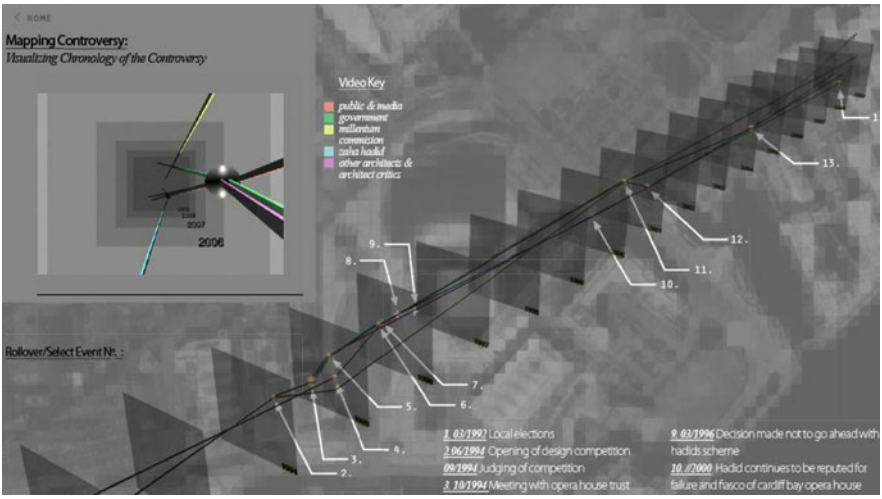
Chapter 8
From Reflecting-in-Action Towards Mapping of the Real

Albena Yaneva



Mapping of the Cardiff Bay Opera Controversy (2008/2009). Courtesy of Peter Brown, Lindsay Griggs, Natalie Harris, Abigail Phillips, and Sean Wilkins

Donald Schön's (1983) concept of "reflection-in-action" made a revolution in design anthropology in the 1980s, founding a new epistemology of practice, one that stands the question of professional knowledge on its head by taking as its point of departure the competence and artistry already embedded in skilful practice. This type of studio-based reflexivity can be followed in many architectural schools today, and is commonly privileged by the professional schools of many research universities. If reflection-in-action stands against the systematic, scientific, linear way of knowing,

A. Yaneva (✉)
Manchester Architecture Research Centre (MARC), School of Environment and Development (SED), University of Manchester, Humanities Bridgeford Street, Oxford Road, Manchester M13 9PL, UK
e-mail: albena.yaneva@manchester.ac.uk

I. Doucet, N. Janssens (eds.), *Transdisciplinary Knowledge Production in Architecture and Urbanism*, Urban and Landscape Perspectives 11,
DOI 10.1007/978-94-007-0104-5_8,

what kind of enquiry could complement the systematic way of knowing about architectural theory? I will argue that architects today need to engage more with a pragmatist type of architectural enquiry that would be a situation-based, distributed way of learning about architecture and its various entanglements, rather than one that would rely on a stable stock of systematic, scientific knowledge. An experiment in introducing such a pragmatist, self-exemplifying mode of engaging with architecture will be discussed here – Mapping Controversies – and some results of this educational experiment will be presented and discussed. As opposed to the reflective studio-based learning of what it means to design, Mapping Controversies implies an out-of-the-studio way of learning *about* design, which is simultaneously an out-of-the-auditorium mode of questioning the multifarious connections of architecture, society, economics, culture, and politics.

