

# A new atlas for abstract spaces. Visual tools for the exploration of complex contexts.

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## Abstract

In the tradition of research, text is the preferred solution for research and communication. The linear sequence of writing explains reality: it transforms synchronic scenes into a sequence of codes that describe it diachronically. Nonetheless, while textual representation still remains extremely useful in scientific communication, the linearity of writing is lately appearing as inadequate to the latest models of science and to the representation of current knowledge systems.

In this context the language of cartography in particular seems to be fit to work as a structural model for the representation of complex systems, and Design can find in the atlas a model for the communication of complex contexts. As a tool designed to describe and act upon complex context, the atlas provides a model to strategically describe highly heterogeneous knowledge spaces. As a communication device, the atlas sets up a strategic network of images in order to achieve a set of communicative goals: maps, illustrations, graphs, and texts work together to describe and act upon space.

In the first part of this paper, we examine the structure of the atlas in order to expose the mechanisms that allow actions of exploration of complex and heterogeneous contexts. In the second part of the paper, the format of the atlas is discussed in its transfer to the digital domain and in its application to knowledge contexts. The first experimental results of such an approach are displayed by presenting a software tool for the collaborative management of design knowledge resources.

## Keywords

Communication Design; Interface Design; Knowledge Visualization; Information Visualization; Cartography; Atlas.

In the tradition of research, text constitutes the preferred solution for research and communication. The linear sequence of writing *explains* (from the Latin verb *explico*: to unfold) reality, it transforms a synchronic scene into a sequence of codes that describe it diachronically, slicing it in discrete elements. The subdivision of reality in discrete elements allows the reasoning of scientific thought: logical reasoning, proof and deductive processes build upon the linear narrative created by writing to give an order to the scientific process. The linearity of the text, in other words, matches perfectly the logical nature of the scientific-deductive method, which ultimately represent the ultimate expression of historical consciousness (Flusser, 1997). Nonetheless, while textual representation still remains an extremely useful in scientific communication, the linearity of writing is lately appearing to be not enough to the latest models of science, and to the representation of current knowledge systems.

The changes that the current knowledge paradigm is undergoing can be summarized in two main aspects. On the one hand, the developments of systems theories and epistemologies of complexity are transforming the scientific discourse in a model that aims to describe complex phenomena in their entirety. The focus is not so much in the sequence of an explanation, but on the relationships that link the components of a system irreducible to its analytical decomposition. On the other hand, the explosion of social knowledge paradigms that surpass the models of idealism are changing the structure of knowledge itself, exposing the social and relational dimensions of cultural processes that were gradually hidden by writing and printing technologies.

Knowledge is less and less considered in terms of *possession*, and increasingly in terms of *access* to information and skills. Knowing means having access to social and technological networks able to provide necessary information and insight at the time of need. The rigid and permanent structures of disciplines and subject areas are therefore progressively replaced by fluid and dynamic spaces in permanent movement and evolution, able to define cross-cutting paths, areas of interest and clusters.

Although a new paradigm for knowledge is clearly emerging, appropriate narratives for its representation are still lacking. Traditional interfaces based on the linearity on text or the hierarchical models of knowledge struggle to meet the needs of increasingly complex and ever-changing research contexts, in which relationships between elements part of the knowledge system are as important as the elements themselves.

## **Maps for the exploration of complex contexts**

In this context, design is involved on two different levels:

On the one hand, the nature of design process requires the designer to be confronted daily with complex and transdisciplinary systems, in which the different design dimensions cannot be analyzed separately. As a synthetic discipline, Design is focused on keeping together, rather than distinguishing between heterogeneous elements. Social, semiotic, linguistic, cultural components appear as an irreducible system that has to be synthesized in the design process.

On the other hand, Design in general, and Communication Design in particular, is responsible for the creation of formats and tools able harness the characteristics of images in order to address this kind of communication needs. Designers are responsible for the creation of a new rhetoric of complexity, a visual rhetoric not limited to the elusive search for scientific neutrality, but a language aware of its involvement in the creation of a cultural artifact in which the author is an expression of a cultural and social context.

