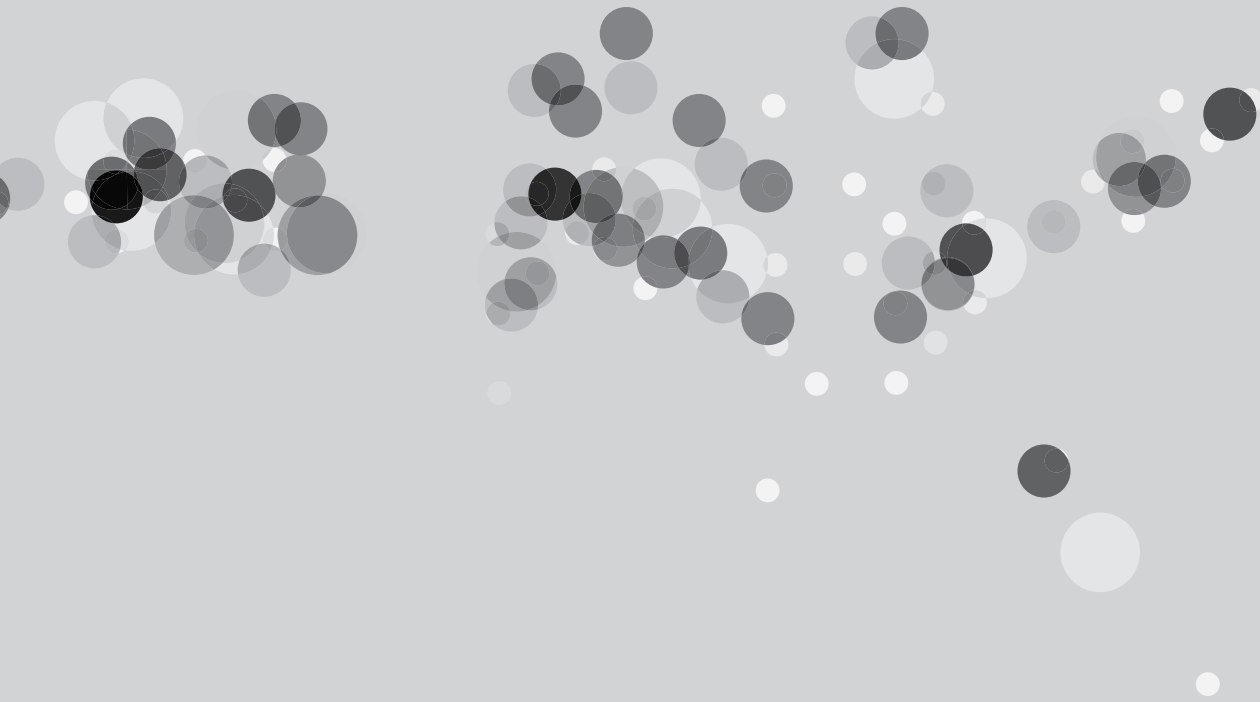
01. Full papers

3 : Informative Animation



Animation to explain Constructive Geometry

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Fig. 1. Palau Güell Chimney Stacks examples

Abstract. Development and widespread deployment of digital technologies, CAD and CAD-CAM systems, have modified not only the way we work but also the way we think . This fact, which is extensive to all design areas, is even truer in some branches, such as architectural design, sparsely identified with industrial production processes. Having a good CAD system, formalization capabilities are almost limitless. In the planning stage we can conceive all sorts of formal solutions in a relatively easy way. But in most cases this free creativity will clash with the reality of traditional production processes that are still predominant in the field of architectural construction. This contradiction is not important for middle-aged architects, still trained within the framework of a traditional culture, but it is important for young people, and especially for students.

Digital culture is fully integrated into the way new generations think. Today young people are used to generating forms very easily by using a few tools from some CAD software. It is not easy for them, though, to accept that those forms must be rethought from a completely different viewpoint, if they want to build. But this different viewpoint, from the constructive geometry, is rarely found on the Internet, where geometry is usually dealt with from its more mathematical side. We must go to some construction old treatises, where these topics are shown by an anachronistic visual language that is difficult to read for people of the 21st Century. In this context, we believe that animation can be a good resource to show how you can carry out a wide range of constructive forms, only helped by a ruler, a set square and some strings; a range of forms we could see, from current viewpoint, as impossible to be conceived and constructed without any digital system.

Gaudi's work is full of formalizations that from current thinking may seem as inexplicable as the Easter Island statues. However, the fact is that

all of them were designed and executed without any of these instruments which seem so essential today. The project we are working on, and the one we want to present to the Conference, aims precisely to show, from a constructive viewpoint and by means of animation, what the geometry that supports the design and construction of several elements of the Gaudi's work is. In particular, we are planning to present a video clip showing the constructive control of geometry of one of the Palau Güell's chimneys. Through the visual capability of the animation, this clip goes to show: how the hat of this chimney is governed by a logarithmic spiral and in which way we can control its construction only by means of a ruler, a set square and some strings.

Keywords: Constructive Geometry / Visual Communication / Antoni Gaudí / Architecture

1 Introduction

Precedents. Our first contact with animation, not only as an exercise but with the clear intention of putting forward our message was in 1999. The preparation of a programs series about the centenary of the foundation of FC Barcelona [1] took us to take an order from a TV channel to our school. Thinking towards the future, they asked students to draw up an architectural hypothesis about how the club stadium would look like in fifty years' time; that is about 2050. The proposals were to be presented in one of the series programs, and the exhibition format seemed obvious. In a TV channel, especially if it is the most popular and best high-rated channel in the country, rhetoric presentations or graphics with professional looks are not appropriate. We needed a moving images language that, talking about future projections, couldn't be other than animation.

Fig. 2. Frames of FC Barcelona Short Film

Any television channel, obviously, has both professional people and facilities to produce any sort of audiovisual formats, real or animated. However, they understood that the project required some knowledge exceeding their own field of expertise. It required somebody with some knowledge of architecture and architectural geometry and being able to translate to a visual form the expressions – often vague and emotive but not much actual – as students express their proposals. So our position as teachers of architectural representation, specifically

interested in exploring new expression forms arising from the use of computer systems, pointed us as the right team for this task.

Since then, the situation of having the required conditions to carry out the animated explanation of a particular topic has been repeated several times. We did the visual discourse on the geometry of Gaudi "Gaudí. Exploring form[1], "or the explanation of building systems and architectural elements of Catalan Romanesque churches, or virtual trip to the historical transformation of a territory, or the submission of proposals for the creation or renovation of a neighborhood or the explanation of the basics of Catalan brick vaults, or…

Fig. 3. Gaudí, Exploring Form Exhibition

All are job orders we have had because our expertise, as architects and teachers, about the concepts they wanted to explain and how to do it in a didactic way. But this expertise was not the only reason why we were the right people to do these jobs. A certain capability to express ourselves in a visual speech by animation was the main reason. Therefore it is because of this combination of factors that we could carry out these experiences.

[1] "Gaudí. Exploring form"[2] the central exhibition of the several cultural manifestations organized in Barcelona because of the "International Gaudí year", in 2002. Conceived as itinerant exhibition, it could be later seen also in León, Genova, Tokyo, Sao Paulo, Napoli, Peking and Shanghai. The exhibition contents can still be seen by means an interactive DVD, published in 2008[3]

Nevertheless we must make clear that we are not professionals in the animation field, we cannot even say that we are experts in it. Our specific area of expertise is architectural representation. And our experiences in the field of animation must be seen as exploring some new expression in this area. Ways in which we feel more and more interested and we are more confident about its potential. However, these ways do not seem to attract much attention among colleagues of our specific knowledge field. We can define ourselves as "frontier people" between two adjacent fields of knowledge perhaps disjoint excessively.

Communicating with Students. For years, our animated works were always motivated by external requests. We were looking for any solution to some communication problems coming from outside. But a few years ago we observed, also in our daily work as teachers, important communication problems. Retaining attention from students for an hour lecture has practically become an unattainable desire, like trying to make them read, carefully enough, any academic text, either a lesson or a simple instruction manual. New student generations have grown into an audiovisual culture, and we can say that they do watch the world through a screen. Our awareness of this fact, among other reasons, has led us to change our lessons model. We do not do theory sessions any longer and we have channelized its contents towards a collection of 50 video tutorials [4] with an average duration between 8 and 10 minutes.

Fig. 3. Students in a working session

In the same work line, we want now to take a new step forward. The present project aims to contribute to finding solutions to a more general problem: the libraries of our schools are losing their readers. Students use the library books only to make some photocopies from their pictures or drawings, but they rarely pay attention to the text, to the narrative or argumentative discourse. In most cases, if the text is not read, those photocopied drawings and images become

nothing but a few graphics without any meaning. A substantial amount of information is lost.

For many teachers, the first reaction is to complain about the apparent lack of interest from students. But complaining does not change anything. We need to find solutions for this problem. The experience of our video-tutorials system demonstrates the interest of the students to acquire knowledge has not diminished at all. What has really changed is the way to connect with these skills. If you succeed in finding the way, students respond and, at least in our case, they respond very well.

We do not believe there is a magical and universal formula to deal with this problem. We think that, right now, what we need is trying new experiences, testing new ways to transmit knowledge to students. Therefore, the project we present aims to be only a contribution to this experimental path.

2 Key Features of the Project

From Communication by Text to the Audiovisual Communication. Geometry and construction processes are subjects traditionally transmitted by means of texts together with some drawings illustrating them. So they are publications where graphics or visual parts already play a key role, because the text cannot be completely understood without the picture. However, in a printed edition, the reading flow is channeled by the text, whereas in an audiovisual this flow becomes governed by the image. The voiceover plays the role of guiding the eye and it complements the image. But voice can pause and "disappear" whereas image cannot. It has a constant presence. If the voice extends his speech, the total time will grow and, therefore, the temporary space to fill with images will grow as well.

We cannot expect that, while the voice is completing a long speech, the reader remains looking at the same static picture or watching some actions or processes having a predictable ending. If it happens, our reader is likely to give up. In contrast to the textual reading, where readers impose the rhythm (they decide when to stop and when to do a quick read), in audiovisual media tempo is already established previously. Thus, image carrying a reasonably strong rhythm will be a required feature, without temporary delays that cause boredom and make our reader disconnect.

We must accept that an audiovisual with these features cannot have the same ability to contain information as a theoretical conventional publication for teaching. This fact, let us face it, is always painful for teachers, because of our natural tendency to more rhetorical speeches. The counterpart lies in the expectations of significant capabilities improvement of connecting with the reader and getting concepts better understood.

Narrative Proposal. All chapters of the collection we are projecting follow the same plot pattern. We report a real architectural element, showing a geometric

structure evident but not trivial. After a description of the chosen item, we explain its main morphological features. Then we expose, from an abstract viewpoint (what we call "digital thought"), the geometric concepts being behind these morphological features. Concepts belonging to the mathematical universe, but that they do not seem to have any direct transcription into the material world, beyond the industrial production environment. Therefore, next step proves this is not true and shows in which way the same shape can be rethought from the tangible world of constructive geometry. Then, we show how that geometrical definition can be controlled, by hand and on site, only helped by instruments that builders of Gaudi's time could use, as rules, triangle, strings…

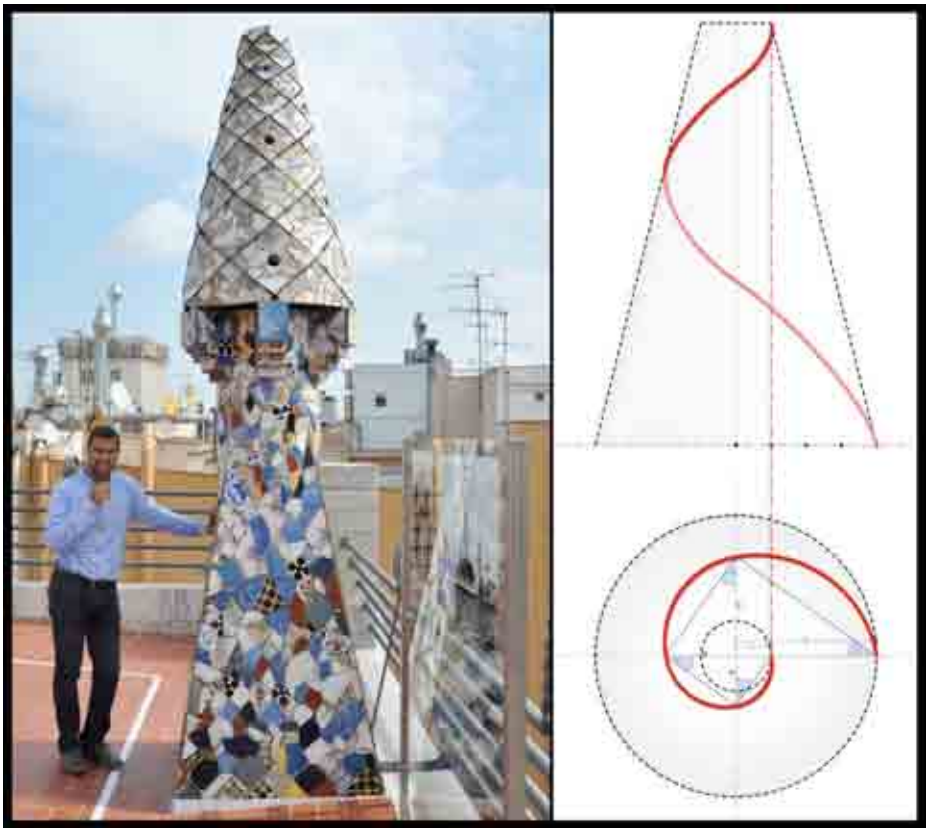

Fig. 4 Fotography Chimney number 13 and helix projection of a logarithmic spiral

In the specific case of the example we are taking as prototype, the chosen element is chimney number 13 on the flat roof of Palau Guell in Barcelona [5]. When this element is examined in detail, a disconcerting point appears: the surface treatment of its top section is ruled by a helix that is a projection of a logarithmic spiral. As its name suggests, this curve is the graphical expression of a logarithmic function. It has an immediate drawing using CAD systems (just enter

the start and end radii). But, at first appearance, the way to draw this curve on site is not evident. Even if we achieve its drawing with a reasonable effort, obtaining the projection on a cone does not seem an easy thing. So this video clip tries to answer these apparent enigmas.

Dark Points. In brief, this is the plot of the story. But, told like this, this story leaves several dark points. For example, we claimed that this Gaudí's design was ruled by a helix that is a projection of a logarithmic spiral [6]. Obviously this statement must be argued, because we are into an academic context and, therefore, unreasoned statements cannot be admitted.

The point to be discussed then is: how much extension and depth we must give to argue these dark points? As teachers, we can consider very interesting making a comprehensive explanation of arguments. But we must consider the aforementioned limitations of this media, and be aware that excessive scholarship can easily ruin our global discourse. How to get out of this dilemma?

Browsing Reading. In our project, animating audiovisual is the main component, but it is not the only one. By means of these clips we will try to capture the reader's interest on a set of chosen subjects, but without any intention to make an exhaustive discourse. The voiceover and images should refer to those aspects which we called dark points. So, readers can see that there is a statement without being argued, but also without being hidden.

If the clip captures the readers' interest, we expect them to want to increase their knowledge about the subject. And here, in this second level of information, keeping audiovisual support is no longer needed. Now the matter is providing some easy access towards the answers to the questions that the clip has left opened.

So, our idea is that a set of links are joined with the video clip. These links will lead to complementary pages where, already in a conventional form (text and graphics), the arguments will be widely explained. This is a mixed format that, in fact, is matching the model of reading through hypertexts. And we are all used to this model already.

Abstract Geometry and Constructive Geometry. As is clear from all that has been said so far, comparison between abstract geometry and constructive geometry is the common element for all chapters in this collection. We want to get the message that, in Gaudí times and even now, abstract geometry, which is essential for conceiving forms, is not enough to accomplish their construction. To materialize these forms, we should think them again from a different geometry, this is: the constructive geometry.

From one or other viewpoint, the story focuses always around geometry. Therefore some perceptible differences in their look, between both discourses, seem necessary. With this aim, when the explanation refers to concepts of abstract geometry, we adopt a drawing look, cold and neat; however, when the sto-

ry is at the constructive geometry universe, its look is changed to visually express this difference through environment.

Changing looks does not mean giving up abstraction. If we have chosen to operate with animation instead of real video, is only for its capabilities to make abstractions. Keeping the abstract aspect, the change of scenario is expressed by several strategies such as the adoption of perspective viewpoints or the use, in an iconic expression, of some hands and tools masonry (set square, straightedges, pencil, strings, etc.), to try to communicate the manual character of the building processes.

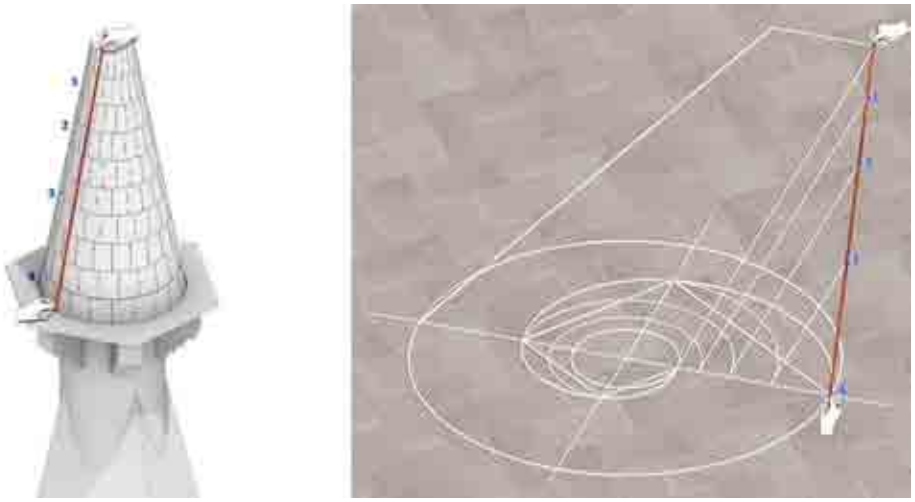

Fig. 5 Visual Expression to communicate the manual character.

