Human Geodesy - Shaping a New Science and Profession for the World of Tomorrow

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SUMMARY

This article defines the framework and the basic questions for a new science and profession, human geodesy. Similar to the 'human' counterparts of physical geography, physical ecology, cultural anthropology and technical informatics or information sciences, mathematical and physical geodesy needs a 'human' equivalent. The article advocates that there is a need for human geodesy in order to specifically formulate new concepts and basic paradigms on why and how people divide the earth, the land and the real estate. Society needs such a trans-discipline because current disciplines are fragmented and often contrasting, which in the professional practice results in counter-productive effects. Moreover, societies are changing in their priorities and views on land and real estate. The main aim is to derive principles of human geodesy. The starting assumption was that it should be possible to derive generic elements and a comprehensive framework with specific research goals based on personal experiences, stories and collected insights and perspectives over the past 25 years. A number of distinctive aspects of what could be human geodesy are first derived using a 3 vignettes describing personal experience where a distinctive science would have been useful. Then, the contours of the human geodesy science are specified using both a more pragmatic method of relying on Aristotle questions followed by a more rigorous description using basic descriptors of what a science is (using ontology, epistemology, axiology and methodology). The final conclusion section provides a definition of human geodesy and an outlook of how and where human geodesy could be utilized.

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1. INTRODUCTION

If you can be at two different places at the same time, as quantum mechanics claim is possible, a geodetic line becomes a point, a political point becomes a slippery slope, and at every point you can have **heimweh** *and* **fernweh** (de Vries 2013)

Geodesy is the science studying and designing the division of the earth. The original meaning of geodesy is shaped by two Greek words, γεωδαισία or *geodaisia*, literally meaning the "division of the Earth". So, the original meaning of geodesy deals with activity of dividing rather than the static status quo of division. Normally, geodesy is associated with measurements of the earth's shape, the boundaries between parcels and zones and the gravitational field. It uses basic concepts of coordinates, coordinate systems, geoid, orthometric heights amongst others to locate a position and help the description of objects in relation to a relative or absolute coordinate system. As the earth's surface is not static but subject to change, forces changing the surface must be studied and measured as well. For that reason, various principles of geophysics and a variety of statistical methods are also often employed in order to describe positions in time. Geodesy in principle therefore heavily relies and relates to exact and natural sciences. Consequently, Wikipedia qualifies it even as a branch of mathematics studying the shape of the earth, dealing with the measurement and representation of the Earth, including the gravitational field, in a three dimensional time-varying space.

On the other hand, the major reason why geodesy was developed was the division of the earth, either as large territories, for entire countries) and/or for smaller parts of the earth, as individual parcels on which rights can be exercised. Many of these division activities are strongly connected to human actions, human claims, human beliefs and human choices. Hence, the division itself and the power and social activity that comes along with it, is fundamentally a human activity. Understanding how and why these activities takes place, and what the consequences of these are, require a new fundamental perspective. In many geodetic faculties there are lots of subjects which primarily deal with social and legal relations of people to the earth's surface. Usually this translates to land administration, land management, land use planning, land valuation, land policy, cadastre, cadastral science, etc. In practice there are also many new dimensions of activities and ways of organising people's relations to the earth – VG, LPI, Neocadastre, etc. Moreover, such activities and the relations that people make to the earth do not only relate to land, but also to water (marine cadastres,) subsoil (mining cadastres), resources (environmental protection cadastres / conservancies). Encompassing the variety of relations that people with the Earth shape calls for a comprehensive science - ***Human*** Geodesy.

Why such a new science related to earth and human necessary and what would it add to already existing sciences and professional practices? There are a number of reasons. First of all, many

geodesy and geo-information sciences faculties include already many social, human and management topics / modules in their curricula which in general do not have a common name or generic research umbrella. These include topics such as land administration, land management, cadastre and land registration, land valuation, principles of spatial planning, operational management of land agencies, just to mention a few. What these topics tend to have in common is that these all relate to land, how humans interact with land, and how human claim of plan pieces of land. Other than for example land surveying, photogrammetry and physical geodesy, determining the height or location via mathematical or physical calculations is not the prime objective of these types of topics, but determining the human – place - object relation has the prime focus. Within the human aspect these topics would not exist.

