

**Chapter accepted for publication in the forthcoming**

**Encyclopedia of Geographic Information Science**

**SAGE Publisher**

**Karen Kemp editor**

**2007**

## **Geomatics**

Geomatics is the science of building efficient Earth-related data production workflows. Such workflows go from initial measurements using diverse technologies to the processing and dissemination of these data in various formats: maps, geospatial databases, field coordinates, spatial statistics, aerial images, etc. For example, Google Earth success relies on an efficient workflow to acquire, integrate, process and disseminate satellite images, aerial photographs, 3D digital terrain models, roads maps and GPS positions obtained from heterogeneous sources. Geomatics is thus concerned with the measurement and representation of the Earth, its natural and man-made features, its resources, its use and of the phenomena taking place on it. It is also concerned with the influences of geospatial digital workflows on the Society, organisations and individuals.

Geomatics is a broad paradigm that emphasizes the use of a system approach to chain heterogeneous Geospatial Information Technologies (GIT). It embraces the more specific disciplines of surveying, geodesy, photogrammetry, remote sensing, cartography, hydrography, positioning, and geographic information systems. It heavily relies on geoinformatics which focuses on geo-enabling modern information technologies (eg. database, decision-support, internet), communication technologies (eg. wireless networks, cell phones) and interconnection solutions (eg. protocols, standards, compatibility, interoperability).

Geomatics, similarly to informatics, physics and mathematics, involves generic knowledge applied in various fields such as forestry, geology, civil engineering, administration, public health, environmental protection, land management, urban planning and tourism, to name a few. Geomatics brings the knowledge necessary to master the hidden complexities of the numerous spatial referencing methods (quantitative and qualitative) used as integration basis for many projects and systems.

Geomatics deals with highly precise technical data (eg. Earth crust movement detection) as well as static thematic data (eg. map showing spatial distributions of damage categories after a hurricane), real-time mobile data (eg. monitoring of emergency vehicles), administrative and legal geographic information systems updating workflows (eg. a cadastral information system), and so on. Geomatics expertise is highly valuable to build applications with geographical information systems (GIS) software, but many geomatics projects do not use GIS software since there are many alternatives (eg. Computer-Assisted Drawing software (CAD), Spatial Database Management Systems, Web map servers) and there are many one-shot projects not requiring GIS software (eg. field survey for a dam construction, satellite image processing for an environmental impact study, volume calculation from 3D scans of extracted mining material).

Although it is common to see non-specialists who perceive geomatics as a synonym of GIS, it is not and has never been intended this way, GIS being one of the several components that may contribute to the geospatial data workflow of a project or an information system. In other words, geomatics is the science of selecting and chaining

different Geospatial Information Technologies in the most efficient manner while taking into account today's communication technologies and users' needs and contexts (budget, time, legal, organisational).

## Origins

Geomatics comes from the French word “*géomatique*” which can be used as a noun (*la géomatique*) or derived as an adjective (eg. *projet géomatique*), a verb (*géomatiser*), an action (*géomatisation*) and an actor (*géomaticien*). Its roots are “geo” (Earth) and “informatics” (information + automation + “ics” which is the accepted form for the name of sciences).

The first documented appearance of this term goes back to the early 1970s in France, at the Ministry of Equipment & Housing (cf. *Commission Permanente de la Géomatique*). At that time, it simply referred to the automatic processing of geographic data. At the same epoch, the word "photogéomatique" was also coined specifically for the automatic processing of data obtained from aerial photographs. However, these two words and their narrow definitions never achieved widespread attention and stopped being used.

A few years later, the term "*géomatique*" was reinvented in Canada, more specifically in the French-speaking Province of Quebec, to convey the modern view that was becoming common amongst the disciplines involved in data acquisition, processing and dissemination of spatial data (i.e. surveying, photogrammetry, geodesy, hydrography,

remote sensing, cartography and GIS). It was created as an umbrella term encompassing every method and tool from data acquisition to distribution. Without knowing about the earlier, narrower use of this term, it was Michel Paradis, a photogrammetrist working for the Ministry of Natural Resources in the Quebec Provincial Government, who created this word especially for his keynote paper at the 100<sup>th</sup> anniversary symposium of the Canadian Institute of Surveying (which became the Canadian Institute of Geomatics). It was Laval University Surveying Department, in 1986, under the leadership of Dr Pierre Gagnon, who recognized the importance of the new paradigm and developed the first academic program in geomatics in the world in replacement of its Surveying program. It also changed the name of the Department and of the Faculty.