8.1 Two Types of Enquiry

Let us follow Petra (a student) and Quist (the coach) in their attempt to design a building. The example is taken from Schön's *Educating the Reflective Practitioner* (1987). They discuss the project and as they do so, they also sketch different buildings. That is to say, a reflective mode of designing. This reciprocally reflective dialogue of coach and student happens in the studio. Their design process traces a web of projected moves and discovered consequences and implications, sometimes leading to a reconstruction of the initial coherence – a reflective conversation with the materials of the situation. We follow Petra and Quist's conversation with materials and shapes. Drawing and talking, Schön informs us, are parallel ways of designing and together make up what he calls the "language of designing". Petra is stuck. She has tried to place the shape of the building into the contours of the land there, but the shape does not fit into the slope. Quist criticises her framing of the problem and he repositions the problem as follows: "you should begin with a discipline, even if it is arbitrary… you can always break it open". In the media of sketch and spatial-action language, he represents the site, draws and redraws different options, and simultaneously evaluates the consequences of every move on the sketch. Each of these moves has implications binding on later moves, and each of them can potentially create problems to be described and solved, sketched and re-sketched. Thus, Quist designs "by spinning out a web of moves, consequences, implications, appreciations, and further moves" – that is how Schön recounts what it means to design. Both Petra and Quist engage in a reflective conversation with the situation. Each move is a local experiment that contributes to the global experiment of reframing the problem. It is a reflective process: "As Quist reflects on the unexpected consequences and implications of his moves, he listens to the situation's back talk, forming new appreciations, which guide his further moves" (Schön, 1987, p. 57). Design progresses as Quist reframes the problems posed by the student Petra and engages in a reflective conversation with the situation and the implications of the new design moves.

Here is another type of enquiry: We are in the midst of 2006 with the controversy surrounding the proposed expansion of London's Heathrow Airport. Robert, Aisha,

Joe and Sophie plunge into the press clippings and image galleries on the web to try and unravel all the traces this controversy has left in the digital sphere: archives of the Heathrow developments; governmental papers; press clippings covering the community and activists' protests, images, and videos. They are my Architecture students, and I am not a coach in the studio, but a lecturer in Humanities. They learn about the nature of dissent, they identify the actors, they stare at a complex timeline of the controversy that incorporates all the actors, and they follow the different events. Images and YouTube material inform us about the key actors and we can literally hear their voices: "voices from the remembrance service for the victims of climate change on the taxiway at Nottingham East airport held by the Baptist minister, Reverend Malcolm Carroll, held on 24th September 2006"; "Voices of protest from the 14th – 21st August annual climate change camp held at Sipson. Over 2,000 people attended"; "Voices of protests from 21st March when Plane Stupid activists do a banner drop near Edinburgh airport". And we can extend the list. Robert, Aisha, Joe and Sophie immerse themselves in the complex data sets that allow them to reflect not only on the design of the third runway and the sixth terminal to London's Heathrow airport, but on all those issues design is related to: How would the new terminal affect climate change? How many surrounding homes would the expanded airport destroy? How would the new design affect the residents of the village Sipson? Will the campaigns against Heathrow's expansion change any of the design plans? Thus, as my students collect data on the controversy and try to analyse and visualise it, they actively engage in a type of pragmatist enquiry called mapping the controversy.[1] Tracing the actors' trajectories, drawing their diagrams of relations and the timeline of the controversy while collecting the data, they do not simply deal with the sketch and the design coach, but rather interact with a much vaster and heterogeneous assembly of actors: the London Mayor Boris Johnson, greenhouse gas emissions in addition to nitrous oxide levels, Greenpeace, environmental impacts, the West Drayton Residents' health concerns, the activist group Plane Stupid, environmental, aviation and welfare groups, celebrities like Emma Thompson and Alastair McGowan supporting Greenpeace, airlines like Cooptravel and British Airways, British Airports Authority, and so forth, all become part of the complex ecology of the proposed airport expansion. When dealing with all these actors, Joe and his team do not learn what design is; they rather learn about *what design does* – what kind of effects it can trigger, how it can affect the observer, divide communities and provoke disagreements; they immerse themselves into the many consequences of design practice and gain an awareness of its various implications. So, if Joe, Robert, Aisha and Sophie were about to design a new terminal, especially after the controversial fame of the recent Terminal 5, would they still stay in the studio, absorbed in a meditative dialogue with the sketch, staring at a model and "engaging in a dialogue with materials and shapes", trying to solve the paradoxes of design? No, they would rather plunge into the design world outside the studio and face its complex ontology.