Secondly, other sciences related to earth and environment also have a human component besides a more physical or mathematical component. Examples include:

- Human geography (also: cultural geography - versus physical geography). It is the branch of the social sciences that deals with the world, its people and their communities, cultures, economies and interaction with the environment by emphasizing their relations with and across space and place (Johnston, Gregory, and Pratt 2000).
- Human ecology (versus physical ecology). Human ecology is about relationships between people and their environment (Marten 2001).
- (Social) anthropology (study of humans) - versus economic, biological, cultural anthropology. Social anthropology focuses on the diversity of positions and perspectives, ambiguities, conflicts, and contradictions of social life (Social anthropology journal & wikipedia).
- Human / social informatics – versus technical informatics. Social informatics is the study of information and communication tools in cultural or institutional contexts (Kling, Rosenbaum, and Sawyer 2005) - Studying and Teaching the Human Contexts of Information and Communications Technologies

This article will derive the basic principles of what I will call ‘human geodesy’. I will argue that ‘human geodesy’ is a sub-discipline, part of geodetic sciences, and, although until now hidden and unnamed, a self-standing science, with its own ontology, epistemology, methodology and axiology. It is closely related to other disciplines such as human geography, human ecology, land management, land administration, public administration and policy sciences. I will rely on a personal narrative, using places where I have lived and worked in the past 50 years. Stemming from the social constructivist standpoint that science is also dependent on context and social frames, and also that science is somewhat pragmatist I argue that it is reasonable to start from this start point. I belief that in my private and professional life I have gradually developed my own interests and questions within the world, my own preferences and choices in how and why the world is shaped the way it is, my own way of how to make sense of the world around us, and my methods of how to look at the world. Obviously, all of these aspects have been strongly influenced by my own experiences, upbringing, academic formation and professional experiences. However, I strongly believe that these aspects are largely shared by a specific academic and professional community, which until now have been working under different headings, umbrellas and research themes. Yet by extending my own views and classifying these in a framework which is comprehensive and

adhering to a number of generic analytical aspects of science, I aim to make a first step towards a more common framework for a hidden science with a new name: human geodesy.

The argument has the following sequence: first, I present 3 vignettes of places where I lived and worked over the past years, in order to state the particular perspective of what I call a human geodesist, someone with a background in geodesy, with an attentiveness and particular eye for human development, human (and discretionary) choices and human wellbeing. These narratives derive the first contours of a human geodesy perspective. Then, a general introduction is given in how geodesy is usually described, and how the science can be extended with a human component. This supports the subsequent section which uses the basic principles of describing a science in order to describe the basic components, concepts and principles of human geodesy. The article concludes with how and where the insights of human geodesy could be utilized.

2. LEARNING AND EXTRACTING FROM PERSONAL EXPERIENCES

Constructing or defining a new science or sub-science is not a linear or discrete process. One view is that constructing meaning is interlocked in social interactions. This social constructivist standpoint claims that science is dependent on context and social frames, and formulating consistent and coherent interpretations (Marshall, Kelder, and Perry 2005, Maaløe 2007). Practically this view can be made concrete through *vignettes* reflecting personal experience and reflection. Vignettes are, simply put, stories generated from a range of personal sources and personal experiences (Wilks 2004). Vignette descriptions are an appropriate tool when compiling perceptions, experiences, beliefs and attitudes on a context or a phenomenon. I use vignettes to derive some basic understanding of what geodesist would be interested in given particular cases and case descriptions and what a human geodesist perspective could look like.

2.1 Vignette 1 – Poortugaal, Netherlands

I grew up in Poortugaal, a small village close to Rotterdam. When you grow up, you do not notice the special characteristics of the geography and the human constructions of this place, but once you move elsewhere you notice how it is different from other places. Poortugaal is a village established more than 700 years ago located south west of Rotterdam. From a pure mathematical geodesist point of view it has 7,5 km^2 of territory, and a large part of Poortugaal is below sea level, as can be seen from the online data set of the Generic Height Model of the Netherlands, available through http://ahn.arcgisonline.nl/ahnviewer. In addition, being located in both a delta area of several rivers and given its relative closeness to the North Sea it is particularly vulnerable to floods and sea level rise.

Besides the physical characteristics there are a number of socio-economic and cultural characteristics which are closely tight to how the physical landscape looks, and more importantly, how the land has been divided. As a result the infrastructure landscape Poortugaal contains multiple dams, along which houses have been built. Currently it has approximately 10,000 inhabitants. It used to be over 20,000 but part of the territory was allocated to Rotterdam in 1985, explaining the decrease. It still has a somewhat rural character but through the transportation infrastructure and socio-economically it is now strongly tied to the port and industry of Rotterdam. The cultural and

institutional character related to water is however strongly maintained and visible. The water management is administered by Water boards, a separate layer of government, with regular elections and authorities (in this area the responsible agency is Waterschap Hollandse Delta - http://www.wshd.nl/index.html. It as a separate (from other government agencies) administration, which can decide on water measures, protection, evacuation, and engages in continuous dredging of small and big waters (and re-use of dredged materials).