The challenge to be addressed is no longer that of creating better analytical structure to subdivide and classify elements of reality. On the contrary, the current urgency is to 'keep together' the elements of the system in a single representation.

In this context, the languages of visual communication acquire a role complementary to textual communication, and the language of *cartography* in particular seems to be fit to work as a structural model for the representation of complex systems. In the history of image-tools, for thousands of years maps have been providing an interface to describe and act upon the complexity of the territory.

*As narratives*, maps are the expression of communication goals: they operate selections on reality, distort events, classify and clarify the world in order to better tell a particular aspect of a territory. Maps, in other words, can be seen as a 'visual narrative' of space: cultural artifacts created by an author in order to describe a space in terms of a goal.

*As instruments*, maps are tools that allow to reach otherwise unattainable goals. They allow not only to do things better, more efficiently, but also to create new realities. Maps describe the territory, highlight positions, distances, spatial distributions, groups, boundaries. They serve as tools to act on the space: to orient navigations, to mark paths, to plan trips, to explore territories. Or they can be used as design tools: plans for the construction and modification of space.

As with all codes that can boast such a long history, the cartographic representation of space has come to be regarded as a "natural" match between the represented space of the territory and the representing spaces of the map. However, nothing is natural about cartographic representation. As cultural artifact and political tool, maps create a virtual reality that allows the user to perform operations on the area represented. Exploration maps, nautical charts, building plans and world globes all carry with them an intended use and a number of functional purposes.

Building on this heritage, the operative concepts, tools and formats of cartography provide a perfect match for the representation of complex contexts, and their application can be extended to spaces that are no longer strictly geographic spaces. By looking at the theoretical critique of cartography developed by the critical cartography movement, the definition of the map takes on the connotations of a much more general cultural artifact. Moving away from the geographical space

as its only object of investigation, maps becomes a “graphic representations that facilitate a spatial understanding of things, concepts, conditions, processes or events in the human world” (J.B.Harley and David Woodward, 1987, p. xvi). Space becomes an abstract substrate similar to the anthropological space defined by Levy as “a system of proximity unique to the world of humanity and thus dependent on human technologies, signification, language, culture, conventions, representations, and emotions” (Levy, 1997).

This metaphorical space fits perfectly in the realms of research and science. Unlike the structures used over the centuries to manage knowledge by subdividing it in discrete areas, space is a continuous substrate: it doesn't divide culture in sections, it doesn't create hierarchies or define order in absolute terms, but on the contrary, it defines relations, proximities. Space creates clusters, identifies pathways and highlights priorities in a dynamic structure, and likewise it allows to locate, to remember, to relate.

From the moment in which the complexity of the knowledge structure becomes untamable, the metaphor of the 'journey through the territories of knowledge' replaces the institutionalized metaphor of the 'tree of knowledge' that in turn loses most of its ability to provide tools for interpretation of reality. Even D'Alembert, in the prologue to the *Encyclopédie* feels the need to suggest an image that goes beyond the typical representations of the time, proposing a representation of a territory that expresses perfectly the complexities of the project:

[The Encyclopédie] is a kind of world map which shows the main countries, their position and their mutual dependence, the road that leads directly from one to the other. This road is often cut by a thousand obstacles, which are known in each country only to the inhabitants or to travelers, and which cannot be represented except in individual, highly detailed maps. These individual maps will be different articles of the Encyclopedia and the Tree or Systematic Chart will be its world map.

