td>Interoperability solutions for public administrations, businesses &amp; citizens (EU)</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>ITRS</td>
<td>International Terrestrial Reference System</td>
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<td>ITS</td>
<td>Intelligent Transport Systems</td>
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<td>LADM</td>
<td>Land Administration Domain Model</td>
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<td>OGC</td>
<td>Open Geospatial Consortium</td>
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<td>OMG</td>
<td>Object Management Group</td>
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<td>PMG</td>
<td>Programme Maintenance Group (ISO/TC 211)</td>
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<tr>
<td>ROI</td>
<td>Return on Investment</td>
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<tr>
<td>SDG</td>
<td>Sustainable Development Goals</td>
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<tr>
<td>SDI</td>
<td>Spatial Data Infrastructure</td>
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<tr>
<td>SQL</td>
<td>Structured Query Language</td>
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<td>Terminology Maintenance Group (ISO/TC 211)</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<td>UML</td>
<td>Unified Modeling Language</td>
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<td>UN Economic Commission for Africa</td>
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<td>UN-GGIM</td>
<td>UN Committee of Experts on Global Geospatial Information Management</td>
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<td>Universal Postal Union</td>
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<td>World Wide Web Consortium</td>
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<td>XMG</td>
<td>XML Maintenance Group (ISO/TC 211)</td>
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<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
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