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# The power of GIS language

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## 1. Maps as a kind of language

I have been working now for 50 years – since the foundation of Environmental Systems Research Institute (Esri), in 1969 – on building software tools that help different kinds of users do their work better.

Some of this is daily management, some of it is work flows but the power of GIS is the central power, the heart of GIS is really remarkable. It's almost magical to me. So, I'm sort of rediscovering myself and emphasising to all of GIS users all over the world to make better maps. Maps are about telling a story. Many of the maps that users make are maps that don't tell a story. There are lines and dots and a text and graphic display but they are not leveraging the power of this communication language. So I think of maps as a kind of language and we have photographs and paintings – these are graphic expressions of reality but a map is much more powerful and we need to treat it as the power that it has.

They say a photo is worth a thousand words. Well, I think a map is worth a million words because it connects with us as spatial creatures. You can relate to this beautiful graphics and this expression somehow channels into our brain the spatial relationships and we can clearly understand them.

One of my good friends, Richard Saul Wurman, was the man who started TED and one of the things he said is "Understanding precedes action", so this language of mapping precedes action in many ways and we need as authors of the map to think of ourselves as telling stories as a foundation for human action. That means thinking a lot about the story people want to tell graphically, making it beautiful of course, but also impactful storytelling is behind this language that we have.

After all, a long time ago, it was underlined that: "The final stage in any GIS project is the presentation of the results. Geographical data can be presented in many forms, including maps, graphs, statistical summaries and reports, tables and lists. All of these methods of output should ideally be provided by a GIS. Though presentation is a vital part of any substantive application and one which can require access to a wide range of commands" (Maguire and Dangermond, 1991, p. 330).

Nowadays, the possibilities to present and spread the results of their works are manifold and variegated and the web constitutes an incredible source for sharing and attracting the

attention of a huge audience. At the same time, people wish to relate their experiences, their stories and there is the need to put in network data, maps, web applications useful to feed further data, maps and web applications in a virtuous circle.

Getting all the way back to Columbus's time, maps were used but their story was predicting what's going to happen, when you get there. Where will we come to? Today, given the dynamic nature of GIS space mapping, there's so much to be done.

As affirmed in 1991, the development of GIS is related to different elements and particularly (Dangermond, 1991, p. 55)

> hardware, to provide the fundamental enabling capabilities required; construction of a sound theoretical basis for geographical relationships and a model of how geographical reality could be abstracted for data processing; engineered software products which would encapsulate the scientific notions of spatial analysis and geographical data processing; creation of demand for spatial information in order to address complex problems about geography; creation of an industry which could manufacture and distribute GIS technology; and creation of a research environment with all its competitive mechanisms, for ensuring advances in methods and techniques. Each of these elements required appropriate institutional settings and the development of people who would create and drive these institutions.

With the modern tools and functionalities, digital maps can be used to (https://www.esri.com/en-us/esri-map-book/foreword)

> tell many stories and show how creative cartography and spatial analytics are being used to create understanding and communicate this understanding effectively. […]. GIS is becoming a common and popular platform for most organizations. It provides not only visual insights and understanding but also whole new ways for collaboration. A new pattern of GIS known as Web GIS is emerging. This new paradigm leverages web services and can be used to easily make maps from distributed geographic information of nearly any format. Web GIS is enabling geographic information to be easily shared and directly used in apps that support many operations and run anywhere. Today, billions of GIS web maps are used to communicate a story. This is creating a new visual language. The result is the reach of GIS is expanding far beyond the domain of GIS professionals.

As I recently underlined in a discussion, we live and work in an extraordinary world where we can study and create contexts and where we have the possibility to choose our actions and advance our proposals. We can marvellously switch to creative experiences and thanks to GIS and geography we can see things differently, suggest important solutions and act profitably (O'Keeffe, 2017, p. 5), thinking of our past, present and future.

