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Research article

Visualizing the Composition: A Method for Mapping Inscription and Instruction

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Abstract

How are instructions mediated by technical artifacts? What role does technology play? From a Latourian perspective, these questions have to do with composition. The purpose of this article is to review Latour's approach to Science and Technology Studies (STS) and, more specifically, to review and assess his visualization practices. According to Latour, science and technology are not two separated domains. Scientific facts are obtained through cascades of mediation of heterogenous components, and the manufacture and use of technical artifacts is a co-action by humans and non-humans. Latour's STS approach contributed toward the development of Actor-Network-Theory (ANT), which seeks to provide performative narratives of things by tracking their traces and transformations. These analyses reveal a key concern of the composition of things. For Latour, everything that occurs in the world is a hybrid assembly composed by humans and non-humans; we therefore need proper methods to map out the associations clearly and gain a better understanding. Along with attempts to develop theoretical analyses, Latour has also conducted visualization practices to perform the interwoven nature of things. I argue that visualization practices, which are endowed with performative power, can be treated as a supplement to STS research, functioning as a practical method of ANT to show how things are composed and, conversely, providing more cases for theoretical analysis.

Keywords: STS; Bruno Latour; Inscription; Script analysis; Composition; Visualization; Controversy mapping

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Научная статья

Визуализация композиции: Метод отображения надписей и инструкций

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Аннотация
Каким образом инструкции опосредованы техническими артефактами? Какую роль играют технологии? С точки зрения Латура эти вопросы связаны с композицией. Цель этой статьи — рассмотреть подход Латура к исследованиям в области науки и технологий (STS) и, в частности, рассмотреть и оценить его методы визуализации. Согласно Латуру, наука и технология не являются двумя отдельными областями. Научные факты получаются посредством каскадного посредничества разнородных компонентов, а производство и использование технических артефактов — это совместное действие людей и не-людей. Подход Латура к STS способствовал развитию акторно-сетевой теории (ANT), которая стремится обеспечить перформативное повествование о вещах, отслеживая их следы и трансформации. Данный анализ раскрывает ключевую проблему состава вещей. Для Латура все, что происходит в мире, представляет собой гибридное объединение, состоящее из людей и не-людей; поэтому нужны надлежащие методы для лучшего понимания. Наряду с попытками развития теоретического анализа Латур также проводил практики визуализации, чтобы показать переплетенную природу вещей. Я утверждаю, что практики визуализации, наделенные перформативной силой, можно рассматривать как дополнение к исследованиям науки и технологий (STS), функционируя как практический метод акторно-сетевой теории (ANT), чтобы показать, как устроены вещи, и, наоборот, предоставляя больше случаев для теоретического анализа.

Ключевые слова: STS; Исследование науки и техники; Бруно Латур; Надпись; Анализ сценария; Композиция; Визуализация; Картографирование

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INTRODUCTION

The term “instruction” usually refers to a statement about what and how something is to be done. The most common scenario in which we encounter instructions is when we buy a new product and find inside the package an instruction manual which tells us how to use it. However, sometimes we simply don’t need to read the manual: from the product itself it is obvious how to use it.

A design philosophy known as “Without Thought” has been prevalent in industrial design. It was introduced by well-known Japanese product designer Naoto Fukasawa. Fukasawa (2016) holds the view that “the impetus for design is found in people´s unconscious behavior”[1]: he believes that a good design is one that enables users to work with their intuition. One example of this is a rice cooker, which looks elegant simple and has a small protrusion on the top of the lid. Usually, looking for a clean place for the used scoop disrupts the action of serving rice. With this small protrusion, users can now lay the scoop on it naturally and the action is not disrupted. It is an action performed out of intuition, so there is no need to read the instruction manual. In this case, “instructions” are not “given” to users literally; rather, they are conveyed by the material shape of the product alone. Another famous product designed by Fukasawa is a CD player. It looks like a ventilation fan equipped with a rope attached beneath it. To turn on the device, users need to pull the rope, just as they would turn on a fan. The shape of the product prompts its users to do so. Fukasawa (2016) calls this “a shape with the operation included” (p. 19). Here, things not only bear and convey messages, they also have the power to change and guide action, and this power derives directly from their materiality. To put this in terms used by Akrich and Latour (Akrich & Latour, 1992; Latour, 1994), the instruction is translated into concrete shapes and the product itself contains a “script”, such as “please place the scoop on the protrusion” and “please pull the rope.”

The world in which we live is full of material artifacts. After many years of neglect, artifacts are making a comeback among scholars of the philosophy of technology, post-phenomenology and STS (e.g. Ihde, 1979; Latour & Woolgar, 1979/1986; Latour, 1994, 2007; Verbeek, 2005). As a participant in this discourse, Latour proclaims resolutely that we should give material artifacts their due, that we should treat both humans and non-humans symmetrically (e.g. Latour 1994, 2005a, 2007). Since their early book *Laboratory Life*, Latour and Woolgar (1986) have consistently focused attention on what they termed “literature inscription” and the inscription devices that most sociologists of science had hitherto ignored (Schmidgen, 2012). Along with their appeal for symmetrical relations are a return to materiality, Latour’s studies focus on performativity: they are about tracking chains of mediation in order to show the geneses of science, technology, society and many other “fixed” domains. This approach also gives rise to the crucial inquiry into the composition of things, and for Latour the philosophy of science and technology is related precisely to this. In addition to his theoretical analyses, Latour is involved in several practical

[1] See the introduction page of the website of Naoto Fukasawa, https://naotofukasawa.com/about/

visualization projects. In this article, we will review both his theoretical analyses and practical visualization practices and discuss how visualization practices can contribute towards future STS work.