What kind of enquiry is this, and how does it differ from the studio type of reflection-in-action? (Schön, 1985) Would it still require the designers to engage in a meditative process of communicating with materials and shapes in search of the good airport design? Or, is it a meta-reflexive analysis of what could explain

design by situating it as much as possible into reflexive frameworks (that is, a critical theory-inspired view of architecture)? No, none of these can describe the mapping controversies exercise in which Joe and his friends engage. It is neither purely reflective nor a meta-reflexive enquiry. As compared to the studio reflection-in-action that deals with the uncertainty of design, taken in the specific materiality of cognition, the mapping is rather a self-exemplifying type of enquiry that deals with the consequences of the manoeuvres of all actors involved in situations of uncertainty, their implications, their changing positions and opinions. As Joe and his team search among the piles of articles in the library and navigate databases and image galleries on the Internet, they witness a web of moves composed of all the actors' stances involved in the controversy. This exercise is not about designing a building, and trying to fit it into a slot; but rather about weighing up the impacts a building could have, evaluating the consequences of design and its implications. The mapping does not advance by a subsequent reframing of the problem or by the sketching and re-sketching of different options and possible scenarios; it progresses rather by following all extending webs and multiplying their proliferation through the enquiry. In the first case, Petra and Quist try to understand what their building will look like and how to design it in a better way by solving all the problems of site, scale, materials, and shapes. While in the second case, Joe and his team try to comprehend the consequences of design and the web of shifting positions within the controversy.

In fact, you could argue that the two types of enquiry are not comparable at all. One occurs in the US during the 1980s, the other, in the UK in 2009; one involves a student and coach; the other, a group learning environment with a lecturer; one refers to a situation of learning *to* design; the other, implies situations of learning *about* design; one could be quickly called "design practice"; the other, "design theory"; one will take its inspiration from Technology; the other, from Humanities. And if we were to continue the list of comparisons, we would get deeper into the dualism of Technology and Aesthetics, Architecture and Society, Theory and Practice. Sceptical of the rationalism that distinguishes Art from Science, the mapping controversies method makes an attempt of endorsing and cultivating through teaching a specific attention to the performativity of design.

In this essay, I refer to Schön's study in order to shed light on the differences between a reflective enquiry, one that is bidirectional, with the self-exemplifying multidirectional type of enquiry implied by mapping controversies. In the former, the designer and the result of his design are affecting one another in a situation that renders both directions into a relation of cause and effect, where every design move "bends back on" and affects the entity instigating the action. There are many ways of comparing the design reflexivity of Petra and Quist described by Schön with what typically happens today in a studio's practice. Whatever the differences we could establish, the types of reflectivity accounted by Schön can still be found today. Moreover, there is a variety of other data that designers take into account when designing: they do not engage in solitary coach-and-student problem-solving with the help of a sketch; this dialogue with sketches and shapes is complemented rather by an intense search of data, design precedents, image retrieval, fresh actors'

statements, archival materials, government papers, and data about the architects in charge. These new sources of design inspiration would imply a different mode of communication with materials and shapes, a different type of cognitive practice. The thinking about what they are doing while they are doing it makes the *drawing* design practitioners reflective, while the mapping designers are rather "*surfing* practitioners". You could object to this perhaps rash comparison, and say, "but many professionals today rely on browsing large amounts of data at the beginning of every enquiry". What is it that makes the surfing Joe a design practitioner? If design happens by surfing and drawing, how do designers today find their way within these various datasets – the digital masses of data on their computers and the heaps of drawings, paper cut-outs and physical models in the studios? How is it that this type of hybrid enquiry, with tracing paper and screen pixels, travels and generates a new type of design practice?

To answer these questions we will leave Petra and Quist for a while arguing over the sketch and reframing design problems, and focus on the mapping venture that Joe and his team are about to undertake. Why do they deal with controversies rather than simply with buildings and shapes? What is a controversy and how does this type of enquiry lead us to a different epistemology of practice and has different implications for design education?