3 Conclusions

In the current stage of the project development, there are still many questions to solve. Questions such as, the most appropriate support to contain and run this collection is not decided yet. We think, right now, this support could be any university multimedia website, either as MOOC form or as a multimedia collection for students.

In fact, this is not a question of first importance, right now. Producing some early chapters is now the priority. This will allow us to follow a process of trial and experimentation. A certain amount of experiences, both in production and in reading, will allow us solving several communication issues, which we are aware, and other ones which we still ignore. The reviews, advices and all that can bring us ideas to improve the prototype will be welcome inputs.

It is even possible that, after these experiences, we conclude that this path was not a good solution for the problem we wanted to solve. It is a risk we should accept. What we cannot accept is complaining without looking for answers.

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The CB3 Method.
Or how to train an Art Director against the Straight Line

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Abstract. During my vast experience teaching and coordinating programs on Art Direction, I have found myself in more than one occasion with the situation that when the students have to deal with a new project, they resort to the bank of images already in their minds. With the goal of conceiving the way of avoiding this easy path – the straight line – I have carried out an investigation that ended up into a method that pursuits to distance the student from the comfort zone in order to –using a spiral trajectory – force her to face the accidents and the surprises that will enrich the process and which will allow to contemplate it from a total different perspective. In the end, it is about generating a method that obliges to transit not planned ways, a systematised way to distract them from the usual path and, therefore, provoke those fortunate accidents in which a great number of times new forms have been discovered.
What follows next is the formula that we have invented to involve the students in this complex process.

Keywords: Art Direction / Project Methodology/ Generating Ideas/ Design Investigation/ Non Conventional Thinking

1 Introduction

During my years as a teacher in Pompeu Fabra University and in Escola Superior de Disseny i d'Ingenieria de Barcelona (Elisava), I had the chance to confirm two significant questions that restrict the quality of the creative proposals made by my AD students: the usage of previous mental images and the non conscious imitation of professional patterns.

Using previous images limits the possible discoveries that could widen their creative frame, while the trend to unconscious imitation trend shows a evident "lack of poise" in the investigation / discovering phase and a "no pleasure" in the process, which induces to a quick and easy solution for the trouble on hand.

2 Working Hypothesis

By means of encouraging the AD student to go throw a broad investigation field that would involve the use –metaphorically– of all their senses, accidents will be produced as well as surprises that will result in not expected ideas, and finally in much more original conclusions at the time to find solutions to given problems.

The formula will have to dote the AD student of a specific method that would allow her to get some distance from the first thoughts. By thinking with the feet (moving away from the working space in order to elaborate a field work), with the hands (drawing, sketching and creating prototypes), and thinking with the eyes (connecting images and concepts, and creating visual minds maps), she will be able to go beyond her primary mental images and a whole new world of possibilities for the problems will be created.

3 The Investigation

3.1 Used Methodology

In the major part of the bibliography consulted to carry out this study, we have realised that the authors have focused mainly in the AD in advertising: Odejo (1998), Rom (2006), Mahon (2010). None of them went in depth into a precise method for the AD in general. Many of them proposed logical paths in design, marketing and advertising, but never adapted to a kind of professional that –as a responsible of an aesthetical strategy– will have to interact with architects, graphic artists, video makers, fashion designers and photographers, as well as having to participate in interior and design projects, selling points, creating visual universes for brands and products or even collaborate in considerable institutional and social ventures.

The lack of particular bibliography forced us to lean towards a methodology of investigation more focused on the Art Director praxis than in theoretical questions, working with interviews, tests, and samples taken from professionals and students.

3.2 Description

The investigation was divided into two principal sections:

A. Procedural tests with professionals and students

B. Samples taken with two different groups of students

A. Procedural tests with professionals and students

A. 1. Testing with professionals

We worked in two distinct ways with the professionals. Firstly, we held a Focus group and we continued with individual samples.

Focus group: The group was composed by seven professionals coming from advertising, communication, graphic design, interactive communication, computer graphics and product design. We asked from all of them if they usually use any kind of method for develop their AD projects and, if positive, which was its procedure and development.

One of the most concluding results was that in the professional world the methodology only exists and the beginning of the process (client commissioning) and at the end (the AD commissions to a specialist collaborator), meanwhile in the more creative phases based on generating ideas and concepts, no other process it has been realised but the model seeking.

Another evident fact was the difficulty of the professionals trying to talk about their manner of working: there were not aware of applying a specific methodology neither following a defined written or visual process. One of the few procedures that they were actually conscious about, was referred to the existing contact with "the other", being who were giving then the instructions (client or planner) or to whom they must passed them.

Individual samples: In this case, individual semi-structured interviews were carried out.

The most interesting observation in this modality lies in the fact that the professionals widened considerably – from a qualitative and quantitative point of view– the results obtained during the *focus group.* They put more effort in detailing their working manner and they add more diversity of important words and concepts – not very methodological, although– that contributed to the enrichment of the method that was elaborated after the investigation.

A. 2. Procedural test with students

The study of the project process about the practice of the students proved that this one was taking place in a mixture between the design process, communication process and marketing methods. During the testing frequently appeared concepts straight from the marketing world, but none was referring to aspects related to the context of the project, the management of ideas, neither the chosen information nor the follow up of the work carried out by the collaborators.

When asked about the source that they were looking for the information and the examples in order to deal with a project, the first answer was Google, being followed by magazines and the environmental public space. They never mentioned libraries or places with a specific interest for the project in question, the use, purchase or consumption of the product by the consumer either.

Everything above showed that the student follows a previously established guidelines and that searches for safety lines during the whole process without

any proper systematization. This is to some extend positive, because it helps avoiding the student to get lost or forgetting something important, but from another hand it is not contributing finding new, distinct and distinguishing elements. The majority of times they try out formulas or successful cases with a "professional tone". And in the end, without a project protocol that would lay on an initial solid phase of investigation, the creative cannot address the complexity required by the projects to generate innovation.

B. Samples taken with two different groups of students

B. 1. Sample 1

It was required to a group of seven students to develop a project of conceptualization and designing a visual universe of a new perfume providing them with a series of essences. It was said to them that they must stick to the process exposed by the authors Oejo (1998), basically focused on the advertising world, Martí Font (1999) with, from one hand, some set up phases and, from another, opened to the generation of divers hypothesis– even though very linked with the design process– and Mahon (2010) more focused in the expression and execution than to generation of ideas and to the direction, combined to a proposal realised by the same students than in the test, what we have named the "Hierarchic Scheme" by its step by step process.

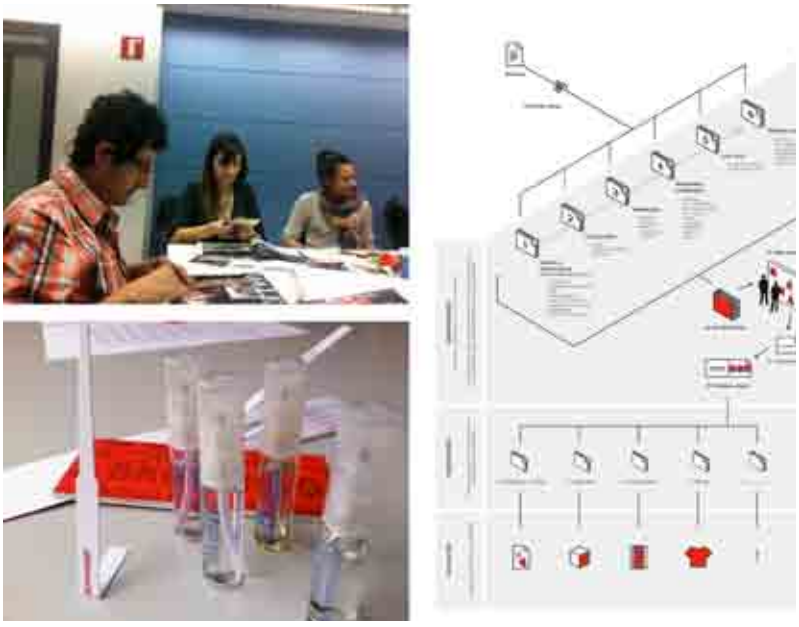

Fig. 1. The process test, done with the "Hierarchy scheme", a process involving a series of steps.

The answers of the students were very predictable and uniform, full of topics related to the world of perfume.

The results brought up as naming samples were:

Moi
Miroir
Toxique
Blue
White city (referring to Lisbon)
Désir
Oximor

The results for the images/places were:

Paris (five of them)
New York
Lisbon

The results for the imaginary/context were:

Urban. Fall or spring (never summer or winter). Parks or streets not very crowded with single-family and flat houses. Floral environments. Two of them include a river. In three of them there is a hotel.

Fig. 2.

The results for imaginary/ context were:

The perfumes are, in some cases, ambiguous. Not explicitly masculine neither feminine. The students even doubted that the gender could be used. In five cases the character was a young female, blonde and dressed up in casual clothes. In four cases was driving a bike or at least the bike was somewhere the proposed image. The men were rough and exotic. (Figure 2)

B.2. Sample 2

Equally than in the Sample 1, we worked with a group of seven students to which we proposed the same wording: creating the concept and the visual universe of a perfume after the same essences given in the Sample 1. In this case the method applied was the elaborated after the results of the investigation (the CB3 method, that will be discussed in detail in the up coming section), which is what we have named the "Liquid Scheme".

The difference between the results with the Sample 1 was quite surprising. If in the first case they were not stepping out the established conventions, in the second one they achieved creating personal and well-defined universes.

The results brought as samples of naming were:

Tasmania
Öwel
Wonder woman
Revolt
Revolt dolce
Confidence
Armand

The results for the imaginary/places were:

Tasmania
The invincible Spanish armada
California
Big cities in general
Norway
Paris
Italy

The results for the imaginary/context were:

All the above mentioned during the four seasons of the year. Parks, forests, roads, festive streets, bottom of the sea, sea battles and the interior of a classic painting.

The results for the imaginary/character were:

In four of the seven proposals were men: Nordic, revolutionary, conservative and surfer respectively. The other three were females very different between each other: funny and radical, delicate and sophisticated, independent and provocative.

4 The CB3 Method

The CB3 method (applied to the work as in Sample 2) consists, as we have already pointed, in searching the way of marking the distance between the student and the comfort zone – the straight line– in order to separate her from the mental images that would drive her to commonplaces.

In the eagerness of visualising and systematising this complex process, was the moment were was created this map that consists in threw phases of work, THE CONTEXT BOX, THE CONCEPT BOARD and THE THREE STAGES:

CREATIVE BOOK, in which four steps are clearly defined: Thinking with the feet, Thinking with the hands, Thinking with the eyes, and Thinking with the head.

CONTEXT BOX: **Thinking with the feet**

The CB3 methods starts with the research in spiral through the areas of investigation and the archive from which the AD generates new ideas and proposals: the context, the models, the trends, the field of work, the image, the word, the narration, the expression, the challenges, the *nots* and the held intuitions. Everything is combined in a path that privileges an opened and curious attitude, against the straight line.

Thinking with the feet means moving away from the comfort zone in which the AD carries out her work in order to trace a hazardous route for every basis of the investigation above mentioned, with the intention of getting back to the desk with the backpack full of unexpected new references. This might certainly be the most fertile part of the CB3 method.

THE CONCEPT BOARD: Think with the hands and with the eyes

The discovery of the concept is always one of the key moments of the process, and perhaps one of the most creative. The concept will help organising and rationalising the creativity and doting it with a long course afterwards. It will be the nuclear idea, the DNA of the project, the seed of *How.* Is in this point when the students extract all the compiled elements in the CONTEXT BOX and the spread them in front of themselves.

Thinking with the hands means operating this material and disposing it in a thousand different ways to allow the concept to pop up out from this research.

The physical relationship with these objects horizontally disposed (on a table) introduces the proxemics, very stimulating when it comes to discern new forms. Thinking with the eyes means reading these shapes in order to extract from them all their potentialities. Summing up, in the end it is about COpying, COmbining and TRANSforming this material into something else (COCOTRANS).

Once the concept has been found, it will be expressed on a CONCEPT BOARD, the visual synthesis, inspiring and triggering of the creative project, which contains as well a brief explanatory – and inspiring– text filled with various images that are referring to the public, the aesthetic, the tone, the light, the emotions, the values and the context desired.

THE CREATIVE BOOK

Once the concept has been defined, we spread the CREATIVE BOOK, a synthetic visual universe that will show the lines that the team will have to follow.

Thinking with the head means defining, after all the work of exploration carried out during the previous sections, such complex aspects as the brand territory, the tone of the "conversation" between the brand and the user, and the attitude of the models responsible of communicate the image and to interpret the roles that will represent the communication and the persuasion of the discourse,

The CREATIVE BOOK is the tool of communication by means of the AD will transmit to her collaborators all the parameters that they will have to take in consideration at the time to develop and formalising the aesthetical strategy. It will be inspiring and regulating, but it will keep an open space to ease the creative contribution of the collaborator and specialists.

5 Communicating the Method: the explicative supports

Aiming to explain the functioning of the CB3 method, we have created a document that combines conceptual texts, protocols, instructions, and graphic visualizations that pretend to refer, by means of the colours and shapes, the sequential developments, which describe the dynamics of the processes.

The goal was to find the way to express graphical and synthetically the idea that in the end a process in a trajectory.

To be able to accomplish our commitment we attend:

- A map that contained the whole process that we intended to reflect, in a single image, the global evolution of a project, from the briefing until the final perception from the user's point of view. (figure 3)
- Nine working areas, a field work and a creative book, as exploration tools assigned to involve the student in this path in spiral and try that this one creates some distance from the comfort zones and their usual process and therefore get her close to the peculiarity and surprise.

- Four phases or manners of reflexion that have to do with starting from a more distance beginning than the mental images of the student, the feet, and from there build a ascendant tour that, by means of the hands and the feet, finally arrives to the head.

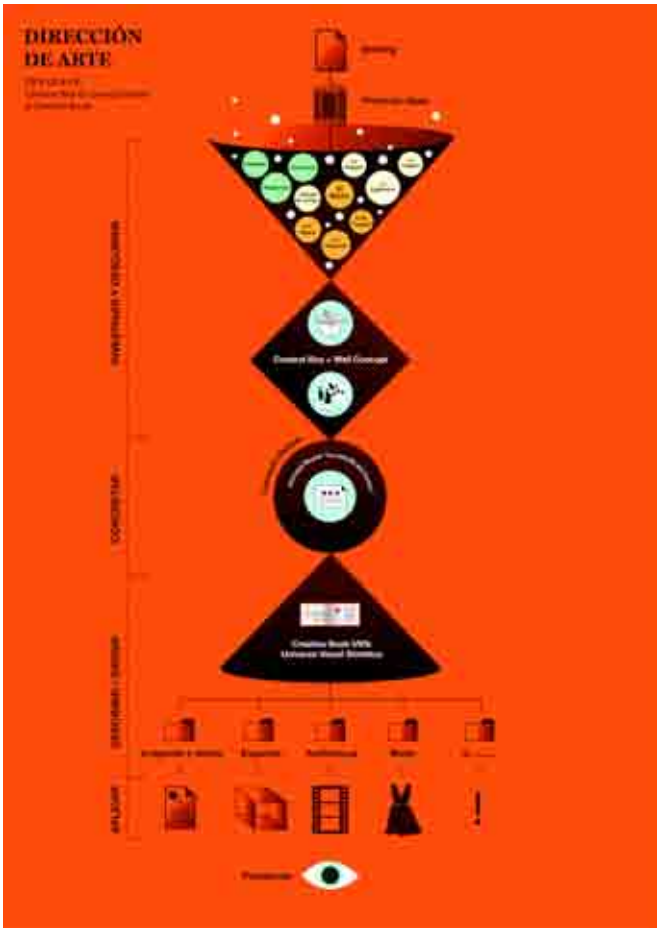

Fig. 3. Map of the whole process in a single image, from the brief to the final presentation

During the following stage we wanted to explore the audio-visual medium as a way to present the CB3 method, for what we made a four minutes long animation video that shows the different stages for which a project moves forward.

Its confection included a fieldwork in which, after the study of more than seventy videos that communicated educational content, we identified the characteristics of each kind of language (computer graphics, data, stereotypes, key concepts, lettering in motion and transformations) and we selected the ones that were more convenient for our case.

The video was shown as an efficient tool when presenting the method and helped understanding the philosophy of itself – the idea that a project is in fact a trajectory that it is not moving forward drawing a straight line –, but we considered that a support that would have ease the interaction with the user would have resulted much more efficient to deepen in the comprehension of its particularities.