CONSTRUCTED SCIENTIFIC FACTS

Latour distinguishes between ready-made-science – an already settled scientific controversy – and science-in-the-making – an open dispute on which scientists are still working. The focus of his science studies lies on the latter, namely, on the history and genesis of science, on the process of how scientific knowledge is made. Latour describes his research as “opening Pandora’s black box” (Latour, 1987, p. 1). He points out that every fact has its history. A fact is neither isolated nor “bald”, rather it is “hairy”, historically situated. Before a statement is perceived as an undisputed one, the question that prompted it was still an unsettled controversy. Not until a statement has been accepted by others is the open dispute settled and a corresponding scientific fact constructed. Science in action thus turns into ready-made science. Accordingly, the uncertainties, controversies, manipulations, instruments, chemicals and people involved in its generation will be enclosed inside a “black box”, with all processes and prior traces erased; no matter how and why this controversy was settled, the scientific statement stands as “fact”, as if it had been there from the outset. What Latour attempts to do is reopen these “boxes” and to take us back to study the controversies before the boxes were closed (Latour, 1987).

Observing the daily work of scientists, Latour sees the laboratory as “a system of literature inscription” (Latour & Woolgar, 1986, p. 52). Inscription is a term borrowed from Derrida, but here it has a broader meaning than just writing. It designates “all traces, spots, points, histograms, recorded numbers, spectra, peaks, and so on” (Latour & Woolgar, 1986, p. 88). It is the end product of a succession of experiments, visually displaying the content and context of a series of experiments. Inscription is also an “immutable mobile” (Latour 1986, 1987). It is readable, superimposable, combinable with other immutable mobiles, and can be easily brought to one place, modified, recombined, superimposed, integrated and printed as figures in a scientific article. Even after very many years, when laboratory samples or conversations between scientists are unlikely to have been preserved, inscriptions and articles can last for long. Different times, spaces and disciplines are linked together by accumulation of these immutable mobiles – they provide a ready glimpse into what scientist did even in distant lands or long ago.

Inscriptions are obtained from a certain arrangement of inscription devices. An inscription device is an instrument, “any set-up, no matter what its size, nature and cost, that provides a visual display of any sort in a scientific text” (Latour, 1987, p. 68); the NMR spectrometer in Roger Guillenmin’s laboratory (Latour & Woolgar, 1986) is such an example. Experimental materials taken from nature are transformed into a fixed inscription in a scientific paper. In the laboratory, scientists breed experimental rats, they classify, cut, mix, mark, record, handle them with various items of apparatus; they process numerous data, comparing and merging them to generate images. In this

process, all three-dimensional materials are gradually abstracted into two-dimensional diagrams, tables, charts and curves. This abstraction is ultimately all that counts. From a real rat to a chart, from a chart to a simpler chart, forms become less and less material and more and more abstract through cascades of visualization performed by inscription devices. Successive transformations make up a chain of references, and continuous chains that turn tangible materials into abstract forms give rise to the final conclusion (Latour 1986, 1987, 1999a; Latour & Woolgar, 1986).

These chains are obtained through mediation. Mediation is a modification of the meanings and elements transported in chains of references and networks. It is not just transportation, its synonyms are translation, transformation and manipulation (Latour, 2005a), which means that each segment in the chain needs to be obtained by mediating the former one, its meaning is transformed or modified on its way to the next stage in the chain. Therefore, to visualize something or to make an image is to mediate, transform, translate, and manipulate. Scientific images are not simply re-presentations of nature; instead, they are mediations to reality. What really matters is not any isolated inscription per se, but rather the chains of transformation behind the visual (Latour, 1986, 1998). One single image or diagram without any connection with other visuals or materials cannot provide any credible knowledge; it is the chain of references indicating how this visual is transformed step by step to this stage that achieves this (Latour, 2005b, 2014). Statements are regarded as reliable due to the existence of these chains of references which can be traced back. The traceability of chains endows them with truth value. If any section of the chain breaks, no truth can be gained, because the truth value cannot be transported and translated into the next section. The length of these chains of references has no limit: both ends could be extended and attached to other forms. Moreover, different chains can intersect, forming crossing points through which form is transformed and truth value can flow. Scientific facts are constructed in this way (Latour 2008b).

