Responsibility through design, design through semiotics: The case of the Italian Electric Smart Meter: An attempt to remediate its non-responsibility.

Responsibility through Design, Design through Semiotics

The case of the Italian Smart Meter: an attempt to remediate its non-responsibility

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INTRODUCTION

We present an attempt to design a device for the visualisation of electrical consumption in order to remediate the way consumption is (not) taken into account by the new Smart Meters (see ill. 1b) installed in basically all Italian households by ENEL, the Italian national electric utility company.

If we assume that responsibility within design has to do with taking into account the effects generated by a certain artefact, then the artefact we present, designed by Simone Marian,[1] is an attempt to make a well-known household device more responsible first toward electrical consumption and, eventually, toward environmental issues related to CO_2 emission.

Our paper is furthermore an attempt to test the ability of semiotics to dispose responsible design. The semiotic approaches we follow are one established by the Danish linguist Louis Hjelmslev *(Hjelmslev 1943)* and further developed by the French-Lithuanian semiotician Algirdas J. Greimas and his school *(Perron &Collins 1989)*, and a complementary one developed by Madeleine Akrich and Bruno Latour *(Akrich & Latour 1992)*. Thus, with the term *semiotics*, we refer to a discipline, which describes relations and articulations of relations, and which, through these descriptions, is able to account for signification *(Mattozzi 2006; 2010)*. Since "humans do not see and act on the physical qualities of things, but on what they mean to them" *(Krip-*

1 The artefact we present is a concept that Simone Marian designed for his Bachelor degree at the end of a three years design programme at the IUAV University of Venice. Between 2004 and 2011, Alvise Mattozzi taught *Semiotics of Industrial Design* at the university. Simone came up with the idea for the design concept after attending Alvise's lecture about the new Italian Smart Meter. Thus, the article is the outcome of our collaboration and has been elaborated by both of us. Parts of the article have been written by Alvise Mattozzi **(A quick overview of ENEL's Smart Meter** and **A concise analysis of the old and the new meters)** and parts by Simone Marian **(Introducing Espy)** others **(Introduction** and **Espy as a remediation of a non-responsible design)** by both of us.

pendorff 2006, 47), we consider semiotics to be a fundamental discipline for design. Other disciplines related to design, like ergonomics and human factors, are normative and hence judge artefacts. Semiotics, on the contrary, is a descriptive discipline, which can be used to account for the articulation of relations that a certain artefact predisposes and to devise different sets of alternative articulations. On the basis of these descriptions, it is possible to decide and eventually implement, which articulation is more responsible, i.e., as we have stated before, which articulation takes better into account the effects generated by a certain artefact.

Latour proposed an eventual non-modern constitution, which should dispose a new way to manage the collective of humans and non-humans that constitutes our society *(Latour 1999)*. If we assume this non-modern constitution and the two powers guaranteed by it, namely the one of *taking into account* and the one of *putting in order (cf. Latour 1999)*, then, from what we have just stated follows that semiotics would be related to the first power; it has to investigate and inventory the articulations of humans and non-humans, which are available. Design, on the other hand, would be related to the second; by devising and developing artefacts, it hierarchises, selects and implements these articulations.

Illustration 1 a/b

A QUICK OVERVIEW OF ENEL'S SMART METER

In 2001 ENEL, the Italian national electric utility company, started to replace the old, traditional electro-mechanical meters (see ill. 1a) with new electronic ones (see ill. 1b) – generally referred to as *Smart Meters* – with an outer shell designed by renowned designer Michele De Lucchi. This was an extraordinary endeavour: By 2006, 30 million meters had been replaced with an average of 40,000 replacements

per day *(Cannatelli 2003)*. The operation cost 2.1 billion Euros. ENEL was the first electric company in the world to carry out a nationwide replacement of electro-mechanical meters with electronic ones.