6 Conclusions

The students, after being thrown into a new challenge, they use to turn to the images that they already control. This leads to a very limited space for novelty. However, when they are being encouraged to explore areas that usually they would not have *walked thru*, the proposals get much more rich in originality and *personal touch.*

Many times happens that – in Design, but also in science and in all the creative processes in general – that the best results – the best discoveries – are found by pure chance, when one is standing far enough from what she was looking for. The technical term that names these fortunate accidents is *serendipity.* An unexpected discovery that it is produced when something else has been searched. Then, How can we generate a method that assures and systematises the appearance of these enriching detours? In the end, how can we program the hazard?

The CB3 method pretends to contribute with an educational tool that would cooperate in this direction.

Regarding the elements that have been developed for the communication of it, we consider that the ideal support would be the one with what the user would not be just a mere spectator of the shown contents, but someone that could interact with them, opening windows which would lead to different levels of explanatory depth. In a future stage we will direct to develop the material that it is going to this path.

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Animation as Boundary Object. Promoting Cultural Changes through Audiovisual Design

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Abstract. The paper will address the issue of dialogue between actors with different skills, starting from some evidences: 1- TRANSLATION. The growing need (in the scientific field and dissemination) to display and shape ideas, information, data, to communicate results and findings making them accessible, interpretable and sharable [1] by communities that are heterogeneous in terms of skills or operational contexts; 2 - TRANSFORMATION. The interdisciplinary nature of transformation design, that has its great strengths in its ability to mediate diverse points of view and facilitate collaboration due to the assumption that complex problems cannot be addressed from a single point of view [2]; 3 - ENVISIONING. Communication design therefore takes on the role of promoting cultural change using tools for listening and expression, that are common or shared between disciplines, and able to activate a dialogue for social innovation. It has to face and drive change by developing processes, tools and forms of communication that assume listening and storytelling activities, and the relationship among people as the real engine of innovation.
The paper proposes an approach that considers the audiovisual artifacts, especially the "informative animation", as "Boundary Objects", artifacts produced in the context of decision-making and collaborative processes that involve actors with different skills and heterogeneous expectations: "Their boundary nature is reflected by the fact that they are simultaneously concrete and abstract, specific and general, conventionalized and customized" [3].
Will therefore be proposed examples of animations created over the years (since 2009) by the IMAGIS research team and some students in communication design (School of Design, Politecnico di Milano). These short forms of audiovisual communication are dedicated to the theme of urban transformation and are part of a process of dialogue between stakeholders (citizens, city users, associations, businesses, schools, institutions), giving shape to their expectations and the collective aspirations in order to build shared visions of the future [4] [5].
These audiovisual artifacts will be analyzed from the point of view of aesthetics and languages, focusing on the complex relationship between live action and animation. As far as animated images have been created rather than captured, they foster people to reflect on what is represented and not simply observe what is shown [6]. For this reason animation can be account as "boundary object", being characterized, at the same time, by *con-*

structedness [7], and by the high flexibility given by the reactivation of a rich toolbox [8].
According to the state of the art, our experience highlights how communication designers often use forms of animation to activate a dialogue with other disciplines. Therefore, the main goal of this work will be to bring out an aesthetic of the so-called “video scenario” as a "boundary object" and going beyond the definition of the 4 types proposed by Star and Griesemer (Repositories, Ideal type, Coincident boundaries, Standardized forms).

Keywords: Audiovisual Communication/Animation/Boundary Objects)

1 Towards Transformative Communication

This instruction file should be used as a template. The research on social innovation has been investigating the role and impact of creative communities and ordinary people developing good practices to solve everyday life problems related to housing, food, ageing, transports and work [9] [10] [11]. Design is getting more and more involved in promoting actions and providing solutions coming from a collaborative process with actors and specific competences coming from various fields, each one of them advocating different perspectives and expectations. Collaboration among individuals can vary widely in nature. When applied to the fine arts the term usually describes a diverse set of creative interactions between two or more people: «the most common and traditional use of the word within art history refers to […] collaborators (who) are essentially hired hands, not necessarily true creative or intellectual contributors to the project» [12]. However, here we refer to participatory processes of change involving communities and groups within organizations or among society and organizations not necessarily having a role in the realization of artifacts but just sharing visions and ideas. According to the definition by Burns, Cottam, Vanstone, and Winhall (2006), the concept of transformation design suggests that: «Because organisations now operate in an environment of constant change, the challenge is not how to design a response to a current issue, but how to design a means of continually responding, adapting and innovating. Transformation design seeks to leave behind not only the shape of a new solution, but the tools, skills and organisational capacity for ongoing change» (p. 21).

Burns et al. (2006) summarize six key characteristics of transformation projects. The following ones are particularly interesting for us: «Collaborating between disciplines […] Recognising that complex problems cannot be addressed from a single point of view»; «Employing participatory design techniques […] that involve users and front-line workers in the design process»; «Creating fundamental change […] Leaving the participants with the tools and capacity to continue to adapt and innovate means». These processes of change are funded on the imagination of a possible and better future. Which contribution communication design can provide to the dialogue about possible worlds and sustainable innovation? The transformative role of design is combined with the potential transformative role of communication due to its capacity of translating between

viewpoints. Our paper proposes the analysis of audiovisual forms and artifacts as part of a process of dialogue for societal transformation. The production of images is a design practice for sharing, producing and nurturing collective knowledge: a continuous interaction between the images themselves and their multiple interpretations, which gives way to a collective dialogue. Envisioning ideas and making them explicit through their representation leads the actors involved to develop it in the light of their perceptual and evaluative frames and to give feedbacks according to these patterns. The images produced within this kind of collaborative processes get added value as they represent tracks and evidences of social practices, a catalogue in memory of the creative process that becomes always available for further reflections. «Image has an operational identity: it configures our vision of the world and things» [13].

2 Audiovisual Artifacts as 'Boundary Object'

The need to support a dialogue among people with different perspectives brings out a new cultural paradigm that is grounded in audience participation in the meaning-making processes: «[...] the shift from a culture shaped by the logics of broadcasting toward one fostering greater grassroots participation» [14].

The IMAGIS research team (School of Design, Politecnico di Milano) starts from the assumption that audiovisual artifacts are capable of promoting dialogue among people, relying on the storytelling ability to foster multiple perspectives. A research able to combine methodological development and participatory design in order to propose an innovative point of view on social communication flows. This process allowed us to use the audiovisual language as a knowledge instrument capable of activate and nurture the "socially produced images": the iconic archive that has been forming over time and from which we can draw on to produce knowledge [15] [16].

Indeed, Manovich states that «[a] hundred years after cinema's birth, cinematic ways of seeing the world, of structuring time, of narrating a story, of linking one experience to the next, are being extended to become the basic ways in which [computer] users access and interact with all cultural data» [17]. Therefore, the audiovisual artifacts from one of the most popular languages are «[...] becoming the cultural interface, a toolbox for all cultural communication, overtaking the printed word» [18].

For this reason, when it is inserted in a participatory design process it is possible to consider it a *boundary object*. This concept has been developed in the sociology field by Susan Leigh Star and James R. Griesemer: they identified an analytical framework for those objects that can reside in different social worlds and that are described as «[...] objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites» [19]. The application of this concept to their case study allowed them to find four types of boundary objects. First of all, there are the repositories, that are «ordered 'piles' of objects» and where «[p]eople from different worlds can use or borrow from the 'pile' for their

own purpose without having directly to negotiate differences in purpose» [20]. The second are the ideal type, objects «such a diagram, atlas or other description which in fact does not accurately describe the details of any one locality thing», «'a good enough' road map for all parties» [21]. The last two objects are the coincident boundaries, that are «common objects which have the same boundaries but different internal contents» [22], and the standardized forms, shared methods and guidelines for collaboration among diverse work groups.

According with these thoughts, it is possible to consider the audiovisual artifact as a boundary object for its ability to maintain the identity when goes through different social worlds (as a common language understood by all), and being at the same time adaptable and open to different interpretations (becoming a dialogs activator). In agreement with these thoughts, it is possible to consider the audiovisual artifact as a boundary object according to the ability to maintain its identity when goes through different social worlds (as a common language understood by all), and being at the same time adaptable and open to different interpretations. Therefore, it becomes a dialogue's activator because the relationship between viewers and audiovisual artifacts provokes the development of appropriation practices that are filtered from personal reference imagination.

Starting from the assumption that collaborative processes need the sharing of the design objects and methods (coincident boundaries and standardized forms), for this work we focus on repositories and ideal type because they can be linked to the audiovisual language. Specifically, the former are related to the concept of collective imaginary, the latter are objects similar to those audiovisual artifacts whose primary goal is information, and whose linguistic style is based on the elements' stratification ranging from photography to graphic design, from illustration to typography (motion graphics, information-animation).

In the following section we propose the analysis of audiovisual artifacts produced during the years. Examples able to highlight how the digital age has resulted in the return of the animation techniques in the filmmaking production, and capable of underline the emergence of a new stylistic choice between live action and animation: the aesthetics and ethics of remix [23] [24].

3 Communication Designers Working with Animation

Since 2009 the IMAGIS research team and some students in communication design (School of Design, Politecnico di Milano) has been involved in the project and production of short videos dedicated to the theme of urban transformation. The forms of audiovisual communication are part of a process of dialogue between stakeholders (citizens, city users, associations, businesses, schools, institutions), giving shape to their expectations and the collective aspirations in order to build shared visions of the future. The main areas of actions were, specifically: listening, envisioning and promoting, leading to the productions of short videos of documentation, scenarios, advertisement.

In all these audiovisual projects it is possible to observe the use of animation. Often, even in cases where the work is on documentation and listening, the designers have decided to use techniques and forms related to animation. If the choice of using animation doing video scenarios looks quite natural - sometimes the designers decided that they could achieve their communication objectives coherently through the animation also when they had to show the results of their process of listening, observation and analysis.

Sometimes the intentional choice of the communication designers was to make a fully use the animation. In the case of the video scenarios dedicated to the walkability in the Isola area, the designers have used, from the beginning to the end, the stop motion technique, and they added successively digital animations. The public space in the Ticinese area is the subject of another video scenario, where the animation is a entirely digital, and the movements are created by a 3D technique. Among other things and in different ways, both the scenarios play with the trick of opening and close a book (in this case a pop-up) to tell a story, a trick with a long tradition in the field of animation.

Fig. 1. (1st row): Frames from 'L'Isola che ci sarà' - Francesca Cattaneo, Annamaria Greco, Francesca Pasini, Marta Pucci - Laboratorio di sintesi finale "Cammina Milano", 2° LM, School of Design, Politecnico di Milano. Lecturers: Marisa Galbiati, Francesca Piredda, Walter Mattana, Katia Goldoni, Paola Bocci; tutor: Marco Ronchi, Andrea Corti, Elisa Bertolotti a.a. 2009-10

(2nd row): Frames from 'Ticinese, un nuovo mondo' - Francesca Foglio, Shirin Nekoei, Luca Pecori, Giulia Pozzetti, Esther Zanon - Laboratorio di sintesi finale "Racconti di strada", 2° LM, School of Design, Politecnico di Milano. Lecturers: Marisa Galbiati, Francesca Piredda, Walter Mattana, Katia Goldoni, Paola Bocci; tutor: Marco Ronchi, Mariana Ciancia, Davide Grampa, a.a. 2010-11

Beyond these cases where the use of animation is clearer, it is possible to observe in many other videos the reappropriation of traditional animation techniques through the use of postproduction softwares. The previous listening activity for the district of Dergano becomes the starting point for its video scenario; the negative aspects of living in the area are challenged through positive pro-

posals; the narrative is largely based on the presence of key words of negative valence that are animated and replaced by new key words, which are propositions for a new way of living the area. The change between before and after is done through the introduction (often by hands) of small objects in the scenes. The animation of hands is a great classic of traditional animation, retaken here in a minimal way, as if the screen was almost a large touch screen where everything is possible. The live action for the scenario dedicated on how the Navigli district can become a pedestrian area in the daily time is the basis for a post-production work; what is not there in the current reality, is then made through the introduction of digital forms, typography, colors that in the video come alive and relate with people filmed as if they were themselves actors. In the scenario dedicated to the construction of a possible public space in the Buenos Aires area in Milan, the live action footages are the basis of a work in post-production with key words, to strengthen the story.

In addition to the examples mentioned above (Dergano and the Navigli by day video scenarios), other video projects stress the relation between live action and animation: in the video scenario dedicated to a different way of experiencing by walking the Navigli area by night, the students choice has been to focus on a great work on the still or moving images using digital post-production softwares; the photographs of the neighborhood are often used to be drawn and become the scenes of the video; the actors, shot in green back, are processed in post-production to become silhouettes; other elements animated into the scenes are completely drawn. The video scenario dedicated to the Sarpi area alternates moments of live action with raw animated moments. The transition from one world to another is given by the editing. The animation comes into play when the characters look at projects or articles on the newspaper, so when they are confronted with new ideas. The live action is thus experienced as a material from which suggesting debates, hypotheses, reasoning, and proposals for possible futures. The new scenarios and ideas are represented by a work on the taken pictures, a work always declared and never hidden, not seeking for realism.

Fig. 2. Frames from 'Navigli di notte. Un bagno di cultura sulla riva di Milano' - Gabriele Carbone, Martino Cazzaniga, Angelo Chiacchio, Francesca Ferrario, Ilaria Mariani, Arianna Vandea, Laboratorio di sintesi finale "Cammina Milano", 2° LM, School of Design, Politecnico di Milano. Lecturers: Marisa Galbiati, Francesca Piredda, Walter Mattana, Katia Goldoni, Paola Bocci; tutor: Marco Ronchi, Andrea Corti, Elisa Bertolotti a.a. 2009-10

The use of semi-finished audiovisual forms (such as storyboard or animatic) can be a way to talk about some ideas and open possibilities. For example, the video scenario *Commando Jugendstil* (a project for a master thesis) uses the trick of moving a storyboard drawn by hand. The traditional storyboard boxes and the drawings just sketched and animated with a few frames become the stylistic atmosphere of the short film. The animation, rough until almost the end, is supported (as often happens in the limited animation) by an inventive screenplay played by a professional actor. Towards the end the drawings become digital, the color is introduced and more frames are animated. It is the time when the story opens and shows the possible scenario. The fact, however, to have shown for most of the time an animated storyboard provides tools to read the technical skeleton of the film and its construction.

Sometimes the use of very simple animations, deliberately rough, is a choice for envisioning scenarios very open to debates and dialogues. The digital animation, with geometric shapes, spot colors and rough movements (always with the support of typography) is used in the case of video scenario *Agriequo* to describe a system that could be created among farming communities to support the local economy and culture.

From *Spread*, an international workshop on social innovation, came the need to show some scenarios imagined by the working groups on how it would be possible to live in 2050, starting from promising practices (entrepreneurial and self-aware society connected wealth; alternative economies for dense communities; happy sharing communities; the convenience of trust). The result is the construction of very short video formats. After an initial animation of texts introducing the project, the videos are animated with stylized digital drawings, in which the movement is given mainly by moving objects, change of focus or camera movements. The videos are not looking to give a sense of realism, but they want to illustrate synthetically the ideas developed within a few days of workshops.

In this experience, where communication designers are using audiovisual as a tool to activate processes of listening and dialogue, it is possible to see how the choice of employing animation works very well to achieve the goals. Animation in fact allows to work on unfinished forms (such as storyboards and animatics) that give a sense of how a project is open and under discussion; it opens to a whole range of tricks from limited animation experience. It is the possible to build audio-visual artifacts that play with the limits and the few resources available, and that consent to keep the story open to further proposals; by being so openly constructed and declared and for its self-reflective nature, animation can also help on the meta-discourse level, allowing to use audiovisuals as open tools for dialogue.

Fig. 3. (1st row): Frames from 'Commando Jugendstil. Cartolina di un mondo possibile' - Guglielmo Miccolupi, http://cargocollective.com/mikeoloopie/Commando-Jugendstil. Master Thesis, supervisor: Francesca Piredda, School of Design, Politecnico di Milano, a.a. 2011-12
(2nd row): Frames from 'Agriequo' - Giovanni Montuori, http://vimeo.com/8601353. Master Thesis, supervisor: Francesca Piredda, School of Design, Politecnico di Milano, a.a. 2008-09

3 Conclusions

Communication designers have historically used the animation within their projects: for example, since the fifties, Ray and Charles Eames worked with several animators for the realization of audiovisual artifacts as *A Communications Primer* (1953), *The Information Machine* (1957), *The expanding airport* (1958) o *Powers of Ten* (1969).

However, the audiovisual artifacts should represent not only the final outcome with the aim of communicating and disseminating results, but they also should be integrated in different phases of the design process, both as tools and as evidences of the unfinished work in order to open possibilities and future actions.

Using these artifacts as tools for dialogue within participative processes, it is possible to define them boundary objects, items that «are simultaneously concrete and abstract, specific and general, conventionalized and customized» [25].

What emerged from the analysis is the definition of an aesthetic of the so-called video scenario, whose main feature is the use of animation techniques able to re-activate the memories of traditional animation, thanks to a more accessible digital technology. The audiovisual artifacts are taking, indeed, the shape of sketches and dynamic memos, thanks to the accessibility of production tools.

The linguistic consequence is the arise of a hybrid language between the two opposing tendencies of mimesis and abstraction [26] [27]: an aesthetic of the semi-finished able to enhance processes and instructions for use, and that is well suited for a format open to dialogue and negotiation.