Further, it is not only the effort of scientists that counts. Inscription devices, chemicals, financial support from other institutes and even laboratory architecture all play a role as well. All components and actions are involved. Subjects and objects and all natural and social components should be taken into account. Latour introduced the term “actant” to cover all humans and non-humans that play a role in such processes (Latour, 1987, 1999a, 2005). Both subjects and objects are mobilized and connected in the network. They adapt each other mutually and cannot be separated clearly from one another (Latour, 1999a; Wieser, 2012). Thus, Latour rejects the so-called Great Divide: there is no such thing as a world of human entities and another world of non-human entities, and thus no absolutely strict divide between what we call natural and what we call social. What happen in the world are rather hybrid, heterogeneous, entangled and interactional associations of human and non-human components (Latour, 1987, 1993, 1999a). In this sense, things are no longer conceived of as solid, unitary, isolated, prematurely naturalized matters of fact, but rather as complex, entangled, attached, historically situated, multi-faceted matters of concern (Latour, 2004).

Science is thus a consequence of networks that mobilize and gather all human and non-human elements from all places and times using innovative inscription devices. It is

advanced by drawing things together through cycles of accumulation. The history of science is the history of mobilization and of the innovations introduced by new visualization devices. It is by means of these mobile and immutable inscriptions that relevant allies can be assembled in one place, enabling scientists to solve scientific problems and to propose and prove their theories. The innovations embodied in new visualization tools along with the ability to manipulate inscriptions have contributed towards settling controversies, and have thus become one of the main forces promoting the tremendous progress of science and technology (Latour, 1986, 1987). Thus, to know something is not a process that happens only in the mind; it is “thinking with eyes and hands”, a praxis of “drawing things together” (Latour, 1986). The emergence of modern science and technology is a result of scientists being able to invent more inscription devices, working on papers and inscriptions, and being able to gather more and more immutable mobiles together. Now, then, we have a performative definition of scientific practice: it is an accumulation of inscription, a network of assembled hybrid components. Only through a cascade of mediation and displacement that draws all things together can scientific knowledge be constructed. The word “construction” here does not imply any opposition to realism (Latour, 2003). It does not mean that science is non-credible or unreliable; what it means instead is that it is only after step-by-step manipulation that we can obtain facts and objectivity. In order to get close to reality, much must be mobilized, gathered and manipulated (Latour, 2014).

TECHNICAL MEDIATION

There is a widespread view that technology is the application of science. However, as discussed above, inscription devices, i.e., technical artifacts, themselves contribute towards the development of modern science. For Latour, science and technology are not two separated domains; they are connected to and exert an influence on each other. He uses the term “technoscience” to cover “all the elements tied to the scientific contents” (Latour, 1987, p.174). Along with science studies, Latour also observes engineers in order to study chains of reference and analyze mediation in the making and use of technology. His script analysis with Akrich (Akrich & Latour, 1992) and technical mediation theory (Latour 1994) provide a glimpse into how technology influences our actions and the relations between humans and technology. Even today they continue to contribute much to the development of new theories in the philosophy of technology and design research, serving as background theories (e.g. Verbeek, 2011, 2016; Eggink & Dorrestijn, 2018; Fallan, 2008).

Akrich and Latour (1992) drew up a list of terms to describe the interaction between humans and technology in the manufacture and employment of technical artifacts. Akrich (1992) refers to the concept of “script”, which she defines as a scenario, “a program of action” that is pre-scribed in(to) technical artifacts. That is to say, designers or manufacturers predefine the circumstances regarding what users are supposed to do and what the results are expected to be. Latour points out that “Each artifact has its script, its ‘affordance’, its potential to take hold of passersby and force them to play roles in its story” (Latour,1994, p. 31). In other words, an artifact is not a

mere tool or a neutral medium, but rather a mediator – it has the ability to influence the actions of users. To take two examples provided by Latour, a speed bump contains the script “Please slow down,” while a hotel key with a heavy pendant attached implies the script “Do not forget to bring the keys back to the front desk.”

Three other terms associated with the etyma of “script” are also worth explaining at this point:

Antiprogram: Since new technical innovations begin with controversies and conflicts, every program has its antiprogram and it is exactly the problem the designers want to solve. The “front line” is where a program and its antiprogram are confronted.

In-scription: Unlike the same term used in science studies, inscription here designates an act of translation. Through in-scription, the message is translated in order to “struggle with” antiprograms.

De-scription: This is the opposite movement to in-scription, a translation by analysts from things to signs.

Let’s take the hotel key as an example to explain these terms better. It is a story Latour has told in many articles. A hotel manager wants his clients to return their key to the front desk every time they leave the hotel. This is the program of action through which he defines the clients, and the antiprogram is that many clients neglect or forget to return their key. In order to make the clients follow this program of action, the hotel manager devises many methods successively, such as making a verbal appeal, adding a written notice, and finally adding a heavy metal pendant onto each key. Each time the hotel manager makes a change, the front line between program and antiprogram shifts accordingly, as more clients return their key. After the heavy metal pendant is added, the majority of clients does what the manager defines in the script. Each change is designed to inscribe the message “do not forget to bring the keys back to the front desk” into different countermeasures. Finally, the message is translated by attaching a heavy pendant to the keys: the inscription is inscribed in a concrete tangible stuff. The hotel’s clients do not wish to carry such a heavy object in their pocket all the time, and in this way they are forced “to be reminded to bring back the keys to the front desk.” Each translation is a mediation. In this mediation, human (i.e. the hotel manager) and non-human (i.e. the heavy keys) co-act; they both play a role. Without the heavy metal pendant or with another material, the front line would move to a different place.