8.2 What Is a Controversy? What Is Mapping Controversies?

The methodological and conceptual roots of this approach stem from the discipline of Science Studies with the writings of the French sociologist and philosopher Bruno Latour forming the primary source for its subsequent development. Latour first developed his ideas in relation to the analysis of scientific and technological controversies (Latour, 1987). According to the MACOSPOL project:[2] the word "controversy" refers to every bit of science and technology which is not yet stabilised, closed or "black-boxed"; it does not mean that there is a fierce dispute nor that it has been politicised; we use it as a general term to describe shared uncertainty. Controversy analysis is the educational application of Actor-Network Theory (ANT), a method of enquiry that questions the traditional epistemology of the social sciences (Latour, 2005; McLean & Hassard, 2004, 2007).

Following a decade of teaching and exploration of this methodology in relation to science and technology issues, it has been explored how this new approach could be extended to other disciplinary areas, such as design and architecture. This can be considered just a stage in the development and extension of this evolving inter-disciplinary area of design studies and ANT (Latour & Yaneva, 2008; Yaneva, 2009). Thus, drawing on controversy mapping theory and previous teaching experience in *École des Mines*, I engaged in a new mapping experiment in 2009. I asked my BA architecture students to use their advanced design skills to draw, map and visualise not an object (typically a building or a site) but a controversy, i.e. a complex ecology of connections of an architectural, cultural, economical, and political nature. They followed and mapped different controversies focussing on the dynamic

debates surrounding particular buildings or construction projects ranging from the redevelopment of Manhattan's Ground Zero to the reform of 1930s modernist high-rise buildings in Sheffield, England.[3] Controversy, I explained to them, does not refer particularly to media debates, scandals, rumours surrounding design plans, uncertain architectural knowledge, buildings-in-progress, tentative technologies or building innovation. Controversy points to the series of uncertainties that a design project, a building, an urban plan or a construction process undergoes; a situation of disagreement among different actors over a design issue. It is rather a synonym of "architecture in the making". Mapping controversies means "analysing controversies" and covers the research that enables us to describe the successive stages in the production of architectural knowledge and artefacts, buildings and urban plans. By mapping controversies we also refer to a variety of new representational techniques and tools that permit us to describe the successive stages of controversies.[4]

In their attempt to map the Heathrow controversy, Joe and his team returned to the library and spent many hours browsing the Internet. First, they started by following the controversy. Following it required that they be able to trace the dynamics of the controversy in time: the actors (individuals, groups or institutions), their arguments, the different positions and how they change and progress over time, the spaces in which they develop, the many ways of closing and re-opening the debates, and the extent of public involvement and participation in the process. Second, they documented the controversy and collected a variety of materials and compiled a research dossier composed of press clippings, images, and interviews with architects, clients, investors, public bodies, concerned citizens, and users. They added materials and extracts from the literature related to other buildings of a similar type, looked for information from governmental papers and archives, and examined architectural plans, drawings, and diagrams. Third, and the more challenging step for them, was to map it, i.e. analyse and visualise – to present the chronological development of the disputes surrounding the airport expansion design plans, but also to represent it with visuals; to capture the dynamics, visualise the timeline and the weight of the different actors' positions. They also made videos and used materials available on YouTube, as well as related podcasts that were made accessible through iTunes. They provided visualisations of how the actors' positions disperse or converge, and how a personal position might change the whole configuration of arguments and the spacing and timing of these arguments. Thus, the creative use of visuals led them to *trace* the dynamics of the controversy and its changing argumentative spaces.

The students have no definitions to learn, and no strict recipes to follow; they should describe what they see with the variety of tools available, meaning that they must be attentive to the details to find a uniquely adequate account of a given situation. This is an experiment for two reasons. First, because my students should restrain themselves from explaining the design with a single theory or viewpoint; for instance, the political factors or the ecological crisis that would give a particular shape to airport design. Second, they should try to observe the controversy not only through the singular design viewpoint or through the narrow glasses of the sketch (as Petra and Quist would do in their studio). Joe and his team should put different hats on their heads when trying to unpack what such a design project means. They follow

it from as many viewpoints as possible: the village inhabitants, the land occupants, the aviation companies, the pollution, the planners and the designers, the celebrities, the airport authorities, the carbon dioxide emissions, etc. They listen more to the voices of the actors than to their own presumptions. Trying to ignore the design critics and theorists for a while which will provide quick and easy explanatory schemes, Joe and Aisha, Sophie and Robert listen rather to what the actors will say, and forget (even for a while) all presumptions of what this controversy might be about.