In conclusion, we suggest to consider the video scenario as a boundary object that is characterized by a hybrid language based on the relationship between real (*repositories*) and ideal (*ideal type*): not mutually exclusive categories, because the «animation's essential "abstraction" tends to make the viewer aware that s/he is watching something other than a mimetic recording of an external reality» [28]. Furthermore, as the audiovisual artifact is characterized by the highest degree of internal construction (*constructedness*) [29], it pushes people to make reflections on what is represented: an effective "toolbox" able to convey at the same time tools for decoding and transcoding the message (*coincident boundaries* and *standardized forms*).

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Communicating Complexity and Simplicity: Rediscovering the Fundamentals of Information Design

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Abstract. As more data has become available through open data initiatives, and as barriers to access have decreased, interest in and demand for new ways to visually communicate data and other content has risen dramatically in recent decades. This situation, compounded by the rapid pace of technological development, has caused a shift of attention towards the perceived problem of "complexity" and ways to manage it. At the same time, "simple" communication challenges suffer from undue complexity, as displays of basic information sacrifice clarity and human-centeredness for other priorities such as marketing appeal and self-interest.

While visualization in its many forms has become widely recognized as a powerful means of presenting complex and simple information, quite often the visual solutions themselves tend to create more complexity than address it. Information graphics, informative animations, data displays, and visual analytics tools have achieved an unprecedented level of technical sophistication and intricacy in visualizing content, yet beneath the surface, a fundamental sense-making sensibility is missing.

In this paper, we argue that facilitating understanding is not related to the size or complexity of a problem, nor is it a function of the tools and techniques used. Foundational information design principles are the same for all kinds of problems and should underlie all visualization tasks, but when creators of visualizations do not learn and thoroughly apply these principles, the risk of misconceived solutions and confusion increases. This paper discusses case studies that demonstrate how the absence of basic information design principles may produce negative outcomes and presents recommendations for improvement.

Keywords: complexity, simplicity, understanding, information design, visualization

1 Introduction

Complexity has always existed in different forms throughout history [11, 17], but only in recent years has the "complexity crisis" caught widespread attention. Accelerated by the explosion of computer technology, the present Information Age is characterized by more, better, and faster access to information [6], which continuously challenges us to manage the growing volume of information that fills our screens, printed pages, and environments. Access to vast data sets across numerous dimensions of business and society has opened possibilities we are only beginning to understand, and our facility to work with "big data" is still in its early stages. While technology may help us create, store, analyze, and display data and other content, the real work of making sense of complexity and determining the most appropriate way to represent it requires further attention.

Equally important is the task of communicating simplicity. Everyday examples such as furniture assembly instructions and airline safety cards attempt to convey step-by-step tasks to the broadest audience possible, but the variability in execution and effectiveness from one to the next demonstrates the persistent lack of universal guidelines for presenting even minimally complex information.

Visualization has long served as a means to help us understand the world. It allows us to process more information by distilling it into a form we can rapidly perceive and process [6, 25]. However, as visualization methods have evolved over time, and new languages and technologies have emerged, the core purpose, practice, and process of visualization have remained largely undefined at a high level. The inner state of complexity that exists in the field of visualization is reflected in the wide variation of approaches and outcomes that characterize visualization today, especially in the ways complexity is regarded and handled.

The notion of visualizing complexity presents a host of challenges for creators of visualizations, from concerns about what level of simplification is appropriate for a given audience to decisions about which graphic techniques and formats to use. Tangled together are issues of content, process, audience, tools, techniques, and other factors, all with competing priority evidenced in final design solutions. Many current visualizations have become too complex, as a result of the following:

- Clear guidelines for "appropriate" visualization are largely absent from education and professional practice. No consensus exists on what "appropriate" means when dealing with complex or simple subjects.
- Product overshadows process, and as a result, displays of complex information tend to be overly elaborate and indecipherable [22, 26, 28, 29]
- Intentions and methods are not aligned with outcomes: visualizations focusing on novel tools and techniques fail to address complex material appropriately for the intended audience [8]

To effectively visualize complexity, we need to understand what "effective" means and work towards achieving it. We will discuss the current state of com-

plexity and simplicity in the context of technological advancements, then argue that establishing understanding is the primary goal in managing complexity, by way of information design. We will propose a fundamental set of information design principles drawn from existing literature [9, 20, 27, 11, 18, 14] to guide visualization practices. We will then apply that set of principles to an analysis of several information visualization case studies (information graphics, interactive data visualization and informative animation) to illustrate ineffective as well as effective practices. Finally, we will propose broad guidelines for visualization education and professional practice.

2 Methodology

We used literature review to gain a general overview of information design-related simple and complex problems. This review was complemented with secondary research and case studies. Books, papers and PhD theses of the last 30 years provided in-depth understanding of the current state and evolution of complexity. We analyzed 14 case studies using a set of information design principles that emerged from our research and are discussed in Section 4. A Likert scale of three degrees was used to measure how well each case study addressed each principle (3 is "strongly," 2 is "moderately," and 1 is "poorly."). In addition, we built on [15] framework to structure the analysis.

3 Related Work

3.1 Understanding Complexity in the Information Age

Before discussing ways of managing and visualizing complexity, it is important to note that complexity is as normal and necessary in everyday life as simplicity [10, 28]. Complexity itself is neither good nor bad [10]. Rather, the confusion, ambiguity and lack of understanding that may result from complexity are bad. While complexity is described as an ordered and reasoned combination of various interrelated "things," highly related to context and experience, among other factors [10, 17], simplicity refers to the *right* amount of those things [13]. When all parts (e.g. purpose, details, difficulties) are assembled together in an appropriate way, complexity is perceived as simple, because there is a "sense of clarity" and that each part is in the *correct* place — that is, it has meaning [13].

The role of technology in shaping our perception of complexity is significant. We live in an "information age," with high amounts of information being produced, freely transferred every day, and instant access to knowledge [12]. Consequently, "the volume of information to which people have access is growing at an incredible rate, vastly outstripping [their] ability to find, assimilate and manage it." [3] With the higher volume of available information, more sources and formats, and faster production of information, the benefits of greater access can

be quickly overshadowed by the amount of time and effort one must expend to find relevant, useful information.

3.2 Managing Complexity

In business, government, and daily life, the need to manage complexity requires first an *understanding* of the complex situation or content — finding patterns, making associations, and ultimately extracting personally relevant meaning — in order to accomplish a goal or task [3]. This activity of *making sense* of complexity is in some ways distinct from *visualizing* complexity, as the underlying structure or organizing principle must be revealed *before* (or in the process of) creating the visualization. The challenge is learning those underlying principles that give order and reason to an apparent chaos, and help us determine which parts need to be removed, which ones to be kept and how they need to be arranged to achieve clarity and understanding [2]. However, as we discuss in this paper, the tools and techniques employed to visualize complexity erroneously *precede* the deliberate application of principles and frameworks to make sense of a situation or content, as seen in the numerous ill-conceived design solutions being produced today. Without a clear governing framework, a visualization is just an arrangement of graphic elements without a coherent message or story.

3.3 Information Design as a Means of Understanding Complexity

Information design plays an increasingly important role in the communication of complexity and improving understanding [12]. It is a multidisciplinary field of study, drawing from a varied range of academic disciplines [11]. Some of the disciplines that have a closer influence on information design are graphic design; communication sciences and journalism; interface and user experience design; information and media production technologies; cognition, perception, behavior and applied psychology; information science and management, and sociolinguistics [11, 24]. A rich, robust body of knowledge underlies the information design field, and as such, we draw from this foundation to establish a rationale for making sense of complexity. In the next section, we introduce a set of information design principles as one way to manage, understand, and visualize complexity.

4 Information Design Principles

Literature revealed prior studies concerned with defining indicators of effective information design. [10] suggests that ineffective design is related to both the lack of understandability in the design itself as a consequence of a lack of underlying logic and strong foundation, and a lack of designer's understanding of the content, needed to manage complexity. [11] states clarity as the fundamental aim of information design and suggests four sets of principles to achieve that aim:

functional, administrative, aesthetic and cognitive principles. Also highlighting clarity and understanding, [4] stresses three aspects to consider when visualizing information: functionality, multidimensionality and beauty, the latter one in the sense of credibility and transparency. Similarly, [17] present a three-part approach to simplification of complex material: empathize with others' needs, distill an offering to its essence, and clarify the structure and presentation of content. In line with other studies, [1] and [11] point out misleading analysis and information organization as main actions that may lead to unclear or superfluous content. [7], [8] and [4] add that poor problem framing and ill-defined hierarchical structure may result in dysfunctional and unintelligible visualizations. Similarly, [14] introduced the concept of octolinearity, initially discussed for map design and related to the number of trajectories that should be present on a line to facilitate navigation and understanding, as a way to determine visual organization to minimize cognitive load.

Expanding on previous work and our own experience as information designers, we present a set of foundational information design principles:

1. **Unambiguous problem definition:** Adequately defining what information challenge or problem exists (what is the intended purpose or goal).
2. **Human-centered approach:** Identifying and learning as much as possible about the target audience. In-depth understanding of and commitment to the audience is needed.
3. **Constructive synthesis of information:** Dissecting and reconstructing data and other forms of content to find patterns and make associations.
4. **Clear organization:** Defining hierarchies, systems, and structures to inform the design solution.
5. **Content-driven design:** Translating and coding content using a graphic language (color, shape, orientation, etc.) and determining the most appropriate medium and format for the design solution (static/dynamic, print/digital, etc.).

In the next section, we use these principles to analyze case studies from the fields of information graphics, interactive data visualization and informative animation. From the analysis, we highlight diverse current problems resulting from the presentation of complex information through ill-defined visualization practices.

5 Case Studies and Analysis

For this analysis, we selected 14 cases deemed as effective and as ineffective by peers, but also based on our own experience. In both instances, we prioritized those cases dealing with complex content, or displaying relatively simple content in a complex way.

Case Study 1: Calendar Redesign (2007). This visualization (Fig 1), designed by Eliazar Parra Cardenas, was part of an information design challenge to fit a full year on a card. In this case study, simple content — the months and weeks in a year — has been depicted in an inventive but rather complex way to solve the initial problem.

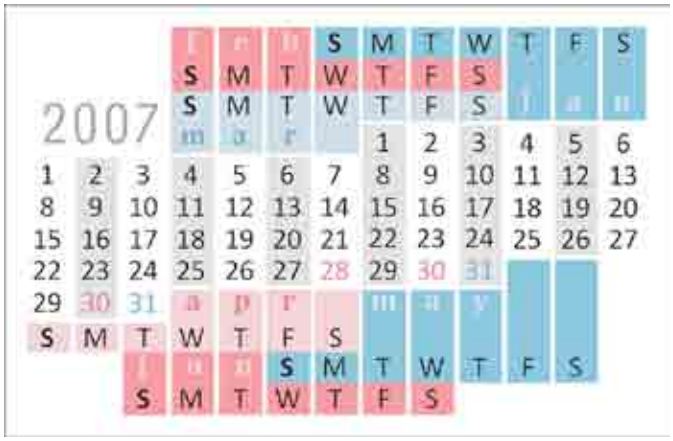

Fig. 1. Calendar design by Eliazar Parra Cardenas

Case Study 2: Health Plan Organizational Chart (2009). This graphic (Fig 2) shows U.S. Congressional Republicans' view on the health system that would have been created by Democrats in the House of Representatives' proposal. A high degree of complexity is depicted and emphasized to bolster opposition to the plan.

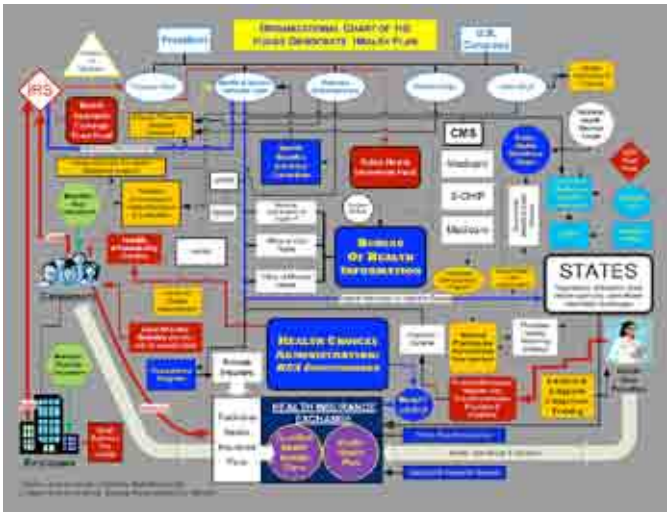

Fig. 2. Organizational Chart of the House Democrats' Health Plan

Case Study 3: Discrimination against women. Created by the Union of International Associations, a research institute that seeks to understand the complexities of international civil society, the visualization (Fig 3) is meant to "create a visual index to show the complexity of relationships between (data) profiles and reveal the data rich domains" surrounding the world problem of discrimination against women.

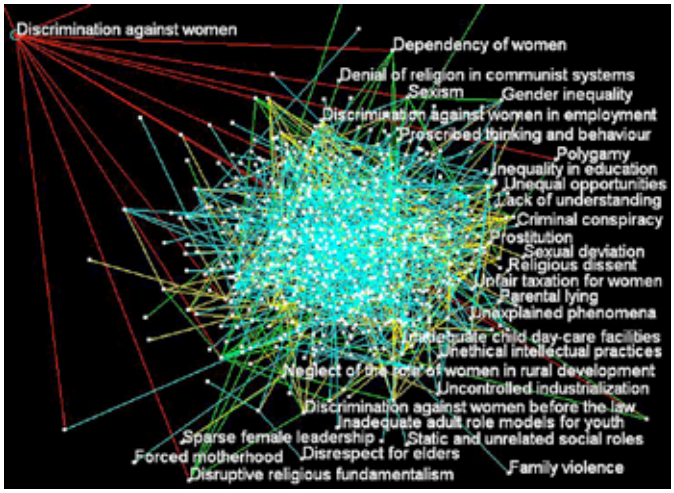

Fig. 3. Discrimination against women

Case Study 4: Global Internet Map by Cisco & TeleGeography (2009). This map (Fig 4) shows traffic between world regions via major routes. There are several layers of information that contribute to the overall complexity of information depicted.

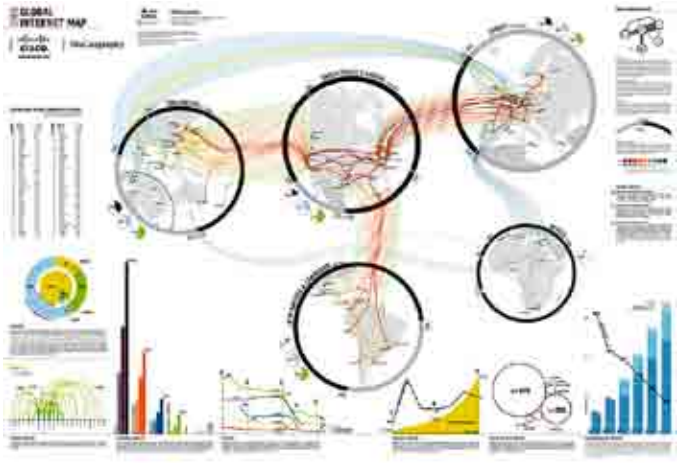

Fig 4 Global Internet Map by Cisco & TeleGeography

Case Study 5: GOOD Magazine infographic: Are You Done in There? (2007). A comparison of simple data becomes complex in the maze-like orientation of people representing quantities (Fig 5).

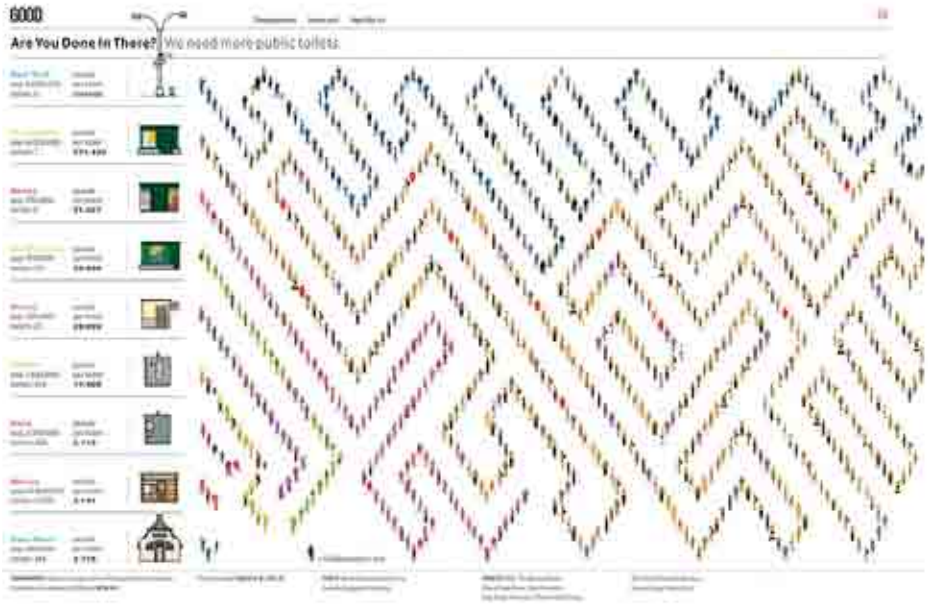

Fig. 5. GOOD Magazine infographic: Are You Done in There?

Case Study 6: GIGA-maps Comparative Map (2012). This timeline compares the evolution of major operations of two different companies. The top half of the schematic map represents one of the companies, while the bottom part displays information about the other (Fig 6).