ENEL's Smart Meter[2] is part of a network for the management and monitoring of electricity distribution and consumption called *Telegestore* (Tele manager). The meter can be turned on and off with a switch placed on the lower part of its shell. It has a display that gives various types of information, when prompted by pressing a button placed on the right side of the display (see ill. 1b). First of all, the display shows the meter's status: A small "L1" on the left indicates, if it is working properly, while a small "V!" on the left indicates, if it is not working. In addition, the display provides detailed information about the contract and the electric consumption. More specifically, each time the button is pressed, the display gives information about:

- The client's account number
- The kind of rate the client pay
- The amount of electricity (measured in kilowatts) being consumed at the time of the display reading
- More general information about electrical consumption in kilowatts:
    - The amount of electricity that has been consumed during the current billing period up to the time of the display reading
    - The highest point in consumption during the same period
    - The amount consumed in the previous period
    - The highest point in consumption during the previous period
- Date
- Time
- ENEL's toll free number
- The name of the contract and the rate.

2 Most of the general information and pictures can be found at http://www.enel.it/it-IT/reti/enel_distribuzione/qualita/progetti_contatore_elettronico/

A CONCISE ANALYSIS OF THE OLD AND THE NEW METERS[3]

A first glance at the old (electro-mechanical) meters and at the new Smart Meter (ill. 1a and 1b) immediately elicits a difference regarding their *plastic configuration* – the general configuration of the object's shape *(Mattozzi 2010)*. The new meter (ill. 1b) is more homogeneous, i.e. displays less discontinuities among shapes, colours, materials, etc.; it basically displays one colour and one material and is an object with a single body and fewer shapes, and contrasts between shapes are developed gradually. The old meters (ill. 1a) are more heterogeneous: different colours, meter and switch are often two separate bodies,

3 Following the example of Akrich (1990), this analysis will focus on the way the Smart Meter articulates various users through its *script*. A complete analysis of the Smart Meter, which follows the model is presented in Mattozzi (2010), see Mattozzi (2008).

the meter contains many different juxtaposed shapes and is made of multiple materials (plastic, glass, metal).

Displaying only a few discontinuities, the Smart Meter's shell arranges, organises and hierarchises the user's actions. For instance, the frontal surface of the new meter has inscribed two kinds of actions: Looking and moving. These two actions affect two different senses, sight and touch, and thus two different parts of the user's body: The eyes and the hands. They also involve two different vectors: The one affecting sight goes from interior to exterior, while the one affecting touch goes from exterior to interior. The opposition between oval and circular shapes of the discontinuities is related to the opposition between sight and touch: The display, which shows data coming from the inside, is oval, while the button allowing the user to interact with the display by pressing it, in order to change the kind of information displayed, is circular. Further underscoring this argument, a third element on the upper part of the interface – on the right, just below the button – is made of an oval inside a circle. This is an optical interface for the exchange of data that affects both directions of the interaction (exterior-interior and vice-versa), which can be used only through a device that is both able to extract information from and add information to the meter. The lower zone of the interface – where the switch is – presents an element that combines the oval and the circular shapes. In fact, this is a zone, where both touch and sight can be performed. Here, the switch is accommodated; it must be moved through a bottom-up movement of the hand in order to turn on the meter and once moved – either up or down – it visually indicates, whether the meter is on or off.

Thus, the frontal surface is an actual interface and through its articulation, it outlines two users or, better *two model users*[4] – users inscribed into the interface – who do not have to correspond to actual users, respectively:

- A *client-user,* who switches the meter on and off and who reads the display
- An *operator-user,* who uses the optical interface to insert and extract data with the right tool

The old, electromechanical meters also devised these two kinds of users, but they were articulated in a different way. Indeed, the operator-user, coming periodically to the house in order to read the display and communicate the consumption to the electric utility company, had to monitor both the meter and the customer: Each of them had to *function* correctly, the former had to measure electricity adequately and the latter could not hack the former *(see also Akrich*

4 Or *enunciatee* (see Graimas & Courtés 1979; and Eco 1979). Every time we will use the word *user*, we will imply the notion of *model user*.

1992, 216-219). The new meter does not need this kind of delegation to the operator-user and, indeed, it does not display any seal, which were formerly used as an indicator of possible user hacking. With the new meter, the operator practically disappears from the interactions: If everything works well, s/he should intervene only for the installation.

The actor referred to as the client-user emerges as a result of the combination of two other actors (fig. 1): the *contracting-user* and the *consumer-user*. These users are related to two different parts of the interface: The consumer-user relates to the display as the display makes it possible to extract information about consumption, whereas the contracting-user relates to the switch, since it is by switching on (or off) that this user accepts (or rejects) the contract *(Akrich 1992, 216-219)*.