Using new objects of research and new techniques of representation, Joe, Aisha, Sophie and Robert do not simply tell a story about a possible/impossible new design of Heathrow. They also tackle the classic question of representing the subjects of design, whose composition is always variable. The mapping refers to the variety of tools that permit us to describe the consecutive steps in the production of architectural knowledge, focusing on visual representations of the stakeholders, linking their various interests and tracing their development through time. The same tools used by Joe and his team in the studio to document and represent static objects are used here to trace their dynamics, to become immersed in design ecologies. There are many digital technologies that students can employ, and I encouraged them to choose freely from both what we provide and also what they may find on their own initiative. The software used to embed these actors into a representational space ranges from basic web tools such as web page editors, Flash and Java, to 3D visual software, in accordance with the content that the students are dealing with. All and all, the design students have succeeded to create novel modes of visually incorporating controversy studies suited to a digital format.

The results were presented in websites in the form of descriptive accounts of design controversies. The controversy and its moves are described on the websites. The aim is not to unveil some general structure of social and political factors concealed behind the phenomena. The only purpose of the websites is to provide the most detailed description of the phenomena as seen by their protagonists. As Latour says, "If your description needs an explanation, it's not a good description" (Latour, 2004, p. 67). The visuals used by architects in-studio do not simply represent, but rather deploy, the distinction between description and deployment. In the first step (following the controversy) and the second step of the enquiry (documenting the controversy) the students just observe and describe what they see and find, thus putting aside any social theory, any meta-reflexive frameworks, that would explain particular courses of actions or the specific nature of actors. Then, in the third step of mapping, they deploy with design virtuosity the ontological charade they find when studying a controversy on the move.

Let us look at the maps and the inventive use of design visuals and we can witness that (Figs. 8.1 and 8.2):

(1) Design controversies involve all kinds of actors: activists, groups and single architects, aviation companies and wind resistance, farmers and celebrities, house owners, and runway drawings.
(2) Every controversy functions as a "hybrid forum", a space of conflict and negotiation between actors (Callon, Lascoumes, & Barthe, 2001). *Forum* refers to

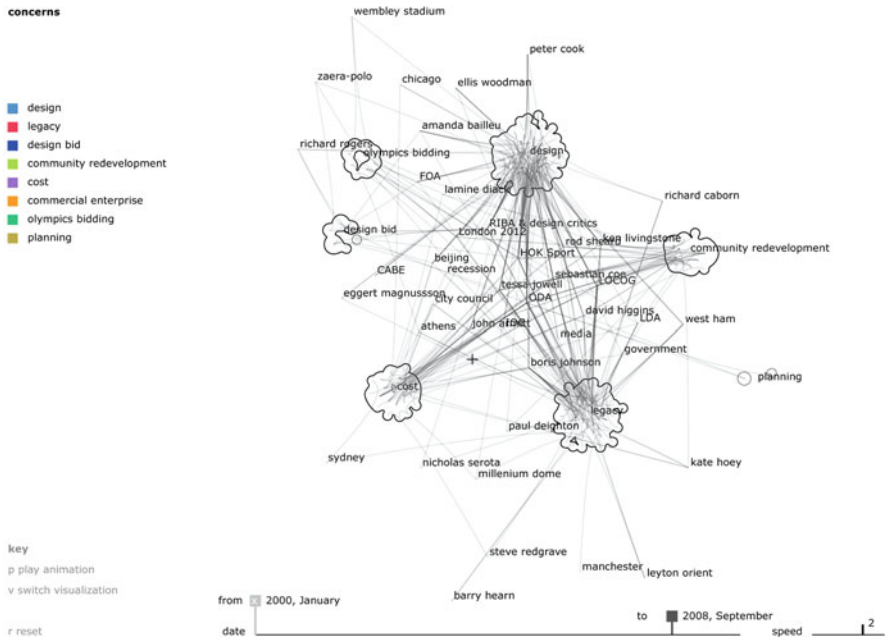


Fig. 8.1 Map of the London Olympics Stadium design controversy. (Credits: Christian Derix & Aedas|R&D, Albena Yaneva and Liam Heaphy)