This formal adoption of the term by a university created a momentum that spread across Canada and the globe. Private companies, governmental bodies and professional associations created “geomatics” divisions or identified themselves as geomatics organisations (eg. Geomatics Canada, Geomatics Industry Association of Canada, *Centre de Développement de la géomatique*, *Association de Géomatique Municipale du Québec*). The Canadian Institute of Surveying became the Canadian Institute of Geomatics not long after its French name was changed to *Association Canadienne des Sciences Géomatiques* (following the recommendation demanded by the Quebec Branch of the Association to the author of this entry). Surveying departments at the University of Calgary and the University of New-Brunswick also adopted this new paradigm in the late 1980s and early 1990s when they changed their identification as well as the titles of their degrees. Nowadays, it is widely recognized that the modern

geomatics paradigm originated from Canada, and more specifically from Quebec, that Michel Paradis is the father of the term while its mother is Laval University.

### **Impacts**

“Geomatics” is now used in many places, many countries and many languages. It first appeared in scientific books and specialized dictionaries in the mid-to-late 1970s and in general encyclopedia and dictionaries in the mid 1980s. Its widespread usage varies among disciplines and among languages. Nevertheless, a brief analysis of today’s education offerings shows about 50 universities and colleges around the World offering about 75 diplomas entitled “geomatics” (eg. “geomatics sciences”, “geomatics engineering”, “applied geomatics”), mostly former surveying programs, as well as over 50 “geomatics” journals or magazines.

The new paradigm conveyed by the word “geomatics” has been very influential. The usefulness of creating such a unifying, broader concept has also emerged in the United States where it has been paralleled. Many people see a striking similarity between the concept of geomatics that stemmed from the Canadian French-speaking surveying and engineering communities of the early 1980s and the American concept of Geographic Information Science (GIScience) that appeared in the early 1990s from the English-speaking geography community. While the former is mostly used by measurement-centric disciplines, the latter is mostly used by geographers and both are used internationally. Both serve as unifying umbrellas for today’s multidisciplinary challenges. In particular, the geomatics vision was born to explicitly shift the emphasis from

mastering individual technologies and methods to focusing on the synergy obtained when properly combining digital technologies from different data production disciplines.

As this approach reaches maturity and leads to the democratization of solutions, geomatics now involves concerns about societal, organisational, business, legal and individual impacts. Geomatics truly highlights the necessary shift from a technology-oriented silo approach to a data flow-oriented system approach geared towards a result under a given contexts. This 21<sup>st</sup> century definition of geomatics still conveys the original intention, but it reaches a new level of maturity by explicitly including concerns about the geomatics ecosystem.

Yvan Bédard

See also Cartography, Geodesy, Geographic Information Science (GISci), Geographic Information Systems (GIS), Google Earth, Photogrammetry, Remote Sensing,

### **Further readings**

Bedard, Y., Gagnon, P., & Gagnon, P.A. (1987). Modernizing Surveying and Mapping Education: the Programs in Geomatics at Laval University. *Proceedings of the XII<sup>th</sup> National Surveying Teachers Conference: Surveying the Future*. In cooperation with ACSM-ASPRS-ILI-WLSL, University of Wisconsin-Madison, July 5<sup>th</sup>-10<sup>th</sup>, pp. 239-256.

Gagnon, P., & Coleman, D. (1990). Geomatics, an Integrated, Systemic Approach to Meet the Needs for Spatial Information. *CISM Journal ACSGC*, Canadian Institute of Surveying and Mapping, 44 (4), pp. 377-382.

Paradis, M. (1981). De l'arpentage à la géomatique (From Surveying to Geomatics). *The Canadian Surveyor*, Ottawa, Canada, 35 (3), pp. 262-268.