## 2. GIS for creating and spreading knowledge for social utility

> The explosive growth of the GeoWeb and geographic information contributed by users through various application programming interfaces has made GIS powerful media for the general public to communicate, but perhaps more importantly, GIS have also become media for constructive dialogs and interactions about social issues. This is something we did not recognize 10 years ago, but it is obvious to us now. This new role of GIS as social media can be understood from two perspectives. First, various users and contributors of online mapping sites have formed their own virtual community for exchanging information. […]. Second, […] A growing number of these actions have resulted in meetings in person and activities in real places. […]. In summary, GIS as media constitute a fundamental paradigm shift in GIS, from the old model of an intelligent assistant serving the needs of a single user seated at a desk, to a new mode in which GIS act as media for communicating and sharing knowledge about the planet's surface with and among the masses. During that process, GIS not only bring people together in cyberspace but also attract people to meet in person for the common good of their community. The paradigm change also implies a simultaneous shift of technical focus, from local performance to network bandwidth, and increases interest in issues of semantic interoperability in place of

> earlier concerns with syntactic interoperability: in other words, sharing requires a common understanding of meaning, as well as a set of common standards of format (Sui and Goodchild, 2011, pp. 1738-1739).

In the last years, GIS have seen an amazing increase in their communicative power and their potential capability to create knowledge, involving a notable amount of users. The possibilities have become so many that it is often difficult to extricate them and discern what is reliable from what only provides dicey suggestions, which are geographically unreliable or even twisted.

Similar considerations can also be referred to the reflections on Big Data, which open up further multiple perspectives and another debate issue, owing to their potentialities to support useful research and activities in many fields but also for their contemporary dispersion (Pesaresi, 2017, p. 51).

GIS and Big Data could feed a formula to make an in-depth analysis of many aspects and phenomena, in a spatial, multitemporal and predictive perspective, producing scenarios and simulations, models and animations with an interdisciplinary approach. Big Data – if harmonically structured and easy to find and download – could constitute the founding basis whereby to organise and create multiple and connected layers; while GIS could be the excellent instrument to realize varied digital representations, meticulous geo-statistical analysis, the "packaging" and sharing of captivating output products, such as dedicated web applications too. All this can provide a notable contribution to the progress of the state of the art in different sectors of the application, planning, landscape feature reconstruction and enhancement proposals, with the goal of social utility. However, it can do this only in the presence of researchers, analysts and professional figures who possess a wide and consolidated baggage of theoretical knowledge, methodological competences and geotechnological abilities, enhanced by geographical contents founded on the study of manuals, further deepening this knowledge through scientific journals and experiences on the field.

In this case the convergence between GIS and Big Data – in a system which compulsively rotates around web opportunities and social media – can provide notable added value and remarkable results for the common interest.

Thus, relevant progress could be recorded by knowing how to choose the right sources, profitably and relationally organising the amount of data selected, and producing digital maps, models and web applications, leaning primarily in a geographical way of thinking and operating towards a GIS environment able to speak a persuasive and communicative language.

It can for example occur with (Tsou, 2015, pp. S70-S71):

(1) *Social life data* [which] include popular social media services […], online forums, online video games, and web blogs. Many social life data include some social network information, which can be analyzed by using social network analysis methods and tools […].

(2) *Health data* [which] include electronic medical records (EMR) from hospitals and health centers, cancer registry data from state and local communities, official disease outbreak tracking and epidemiology data, personal health data from mobile devices, relevant social media data, crowds sourcing data for monitoring disease outbreaks and drug side effects […].

(3) *Business and commercial data* [which] include business transaction records […], online business reviews […], customer relationship management, supermarket membership records, shopping mall transaction records per store, credit card fraud examination, enterprise management data, and marketing analysis data.

(4) *Transportation and traffic data* [which] include GPS tracks (from taxi, buses, Uber, bike sharing programs, and mobile phones), traffic censor data […], social media data […], and mobile phone data (from data transmission records and cellular network data).

(5) *Scientific research data* [which] include earthquakes sensors, weather sensors, satellite images, crowd sourcing data for biodiversity research, volunteered geographic information, and census data.

Some Big Data sources might be linked to multiple categories and used for multiple purposes. […]. 'Data fusion' and 'linked data' are the two key concepts in mapping Big Data, which can facilitate big ideas, big impacts, and big changes toward the future development of cartographic research.