those particular spaces in which various groups can meet and debate different issues and the technical choices of importance to the community. They are *hybrid,* because the people involved and their representatives are heterogeneous: experts, politicians, clients, architects, technicians, and concerned lay people. *Hybrid,* also, because the questions to be tackled are of a different nature: from political and ethical concerns through to mechanical engineering and aesthetics.

(3) Controversy displays the design and the social in a very dynamic way; design precedents and communities, pollution protests and design concerns. The actors never appear alone, but in a network.

(4) Following controversies will also prevent students from falling into the trap of reductionism – reducing and explaining the protest to the runway with the political climate, cultural changes, or social factors. These are easy frameworks of explanation.

(5) Controversies open "black boxes" – things and understandings that otherwise will be taken for granted. Before this runway controversy many people were not aware of all the environmental effects of aircraft or of the fact that the government can forcibly purchase your house.

(6) Design controversies recompose cosmologies. Very often the proposed change in a controversy will reconfigure entirely the connections of existing actors and recompose their worlds. It is crucial for an architect to understand the cosmology of the users for whom he is designing. The architect seeks to trace the

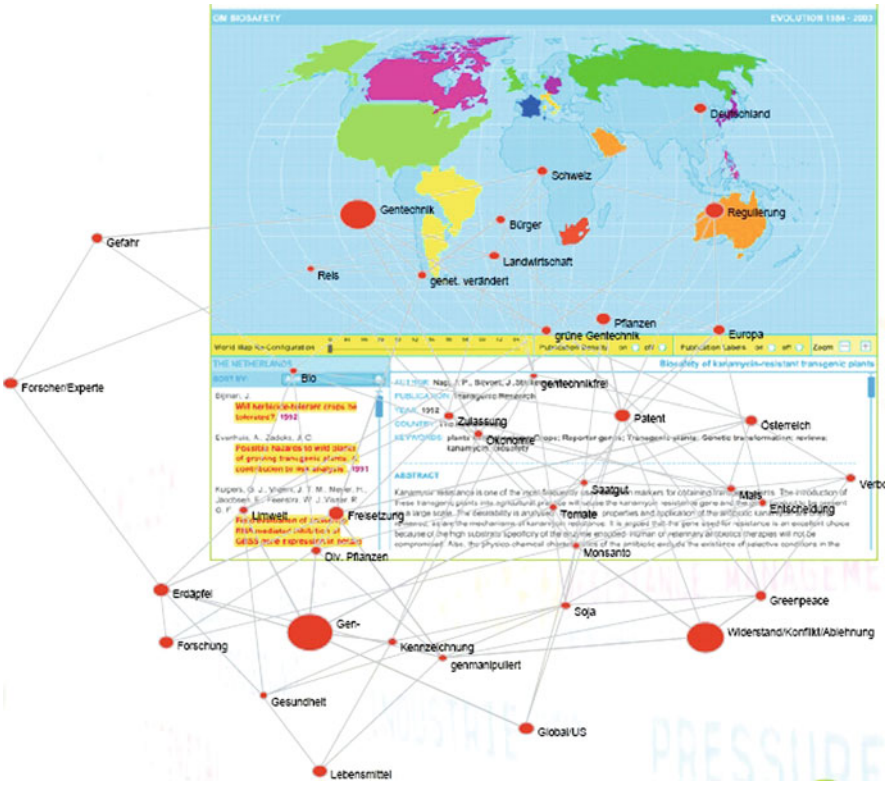


Fig. 8.2 Experiment in mapping. (Credits: Patricia Reed)

cosmogram of their world by identifying and tracking the practices followed by various sets of actors (e.g. clients, actual and future users, contractors). For this reason architects do not ask, "Are you for or against this spatial solution, this design option, this architectural idea?" All that this alternative question can do is generate different opinions. Instead, architects ask, "In which world do you live?" "How is this world structured?" "With whom and with what are you ready to share it?" "What do you cherish the most?" "Who are your allies, and who are your critics?" "How does change happen in *this* world and alter entire cosmologies?" They try to understand its inhabitants and what those people believe in, what they cannot live without, and what they cherish the most.