The *client-user* of the meter differs from the *customer*, who is the one that actually uses the energy and pays the bills. Contracting-user and consumer-user and hence the client-user, who contains the previous two, are actors that emerge only in relation to the meter, whereas the customer emerges from a broader relation with the electric utility company (fig. 1), which includes additional elements such as the contract, other documents and the consumption of electrical energy. Like the client-user related to the meter, the customer results from the articulation of two other actors: The *consumer-customer*, who is the actor, usually collective, that actually uses the energy, and the *signatory-customer*, who is the actor, usually singular, who signs the contract and is responsible for the payments (fig. 1).

5 According to ENEL (2003), *properly* means that the meter should allow the contract to be managed more easily and comfortably, and should also allow electric appliances to be managed more rationally by controlling the electrical consumption and by knowing, how much each device is consuming, i.e. by deploying a more aware consumption, thanks to the information displayed.

6 When within the home, the meter is often installed at the entrance and is somewhat hidden, e.g. in a niche. Despite the fact that the redesign of the meter aims also at making such a device a visible object, suited to be on display in a home, ENEL recommends to place new meters where the old meters were: in partially hidden places.

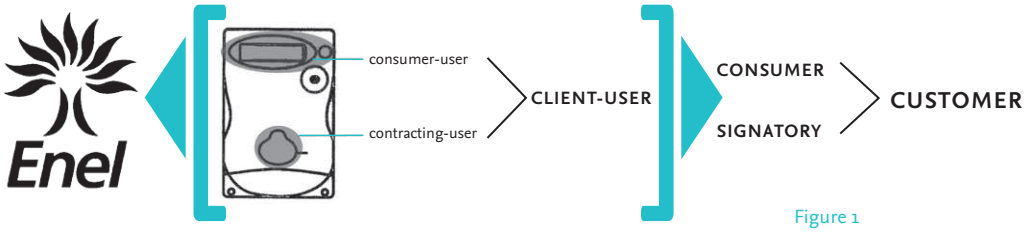

Figure 1

In order for the new meter to work properly[5] all these actors should more or less superpose. This, however, does not happen because the meters are usually positioned at the ground floor of the building or even at the entrance of the basement;[6] this means that almost no one can get into the position of the consumer-user, who monitors his/her consumption. The only time, when a customer gets in contact with the meter, is in fact, when the electric supply is cut and s/he has to switch the meter on again. Ironically, the only moment,

when the consumer-customer can be placed in the position of the consumer-user of the meter as well, is, when the energy supply is stopped and hence s/he is not actually consuming. Thus, since the customer interacts mainly with the meter, when it is switched off, in order to switch it on again, the customer basically interacts with the meter only as a contracting-user.

On the other hand, the Smart Meter identifies its user only through the contract number, the same one belonging to the signatory-customer, who does not necessarily correspond to the consumer-customer.

As we can see the Smart Meter neglects the consumers (fig. 2), be it a consumer-user of the meter, who is almost never actualised, or be it a consumer-customer who is not addressed at all by the meter. The meter addresses only the actors that have to do with the contract – and with the payments.

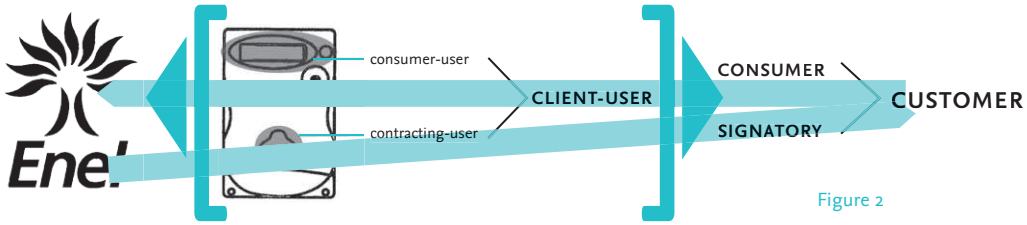

Figure 2

This articulation creates a gap between the consumer-customer and the contracting-user, which become visible, when, after a cut of the energy supply, the consumer-customer has to switch the meter on again and cannot see, which one belongs to him/her, unless s/he knows his/her account number. In order to fill this gap, without passing through the signatory customer, i.e. without reading the account number on the contract, consumer-customers write their family name, i.e. the actual name of the consumer-customer, on the meter (in ill. 1b, it is possible to see a name written on the meter).