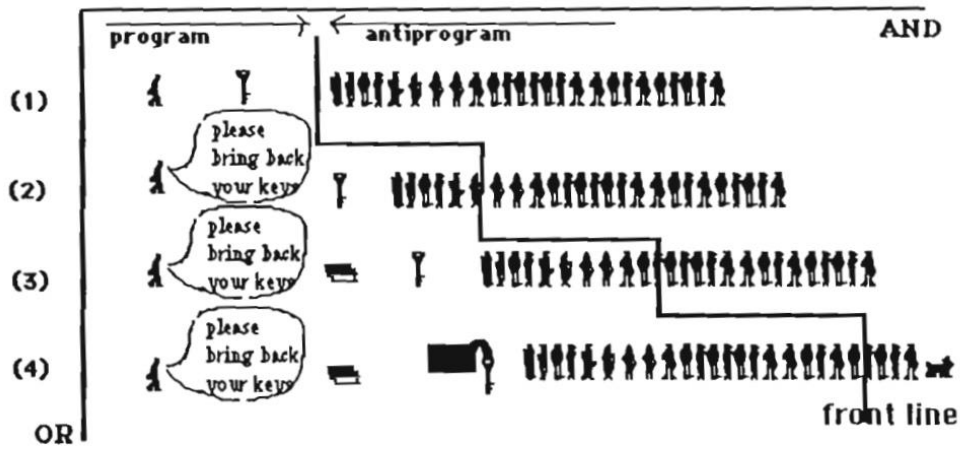

Figure 1. How the program and antiprogram look like in the case of a hotel key (Akrich & Latour 1992, p. 263)

In addition to the meaning of "mediation" discussed in relation to his science studies, Latour (1994, 1999a) develops four meanings of "mediation" while analyzing technology. The first of these is translation. As explained above, a technical artifact can translate goals, actions, and the competences of other agents. To take the example of shooting, the goal or intention of an angry man to hurt someone could be modified by the existence of a gun into the goal to kill. This modification is completely symmetrical regarding the man and the gun. While the man is modified by the gun from a regular citizen to a criminal, at the same time the gun is modified by the person: "a silent gun becomes a fired gun, a new gun becomes a used gun, a sporting gun becomes a weapon" (Latour, 1994, p. 33). This symmetry then leads to the second meaning of mediation, namely, composition. "Action is a property of associated entities", writes Latour (1994, p. 35). The shooting action cannot be accomplished without either the person or the gun. The one who performs the action is neither the person nor the gun themselves, but the hybrid of person and gun. Human and non-human co-act. The program of action is thus composed. However, the joint action always turns into a "black box" after composition. The relation inside the box becomes opaque to us, so that the non-human actants are regarded merely as a tool used by humans. Latour wants to open the black box to go back and observe the heterogenous assemblies that have occurred throughout the process. This, then, is the third meaning of mediation: reversible blackboxing. The last meaning of mediation is what Latour identifies as the most important one: delegation. According to Latour, technology does not produce meanings in the same way we humans do, but rather "via a special type of articulation that crosses the commonsense boundary between signs and things" (Latour, 1994, p. 38). In the case of the hotel key, the program of action which the manager pre-defines is inscribed and translated into a heavy metal pendant. It is neither a shift from one language to another, nor a shift from discourse to matter. The original message is transformed into a new one. Meaning is thus modified: the heavy weight makes the key impractical to carry so that the clients who return their key are not just responding to the message "do not forget to bring the

keys back to the front desk" but are also reacting to their unwillingness to carry such a heavy object around with them. The shifts involved in this delegation are simultaneously spatial ("displacement from here to there and back"), temporal ("displacement from now to then and back"), and "actorial" (displacement from one actant to another actant and back), while in the case of setting there is also a material shift (displacement from signs to things and back) (Akrich & Latour, 1992, p. 260). For example, in order to force drivers to slow down, a speed bump is installed on the road (spatial) to serve as a "sleeping policeman" ("actorial") all day long (temporal), modifying the sign "Please slow down" to the actual hump in the road (material). These four "mediations" are connected to each other and occur together. The occurrence of "delegation" depends on the previous three (Latour, 1994).

The list of a "convenient vocabulary" is explicitly intended for a *Semiotics of Human and Nonhuman Assemblies* (Akrich & Latour, 1992). For Akrich and Latour, semiotics is not limited to signs; rather, it refers to the materiality of things as well: "it is the study of order building or path building and may be applied to settings, machines, bodies and programming languages as well as texts" (Akrich & Latour, 1992, p. 259). We exist neither in a world made up only of words nor in a world of objects alone. We are always in the Middle Kingdom, in a non-modern world (Latour, 1993) full of heterogenous assemblies composed by human and non-human actants. Latour seeks to develop a philosophy of technology that attends to the entire process (Latour 1994) in order to study order and path building (Akrich & Latour, 1992). This philosophy is a study of how technology (non-humans) and humans co-act in the fabrication and employment of technical artifacts, that is, a study of traces and associations, of network-like composition.