But as in the case of the general maps of the globe we inhabit, objects will be near or far and will have different appearances according to the vantage point at which the eye is placed by the geographer constructing the map, likewise the form of the encyclopedic tree will depend on the vantage point one assumes in viewing the universe of letters. Thus one can create as many different systems of human knowledge as there are world maps having different projections, and each one of these systems might even have some particular advantage possessed by none of the others. (D'Alembert, 1751)

Knowledge becomes impossible to draw as a whole in a truthful manner, but only through the choice of a point of view that is both arbitrary and inevitable. Like the geographical and human space of territory, the complexity of knowledge needs useful abstractions, cultural interfaces able to transform the space in map. Although the maps of D'Alembert never actually found any representation beyond the linguistic metaphor, the idea of an atlas of possible trees and maps already emerges as a possible approach to the representation of tightly interconnected knowledge spaces.

## **An atlas for knowledge spaces**

### ***The Atlas as a communication format***

Like any good metaphor, the cartographic analogy applied to knowledge is not limited to a lexical transfer from a proper domain to a figurate domain, but it allows the transfer of knowledge from a known field to one yet unexplored. In the context of knowledge representation, the Atlas is here proposed as a tool and an approach capable of exploiting the representation codes for complex realities developed by cartography in its thousands-years tradition. Just like traditional atlases,

these 'new atlases' provide a format to represent heterogeneous and complex territories, creating a tool to allow a connection, a comparison, a relationship.

The concept of 'atlas' in this context doesn't depict so much a list of maps, as rather a system for the representation of space, a communication device aimed at representing complex contexts through the use of many partial overlapping narrations. A tool combining multiple images with the aim to describe the many aspects that make up a space.

Atlases belong to a particular type of communication formats: as containers they collect information and visual documents about territorial entities. In the same manner, they are also containers of viewpoints: they expose different dimensional scales, techniques and languages of representation, and they express different subjectivities: readings and interpretations that mix descriptions in order to create stories. They have a strong intermedial nature: different media interact with each other in a dialectic relationship (the story told by one media, is confirmed, strengthened, completed by the other media) and they contribute to the construction of a single communicative framework. (Baule 2007b)

In opposition to the totalizing approach of hierarchical models that try to present in a single image the 'true' structure of knowledge (in the Middle Ages) or its most useful representation (in the Enlightenment), the atlas presents a network of partial (incomplete and biased) stories, expressing authorial points of view with no claims of objectivity or comprehensiveness. The 'description of the universe' proposed by the first cartographic atlases is the result of a complex work of collection, amendment, interpretation and comparison of maps, indexes, diagrams, pictures and stories gathered over time from various sources.

The reason for this approach is clearly exposed in one of the definitions of complexity itself, which finds the core of complexity in its inability of being adequately captured in all of its properties by any one formalism (Vries e Goudsblom, 2002). Any given model of any complex system will be 'by definition' partial, unfinished, and incomplete. Only a system of representations, carrying different views of the same real-world phenomenon will have enough information to be useful, if not exact. The structure of the system is not depictable by a single image or even by a formal description, but it needs a multiplicity of views, a system of descriptions, a network of texts.

From this perspective, the atlas as a communication device *arranges* the elements of a speech, and "the practice of arranging embodies the idea of structured organization, planning and articulation of the elements that defines the communicative discourse" (Baule, 2007b). The arrangement, in this context, is not a simple list or enumeration, but a strategic placement focused on the achievement of a goal.

The term 'device' – writes Agamben (2006) in his analysis of the use of the same term by Foucault (2001) – seems to refer to a set of practices and mechanisms (both linguistic and non linguistic, legal, technical and military) that are designed to cope with an urgency and to achieve a more or less immediate effect.

The strategic dimension of the atlas is therefore reflected in its design dimension: maps, diagrams, text and peritexts are arranged together in order to allow not only the description of a space, but also its use. Just like the map itself, the atlas is a communication tool with its own mechanisms, materials and supports, an instrument that enables users to act on space: it allows navigation, exploration, change of scale, comparison.