Cultural-social aspects in this region include water education and water awareness campaigns. The '53 disaster part of the 50 key issues of Dutch history as basic education (the 'canon van de nederlandse geschiedenis - https://nl.wikipedia.org/wiki/Canon_van_Nederland), and water awareness is visible by the high rate of swimming lessons as of age 0! A total of 96% of population of <15 years old has multiple diplomas in swimming, and swimming is part of curriculum primary and secondary schools. Finally, there are special websites and contact points in case of emergencies, e.g. http://www.overstroomik.nl/hoe-hoog-komt-het-water.html?postcode=3171+AG.

Although many of the characteristics described above may seem random and coincidental they do provide a particular perspective which in interesting from a human geodetic point of view, i.e. how the land is divided and how human activity is related to this division. In short, a potential role and a particular perspective of a human geodesist could be:

- The land is divided in close connection with the human activities of protection against water from both rivers and the sea. In the division on therefore has to carefully evaluate the impact of and/or the relation of water measures in relation to availability, value and possible use of land (e.g. dredging and diking make certain land available; lead to increase in land value; may restrict certain land use). In other words, the physical context in which people live is crucial for the human activities which relate to divisions. Human geodesist should thus be able to understand why and how land can be divided and allocated optimally given a physical situation.
- The division of land is reflected in the human organisation and governance of the land and water. First of all, there needs to be a sufficient amount of data about water and risks of flooding available at all times in order to make division decisions. Secondly, a formal governance structure needs to be in place to decide on land and water decisions. This is facilitated by an inter-administrative collaboration through sustainable information infrastructure on land and water data, spatial restrictions and obligations (e.g. 'waterwet' via national government 'waterverordening' via Provinces, 'peilbesluiten' via water boards, 'bestemmingsplannen' via municipalities). A human geodesist would thus be interested in how to best design a governance and allocation of rights and responsibilities structure which fits best with the given design of land division and allocations.
- Human activity, values and civic awareness is closely related to how and why land is divided the way it is. In this case is was clear that the population maintained a constant awareness of civic sensibilities in relation to water and land claims and changes thereof. A human geodesist would aim both to discover which sort of values of intrinsic given the division of land, and which sort of activities would this make most sense to maintain and sustain these sensitivities.

2.2 Vignette 2 – Lampung, Indonesia

One of my first jobs was in Lampung in Indonesia. Here my job was to support the allocation of land parcels to farmers after a reclamation project. The area was originally a swamp area. Few people lived or worked in this area, although local residents occasionally visited it. The general justification of the reclamation project was to provide suitable land for transmigratory farmers from other parts of Indonesia. The project itself had multiple components. Besides the land allocation first of all the design and execution of the reclamation was carried out. Many small canals were created which allowed for the drainage of the swamp, and thus created accessible and arable land. Several dikes and dams were made to control the water levels. In addition, farmers were supported in the selection and cultivation of appropriate grows and the communities were supported in the development of additional socio-activities in order to make the community viable and sustainable. Finally, a special program aimed at creating awareness for women's rights and the role of women in rural development.

Despite the project goals and activities, there were quite a number of difficulties in the execution of the project. There was first of all not a homogeneous group of new tenants in the area. Transmigrants originated from different parts of the country. Each had their own experiences and practices of farming and land rights which they aimed to adopt in the newly created parcels. In addition, the original population of the area, the inhabitants of Lampung, claimed priorities in the land right allocation. They argued that although they may not have been using the land, they should be given priority in the land rights, especially considering that the investments of the project should primarily benefit the local population. This variety became a source of social conflict and overlapping land claims. Another difficulty became that many farmers who were allocated land ownership rights sold their ownership right to absentee land owners. This resulted in land speculation.