There are two other factors that hamper the superposition of all the actors articulated through the Smart Meter, even if the device is installed within the home:

1) The information on the meter is displayed in watt, which makes it is very difficult to relate the displayed numbers to actual consumption (and actual cost); the old meter with its rotor disc, which would turn faster for higher consumption, would visualise much more clearly, at a first glance, if the energy being consumed was a lot or not.

2) Related to the first point there is the fact that consumption is a process, and the old meter, through its rotor disc, would display it as such, showing also the modulations of this process basically in real time; the new meter, instead, displays consumption as a fixed amount, registering it every two minutes, and showing it only when the consumer-user prompts the display by pushing the button.

All these elements show that with the Smart Meter, ENEL does not take consumption into account. It is basically interested only in the commercial transaction: The meter addresses only the signatory-customer, hampering the superposition of the different consumers actors, and in addition, it displays only fixed amounts of consumption, not the process of consumption. Fixed amounts refer to the past and can be calculated, eventually to be transformed into monetary value and be paid for.

Thus, the Smart Meter does not predispose the electric energy consumer to take into account his/her consumption either.

If we assume that within design, responsibility has to do with taking effects enacted by an artefact into account, we can see that by not taking consumption into account, ENEL and its Smart Meter act non-responsibly in relation to electric energy consumption according to the semiotic square *(Greimas–Courtès 1979)*, which we have tentatively devised below (fig. 3):

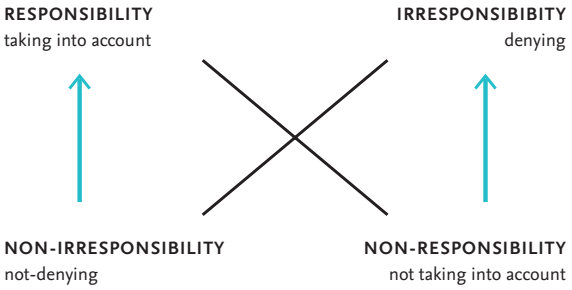

Figure 3

In the model, *responsibility* equals *taking effects into account*, whereas irresponsibility equals *denying any effect*.[7]

INTRODUCING ESPY

In order to remediate the non-responsible design of ENEL's Smart Meter, Simone Marian designed *Espy* (fig. 4 and 5), a device, which visualises households' electrical consumption.

Espy has been conceived as a visual funnel giving access to the electronic network within the walls. It has a plastic funnel-shaped

7 Clearly the way we consider *responsibility* is strictly related to design. Thus, our definition includes artefacts and differs substantially from the traditional one related to individual humans. Following the typology introduced by Luigi Pellizzoni (2004), we consider that an artefact can be considered to be responsible if its design – and more specifically its script (Akrich 1992; Akrich & Latour 1992; Jelsma 2003) – can anticipate some of the consequences of the its use.

shell in, which at the one end is a 7 cm diameter OLED screen and the other is an electric plug (fig. 4). The screen is covered by a slightly concave slide, which works as the only button of the device, thanks to a push micro-switch device.

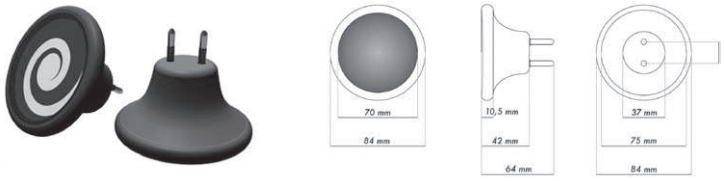

Figure 4

An integrated transformer allows Espy to be powered from the socket, into which is plugged, and thanks to a rechargeable battery, it can stay on even if unplugged and work, for instance, as an emergency light.

It contains a circuit card equipped with an Echelon chip (Long Talk Communication Protocol) in order to communicate with the ENEL's Smart Meter through the socket and acquire data about electrical consumption. These data are elaborated by the circuit card, which stores them on a fixed memory to eventually communicate them to users through the screen.