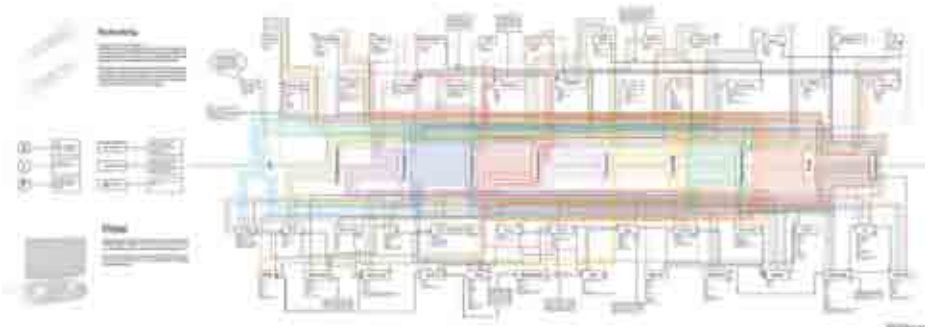

Fig. 6. GIGA-maps Comparative Map

Case Study 7: Ben Fry – Valence (2002). Using software sketches, this project by Ben Fry visualizes the structures and relationships of large biological sets of data (Fig 7).

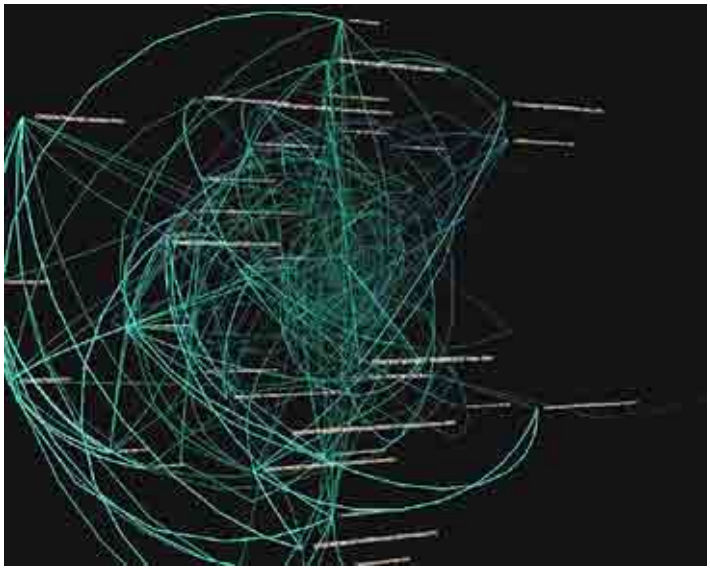

Fig. 7. Valence by Ben Fry

Case Study 8: Software Evolution Storylines (2010). Michael Ogawa's interactive software development timeline looks at several dimensions of activity involving developers and files committed to a project repository (Fig 8).

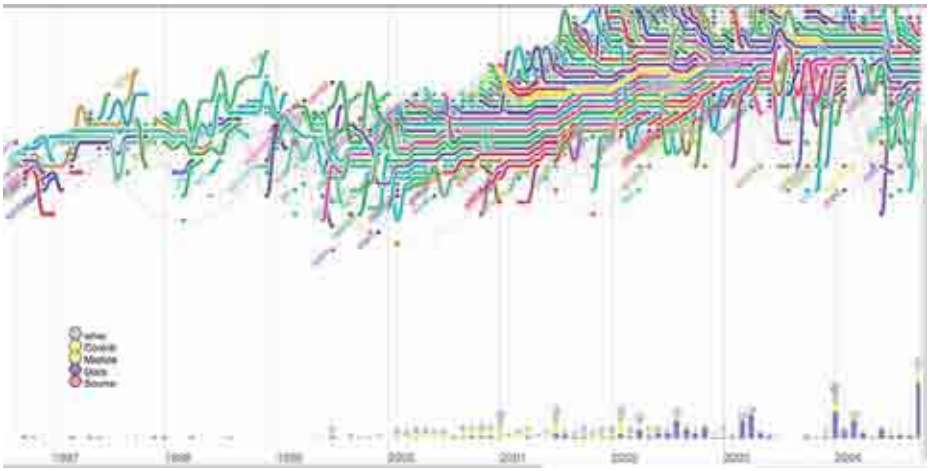

Fig. 8. Software Evolution Storylines

Case Study 9: Cascade (2012). This interactive data visualization by Jer Thorp looks at how information is shared through social media, aiming to reveal patterns in how

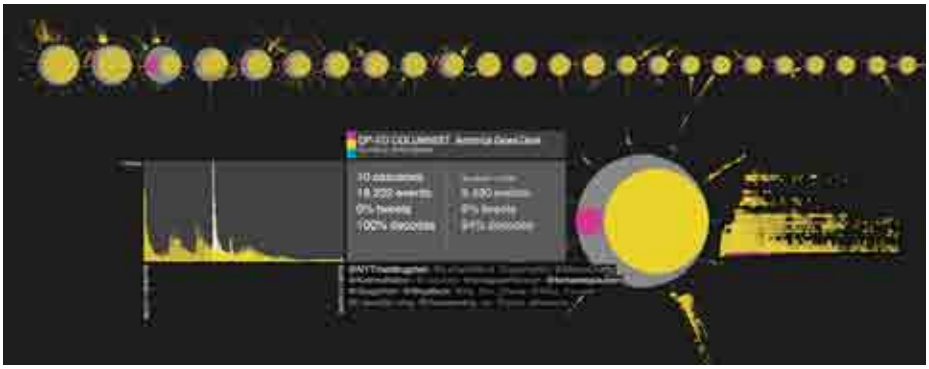

Fig. 9. One view of a Cascade visualization of news stories and their cascade through the web

Case Study 10: Football match data visualization (2012). This animated information visualization created by Andreas Bardenhorst shows football match data such as field position, duels, and passes (Fig 10). The graphic approach is highly abstract, which makes the data labels and supporting text even more essential in understanding the visualization.

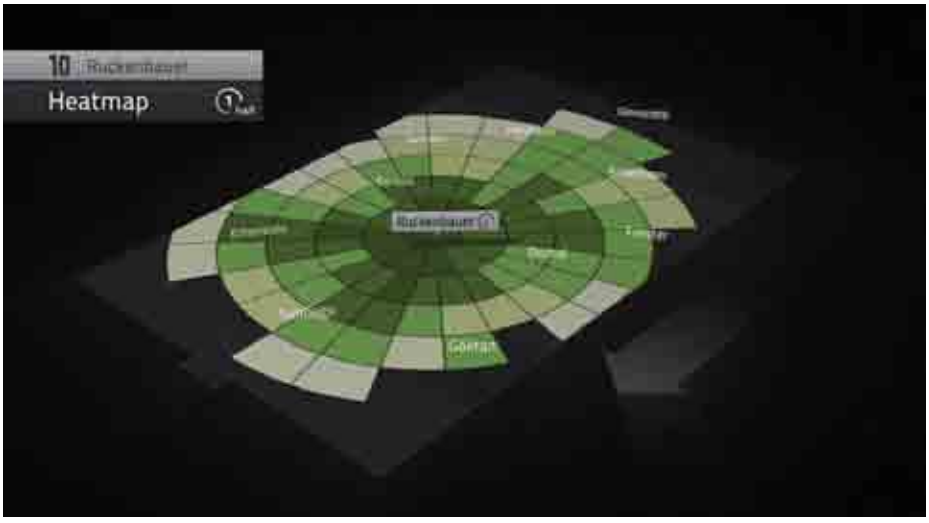

Fig. 10. One screenshot of the Football match data visualization

Case Study 11: Goldstar Beer Infographic (2009). This simple visualization cleverly presents the difference between male "simplicity" and female "simplicity" when it comes to choice of alcoholic beverage.

Fig. 11. Goldstar beer infographic

Case Study 12: Guantanamo Detainee infographic (2012). This interactive *New York Times* shows a comparison of detainees held versus transferred along a timeline (Fig 12).

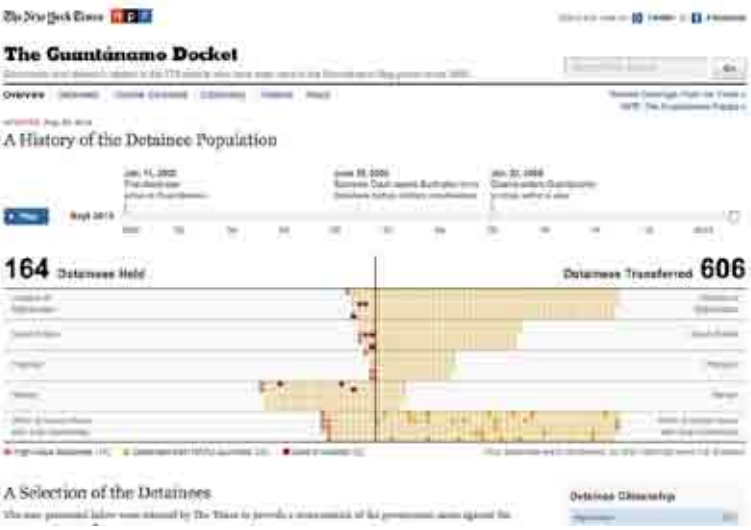

Fig. 12. Guantanamo Detainee infographic

Case Study 13: Obama election infographic (2008). Another *New York Times* example, this data-rich infographic presents a breakdown of electoral votes across the U.S. in the 2008 presidential election.

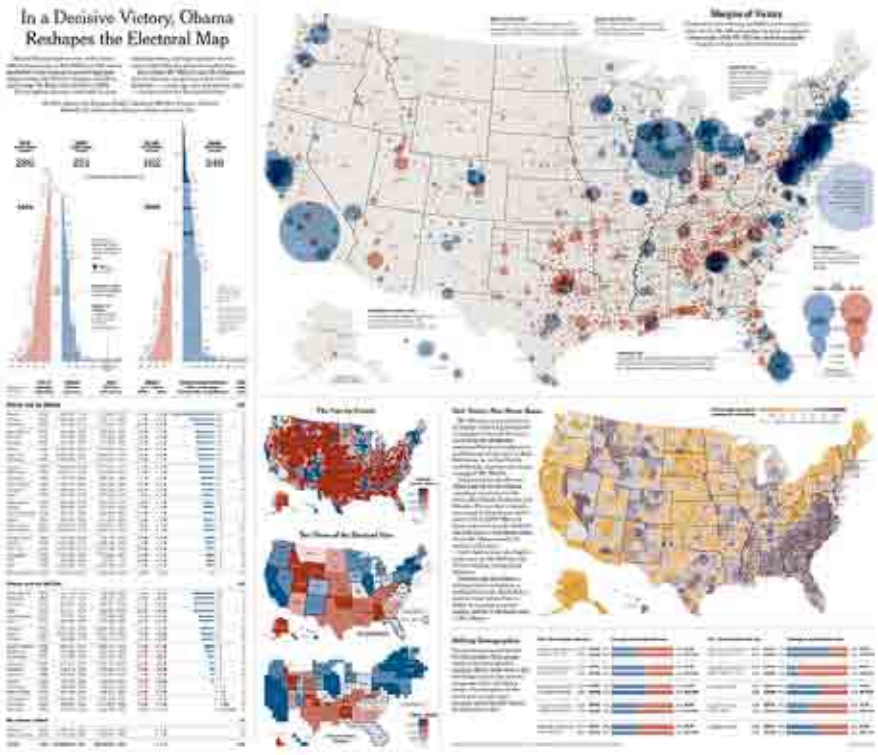

Fig. 13. Multiple maps and charts in New York Times

5.1 Case Study Analysis

The analysis discussed in this section is not meant to be exhaustive, but to provide initial insights into ineffective visualization practices. Table 1 shows the analysis derived from the information design principles explained in Section 4 and used to investigate each case study.

Table 1. Analysis of case studies using information design principles.

	Calendar	Health Plan Organizational Chart	Discrimination Against Women	Global Internet Map	Are you done in There?	Comparative map	Valence	Software Evolution Storylines	Cascade	Football match data visualization	Goldstar beer infographic	Guantanamo Detainee infographic	Obama Map US elections
CASE STUDY (CS)	1	2	3	4	5	6	7	8	9	10	11	12	13
VISUALIZATION CATEGORY													
Informative animation							X			X			
Interactive data visualization			X					X	X			X	X
Infographic	X	X		X	X	X					X		
INFORMATION DESIGN PRINCIPLES													
1. Unambiguous problem definition													
Is the intent or purpose clear?	3	1	3	2	2	1	1	1	1	2	3	3	3
Does it present content that supports the purpose?	3	1	1	2	2	1	1	1	1	3	3	2	3
2. Human-centered approach													
Does it generate interest?	2	1	1	2	2	1	2	2	1	2	3	3	3
Is the information accessible to a broad audience?	2	1	1	1	2	1	1	1	1	1	3	3	2
3. Constructive synthesis of information													
Does it present the content in a new or improved way that reveals underlying connections or systems?	3	3	2	2	2	3	2	2	3	2	3	3	3
Does it make sense of content better than the raw content would by itself?	1	1	2	2	2	2	2	1	2	2	3	3	3
4. Clear organization													
Is there a visible structure?	3	2	2	2	3	2	2	1	2	3	3	3	3
Is there a hierarchy of information?	2	1	1	2	2	2	1	1	2	2	3	3	3
5. Content-driven design													
Does the graphic execution reinforce the content?	2	1	1	2	2	2	2	1	1	2	3	3	3
Does the medium or format facilitate understanding?	2	2	1	2	2	2	2	2	2	2	3	3	3

The first principle is addressed for mostly all case studies, but three of them addressed it only moderately, while five of them very poorly (CS2, CS6, CS7, CS8, CS9). As shown in Table 1, the second principle was the least addressed, with eight of the 13 case studies addressing it poorly. Three were cases (CS11, CS12, CS13) that seemed to have considered the audience when creating the visualizations. Interestingly, principle 3 was to some extent taken into account for most of the cases analyzed, as only CS8 does not display a constructive synthesis of information. From the remaining 12 cases, seven addressed this third principle in a moderate way, while five in a much stronger way. The last two principles present similar trends, with almost the same cases only addressing them poorly, CS2, CS3 and CS8 for both principles, CS7 for principle 4 and CS9 for principle 5. However, principle 4 was strongly addressed for almost half of the cases, while the last principle for only three cases.

5.2 Addressing Principles

Overall, in the reviewed case studies we found complexity being displayed in random and arbitrary ways (e.g. CS1, CS2, CS3), but also insightful ways of visualizing complexity (CS11 to CS13).

Four types of visualizations emerged from the analysis:

- Complex content, simple display: (CS11)
- Complex content, complex display: (CS2, CS7, CS9)
- Simple content, simple display: N/A
- Simple content, complex display: (CS1)

Some visualizations defined the problem clearly and unambiguously by including a title (CS3, CS5, CS10, CS12, CS13,) or using visual elements related to the topic (CS10, CS11). However, many of them neither had a title nor a description of the problem they are aiming to address (CS1, CS7, CS8, CS9) or what they are displaying is not clear enough (CS2). Mostly, interactive information visualizations appear to be omitting the inclusion of this type of information (Is the intent or purpose clear?). Conversely, CS12 is an interactive case that introduces the purpose right at the beginning and does not generate confusion or ambiguity.

The above paragraph relates to principle 2 too, and the need to consider the audience's needs and create visualizations with a well-defined entry point to first engage the intended audiences and then wider audiences.

Particularly, in CS7 is hard to understand from where to start making sense of its content, as in addition of lacking an entry point, all elements are at a similar visual level making hard to distinguish connections. When connections between elements are ambiguous (CS5, CS7, CS8), information lacks context and users/readers cannot construct "a mental information and relationship structure" [2] for the visualization. This supports the relevance of principle 3 for visualizing complexity.

Moreover, visualizations with lack of clear organization and deficient content analysis, principles 3 and 4 respectively, demand heavy working memory load to be understood [14]. CS1, CS2 and CS4 exemplify this problem as many of their elements require long periods of time to be understood demanding more than one processing action in simultaneous: identifying each component type, identifying the relevance of each component type, connecting each component type to the whole visualization.

While defining a clear structure is an important aspect towards creating an effective visualization, defining hierarchies is equally essential. Even though elements in a visualization are displayed in a visible structure (CS2, CS5), that does not always result in elements being well organized or having a well-defined hierarchy. This finding is in line with previous studies [12] which found that incorrect establishment of hierarchies may result in ill-defined visualizations. Similarly, some of the visualizations display strong structures (CS1, CS6), but those structures are not communicating the message clearly as they display lack of hierarchy of information or misleading hierarchies. CS1 is an example of the latter situation. This visualization displays simple content, in a complex manner. While information seems to be structured in a conventional calendar format (days, weeks, month), on closer inspection, those same components are organized in an unclear way. Other case studies failed to address this same principle as well.

CS4 and CS6 present a similar problem: dysfunctional chromatic coding. CS6 displays 10 variables coded with 10 different colors, but not applying content-driven design (principle 5). Paradoxically, the use of excessive broken lines to connect elements makes it harder to see the connections between elements and pay attention to the three different meanings of each line, explained in the key: arrow line, two-arrow line, and circle line.

CS4 appear to display robust content-driven design, but the way content is structured does not seem to be related to its subject matter. Satellite graphics and tables on the edges are visually disconnected from the core elements of the visualization (three big circles). The chromatic palette is highly varied, demanding high cognitive levels to connect each color with its meaning. [14] Conversely, in CS13, content is clearly structured: each graphic, table and map is visually connected. The use of a reduced chromatic palette facilitates the connection of content and elements.