Even though the objects of the above-mentioned science studies and technology studies are different, it is possible to identify similarities in their terms, methods and conclusions. Starting from laboratory studies, Latour directs our attention to the genesis of scientific facts. Science, technology, society and every field we take for granted is the consequence of settling a dispute, not a starting point; it is constructed through chains of mediation. After the associations are made, traces and connections are closed off inside a "black box", becoming invisible. What STS researchers do is reopen the box to make the traces visible again. This approach can be extended further for studying other objects. In this perspective, "almost anything can be STS, from literature and politics, to art and engineering" (Mazanderani & Latour 2018, p. 299). Actor-Network-Theory (ANT) could be seen as a summary of this STS approach. This idea stems from a joint paper on the Leviathan by Callon and Latour (1981). ANT is not a complete theory of the "social" but a guide on how to provide a performative narrative of it. Latour compares ANT with perspective drawing (Latour, 1999b), because it is an approach intended to trace and "draw" connections. Like all things, society is not a pre-existing domain but a consequence of hybrid associations composed of humans and non-humans. From the ANT perspective, we should learn to view things from a trajectory of transformation and draw out the associated invisible networks. By following traces and trajectories, the associations among things can become clear and performative definitions emerge.

A KEY CONCERN OF HETEROGENEOUS COMPOSITION

When we study the genesis of things using ANT, the divides between human and non-human and those among domains gradually fade away. ANT shows that the world we live in is heterogeneous and that all its components have mutual effects on one another. Apparently fixed domains are the consequence of cascades of mediation. In effect, Latour attempts to blur all apparently clear boundaries; in his view there is no neat line between human and non-human, nature and social, or between academic disciplines. This means that each technology, product, issue or problem we encounter is an assembly of heterogeneous actants co-acting together and irreducible to a single factor. The world in which we live is always a sphere of hybrid assemblies.

Latour’s statements challenge traditional ideas of epistemology and modernism. He regards epistemology in western philosophy as “the discipline that tries to understand how we manage to bridge the gap between representations and reality” (Latour 2008b, p. 94). For him, however, there is no such gap in the first place, and knowledge should not be understood in this way. Science studies provide another scheme: to know something is to mobilize more allies to deploy in a continuous chain so that truth value can flow forward and we become more “experienced” and cognizant of the knowledge thus produced. The separation of one world of nature from another of the social never existed. Latour seeks to dissolve the archaic dichotomous doctrines of subject-object, natural-social etc., which are deeply rooted in the mind of the public, in order that they might be liberated from the irrationality of prematurely naturalized “objective” facts.

Although one of the goals of STS is to critique the traditional epistemology is, it is not the ultimate goal. If the complex chains and associations contained within a thing are usually hidden, as in a “black box”, the task of philosophers is to reopen the box to sort out the complex chains involved. If we want to go one step further in the philosophy of science and technology, we are confronted with the crucial task of understanding how things are “constructed”, such as the question of how humans and technology interact during the operation of a machine. To date, STS and ANT have completed only some of the work of de-construction with their guide to observing the actants in things. They do not provide an accurate theory of how everything is composed, but rather constitute a preparatory framework for establishing a new epistemology. For Latour, ANT is a necessary thinking method. It provides us with an adequate way to understand science, technology, society and indeed all things in the world. After “de-constructing” an obsolete narrative we need to develop alternative narratives about world-building using the ANT approach (Mazanderani & Latour 2018): we need to follow the traces and trajectories of actants in order to identify the “associations” and “networks” that comprise things. We need to ask: How are things composed? Despite the general argument that humans and non-humans co-act, we still need to know exactly which humans and non-humans are involved. How do they co-act? How are actants transported and how is meaning transformed? What does an entangled connection look like? How can we make those connections visible? ……

Here, “things” is merely a blank that could be filled with any number of issues or artifacts.

It is worth pointing out here that the word “construction” has brought about some misunderstanding. In order to avoid any further misunderstanding of ANT, many other terms such as “constitution”, “composition”, “performance”, “enactment” and even “design” have been introduced to substitute “construction” (Latour, 2003, 2008a, Mazanderani & Latour, 2018). Among these, the term “design” seems worthy of note. Nowadays, “design” not only contains the meanings of verbs such as plan, arrange, package, project and so on, but can also be used for a wide range of things or even issues. In one lecture on design philosophy, Latour (2008a) argues that the expansion of the term design as well as five connotations of design (modesty, attentiveness to details, symbolic interpretation, to design is always to redesign, normative dimension) is powerful proof of the shift from matters of fact to matters of concern. It indicates that things are not “made” or “fabricated”, but designed in a precautionary way. In such a narrative, our world is a product of collaborative design and provides us with life supports. More important is the normative dimension. It provides a helpful link between the question of design and that of politics, because we are allowed to tell whether something is well or badly designed, while solid matters of fact are regarded as free from goodness or badness. Latour’s new political concept is “Dingpolitik” (“Ding” is a German word meaning “thing” and “politik” means politics) or an “object-oriented democracy”. Both humans and non-humans are involved and all entities are viewed as things, not as one-sided objects (Latour, 2005c). Therefore, how political issues should be addressed depends exactly on the composition contained within these “things”. This is also true for issues such as ethics. In the case of a shooting, who or what should take responsibility is up to the question of who or what performs the shooting action. Thus, Latour asserts that “[i]t is neither people nor guns that kill. Responsibility for action must be shared among the various actants” (Latour 1994, p.34). Since the question of how a thing is composed is not merely an issue of ontology but has something to do with epistemology, ethics and politics as well, it is of significant importance. Indeed, this question of composition has become a major concern in STS (Mazanderani & Latour, 2018) and many scholars are working on it.