As an interface for space, the cartographic atlas anticipates the mechanisms of digital interfaces: browsing through the pages, following links, looking up its indexes, the user can explore complex contexts by moving thorough different views of a single subject. The world, at first displayed as a whole, is then described in its details by different maps designed with many different objectives. Physical, political, geological and economic maps of the same territory are put side to side on the same page to allow comparison. On one side diagrams, histograms, tables and explanations make visible the invisible, on the other side alphabetical indexes and tables of contents and figures allow the navigation of the volume, providing the opportunity to identify the geographic location of a city known only by its name.

Unlike a simple collection of maps, the atlas and holds together the different narrations of the same territory in the creation of a format for the description of space. Through the careful design and

layout of its elements, of the consultation mechanisms, of the graphic and symbolic characters, the heterogeneity of its components becomes a browsable and navigable system, a polyphonic narration, a mosaic made of different tiles that give shape to a single picture.

### ***The Knowledge Atlas***

This concept of atlas as a model for the representation of complex contexts, as already foreseen by D'Alembert (D'Alembert, 1751) and later recovered in the '900 by other actors in the field of knowledge (Rayward, 1994), has been the subject of an experimentation in the context of design research. The *Knowledge Atlas* is a prototype of a software platform for the management of research systems (i.e. resources, actors and relationships that interact in the creation of new knowledge), designed to support research of common tasks such as survey, mapping and analysis.

The software, built on web-based technology, is a social web application that allows researchers and students to build their own bio-bibliographic database by adding five main types of resources (authors, texts, projects, conferences and research groups) related to the research field that's being investigated. Each resource in the system can be then described collectively by the users (as in a wiki) in its essential features (such as date, description, location ...) and individually, by each user, through the definition of tags, comments, and through the establishment of relationships between entities (e.g. relating a text to its author, a person to a research group).

The aim of this management structure, expanding beyond classic bibliographic management, is to adapt to contemporary forms of cultural production: to collect not only explicit knowledge, but also implicit knowledge embodied in people, in communities and in objects. Traditional bibliographic models are therefore hybridized with a model for the mapping of social, cultural and scientific contexts. Using this management structure for research ecosystems, all the resources inserted into the database are shared at different levels between the users. The resources are not limited to their individual use, but instead they represent the nodes of a big network that ties together users, resources, and keywords. On the other hand, the wealth of information available in the network that links resources, users and descriptions makes it impossible to create a single image able to express its complexity.

In order to address this issue, the cartographic metaphor has been applied to the design of an interface to research spaces, with the aim to create not so much a single totalizing view of the observed area, as a series of maps designed to describe the relationships between its components, the pathways develop between them, and the transdisciplinary themes that emerge.

The complexity of the information gathered by the system is represented through a series of partial maps, held together by an atlas, a representation system that acts as container of points of view. Building on a cartographic rhetoric of knowledge spaces, information and data entered by the users are selected, filtered, prepared, screened and symbolized in order to create specific images of the research designed to present specific view of the space.