5.3 Nested Principles

When content analysis and synthesis (principle 3) are not thoroughly conducted, information hierarchy are not properly defined (principle 4), and consequently visual hierarchies are not achieved (principle 5). This is exemplified with CS2 in which visual decisions do not seem to be governed by principles of information design. Shapes, scales, orientations and colors do not appear to respond to informed design choices, as squares of various sizes display similar types of information. In addition, this visualization lacks an entry point as all elements (struc-

ture, content) are at the same visual level: all elements are emphasized, therefore, nothing is emphasized. The design also looks "noisy, cluttered, and informationally flat." [22] This indicates how poorly CS2 is addressing principle 5, but also how strongly interwoven these three principles are.

In short, a visualization should address most (if not all) of the information design principles to be considered effective, as the principles are tightly interconnected.

6 Recommendations

In the previous section, we reported how, by applying foundational information design principles, complex information becomes more accessible, and when these same principles are not considered even simple content can be displayed in a way that generates confusion. This indicates that when foundational information design principles are not thoroughly applied, in-depth understanding is not achieved and confusion is created [12, 14]. In an attempt to reduce complexity, many visualizations seem to be missing their main purpose: to improve understanding [10]. Case studies demonstrated how the absence of informed decisions produces misconceived outcomes.

We present the following recommendations to encourage the application of information design principles:

- Standardize and add rigor, process, and methodology to visualization education programs
- Introduce foundational information design principles early on in the courses
- Teach future visualization creators to think more critically about when and why information design principles need to be applied [2]
- Avoid blindly applying generic design principles or rules
- Shift the design process emphasis away from later-stage implementation (tools and techniques) and towards early-stage problem definition and understanding
- Critically examine each step of the design process
- Understand how people interact with and make sense of information [2]

These recommendations are meant to improve visualization practices from their foundations, rethinking current related education programs, but also serve as a call to action to visualization creators with many years of experience to rethink their current way of visualizing information. In the words of [22]: "Clear and precise seeing becomes as one with clear and precise thinking."

7 Acknowledgements

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Image Sources

Image 1: http://www.flickr.com/photos/eliazar/407605908/in/set-72157594507810147/
Image 2: http://www.healthpolcom.com/blog/2009/07/21/health-reform-hyperbole-heightens/
Image 3: http://www.uia.org/archive/visual-gallery
Image 4: http://www.telegeography.com/telecom-resources/map-gallery/global-internet-map-2009/index.html
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Technical Development of Different Forms of Narrative Art, from Sources such as Data Visualization and Info-Graphics.

Case study: The communication method 'THE NO PROJECT' organization develops, to disclose that human trafficking.

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Abstract. This abstract presents the collaboration between TEI of Athens and the humanitarian 'THE NO PROJECT' organization in the development of informative visual material. The artifacts, mainly animated films, will be discussed in order to demonstrate the power of the communication method developed by the organization.

Scenario: Human exploitation and illegal labor are two main contemporary plagues producing extremely negative conditions of sexual exploitation, very hard working conditions (domestic service, agricultural, industrial, mining and construction works, child soldiers, forced begging and so on are the sign of very critical conditions for many human beings.
Large organizations such as UN or UNICEF, International Labor Organization, etc. internationally active in addressing the problem, collect and publish statistics.
These information are re-published by organizations battling human trafficking, often in the form of data visualization artifacts and info-graphics.
The objective is to offer to the public the highest, clearest and more direct possible information.

Project:
An independent initiative against Trafficking in Human Beings, 'THE NO PROJECT' organization aims to raise attention on human exploitation. The objective is to present an accurate picture of reality in relation to trafficking in Greece promoting awareness of young people to influence our society in order to change attitude.
The organization operates in schools, universities, youth groups; collaborating with various representatives in order to highlight the problem of human trafficking. Various materials such and documentaries, statistics and data are used in this process.
The organization asks from his supporters to offer time, knowledge, experience and skills in order to acknowledge the problem through music, arts, education and social networks. By this way, statistical data collection and other information are being developed in different narrative struc-

tures and communicative forms. The main objective is the dissemination of knowledge and awareness in this sensitive area.

The TEI of Athens worked with the organization by following the method below:
All involved teachers decided, that the students of story board courses will work on the given subject in order to create original scenarios and to allow different options.
The organization's representative Mrs. Judy Boyle, came up at the start of the course at TEI and presented the issue of human trafficking and the ways the' NO PROJECT' organization, prefers to communicate.
The students created storyboards which are finally presented in the lesson with the presence of Mrs. Boyle. Of course during the creation, from concept to final presentation, communications and feedback between all parties (the organization, students and teachers) were continuous.
Then during animation course, students after one semester of cartoon lessons, realized part of storyboards, so that they produced animation movies.
Test screening was made at TEI theater with the presence of TEI students, teachers and Mrs. Judy Boyle in order to be selected the most popular and understandable movies.
The chosen movies delivered to 'NO PROJECT' organization, as part of communication material.

Key Words: Data / infographcs / animation films.

The problem

"The recruitment, transportation, transfer, harbouring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation" [1]

"The Article 3, paragraph (a) of the Protocol of United Nations Convention against Transnational Organized Crime (UNTOC) to Prevent, Suppress and Punish Trafficking in Persons, defines Trafficking in Persons as the recruitment, transportation, transfer, harbouring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation. Exploitation shall include, at a minimum, the exploitation of the prostitution of others or other forms of sexual exploitation, forced labour or services, slavery or practices similar to slavery, servitude or the removal of organs". [1]

On the basis of the definition given in the Trafficking in Persons Protocol, it is evident that trafficking in persons has three constituent elements;

The Act (What is done)
Recruitment, transportation, transfer, harbouring or receipt of persons
The Means (How it is done)
Threat or use of force, coercion, abduction, fraud, deception, abuse of power or vulnerability, or giving payments or benefits to a person in control of the victim
The Purpose (Why it is done)
For the purpose of exploitation, which includes exploiting the prostitution of others, sexual exploitation, forced labour, slavery or similar practices and the removal of organs. [1]

"Trafficking in persons is a serious crime and a grave violation of human rights. Men, women and children are trafficked within their own countries and across international borders. Trafficking affects every continent and every country. Every country is affected by human trafficking, whether it's an origin country where people are trafficked from; a transit country where people are trafficked through; or a destination country where people are trafficked to. Often a country will be all three". [2]

The statistics

Due to the hidden and illegal nature of human trafficking, gathering statistics on the scale of the problem is difficult. The following statistics may represent an underestimation, but are the most credible and frequently quoted. [2]

People trafficking, is the fastest growing means by which people are enslaved, the fastest growing international crime, and one of the largest sources of income for organized crime. — The UN Office on Drugs and Crime. [2]
The headline facts

An estimated 2.5 million people are in forced labour (including sexual exploitation) at any given time as a result of trafficking. *[1]*

Of these:
1.4 million – 56% - are in Asia and the Pacific.
250,000 – 10% - are in Latin America and the Caribbean.
230,000 – 9.2% - are in the Middle East and Northern Africa.
130,000 – 5.2% - are in sub-Saharan countries.
270,000 – 10.8% - are in industrialized countries.
200,000 – 8% - are in countries in transition. *[2]*

161 countries are reported to be affected by human trafficking by being a source, transit or destination count. *[3]*

People are reported to be trafficked from 127 countries to be exploited in 137 countries, affecting every continent and every type of economy. *[4]*
The Victims

The majority of trafficking victims are between 18 and 24 years of age. *[5]*

An estimated 1.2 million children are trafficked each year. *[6]*

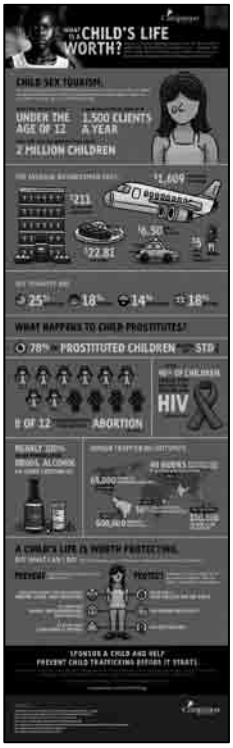
95% of victims experienced physical or sexual violence during trafficking (based on data from selected European countries). *[7]*

43% of victims are used for forced commercial sexual exploitation, of whom 98 per cent are women and girls. *[8]*

32% of victims are used for forced economic exploitation, of whom 56 per cent are women and girls. *[9]*

Many trafficking victims have at least middle-level education. *[10]*

[4]



[5]

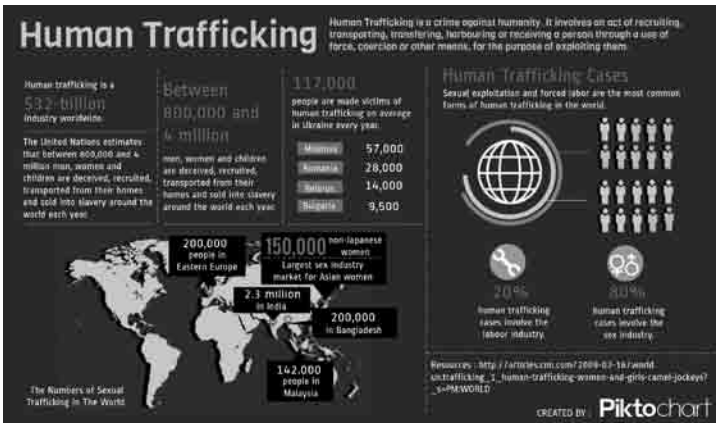
Fig. 1. Infographic from "The Dream Center volunteer organization", with information for the sex trafficking in USA.

Fig. 2. Infographic from "Christian Child Sponsorship", named "Compassion" about child's prostitution.

52% of those recruiting victims are men, 42% are women and 6% are both men and women. *[11]*

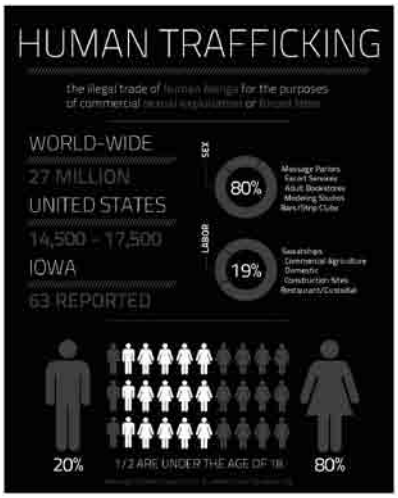
In 54% of cases the recruiter was a stranger to the victim, 46% of cases the recruiter was known to Victim. *[12]*

The majority of suspects involved in the trafficking process are nationals of the country where the trafficking process is occurring. *[13]*



[6]

Fig. 3. Inforgaphic based on the statistics of United Nations Office on Drugs and Crime. From *"Piktochart Design Easy Infographics".*



[7]

Fig. 4. Infographic based on the statistics of National Human Trafficking Resource center. From *"Polaris Project for a world without Slavery".*

The Profits

Estimated global annual profits made from the exploitation of all trafficked forced labour are US$ 31.6 billion. *[14]*

Of this:

US$ 15.5 billion – 49% - is generated in industrialized economies.
US$ 9.7 billion – 30.6% is generated in Asia and the Pacific.
US$ 1.3 billion – 4.1% is generated in Latin America and the Caribbean.
US$ 1.6 billion – 5% is generated in sub-Saharan Africa.

US$ 1.5 billion – 4.7% is generated in the Middle East and North Africa. *[15]*
Prosecutions

In 2006 there were only 5,808 prosecutions and 3,160 convictions throughout the world. *[16]*

This means that for every 800 people trafficked, only one person was convicted in 2006 *[17]* [3]

The No Project Organization

The NO Project is a global public awareness campaign against human trafficking and modern day slavery. The soul of The No Project is the Founder, Judy Boyle, who first encountered human trafficking through reading a newspaper article in Greece, in 2001.

The article described an 18 year-old girl who hanged herself in a toilet using her own stockings. The young woman from Eastern Europe was a victim of Human Trafficking who had been recruited, trafficked to Greece and forced into prostitution. "My world turned upside down that night," Boyle says. "I couldn't sleep. It did my head in."

After extensive research and collaboration with various NGOs against Human Trafficking, Judy Boyle decided to establish the anti-slavery public awareness campaign, The No Project.

The aim of The NO Project is to raise awareness in young people through education, arts, music, dance, film and social media. “Sustainable change lies with a well-informed, proactive youth generation. They are the consumers, the policymakers, the educators, parents and role models of the future. They are also the potential clients and traffickers.”

The NO Project collaborates with artists, musicians, film-makers, educators, writers, academic researchers, and even hip hop dancers. The campaign also works closely with the corporate world through Corporate Social Responsibility.

One reason Boyle targets youth is because of her own background as a teacher, teacher trainer, and writer of educational material. “History books say that Slavery no longer exists. Wrong. Slavery is not history. It is behind our daily products such as chocolate and coffee. It is behind closed doors in our neighborhoods - domestic workers and people enslaved for commercial sexual exploitation. But educational institutions are out of touch and turning a blind eye.

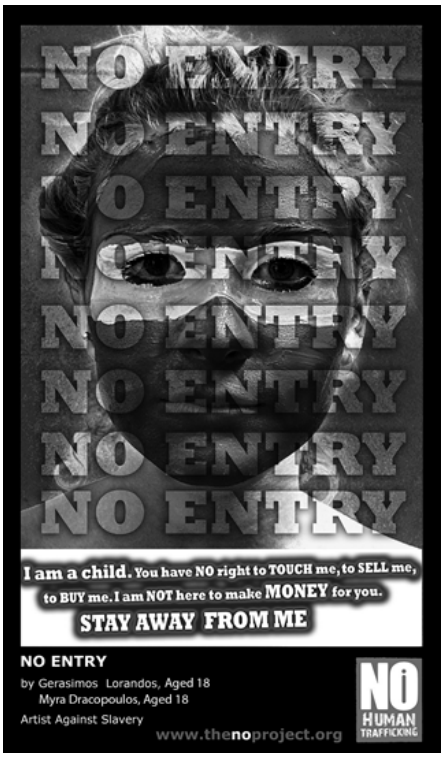


Fig. 5 and 6. Posters created by scholarships in Athens. *From Judy Boyle's archive.*

That's unacceptable," says Boyle. "You can't pick up a school book today that does not talk about the Ecological crisis – but no educational books are talking about the fastest growing crime on the planet- human trafficking and modern day slavery. That's what we do – try to reach young people but not only through formal settings. We reach them in ways that have personal meaning – on line, videos, music, dance, animation."

Supporters of The NO Project are extremely diverse – from the world champion Hip Hop Dance Crew, Request, to a Harvard University Professor and global expert on Human Trafficking. However, fundamental to all the work of The No Project is Art and Film produced by youth activists.

In the summer of 2011 Boyle came across an animation on youtube by Effie Pappa, "1.2 Million Children". She was intrigued by the work of the young Graphic Art student in Athens, but more importantly she thought, "Who are the tutors of this student – I want to work with them." And that is exactly what she did.

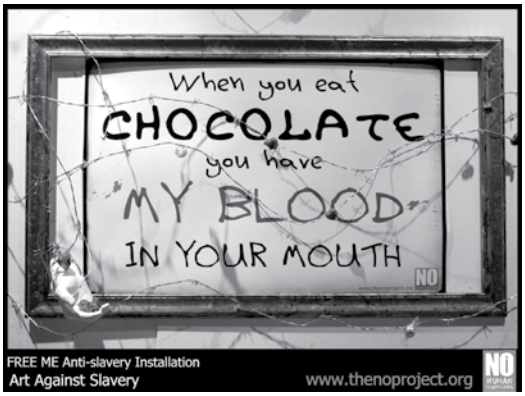


Fig. 7. The world champion Hip Hop Dance Crew, in collaboration with The No Project organization. *From Judy Boyle's archive.*

Fig. 8. Installation Judy Boyle, Illustration Effie Pappa. *From Judy Boyle's archive.*

The Technological Educational Institute of Athens (TEI), Collaborate with The No Project Organization.

The TEI is a public university with many different schools. One of them is the Faculty of Fine Arts and Design, in which the Department of Graphic Design is included. The courses of the department include a series of choice courses in animation. These are three courses of the last semesters. In the 5th semester there's a story board class, within the 6th and 7th, a cartoon and animation class. The lesson of the story board, in theoretical part, includes visual communication via cinema, especially the principles of cinematic language. In the laboratory part, students are required to create a complete story board. The theory of the cartoon course includes the expression of movement through one or several characters. During the laboratory session students have to create different movements or their techniques. The theory of animation includes visual communication via animation and its various techniques. In the laboratory session, students have to create an animation film with their premade story boards. These movies are uploaded on www.youtube.com/teianima.

Judy Boyle had decided to contact with the teachers of the department. Given that 'The No Project' organization collaborates with teachers and young people, this collaboration has been set within the framework of the organization. Accordingly, the teachers, Eleni Mouri (assistant professor) with Stelios Polihronakis and Eleni Tsampra (lab assistants) call at the beginning of each semester a specialist to present an issue which addresses to the students. Boyle's proposal was discussed by us and it is considered by everyone to be matching to the course aims.

By the start of the course Judy Boyle came to TEI of Athens and with her personal radiation and passion, analyzed the problem of Human Trafficking. Students were shocked by this problem and teachers discovered that the issue is almost unknown among the young people, just like the organization highlights. The questions were straight and the answers led to new questions. The presentation lasted for 3 hours without any break. The recruitment of such shocking information motivated our students to thoroughly investigate the matter, through sources given by the speaker, or other that found on themselves. These sources are the different international organizations that act against Human Trafficking as the United Nations Office on Drugs and Crime, Stop the Traffik, Antislavery, Free the Slaves, Not for Sale, Slavery Footprint, The A21 Campaign, Priceofsex, GEMS, Walkfree , etc.