Since societies are always faced with various controversies regarding matters of concern, it is not possible to resolve them by stating so-called “indisputable” facts. Such matters are highly complex and are dependent upon and entangled with one another. Latour’s aim is to find an appropriate method to display this complexity, so that the public can understand what is happening and make better decisions. A “what” question, i.e., the composition of things, then moves one step further to a “how” question, i.e., how to map out the composition inherent in the issue at hand. These questions should be taken into account: How can suitable descriptions of the world be obtained? How can we give a more accurate and useful depiction of the entangled world, so that people are enabled to become aware and get a clearer understanding of a particular controversial state of affairs? In order to render ANT – the appropriate thinking method according to Latour – tacit in people’s minds, he is earnestly calling on scholars from different

backgrounds to work together to develop suitable visualization tools on the theoretical foundations of ANT.

VISUALIZATION PRACTICES FOR DRAWING THINGS TOGETHER

Latour proposes a visualization method called controversy mapping to map out the entangled characteristics of things. He has devoted himself to the collaborative project of controversy mapping for more than 30 years (Latour & Yaneva, 2008). Just as the practice of mapping is to depict roads and trails, controversy mapping is used to reveal the traces of actants and highlight connections and transformations. According to the etymological meaning of design as "drawing" or "drawing together" in French, this mapping is also a way of "drawing things together" (Latour, 2008a). Taking ANT as a theoretical basis, the object of this kind of mapping is controversies, the final version of a map being unknown in advance. It studies transformations and associations before a controversy has been settled. Using visualization techniques, a controversy "datascape" is created (Latour & Yaneva, 2008), showing the contradictory and controversial nature of the issues, including all the humans and non-humans involved. It can make visible those things that were previously invisible and provide a certain degree of traceability. This helps in dealing with the complexity of the issues involved, so that people are able to understand the situation in more detail and more comprehensively. This should enable them to make better decisions in relation to the issue concerned.

In addition to introducing the links between the concept of design and his theories, Latour calls on designers to take advantage of their drawing skills to invent another tool for matters of concern. "How can we draw together matters of concern so as to offer to political disputes an overview, or at least a view, of the difficulties that will entangle us every time we must modify the practical details of our material existence?" (Latour 2008a, p.12). In the same year, Latour co-wrote an article with Albena Yaneva (Latour & Yaneva, 2008) aimed at generating interest among architects in this challenge of drawing a living project of instead of drawing a building – after all, architects are those who view buildings as projects, and "a building is always a 'thing' that is, etymologically, a contested gathering of many conflicting demands" (Latour & Yaneva, 2008, p. 108). Thus, it might be interesting for them to map out and understand the controversial situations associated with their architectural designs.

Before turning to designers, Latour himself first designed a chart. It is obvious that he is keen on employing various types of visuals in his articles and monographs. This turn towards the visual is already apparent in *Science in Action* (Latour 1987), where the theoretical concept of mapping associations and an early form of controversy mapping appear (see Figure 2). In 1991 and 1992, together with Philip Mauguin and Genevieve Teil, Latour proposed a method called Socio-technical Graphs (STG) (Latour, Mauguin, & Teil, 1991, 1992). This was an attempt to develop a new tool to map scientific controversies and technological innovations. It was a collaborative project for de-constructing the technology/social divide by revealing entangled matters of concern, which could be usable for pedagogical as well as analytical purposes. STG was supposed to provide performative narratives by listing all the transformations and

traces involved in a given situation so that users are enabled to grasp it clearly. Figure 3 shows their preliminary design of how to describe the case of the hotel key using STG. The graph appears rather static, however, and is not able to illustrate the entangled (network-like) nature of things.

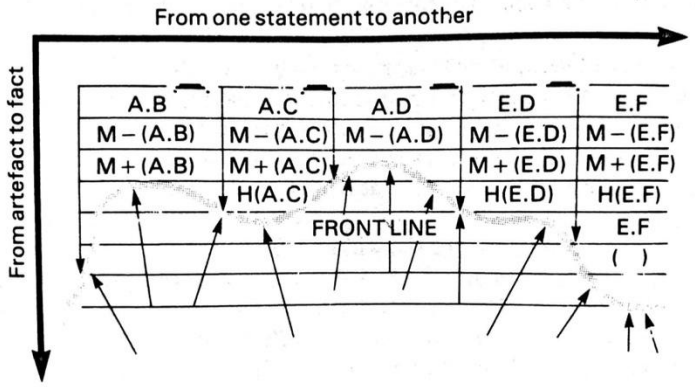

Figure 2. A graph to show transformations of a statement in *Science in Action* (Latour 1987, p. 60)