The geodetic issues in this specific experience could be summarized as:

- 'New' land was created and distributed to new farmers. The project supported the development of the community in order to sustain the newly distributed land. The role of a geodesist was to support this process, i.e. designing the distribution and allocation plan and ensure the administration of associated land rights. Land rights need to be embedded however in local social structures. If it appears that local social structures are perhaps not present in the exact location, it is important to take the vicinity into account. For the land reclamation project is was therefore crucial to bring these in the social support projects.
- The role that human geodesists can play in such socio-technical change processes is to collect pre-reclamation information, prepare land consolidation plans – who would be allocation which piece of land where? - , discuss the pros and cons with all stakeholders in the land (re-)allocation matters and determine who rightful and legitimate claimants are. In the process
- The human organisation related to land division is visible in the emerging governance structures. On the one hand it remains necessary to coordinate information sharing among public agencies and social institutions (water works, land offices, local governments, local populations, representatives from transmigrants, agricultural offices, etc.), on the other hand social extension programs need to combine rural development, gender equity, agricultural optimization and community building.
- Finally, it is crucial for a human geodesist to be aware of the effects of land division. Subsequent research has shown that land speculation and land use changes occur which may be

contradictory to the original plans of allocation (Abelen and de Vries 2016). Hence, the life after land division continues. The question is how, in which direction and why in this direction?

2.3 Vignette 3 – Namibia

One of my long-term work assignments in the nineties of the previous century was a project of institutional support and human resource development for the Ministry of Lands, Resettlement and Rehabilitation in Namibia. The goal of this project was amongst others to prepare the human resources for the implementation of the anticipated flexible land tenure act, which at that time was not yet approved. The flexible land tenure act foresaw a number of new types of professionals, such as community surveyors / land measurers and community land use planners, which would need different skills than conventional land surveyors, land registration officers or land use planners.

This project has to be seen in the national context of Namibia. After its independence in 1990 Namibia started a enormous reorganization of government structures and implementation programs. One of such included the Land Reform Programme, whereby both commercial farms would be acquired for resettlement purposes, and informal settlements areas would gain more tenure security. Practically this led to the Communal Land Reform Act (CLRA), No 05 of 2002 and the Flexible land tenure Act (FLTA), no. 04 of 2012 , for gradual upgrading of informal land tenure (mainly in peri-urban areas) – which was an upgrading scheme to upgrade a basic right to land in a shared area to a full freehold individual title.

In the preparation and execution of these acts a broad of geodetic activities were necessary. Besides setting a completely new reference framework, the activities heavily relied on a significant understanding of local context of people, their practices, their values and their beliefs. Technically, the activities consisted of customary land registration using orthophotos, and the development of a new land registers amongst others. Socially, it required being attentive to other forms of land ownership or land tenure frames (e.g. San people), the development of small scale farms in communal areas with modern infrastructure, the execution of upgrading schemes, mapping, registration and organization, and the support of informal settlers to secure their tenure and opportunities.

The human geodetic position is hereby:

- Division of land cannot be disconnected from historical perspective. Even during a land reform process, multiple views exist and may emerge. These need to be collected and recognized alongside the preparation of division and allocation plans. This requires however also a solid understanding of historical sensitivities and identities.
- The speed of land reform is usually not in line with the human resources development. In order to execute a land reform properly one does not only need to raise the individual capacities, but also needs to develop the recognition of new types of professionals. Human geodesists at all sorts of levels need to be developed to understand both the technical and social effects of land reform.

3.IF HUMAN GEODESY WERE A SCIENCE, WHAT (KIND OF SCIENCE) WOULD IT BE?

The above vignettes of the experiences with land matters show that the process of land division is both a technical and social process. Technical interventions coincide or co-evolve with social changes and human organisation. To make this understanding better recognized a scientific perspective is crucial. One can define a science in multiple ways. A pragmatic way is using Aristotle questions (from his book τόπος (*tópos*, literally "place, location") - http://www.iep.utm.edu/aristotl/). The word τόπος is also related to the ancient memory method of "loci", by which things to be remembered are recollected by mentally connecting them with successive real or imagined places, however using the Aristotle questions one aims at defining an refining a major idea, concepts or framework by formulating how one can best describe the main constellation of:

1. Definition (Genus and division)
2. Comparison (similarity and difference)
3. Relationship (Cause/effect, antecedent/consequence, contraries)
4. Circumstance (possible/impossible, past/future)
5. Testimony (authority, statistics, maxims, precedents)

When one uses this sequence of questions and link it back to the personal vignettes, one could derive the key constituents of the human geodetic science. Table 1 one describes these elements:

1	**Definition (Genus and division)**	a) Interested in phenomena occurring around division of space as human activity b) Constituents parts: role of government and citizens, responsibility and accountability, methods and instruments of decision making, frames and perspectives
2	**Comparison (similarity and difference)**	a) Similar to approaches of geodesy and other 'human' sciences b) Different as it combines technical and social approaches c) Degree: systematically makes the combination
3	**Relationship (Cause/effect, antecedent/consequence, contraries)**	a) Cause/effect: focus on human claims and stakes in relation to land and space helps to reveal/understand hidden powers b) Antecedent/consequence: current focus on location of humans neglects multi-dimensional relation (identities, claims) of humans to spatial entities; c) Contraries: pure ethnographers may state they have already done this; yet, do not make use of geodetic techniques d) Contradictions: against the topic may be that it seems too non-technical

4	**Circumstance (possible/impossible, past/future)**	a) Possible/impossible: it can engineer better spatial designs, aware of multiple frames; it can't necessary change frames or perspective (no social engineering) b) Past/future facts: performance – yet to be seen
5	**Testimony (authority, statistics, maxims, precedents)**	a) Authority: no expert opinion yet on human geodesy b) Testimonial: use of Q proved relevant in tourism study Katrin Struller (participative approach to analyse touristic adaptability of rural communities in Bavaria) c) Statistics: Q sorts help to talk about human geodetic methods d) Maxims: the human geodesist claims space e) Laws: Thomas' theorem (*If (wo)men define situations as real, they are real in their consequences (Thomas, 1928)* f) Precedents: planning and legal geodesy, geosophy

Table 1. Aristotle quesitons related to Human geodesy

In general one can this conclude that human geodesy is the science that focuses on the questions of how can human space be divided in an optimal way taking into account contextual human perceptions, beliefs, values and priorities.

4.WHAT MAKES THE HUMAN GEODESY SCIENCE PART OF 'GEODESY'?

A more fundamental way than using Aristotle questions is relying on fundamental components of a sciences: ontology, epistemology, axiology and methodology. Human geodesy can only be a logical part of geodesy if it is based on similar or equivalent scientific components. The fundamental components of a science (ontology, epistemology, axiology and methodology) can be described as follows for the case of human geodesy:

Both human and physical geodesists reason from a similar 'geodetic' starting point, namely there is a need to both measure and record physical objects with proper reference systems - either as mathematically shaped reference systems or as socially shaped reference systems. In addition, geodesists share a common axiology, namely that a description of accuracy and quality are prominent values which should always be checked and promoted, and that the knowledge gained in either mathematical-physical models or socio-cultural-legal models is of public use and should be available in the public domain. Table 2 provides a comparison of the basic fundaments of the human geodetic science.

Aspects of scientific discipline	**Mathematical geodesy**	**Human geodetic equivalent**
Ontologies / reference systems	Datum / geoid / reference systems	Archetype values, beliefs, principles
Axioms, laws	Laws of gravity	Laws of (land) tenure,

		continuum of land rights, bundle of land rights
Epistemologies	Measurement of angles, distances, place, height, gravity	Measurement and qualification of tenure claims, rights, restrictions, financial and political claims, beliefs, social perspectives
Axiologies	Quality, Accuracy, laying foundations, servicing other disciplines, registration and providing basic data are key values	Quality, Accuracy, laying foundations, servicing other disciplines, registration and providing basic data are key values
Methodologies	Quality of measurements is crucial and needs to be checked by mathematical and statistical replicability	Quality of measurements is crucial and needs to be checked by social and management plausibility and acceptability

Table 2. Comparison of basic fundaments of geodetic science

5.WHAT CONSTITUTES HUMAN GEODESY

Human geodesists reason from the principle that if human activities on land with real estate property are made more transparent and explicit (through better describing, designing and registering rules, rights, restrictions and responsibilities with land) public welfare (through urban and spatial planning, public information services, tenure security, land conflict prevention) can improve. Human activities with land and real estate are rooted in how humans individually and/or collectively view, organise, institutionalise and formalise their rules, rights, restrictions and responsibilities with land. Principles of human geodesy can thus be stated as:

1. Humans determine the rights, restrictions and responsibilities to any location on earth.
2. Every piece of land / earth is unique. Every person is unique. Hence, the relation between a unique person and a unique piece of earth is unique.
3. Discovering, designing, prototyping, testing, transferring and proving human - earth relationships requires an understanding of human behaviour in the context of social, political, organizational, legal and/or institutional relations. Hence, the science is by definition an applied science, with a social orientation and a technical touch.