The images of abused and frightened people who have suffered by violence, opposing to the personal life of the carefree youth (20-22 years old), prompted students to ideas based on contrasts. It led them to ideas that collate the light and color of the beauty of life with the darkness and fear which brings slavery.

Besides, as Rudolf Arnheim wrote, «The privilege of observing everything in connection with something else, elevates the understanding to a higher level of complexity and validity while it simultaneously exposes the observer to an infinite number of possible connections [....] This is because the controversy highlights the dimensions, in which things can be compared, and consequently sharpens the perception of these particular qualities "[8]

Here are five examples coming from the story-board and animation courses. These examples have later, projected by the organization 'The No Project'.

	REAL (Chronological narrative axis)	FANTASTIC - PLOT (Non-chronological narrative axis)
Set up Reveal of a conflict	Freeloaders lure a Third World child, into the promise of a better future.	A child from Africa gazes the stars. A star shines and the child follows it.
climax	The child is persuaded and follows traffickers; feeling joy and optimism.	She flies free in the sky, up in the clouds, she meets a family of birds playing vigorously.
	The danger is sensed, but repelled because of the powerful desire for freedom.	She's riding a grasshopper. A flower closes safely its petals and elevates.
crisis	But the dream turns into a nightmare and overpowers.	The cloud where the kid is, pops and the child falls. She encounters a large carnivorous plant that swallows her.
conclusion	The child captured by the circuit of traffickers and the dream becomes a nightmare.	Located in a flatbed truck along with other sad children. The truck is moving to an industrial western city. The child has been captured by smugglers.

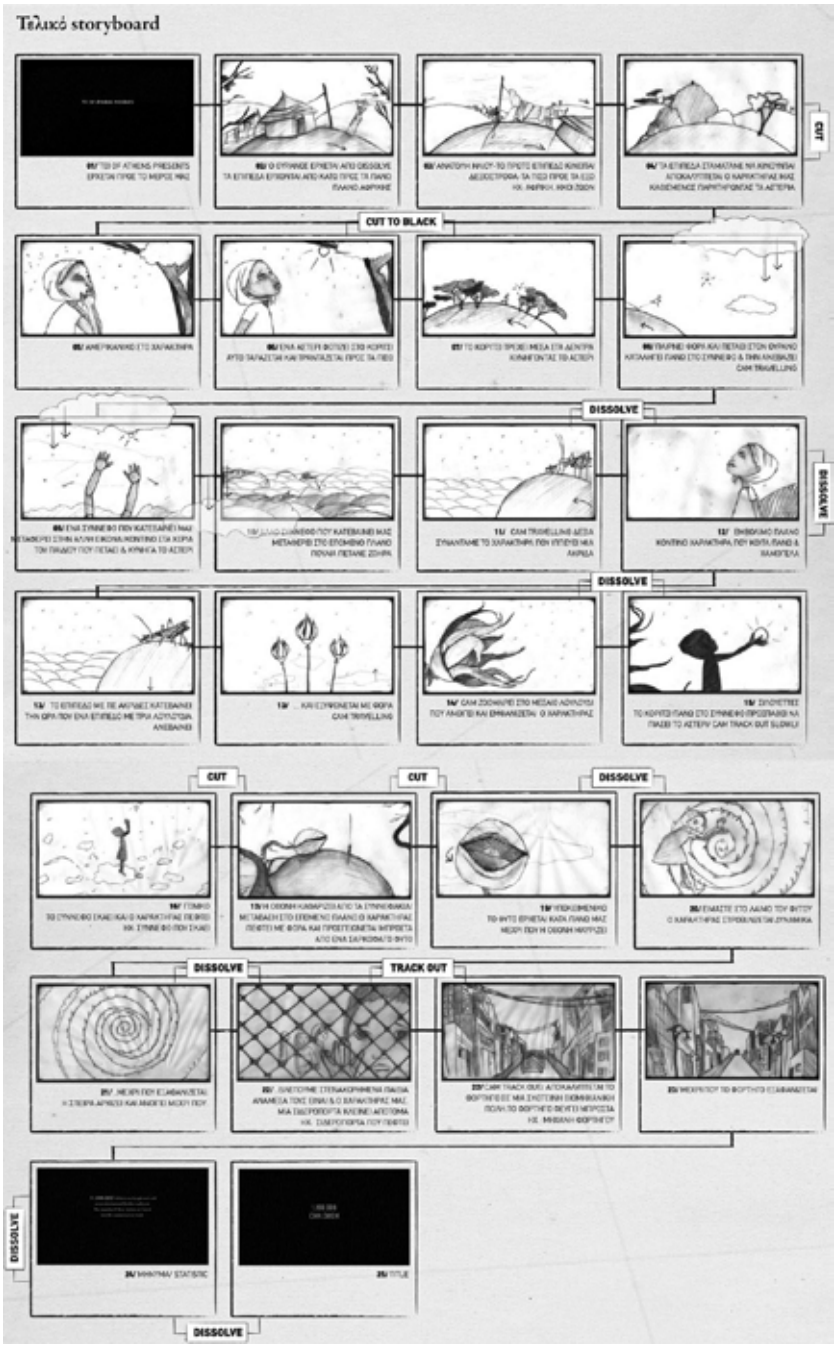


Fig. 9. The story board of "1,2 million children". *The film: http://www.youtube.com/watch?v=JwmZ6dhxRyE*

The first example is the movie called “1.2 million children”, by Effie Pappa. This student chose the topic for her thesis before the collaboration between TEI and The No Project. She work up to the statistical basis for the creation of the script, comes from the UNICEF, UK Child Trafficking Information Sheet (January 2003). An estimated 1.2 million children are trafficked each year. During the structure of the script, we observe the controversy. On the one hand, the reality is placed in a fully chronological axis and on the other hand, the fictional side of the way the child sees the world around them, the plot.

Another element used by students in creating their scripts, was the use of coding and tales that have become codes. Andersen’s “The little mermaid”, is widely developed in Western society and overthrow them.

"The Codes are forms of social knowledge from social practices and beliefs although they are no sign fortification. They organize their understanding of the world in terms of "dominant paradigm meaning", standards vary according to culture and time, but in general it’s taken for granted when we interpret or think about something. "[9]

The second example is Natalia Qadreh’s film; The father sells his daughter to the wolves. The term "father" is decoded on the concepts “love”, “warmth”, and “protection”. The symbol of wolf in western society is decoded in very negative terms. It is a dangerous creature that lives in darkness, eats children and is generally voracious. The overthrow of the concept father relied on statistics that showed that close relatives are, in most cases, the children traffickers.

Fig. 10. A part of “Wolf Market” story board.
The film: *http://www.youtube.com/watch?v=qEGtki1tIiY*

Third example, is the film of Aspasia Hatzirvassanis; The prince of the well - known tale of Hans Christian Andersen «The Little Mermaid" is actually the

trafficker. The tale is well known to every child grown up in the West and it works here as a code.

The ruling view is the one of the Disney's film "The little mermaid" and not the original version of Andersen's. The mermaid is a girl who is sacrificed for her love.

Fig. 11. A part of "Wish" story board.
The film: *http://www.youtube.com/watch?v=WpuoS-hjHwE*

In the 'Factory' example, of Argyri Aronis, the concept factory dominates. In Mythologies theory, Roland Barthes speaks for the first reading level , of denotation and connotation of the second reading level. The denotation is the literal level of significance, the 'objective' present that is easily recognizable by our senses. It is the unencrypted message, direct and obvious, closed to interpretation and belongs to the recognition level. The connotation refers to meanings that are beyond the denotation and depend on it. By connotation, comes the meaning of the Code and symbolism…. It is the level of interpretation, wherein lies the secret, hidden reason, where the reader actively introduces cultural codes in order to interpret it. [10]

In its first level meaning, 'Factory' is the building where products are manufactured. The children are feared to entering the factory and they come out as consumer products. The connotation importance lies in linking consumption - profit, demand - production, child-product. The key elements lead to the human Trafficking.

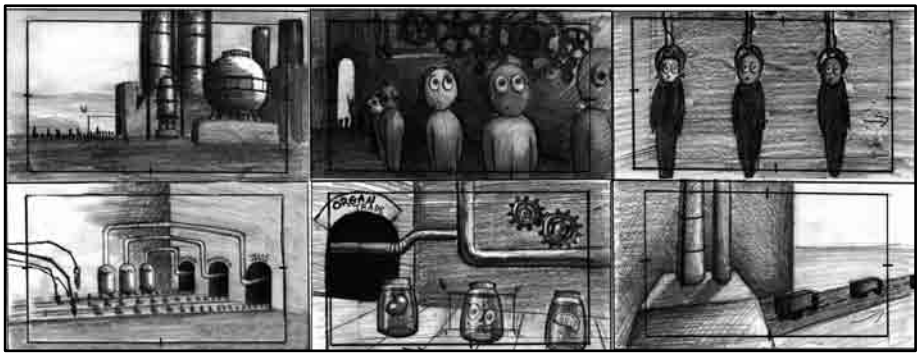


Fig. 12. A part of "Factory" story board,
The film: *http://www.youtube.com/watch?v=EBcWp7yo7DQ*

In the example of Maria Douni, the emphasis is given on the ignorance of sensitized citizens of Western society. It is an ironic comment on our practices. Denotation is the forcible transfer of girls in factories, where they produce clothes, and the woman protesting against Human Trafficking.

Fig. 13. A part of "Stop Human Trafficking" story board.
The film: *http://www.youtube.com/watch?v=asE9nkd9bWc*

The comment is on the link between women laborers and typical western bourgeois. It is a yellow blouse. A color connotation, for a practice that theoretically causes repulsion, yet we are all potential buyers of these exportable products.

The story boards, created in the 5th semester, were delivered to Judy Boyle, who helped with some observations. In the 7th semester in the animation course, students perfected their story-boards and worked on the film production.

At the end of the semester, Test screening was made in front of the presence of students, teachers and Judy Boyle. Attendees' voting criteria were the power of communication, the script, the aesthetics, the expressiveness of the characters and the use of film language.

The movies were delivered to 'NO PROJECT' organization, as part of communication material, and showed by TEI, at Greek animation festivals, 'Animasyros' and 'Be there'. At the same time these films have made an independent course in various festivals which have been sent by their authors.

Conclusions

Human trafficking is a global problem, communicated mainly by data, infographics and documentaries. The students of TEI, at the department of Graphic Design, used this material and created animation storytelling films out of it. The aim was to raise awareness of the audience towards the problem and not to transmit the knowledge that was acquired from the analysis of data, which would result to the creation of informative animation. The most important characteristic of the animation film is the narration of the unrealistic in favor of creating emotions. For this reason suitable means of communication and from the cooperating organization, The No Project and from the teachers of the course. The result proved that this collaboration has benefited both the educational process as well as the organization. Students worked in order to communicate a real problem and find solutions for it, while the organization projects these films to an international audience in order to sensitize. At the same time the university and the students are notified.

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Playing with Data: an Experience in Creative Infovis

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Abstract. Information Visualization (Infovis) methods provide an effective way to make sense of the vast amount of data flowing around our everyday experience. Using creative Infovis designs is possible to convey the meaning and enhance the understanding of complex topics. The purpose of this paper is to present the design method adopted in a collaboration between Polytechnic of Turin and Telecom Italia, whose goal is to devise novel and useful Infovis concepts to deal with data. Powered by the sharing of different skills and experiences, this method led to the first results presented in the paper.

Keywords: complex systems design, information visualization

1 Introduction

We are living in an era of exponential increase in data production, collection and usage in every sector of human life, about people, ideas and object. Nowadays more data is produced in a single second than the entire content of the Internet of twenty years ago.[1] As a result data, seen as a complex system, provide an important opportunity to enhance the cognition of our environment. For this reason the ability to collect, understands, communicate and make sense of information is going to be a very important skill in the next decades [3], in the professional field as well as in the educational and research field [4][5]. Under this premise, a collaboration has been established between the Department of Architecture and Design (DAD) of the Polytechnic of Turin and the Innovation and Re-

[1] An ordinary person today could generate more data in one afternoon's trip to the market than a person born in 1912 would produce in a lifetime. [1] Considering the Internet's content generation rate today, a growth of 44 times in the digital data generation rate in the next ten years could be a reasonable expectation [2].

search Projects department of Telecom Italia S.p.A. This collaboration, involving the authors of this paper (DAD and TI researchers) and a selected group of students from DAD, pointed out, shared and explored new creative design and Infovis methods coming from the experience matured in DAD and TI. Main insights gained in this phase are presented in sections 2,3 and 4 of this paper. In the unfolding of the research activity a pair of case studies, coming from recent Infovis projects in TI and described in section 5, were presented and analyzed by the research group in order to inspire and support the Infovis concept proposals of the students presented in section 6.

2 Data, Complex Systems and Systemic Design approach

Complex systems are those systems and phenomena made of many components or agents interacting with each other in countless possible ways, where the overall behavior is not given by the simple sum of the behaviors of their constituent elements, but depends strongly by their interactions [6]. Therefore, our capability to understand complex systems is not only due to our knowledge about the single system's components and features, but especially to the ability to recognize and validate the overall relations among these components and features. This is the case of the analysis and visualization of complex data sets, especially when the number of data is very large (the so called "big data"). In order to reach the Infovis project's goal, we establish a design process methodology starting from the Systemic Design Approach able to organize, optimize and understand all the actors and parties involved in the phenomenon under consideration.

The Systemic Design approach is a new way to face the design activity in complex systems, used and taught in design courses at the DAD. Defined and verified in different design fields as a way to create innovation by the research group, it is focused on designing the relationships between people, activities and contextual features to enhance knowledge about complex systems. It begins with the collecting of broad and tangential information in order to examine the vast array of issues and features surrounding any given complex topic. The study of this overall picture guides the designer into a deep understanding of the topic outlining the real role of all the actors involved within their scope, their development and their relations in their operational context [7]. As a result, using this approach is possible, in one hand, to become aware of the value of the relationships, expressed in the system’s behavior, creating the given topic’s identity, while in the other hand, the interaction between this identity and the operational context creates the culture of the considered topic. Operating in this iterative process, innovation can be driven using awareness, information and behavior within the system itself [8].

3 Information Visualization

While Infovis can be simply defined as the representation of information in visual form, it is nevertheless a complex multidisciplinary field, ranging from data mining to visual art, from psychology of perception to graphic design. This is because effective Infovis projects try to exploit the great power of human visual perception, creating visual data representations allowing the navigation, understanding and useful pattern discovery in data sets [9]. In other words, the quite ambitious goal of Infovis is cognitive augmentation, i.e. the extension of the capabilities of the human mind with respect to data, allowing to make sense of complex data-driven concepts [10][11][13].

In the collaboration between DAD and TI described in this paper, we've been strongly oriented to the creation of information visualization methods and concepts where one can "play with data", i.e. where aesthetic, creative design and interaction factors [12] are an essential part of the understanding of complex data, in a way that, quoting Andrew Vande Moere, "should appeal both the mind and the soul"[13].

4 Infovis design process methodology

The Infovis design process can be thought as composed of three main phases: analysis phase, encoding phase and display/testing phase. According to the Systemic Design approach, in the analysis phase the designer considers the overall picture of the topic to be visualized, taking into account the different data and elements involved and their relationships in the domain context. In order for the Infovis project to be effective, an important aspect is also the individuation of the target audience and the related communication style. An important design choice is the selection of the actual data to display in the visualization [10]. In this analysis phase is also important to assess data retrieval / extraction / structuring techniques needed in order to actually build the data flow needed by the intended visualization.

In the encoding phase, the most important aspect and design choice is the envisioning and definition of the mapping from data to visual elements, such as shapes, colours, animation, typography, and so on. Effective Infovis projects often make use of creative metaphors in order to convey meaning in an immediate way. The display/testing phase closes a single cycle of the Infovis design process, providing feedbacks and insight for the assessment of the visualization project.