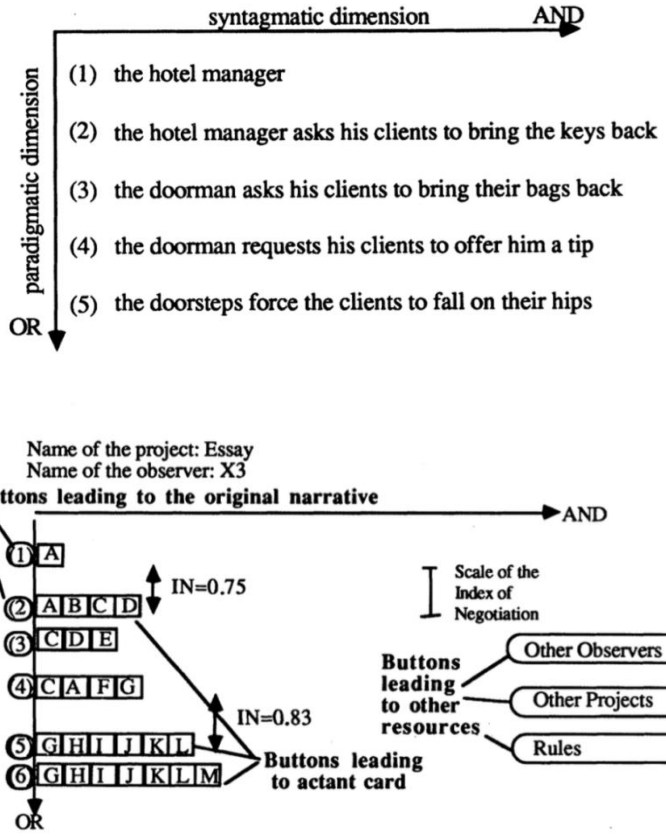

Figure 3. Socio-Technical Graph (Latour, Mauguin, & Teil, 1992, p. 35, 50)

With the development of new technologies, the appearance and function of mapping changed correspondingly. New media technology was able to draw things in greater detail and even to visualize processes dynamically. From 2008 to 2009, Latour facilitated a collaborative project called "Mapping Controversies on Science for Politics (MACOSPOL)", involving groups working in risk cartography, digital methods, architecture and design, geography, journalism, policy making, and so on. The project was aimed at devising a collaborative tool to map out controversies to help European citizens participate in decision-making and make better judgments. Unlike the mapping techniques mentioned above, this mapping became a form of network mapping. It provided a dynamic interface that enabled processes of association and transformation to be continuously traced and illustrated, so that users are able to appreciate the "constituency of a network and the fluency of the social" (Yaneva, 2014, p. 234). With this kind of mapping, the complexity of things is drawn together, various relationships between different actants can be observed in detail, and the ensuring illustration is no longer static in character. What is really novel and important is that the process of genesis can be performed, so that users gain a better understanding of the world to some extent. Yaneva (2014), who participated in this project, asserts the performative force of this mapping. It does not just describe the issues, it is a way of generating knowledge, possessing its own epistemological power. However, since there is no final documentation or other information about this project and the showcase website[2] is no longer active, the actual effect of this mapping is not exactly known.

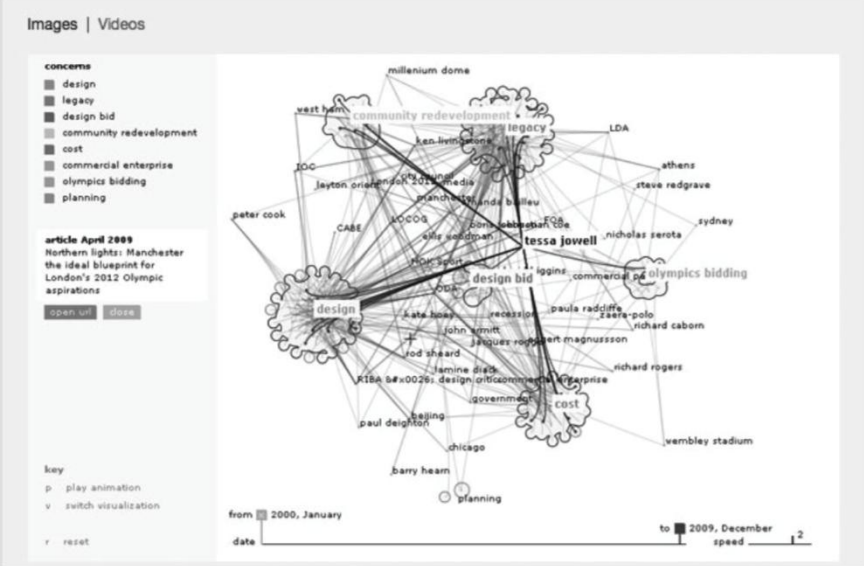

Figure 4. The dynamic network mapping of the process of design and construction of the 2012 London Olympic Stadium (Yaneva, 2014, p. 235)

[2] See https://www.mappingcontroversies.net/.