All of the visuals show the students' awareness that a building, seen through a series of contested projects and users' demands, resembles much more a complex ecology than it does a static object. In this experiment, buildings reveal their nature as "things", i.e. as gatherings of many conflicting demands. They cannot be reduced to what they are and what they mean, as architectural theory has traditionally argued by adding "symbolic", "human", "subjective", or "iconic" dimensions to

them. These visuals (e.g., animated plans and sections, actorial diagrams) talk about the "thingness" of architectural and urban projects. Aiming to understanding controversies in urban design and architecture, this experiment also brought theory and practice together by reconnecting and strengthening the synergies between them.

8.3 From Reflecting-in-Action Towards Mapping of the Real

Such an understanding of a building as a plethora of material and subjective considerations, and as the result of a protracted process involving multiple concerns, will move beyond the traditional two or three-dimensional image, reaching out to represent additional human factors, and indeed reducing the need for distinctions between subject and object. Look at the sketch of Petra: we are in a simple Euclidian space. A building that we witness in a controversy mapping is rather reminiscent to "navigation through a controversial datascape", an animated collection of "criss-crossing trajectories of unstable definitions and expertise". Rather than merely adding external concerns to objective entities, the students' visualisations make a step towards the invention of a visual vocabulary that will do justice to the idea of buildings as "things", contrasting with the older and more reluctant view of buildings as objective static objects.

Both the design enquiries of Petra and her coach and those of Joe and his team deal with uncertainties. We gain valuable insights about the meaning of design in these enquiries. For example, the rhythm, intensity and scope of the disputes; the dispersion of the actors' positions; the trajectory of their arguments; the spacing and timing devices; and the different ways of slowing down the pace of the controversy and closing it. Thus, the designer in Schön's account is someone who deals with uncertainty, with complex, incoherent and messy situations and converts them (here Schön follows Dewey's view of the designer) to a determined form; they "*construct* and impose a coherence of their own" (Schön, 1987, p. 42). In our mapping controversies case, the designer is one that recognises and completely takes into account the complexity of design by observing it, before then simplifying it through the production of descriptions and visualisations. "When we *observe* controversies, we focus on the liquid side, as only in quarrels, disputes and flights, can new actors make their way to the surface of society. When we *describe* controversies, we contribute to the solidification of some portions of social magma reducing its complexity to a manageable level. Both tasks are equally important and closely connected in the practice of social cartography" (Venturini, 2010, p. 11). The experiment of mapping controversies makes us perceive design as being concerned with the entire web of moves that are traced by the actions of design; it is about property, swarms of birds, affected nature, polluted air, the destroyed coherence of the neighbourhood, contested zoning regulations, costs, local politics, legacy, and community vitality. It is much more complex indeed than simply trying to put a building on a site and adjust its scale, gradually solving design problems.

The links between architecture and society are traditionally explored in their solid states. Instead, following controversies allows us to witness the social and