 

High competences in the use of GIS and the selection and organizing process of Big Data – together with a geographical way of reasoning and setting up work and with basic programming abilities – can also open up a series of important job opportunities. It is about job opportunities where rigour in the preparation of the work and analysis, enthusiasm and motivation, creativity and innovation are in synergy to pursue ambitious results.

GIS and geography have become two connected ingredients for understanding and communicating knowledge according to a powerful language for sharing ideas, information and insights, also because people and above all the young "are visual learners and seem to be instinctively attracted to maps" since they "instantly perceive patterns, relationships and situations". In functions of the geographical approach and in the perspective of social utility, GIS has become a tool for integration and interpreting data and urgent problems, availing of an incredible potential to reach a huge number of people thus creating a network among users and organizations all over the world. In this way it is possible to emphasize and illuminate aspects and relations, conduct quantitative and qualitative analysis, animate situations and changes, support the coordination of operations and activities. Moreover, GIS make it possible to produce specific apps, which work and can be quickly consulted everywhere through mobile phones, tablets, various appliances, web browsers, to tackle and solve critical questions, facilitate transports and communication, report the detection of faults and difficulties, and practically GIS go where people go (often without them being aware of it). GIS generate 3D models creating great fascinating opportunities for visualization, planning and analysis, where navigation and exploration functionalities are combined with the calculation and data management and extrapolation ones. And then GIS support storytelling with maps, making available numerous templates for creating and sharing maps online, in which to weave documents (cartographies, photos, paintings, texts…) of various types for creating and spreading knowledge (Wurman and Dangermond, 2017, pp. 74; 84-107).

In 1854, John Snow (1813-1858), studying the cases of cholera in Soho (London) with the support of detailed maps, highlighted the crucial influence of polluted water coming from a water pump for the transmission of the infection among the inhabitants. Practically, he identified and geolocalized the risk factor on the basis of the spatial distribution of the infection. It is an extraordinary example which shows how the "prodromes of a GIS application" in the hands of a prominent scientist provided an exceptional benefit for social utility and public health.

The use of multiple GIS tools and functionalities, as the support of forward-looking brains, guided by theoretical-methodological contents in an interdisciplinary key, have an enormous intrinsic power which must explode in all its potential with tangible results in different fields of application.

Big Data, geostatistical, spatial and multitemporal analysis, 3D Models and geographical rendering, 4D scenarios, reliefs obtained by drones and field surveys imported onto a GIS platform, Story Maps and web applications often represent the glue whereby to move and undertake together complex paths with profitable repercussions, which sometimes go beyond the expected results in the planning proposal phase.

The possibilities of diffusion and transmission of information are nowadays extremely wide in the perspective of the raising of awareness and transformation of the means of common daily use into something that can become a considerable added value for people and the environment.

> For centuries, maps have stirred imaginations and inspired explorations of the unknown. Maps are a rich source of information, showing spatial relationships between climate, vegetation, population, landforms, river systems, land use, soils, natural hazards, and much more. Maps help us investigate the 'whys of where' the essence of scientific and geographic inquiry. […]. They explain far more than simply 'what is where'. They are keys to uncovering the reasons for the location, interaction, and changes occurring over, on, and under our planet's surface, and in addition, in social, cultural, and political networks that often cannot be seen or touched (Kerski, 2013, pp. 11-12).

 

GIS have a peculiar powerful language but this must be framed and contextualized in the geographical approach and education. GIS and geography have to concur towards a widespread sense of awareness, rigor of thought, ability to analytically study phenomena and problems and relationships, the desire to understand and create knowledge, enthusiasm to be an active part in the interpretative and decision-making processes.

"GIS has reached a new phase in its technological development, and we are now able to move on from the purely technical point of view (of being limited by what GIS software can do) and continue to develop the critical spatial thinking aspect of geography within the framework that GIS provides us with" (Bearman et al., 2016, p. 405).

The implementation of geographical and GIS education can have a crucial role in training accurate and meticulous spatial thinkers (Bednarz and van der Schee, 2006); the combination of fieldwork with GIS may provide profitable results for learning geography in a modern successful way (Favier and van der Schee, 2009); the study of geographical contents and didactical methods maximizes the inciseveness of GIS language.