Latour's visualization practice is not limited to 2D depictions. Since 2005, he has been collaborating with artists and curating four exhibitions at the Zentrum für Kunst und Medien (ZKM, Center for Art and Media) in Karlsruhe: *Iconoclash. Beyond the image wars in science, religion and art; Making things public: Atmospheres of democracy; Reset Modernity!;* and *Critical Zones – Observatories for Earthly Politics* (Weibel & Latour, 2007, Mersmann, 2019). Since "to exhibit" means "to submit or expose to view" or "to show", and an exhibition is a place where various things as well as visual displays and technologies for the topics are gathered together, an exhibition itself is a visualization tool. From this perspective, an exhibition is not a place where ready-made knowledge is simply represented and disseminated, but rather one where knowledge is produced, as stated by Basu and Macdonald: "[V]arious 'actants' (visitors, curators, objects, technologies, institutional and architectural spaces, and so forth) are brought into relation with each other with no sure sense of what the result will be" (Basu & Macdonald 2008, pp. 2-3). Unlike other media, exhibitions also assemble things made of different materials, from two-dimensional to three-dimensional, from real to virtual, displaying images, audio tracks and videos as well as interactive technology in a small enclosed place. Everything is dictated by the theme and conditions of the exhibition. It is an ideal place to carry out thought experiments and "an exploration into the techniques of representation" (Weibel & Latour, 2007, p. 98). What is special about this exhibition is that, on the one hand, it displays not just flat images but also three-dimensional materials; while on the other hand, visitors can also become part of what is on view, rather than merely standing in front of and looking at it. In other words, this kind of exhibition is performative democracy itself: it is complex, interactive, visitor-dependent and object-oriented, a place where viewers and objects all act and new media and new technologies will play a crucial role. It is "a parliament of parliaments, an assembly of assemblies" (Weibel & Latour, 2007, p. 98). In addition to which, Weibel and Latour (2007) argue that as a thought experiment, this kind of exhibition is falsifiable, so it is a good method for testing new political ideas. For example, the aim of the second exhibition *Making things public* is to visualize the concept of Dingpolitik, such that, if after visiting the exhibition someone still regarded the modernist political solution as a good one, the experiment has failed. Conversely, if a visitor begins to hesitate and think that Dingpolitik might be worth a try, it has succeeded (Weibel & Latour, 2007). This idea sounds good in theory; however, there appears to be no feedback on the exhibitions and therefore no way of knowing whether these effects were achieved.

According to research on images in intellectual and cognitive activities, the role of vision in thinking has long been ignored (Mitchell, 1995; Reed, 2013). Put briefly, in addition to words, images also play a central role in intellectual practice, but they do not share the same logic as words do. Images possess non-propositional cognitive power, so they do not explain explicitly what they show. In this sense knowledge is obtained by acquaintance rather than by description. When images and words are combined, they help us to understand texts better (Boehm, 2007; Schlechtriemen, 2019). Since visual representations in science have been studied from divers aspects in STS for many years, it is time to explore the power of visualization more thoroughly and take advantage of it.

In fact, Latour’s practices are not unique among STS scholars. More and more scholars have started to take advantage of visual descriptions (Burri & Dumit 2008). Galison (2014) uses the name “Visual STS (VSTS)” to register this spectrum, which contains two stages: first-order VSTS studies the role of visuals in scientific and technological research, while second-order VSTS uses visuals in turn as one method of inquiry for STS. In addition, there is a growing trend of debate and hybridization between STS scholars and art and design practitioners (Basu & Macdonald, 2008; Burri & Dumit, 2008; Salter, Burri, & Dumit, 2017; Yaneva, 2014).

Since STS studies are quite empirical, I would argue that developing visualization tools could be seen as a suitable approach to supplement these theoretical analyses. Visualization can serve as a practical method of ANT to show how things work and in turn provide more cases for analysis. Following Latour’s path, if we want to have a better understanding of science, technology, society and all the issues that we are confronted with in today’s Anthropocene, we need to solve the question of composition and to trace the complex associations among humans and non-humans. If the associations inside things can be performed by more and more advanced media technologies, then the issue of heterogenous composition could be rendered more workable and we might gain a clearer insight into the relations among humans, technology and the world more generally. Clearly Latour has made many effective and meaningful attempts to explore the power of visualization. However, such practices should be more deliberately designed and planned for a long period of time, so that more useful results can be obtained.

CONCLUSION

In this article, we review Latour’s STS studies and visualization practices. Latour blurs neat lines among different disciplines and rejects the traditional dichotomous epistemology in western philosophy. Everything that occurs in the world involves complex, entangled issues and assemblies. His STS studies are thus aimed at offering performative narratives of things by following traces and trajectories in order to draw together the connections between heterogenous components. This concern about the composition of things is a key task in understanding science, technology, society and many other spheres, and thus also relates to ethical and political questions. In order to render the invisible associations and connections clearly, Latour has also devoted himself to several projects of controversy mapping. Equipped with increasingly advanced media technologies, the process of genesis can be now dynamically visualized. Controversy mappings are supposed to possess performative power. When such visualization tools can provide better performative narratives of composition, they can serve as practical methods to complement theoretical STS analyses. In turn, through visualizing actual issues, more cases can be studied for future STS work.

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