The screen visualises data in two ways: Through a graphic animation and through alphanumeric strings (fig. 5). The first one shows a rotating spiral.[8] The speed of the rotation is modulated in relation to the electrical consumption; the higher the level of consumption, the faster the spiral rotates. The second one appears, when the screen is pressed. It shows data about consumption in kWh (kilowatt hour) with the monetary value for the total consumption and the monthly consumption as well as other information about the contract.

8 We chose the spiral together without considering its huge symbolic heritage. For us, it was important to have a configuration that would allow the re-presentation of the circular dynamic of the rotor-disc, would predispose the idea of something that goes into the walls and that was reversible – all at the same time. We think that each configuration acquires a value; first, in relation to its textual actualisation, and only later, in relation to the encyclopaedia of meanings it itself contains.

Figure 5

The screen usually stays in a standby mode, showing just a dot in the middle. Whenever electrical consumption exceeds a certain customisable amount, the screen starts displaying the spiral (fig. 5). A push

on the screen can change its status, from standby to spiral and from spiral to alphanumeric strings (fig. 5). The screen can also change colour according to the rate available. In case of household energy production and sale – through solar panels, for instance – Espy can show the different circulation of electrical current by switching the direction of the spiral's rotation.

Espy is also equipped with a small speaker, which warns the household's inhabitants of the eventual imminent cut of energy supply. Through a WiFi device, Espy can communicate with a router and exchange information through the Internet, so that a user can manage Espy and its information from a computer. The WiFi connection allows the use of Espy within Web 2.0 applications, in order to promote collective sustainable behaviours.

Installation of Espy is easy, it just needs to be plugged in and it will start to detect, elaborate and display data about the electrical consumption.[9] Within Italian homes – and probably in other countries as well – Espy's *natural* habitat is the kitchen, which is usually the most attended room and where there are sockets at arm height.

9 The Echelon chip grants the communication with the Smart Meter. Nevertheless, it is a critical element of Espy's design that needs to be further developed. In any case, *Espy* has been conceived to integrate ENEL's *Telegestore* network and it cannot work in a traditional network. Through the same protocol, it would be able to communicate with domestic appliances.

ESPY AS A REMEDIATION OF A NON-RESPONSIBLE DESIGN

As we have seen, ENEL's Smart Meter does not effectively address the actors related to consumption, but only the ones related to the commercial transaction. In order to rearticulate the relations set by ENEL Smart Meter, so that it can take consumption into full account, we need a device, which fills the gap between the user of the meter and the electric energy costumer, and which predispose the superposition of all the actors.

By redoubling the display and the information of the Smart Meter and by moving them within the household Espy allows the superposition of the two consumer actors – the meter's user and the customer. Yet, we do not consider this remediation to be enough to take the household consumption fully into account.

Espy, however, does not only redouble and transfer the display, it actually remediates the way information is displayed by the Smart Meter. Indeed, Espy reintroduces, through the spiral animation, the analogical rotation of the old electro-mechanical meter's rotor disc, thus showing consumption as a continuous modulated process and not only as a series of fixed amounts. The latter can be visualised either in watt or in money – as a value unit, money is more understandable for the average user than watt.

There is yet another factor that helps to achieve a full remediation. Because of Espy's quite large display, the movement of the spiral – and hence the process of consumption – can be perceived from afar and by more than one user at once, possibly glancing from different points of view, and not necessarily focused on Espy.

These two features – display of the process and of the amount, multi-user perception – characterise Espy, making its use within the household substantially different from the use of ENEL's Smart Meter as well as setting it apart from other similar devices.

In recent years there has been a noteworthy flowering of devices (most of them still at the state of prototype or concept) to increase *energy awareness*, as stated by the tag line of the *Static!* research project of the Swedish Interactive Institute,[10] within which quite few interesting devices have been designed. Beside *Static!*, we can mention *Wattcher* by Marcel Wanders, *EnergyJoule* by Ambient,[11] *Conscience* by Delroy Dennisur, *Coupe-Veille* and *Semaphore* by Gilles Belley, designed for Electricité de France *(Badalucco & Chiapponi 2009)*. Among those, we can distinguish devices that account for a local consumption of energy and devices that account for the global energy consumption of a household, as *Espy* does. Within the first group, we find *PowerAwareCord* from *Static! (see Palm–Löfstrom 2008)* or *Coupe-Veille*, which both visualise, using colours or pattern, how much the appliances directly connected to the energy awareness device are consuming. Within the second, we can further distinguish those devices that visualise consumption quantitatively through digits or graphs, as *Wattcher* and *EnergyJoule,* and devices, which visualise consumption analogically through changing patterns, shapes or colours as the *FlowerLamp* from *Static!* does. Only *Espy* and *Conscience* mix analogical with digital visualisations.