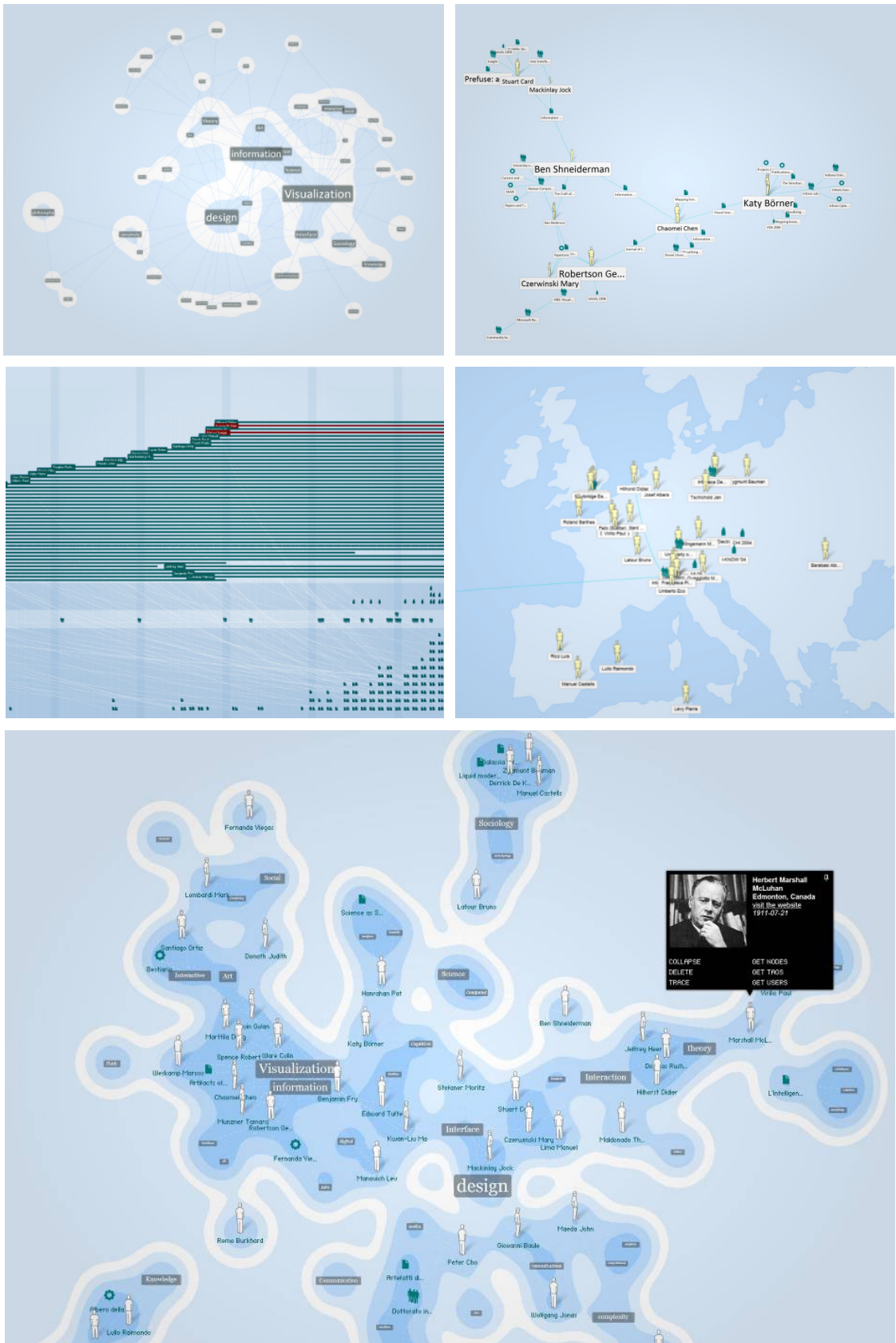


Figure 1 – Sections of the Knowledge Atlas. Each map displays different aspects of the same complex space.





The Atlas format, once transferred into the digital contexts of software applications, finds its hidden nature: it becomes a meta-interface aimed at providing tools for the representation of complex contexts, a device for the creation and connection of different interfaces. It is not so much artifact as 'graphic machine', a system able to articulate set of individual artifacts as expressions of a systemic logic (Baule 2007a). The maps, their typologies and their sequence is generated from time to time according to the user's needs and directions. Building on the potentials of digital systems, the atlas becomes a potentially unlimited network that collects and links a wide range of maps and pictures that can be modified by users to create narrations, reveal patterns, explore unknown territories or communicate the size and extent of their knowledge space.

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## Author Biography

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Marco Quaggiotto is a communication design teacher and researcher with an interest in user interfaces for the exploration of complex systems. His research is focused on the representation of knowledge and development of tools to handle the complex dynamics of digital information.

Currently, he's contract professor and research fellow at the *Politecnico di Milano*, and he's research scientist at the *Complex Networks Unit* of the *Lagrange Complex Systems Group*, working on the design of visual interfaces for real-life social and epidemic networks.

More information is available at [www.knowledgcartography.org](http://www.knowledgcartography.org)