5 Infovis case studies

The case study called "Politics" (fig.1) is focused on gathering, processing and visualizing data and information from Italian newspapers' articles and Italian po-

litical structure. Data are obtained by analyzing articles using Natural Language Processing (NLP) tools, by extracting useful concepts and matching them to structured information (using semantic web techniques) and by classifying articles on a pre-built taxonomy of arguments. That set of tools produces additional information (annotations) for every article: date of publication, people, organizations, places mentioned into the article, and relations between annotations based on their co-occurrences into articles. All of the annotations generated is our dataset, which can be continuously updated. Our visualization design approach is to use simple visual forms and different visual modules to show data at different

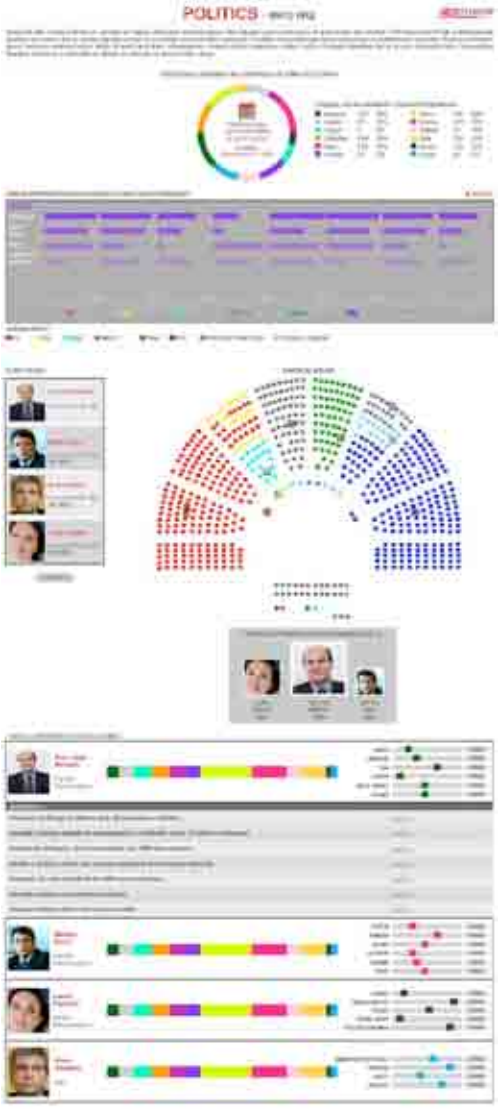

Fig. 1. Screenshot of the "Politics" Infovis project.

levels of aggregation. At the higher level of aggregation we use a donut chart to represent articles by argument. For more detailed information on deputies and their mentions in articles we use still images of the deputy to identify him. Moreover, to represent all the politicians whose information we deal with, we use the metaphor of the Italian Parliament drawn as a circular sector composed of tiny circles, one for every deputy; the colour of the circles can be arbitrary or the one traditionally associated to the party.

The “Colours of the Vineyard" (fig. 2) is a visual recommender system on the domain of Italian wines from the Piemonte region, based on a database of these wines and their properties related to smell, taste, grapes and production locations. When the user chooses a wine from the list, the system extracts from the database a set of wines with similar properties and creates an interactive visualization of this set, allowing visual exploration of wines' properties. Visual layout creation is driven by a fitness function taking into account not only data relationships, but also aesthetic, perceptual and graphic design factors. This method follows the approach of generative visual art and generative graphic design, where the artist/designer, after envisioning a set of aesthetic, functional and semantic criteria, models them as a process and lets the resulting system organize into the actual, emergent visual patterns [14]. The flexibility and modularity of the fitness function allows the designer to experiment with different aesthetic criteria and styles. Moreover, the generative approach naturally leads to the creation of a diverse set of visual solutions for a given data set, enriching the user's experience with a source of visual novelty. A detailed description of the project can be found in [15].

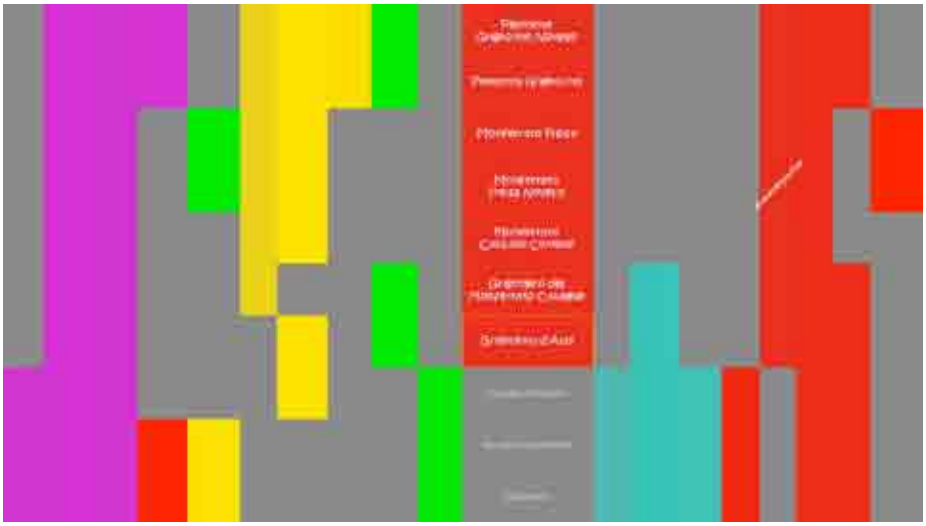

Fig. 2. Screenshot of the “Colours of the Vineyard” Infovis project.

6 Playing with data: Infovis design concepts

The design concepts produced by students follow the systemic design methodology explained before and embrace a range of different domains.
Every concept is briefly exposed hereafter:

Realtime Communication (authors: Pallaro Agnese, Rudà Elisabetta, Schioppetti Marzia, Tron Valentina). This work presents (fig.3) the concept of a system for realtime, interactive visualization of data flows in worldwide telecommunication networks. The key metaphor used is the sea, evoked by the color palette (also in line with the "control room" overall layout of the visualization) and by the wave-like shapes of several graphical elements. This, jointly with the envisioned advanced navigation features in (geographical) space and time of the visualization, effectively addresses the current need of surfing the ocean of data in a way that allows awareness and understanding.

Fig. 3. Screenshot of the "Realtime Communication" Infovis concept. Authors: Pallaro Agnese, Rudà Elisabetta, Schioppetti Marzia, Tron Valentina

My Energy Consumption (author: Altobelli Claudia). This work presents (fig.4) the concept of a system for the monitoring and visualization of home energy consumption. The metaphor and key graphical element used in the visualization is a little plant, whose different leaves represent different days, while the degree of filling of each leaf is proportional to the energy consumption in the associated day (in alternative visualizations, the leafs can represent different dimensions, e.g. the consumption of different household devices). This results in an intuitive and immediate method for becoming aware of the often quite elusive data about personal energy consumption.

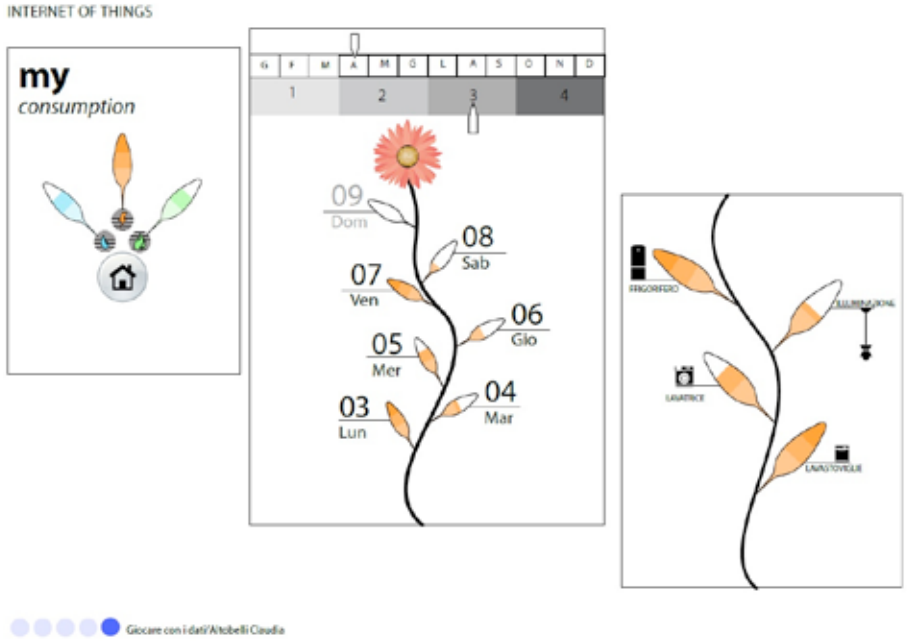

Fig. 4. Screenshot of the "My Energy Consumption" Infovis concept. Authors: Altobelli Claudia

Data to Think About (author: Altobelli Claudia). This work focuses (fig.5) on the goal of raising the awareness about the problem of violence against women. Key design factors are the navigation of statistical data in an interactive way, a clean, stylized graphic layout and the use of evocative shapes metaphorically related to the problem analyzed (e.g. the pointer indicating a particular statistics about feminicide has the shape of a gun). This results in a work having a strong emotional impact while allowing a clear understanding of actual facts and social factors related to the analyzed problem.

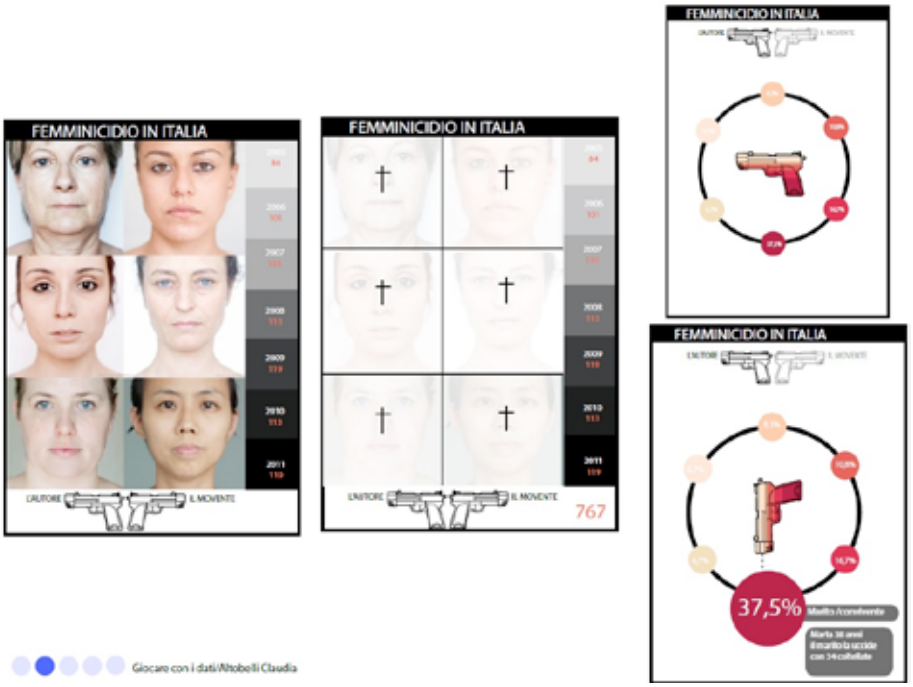

Fig. 5. Screenshot of the "Data to Think About" Infovis concept. Author: Altobelli Claudia

Who is the Fastest Sprinter of 2012 in 100 Meters? (authors: Amouzad Khalili Hamid, Khorramian Kaveh). This work presents a visual comparison of the speeds attained by top athletes in different sports, using as metaphors a clock/timer wheel and a virtual "speed contest". The visual comparison is integrated in a video showing the protagonists of this contest in action. This results in an immediate and effective way of explaining the concepts of speed and time (in an educational setting, for example) in different contexts.

Smart Cities (authors: Casale Enrico, Conte Fabio, Lopez Eliana Paola). The focus of this work (fig.6) is on improving the visual presentation of open data about cities. Key design factors are the switch from traditional infographics to a more intuitive and appealing design (like the radial layout proposed) and the improved navigation among the data, in order to easily move between their different levels of aggregation and categorization. This results in a easy-to-use tool allowing rapid understanding of complex data sets about the cities and their inhabitants.

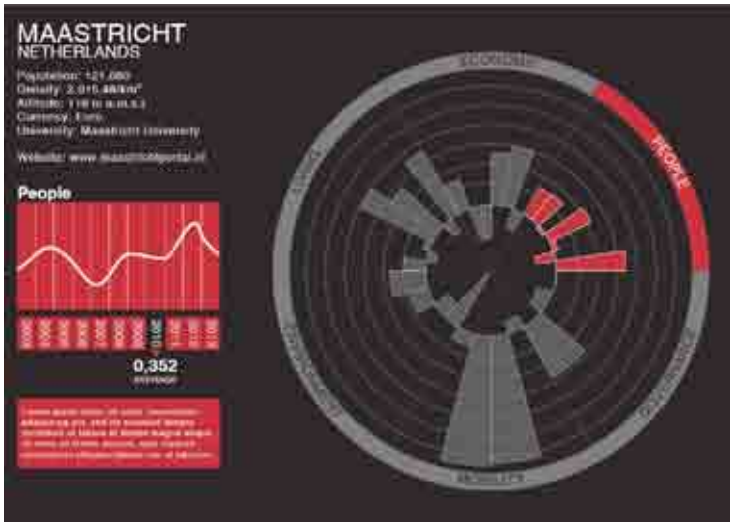

Fig. 6. Screenshot of the "Smart Cities" Infovis concept. Authors: Casale Enrico, Conte Fabio, Lopez Eliana Paola

ToriNoi (authors: Guataquira Sarmiento Nataly Andrea, Rugeles Joya Willmar Ricardo). This work (fig.7) proposes a tool for social networking / information retrieval with the goal of helping people, coming to Torino from foreign countries, to get the right information on travel, healthcare and legal documents required to live in Italy. The key visualization/navigation metaphor is a stylized shape of the Mole, Torino's iconic monument, composed of the stylized shapes of the users' avatars (the name of the concept, "ToriNoi", is the fusion of "Torino" and "Noi", the Italian word for "Us". Hence, the meaning is "Torino for Us" or "Torino are Us"). This design results in a warm welcoming feeling and in a great immediacy in the user experience when looking for information.

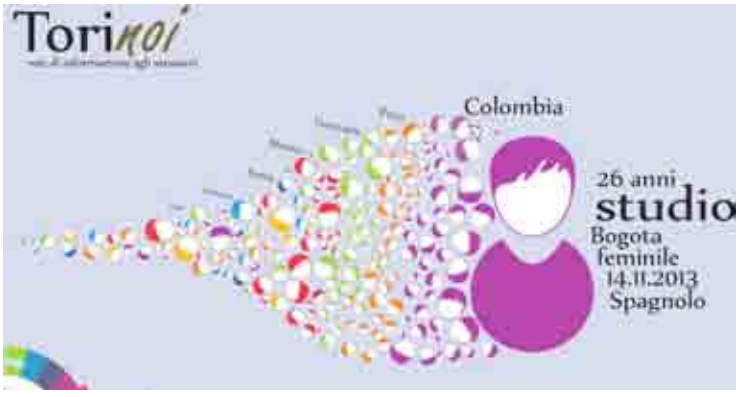

Fig. 7. Screenshot of the "ToriNoi" Infovis concept. Authors: Guataquira Sarmiento Nataly Andrea, Rugeles Joya Willmar Ricardo.

Italian Political History (authors: Cirillo Letizia, Sorgente Livia, Spagnuolo Anna). This work (fig.8) envisions a visualization tool on the data about the complex domain of Italian political history. Key design elements and metaphors are: 1) a "time wheel", i.e. a timeline with a circular layout organized in circular segments, representing different periods of Italian political history; 2) a schematic drawing of the Italian Parliament, showing the composition of the political forces (overall and in detail) in a interactively selected time period; 3) a graph layout visualizing the links among political actors, their parties, the available information about them, their media appearances, and so on. This results in a powerful, yet easy to use, analysis tool to explore and understand the past and present Italian political situation.

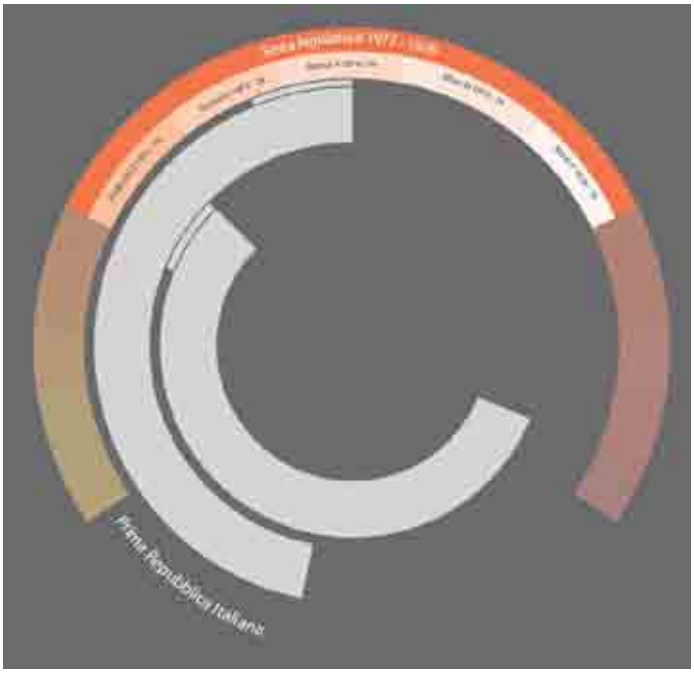

Fig. 8. Screenshot of the "Italian Political History" Infovis concept. Authors: Cirillo Letizia, Sorgente Livia, Spagnuolo Anna

Augmented Journalism (authors: Basile Carmine, Dellalibera Mattia). This work (fig.9) envisions a tool for the spectator of talk shows and similar TV programs, allowing to more easily understand important and complex themes. The key metaphor is the scientific optical instrument (e.g. microscope or telescope), penetrating under the surface of the visible TV show and visualizing in a realtime, accessible way the information linked to persons and themes present in the show, making use of information extraction, information matching and image recognition technologies. This provides the spectator a "augmented view" layer for an improved understanding of what she/he's seeing.

Fig. 9. Screenshot of the "Augmented Journalism" Infovis concept. Authors: Basile Carmine , Dellalibera Mattia

7 Conclusions

First results of the collaboration between our research groups were encouraging, because the students, guided by the systemic design approach and by the insights gained during the projects meetings, were able to produce high-quality visualization designs and "play with data" across the different phases of the design process, giving us a very strong positive feedback.

The future of our collaboration will explore the application of these design methods and insights in other domains, especially focusing on visualizations with strong interactive and aesthetic features.

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