Analogical visualisations are usually the only way to show consumption as a process that is clearly perceivable from afar[12] by more than one user, not necessarily focused on the display. These are also features of a visualisation system, which ease coordination and collaboration among actors. Indeed, it has been shown that visualisation systems are not only used to acquire information,[13] but also to coordinate actions *(Goodwin 1995)* and achieve mutual understanding *(Heath & Hindmarsh 2000)*. Nevertheless, the design of interactive systems is often based on the way Human-Computer Interaction conceive interaction, namely individually. Thus, such design addresses just one person even if it is not necessary or desirable. Such design actually hampers the emergence of coordination and collaboration among actors *(Heath and vom Lehn 2008)* – ENEL's Smart Meter does clearly so, and both *Wattcher* and *EnergyJoule* tend to do it.

10 See http://www.tii.se/projects/static. We thank Anna Thies for mentioning this research project to us.

11 For Wattcher see http://www.wattcher.nl and for EnergyJoule see http://www.ambientdevices.com/products/what-is-ambient– the only commercialised devices.

12 Unless the display is very big, which is not suitable for a household.

13 Our analysis here rejoins approaches to behaviour change related to energy consumption based on practice (among others, Jegou, Libermann & Wallenborn 2009; Jelsma 2003; Ropke 2009; Shove 2003; Shove 2005; Shove 2010) and not on rational choice made possible by adequate information. All the approaches related to practice give, as we do, a central role to artefacts in disposing change.

If we consider that the consumer-customer, who contrary to all other actors articulated by the ENEL Smart Meter is a collective actor, emerging from all individual behaviours of a household's inhabitants, it becomes clear that managing the electric energy consumption requires coordination and collaboration.

Espy predisposes the emergence of this collective actor keen toward a common goal[14] in two connected ways. First, because the singular behaviour of each household's inhabitant gets translated through Espy into a single process, which is objectified[15] and made visible for the very same household's inhabitants, offering them self-reflection about their collective behaviour, and actually making them a visible collective actor *(Latour 1994; Ueno 2000)*. In this way Espy, at the same time, takes into account consumption and predisposes the consumer-customer to take it into account as well. Secondly, because, by showing a process that can be seen from afar by more than one actor at once, not necessarily focused on Espy, the Espy allows effective coordination and mutual control.

Thus Espy completely rearticulates the ENEL Smart Meter's display, which even when within the home can be only looked at, when standing close to it and only by one user at time, who can only get information about the amount of energy already consumed in watt.

In semiotic terms Espy is a *sanctional artefact (Greimas & Courtés 1979)*, i.e. an artefact, which takes into account, evaluates and judges the performance of a certain actor. ENEL's Smart Meter is also a sanctional artefact, but it works differently. Whereas Espy explicitly evaluates all the actions continuously, showing them as a singular process, the ENEL Smart Meter evaluates them implicitly – the display is empty if not prompted – except, when the amount of energy exceeds the limit and the energy supply is cut. Thus, ENEL's Smart Meter sanctions explicitly only negatively through a punishment, which usually arrives almost unexpected, because of lack of coordination, which the meter does not dispose. The ENEL Smart Meter behaves as a tyrant, who punishes virtually innocent people, who are not given the competences to behave correctly and hence do not feel responsible. Espy, on the other hand, is more democratic because it allows a distribution of control and hence a distribution of responsibilities.

14 In semiotic terms we have the emergence of an actant on the base of a unique *narrative program* – or *program of action* – which has the appearance of the collective actor constituted by the behaviours of the household inhabitants. Such a program can be related to the prevention of the energy supply cut, to saving money, lowering the electric consumption, lowering CO_2 emissions, or to a combination of the previous.

15 In semiotic terms *shifted out* (Akrich & Latour 1992) or *disengaged* (debrayé) (Greimas & Courtés 1979).

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