the architectural in a non-stabilised state where all is melted. Follow the actors in a controversy, how they agree and disagree, how they shape alliances, how they scale and rescale the spaces where they move and create spatial disjunctions. Here is where you find the social. The cartography of controversies is conceived as a toolkit to cope with the different hybridisations of actors and knowledge, as an effort to follow disputes when they cut across disciplinary boundaries. Mapping design controversies pushes the investigation of architecture students far beyond the limits of sociology and history of design, not only towards neighbouring human sciences but also towards technology and even the natural sciences. Questioning the new Heathrow Airport runway will lead us to question climate issues, airline politics, and landowners' property rights. How can aviation companies profit better from the design? What kind of impact can a new terminal have on the environment? How will the property prices change as the construction progresses? All these issues are not technical minutiae but important questions that lie at the core of the controversy and deserve greater attention. This realistic mode of enquiry greatly differs from the reflexive enquiry and the meta-reflexivity-based approach in design education. Through mapping controversies, architects learn that a building is something to be scrutinised, investigated and sought. It is not "out there"; it is to be followed and mapped. Only through a constant attention to the performativity of design can design education sustain its integrity, value and effectiveness. Developing the mapping controversies approach is a way in which design education can have a future.

Notes

1. The Mapping Controversies method was initially developed by the French sociologist Bruno Latour and applied across a variety of disciplines. The method offers a new way of enquiry in social sciences based on Actor-Network Theory, which consists in following, documenting, and mapping ongoing controversies. Mapping controversies implies a research method, a teaching philosophy, and a way of approaching public debate. It is used largely in the fields of Sociology, Political Sciences, and Engineering Studies, and primarily in French-speaking Universities across Europe. Only recently was the teaching method introduced in English-speaking Universities with Manchester (Architecture) being a pioneer in this field, along with Oxford (Geography) and MIT (Science Studies). All these institutions form part of a teaching consortium and have a website platform managed by MIT: http://www.demoscience.org.
2. MACOSPOL stands for Mapping Controversies in Science for Politics, and is an EU-funded project (http://www.macospol.com) realised by the following institutions: Science Po-Paris, University of Munich, University of Oslo, University of Manchester, École Polytechnique de Lausanne, University of Liège, and Observa, Italy. The project led to the construction of an interactive web-based platform (http://www.mappingcontroversies.net).
3. A web-based platform "Mapping Controversies in Architecture" was set up in Manchester (http://www.mappingcontroversies.co.uk, or http://www.msa.ac.uk/mac). This platform is devoted to understanding urban controversies and bridging the gap between theory and practice. The methods have the potential to serve as an example for other disciplines, especially given the rising interest in Actor-Network Theory from a range of disciplines like Geography, Anthropology, Organisation Studies, Planning and Landscape.
4. For a collection of resources, see http://www.demoscience.org (Resources); for a selection of tools relevant for design education, see http://www.mappingcontroversies.co.uk (Resources).

Bibliography

Callon, M., Lascoumes, P., & Barthe, Y. (2001). *Agir dans un monde incertain: essai sur la démocratie technique*. Paris: Seuil.

Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Cambridge, MA: MIT Press.

Latour, B. (2004). On using ANT for studying information systems: A (somewhat) socratic dialogue. In C. Avgerou, C. Ciborra, & F. F. Land (Eds.), *The social study of information and communication study* (pp. 62–76). Oxford: Oxford University Press.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.

Latour, B., & Yaneva, A. (2008). Give me a gun and I will make all buildings move: An ANT's view of architecture. In R. Geiser (Ed.), *Explorations in architecture: Teaching, design, research* (pp. 80–89). Basel: Birkhäuser.

McLean, C., & Hassard, J. (2004). Symmetrical absence/symmetrical absurdity: Critical notes on the production of actor-network accounts. *Journal of Management Studies, 41*(3), 493–519.

McLean, C., & Hassard, J. (2007). Actor-networks and sociological symmetry. In J. Hassard, M. Kelemen, & J. Wolfram Cox (Eds.), *Disorganisation theory: Explorations in Alternative Organisational Analysis* (pp. 45–71). London: Routledge.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Schön, D. A. (1985). *The design studio: An exploration of its traditions and potentials*. London: RIBA Publications.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco: Jossey-Bass.

Venturini, T. (2010). Diving in magma: How to explore controversies with actor-network theory. *Public Understanding of Science, 19*(3), 258–273.

Yaneva, A. (2009). Making the social hold: Towards an actor-network-theory of design. *Design and Culture, 1*(3), 273–288.