Human geodesy can now be explained as:

- a scientific discipline
- studying how people organise, value, perceive, choose, claim and institutionalise their relations with land and space
- whereby each cultural setting and personal identity and memory derives different choices to manage land and space,
- Whereby information, participation and assessment of quality of result are crucial

Implications of this definition are that the local and contextual differences challenges both engineers and social scientists in close collaboration to come up with feasible and acceptable (socio-technical) solutions to manage land & space in each respective local context. In addition, it has to be acknowledged that each local contexts derives new solutions and dilemmas at the same time.
The core questions of human geodesy:

- Which relations with the earth have people shaped?
- How do people shape their relations to the earth?
- Why, and under which circumstances do people shape their relations to the earth?
- With which tools do people shape their relations to the earth?

6.WHICH CONCEPTS ARE CRUCIAL IN HUMAN GEODESY?

A number of fundamental concepts are hereby crucial. First of all there is the concept *division*. Division is both an activity, a goal and a reflection of both physical and social reality. Division therefore relates to boundaries and boundary objects. Boundary objects have both a physical and social connotation. On the one hand, boundaries are locations where spatial characteristics, values and objects undergo fundamental changes (e.g. legal boundaries of ownership or land tenure between two parcels, boundaries of land use and related economic value boundaries between urban, peri-urban, and rural areas). On the other hand, boundaries are also abstract notions reflecting different leitmotivs, opinions or beliefs, expressed through disciplinary or professional perceptions of epistemology and ontology (contrasting governance positions, policy beliefs or gradually adopted social perceptions). For this reason, many land use analyses based on contrasting ontologies result in different policy recommendations. Such a situation is most obvious close to administrative boundaries of local governments, which each implement a different local land use policy. The boundary object theory, originally developed by Star and Griesemer (1989), is relevant in the context of this research.

A second concept crucial for human geodesy is the *human reference*, or otherwise put the anthropo-geodetic reference. This relates to how people view and act on their spatial identity, how people refer and go back to spatial memory, which perspectives and frames people have in relation to land and land division and which (geo-)stakes are present in land related projects. Analogous to mathematical geodesy one can measure human references using Q-Methodology for example.

A third crucial concept is that of *choice*, in particular choice under uncertainty or choice based on coincidence. This type of choice, which can be described by the concept of discretionary choice, can be described by discretionary space, i.e. the space which people seek to enact their spatial influence and stakes. In this discretionary space there is active operant subjectivity, described by references, priorities, views, beliefs and changes in these over time and place. Views and beliefs change either according to predictive patterns or by coincidence and discretions. In analogy to mathematic geodesy we can measure here the distances from archetype choices.

Finally, a crucial concept is *Inter-scale*. The level, or scale at which one observes human references or choices is actually independent from administrative levels or scales. If fact, these levels or scales are inter-connected. Someone may have a view or belief about different kinds of areas which are not necessary connected. One sees this phenomenon for example in cases of inheritance. People

may have never lived in a certain area, but feel the need to have an opinion about this area. In this case the human connection or human network overrules the existing administrative or governance structures. It is not necessarily a system effect, i.e. one system of activities or system of governance structures is connected to another. Instead it is more emergent and discretionary. At a given moment in time or space, one may decide to get involved. For a human geodesist it is important to understand how and when these connections emerge. People are connected in different ways when it comes to the division of the earth.

7.CONCLUSIONS AND FURTHER WORK

This article has given the basic contours of a new science called human geodesy. It has argued that constituting, defining and framing such a new science is relevant given the transdisciplinary and human nature of dividing the earth. The utilization of human geodesy can be widespread, but should also be specific at the same time. It is crucial that technical engineering solutions should not only be created in laboratories, in isolated offices, within the government / public administration and by professional (engineering) communities of practice only. They always require a solid input of stakeholders, beneficiaries or affected people. Local circumstances, including culture, politics, conventions and traditions, are often decisive in the success, ownership and adoption of the technical solutions. A human geodesist should therefore rely on measuring opinions and views, angles and distances of opinions and views. There is not a one-for-all solution. Often solutions need to be contextualised (issue of inter-scale). It is thereby vital to remain attentive to other frames, conceptual beliefs, meanings, perspectives and priorities than your own; sometimes they contradict your own (issue of boundary objects). The impact of solution and changes that occur after implementation must always be evaluated (a priori and ex post) and monitored (issue of quality). And, finally, scale, frames, references, quality, space and boundary objects make the links between technical and social solutions.

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BIOGRAPHICAL NOTES

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