By harmonically integrating GIS into educational aims and learning approaches, it is possible to promote and conduct stimulating and fulfilling experiences that show the power of geography's spatial and temporal perspectives. Moreover, it is possible to open various opportunities for geographers and expert users to consider innovative and rigorous ways in which maps can be used (Sinton, 2009, p. S7). At the same time: "Geography is one of the most interesting, vibrant, and dynamic fields of study […]. It's also one of the most vital" (Artz, 2013, p. 5) and it can give a soul, emotional contents and operative guidelines to the analysis carried out with GIS and geotechnologies.

After all: "GIS can tell us a lot about the world that is valuable and useful. But only a user who is always thinking critically can filter what is valuable and useful from what may be dangerous and misleading. Always question!" (Goodchild, 2017, p. XI).

We have great things to do. We must not be in a hurry; we must assume our responsibilities; we must also follow hard routes with enthusiasm, and we must do it in the awareness that we can do something important and that we are willing to do it for a better and better present and future. Moreover, we have to do it with a thundering geographical and GIS language, able to shake, involve and associate people: a language that is scientifically exciting.

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**References**

1. Artz M., "The New Geographers", in Esri (Ed.), *Essays in Geography and GIS*, Redlands, 2013, pp. 5-6.
2. Bearman N., Jones N., André I., Cachinho H.A. and DeMers M., "The future role of GIS education in creating critical spatial thinkers", *Journal of Geography in Higher Education*, 40, 3, 2016, pp. 394-408.
3. Bednarz S.W. and van der Schee J., "Europe and the United States: the implementation of geographic information systems in secondary education in two contexts", *Journal Technology, Pedagogy and Education*, 15, 2, 2006, pp. 191-205.
4. Dangermond J., "The Commercial Setting of GIS", in Maguire D.J., Goodchild M.F. and Rhind D.W. (Eds.), *Geographical Information Systems*, vol. 1 (Principles), Harlow, Longman Scientific and Technical, Longman Group UK, 1991, pp. 55-65.
5. Favier T. and van der Schee J., "Learning geography by combining fieldwork with GIS", *International Research in Geographical and Environmental Education*, 18, 4, 2009, pp. 261-274.

 

6. Goodchild M.F., “Preface”, in Pesaresi C., *Applicazioni GIS. Principi metodologici e linee di ricerca. Esercitazioni ed esemplificazioni guida*, Novara, UTET – De Agostini, 2017.
7. Kerski J.J., “Understanding Our Changing World through WebMapping Based Investigations”, *Journal of Research and Didactics in Geography (J-READING)*, 2, 2, 2013, pp. 11-26.
8. Maguire D.J. and Dangermond J., “The Functionality of GIS”, in Maguire D.J., Goodchild M.F. and Rhind D.W. (Eds.), *Geographical Information Systems*, vol. 1 (Principles), Harlow, Longman Scientific and Technical, Longman Group UK, 1991, pp. 319-335.
9. O’Keeffe L., “Extraordinary World. A discussion with Esri Founder and CEO Jack Dangermond on the value of the big picture”, *Flora*, 1, 1, 2017, pp. 4-7.
10. Pesaresi C., *Applicazioni GIS. Principi metodologici e linee di ricerca. Esercitazioni ed esemplificazioni guida*, Novara, UTET – De Agostini, 2017.
11. Sinton D.S., “Roles for GIS within Higher Education”, *Journal of Geography in Higher Education*, 33, S1, 2009, pp. S7-S16.
12. Sui D. and Goodchild M., “The convergence of GIS and social media: challenges for GIScience”, *International Journal of Geographical Information Science*, 25, 11, 2011, pp. 1737-1748.
13. Tsou M.-H., “Research challenges and opportunities in mapping social media and Big Data”, *Cartography and Geographic Information Science*, 42, S1, 2015, pp. S70-S74.
14. Wurman R.S. and Dangermond J., *Understanding The Science of Where. Map*, 2017.

 