Shaping Technology / Building Body(Nets)

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Technologies as Environments

Imagine two cities separated by a river and connected only by boat. Now think of the changes that are brought about by the construction of a bridge; transformations will be felt throughout, affecting all the elements involved in this interaction. These transformations will, to a great extent, be caused simply by the presence of the new artefact (bridge). However, the properties of the artefact will also influence the character of the changes. There is, for example, a great difference between a small wooden bridge that can only carry pedestrians and bicycles and a steel bridge that is equipped for cars, buses and trucks, but not for pedestrians. The characteristics of the bridge affect the two cities it connects. The contrary is also true; that is, the characteristics of the cities affect the shape and use of the bridge. Before the actual building of the bridge, studies were done (hopefully) and assumptions were made (certainly) regarding the characteristics and needs of the cities on both sides of the river. Hence, much in the same way that the social (the two cities) is shaped by the technical (the bridge), the bridge is shaped by the cities it connects. This is true of the processes of development, implementation and use of any technical artefact.

Other actors, besides these immediate ones, also affect, and are affected by, the introduction of the new bridge. For instance, the river actively shaped this process, as its characteristics had to be taken into consideration while the bridge was being designed and developed. However, the river does not remain unchanged when the bridge comes into existence. While earlier its crossing may have presented itself as a recalcitrant, often rebellious, obstacle, or perhaps as a moment of joyful leisure, it is now silenced, almost invisible. It loses the physicality of an "obligatory passage point",[1] awarding it to the bridge instead, and in the process acquiring a new identity. The river shores, freed from the requirement of anchoring boats, may become the perfect place for a Sunday morning promenade.

In the network of river, bridge, cities and surrounding environment nothing remains unchanged. Social and technical actively interact, exchange properties and negotiate identities, thus shaping one another. Technologies, then, are not neutral tools, or passive containers, but environments that shape and hold together a set of social dynamics that are simultaneously a consequence of their existence and necessary for their survival.[2] The intro-

duction of the new bridge does not result in two cities plus a bridge, but in a qualitatively different urban landscape composed by distinct social relationships.[3]

The metaphor of technological environments highlights the networked, distributed character of a socio-technical project and emphasizes the multi-directional influence of the actors' (people and artefacts) actions, thus leading to the rejection of cause and effect, deterministic theories. The connections between social and technical can be studied simultaneously, as they actively shape one another.

However, it is also true that the identity of the actors involved in this interaction is not infinitely fluid or malleable.[4] Technological artefacts have characteristics that need to be taken into account in this mutual shaping relationship. For instance, if our bridge is built for pedestrians it may be used by bicycles, perhaps even cars, but certainly not by trains.

In this framework, the separation of social and technical vanishes and is substituted by hybrids that defy categorical divisions. Technologies become socio-technologies, i.e. materialisations of a given view of society and behaviour that enhance or constrain certain social dynamics. For instance, if our bridge is one-way only during rush hour, those who find themselves excluded from using it must find alternative ways to cross to the other side. If, at a later stage, city planners arrive at the conclusion that traffic is becoming unbearable, they may decide to add a public transportation lane that works both ways, thus making it more attractive to take the bus. We can say, therefore, that the way a certain technology is, that is its present shape, reflects the result of the struggle between different actors.[5]

Creating Networked Bodies

Although there is no formal definition of body(nets),[6] I propose that we think of them as bodies networked for (potentially) continuous communication with the environment (humans or computers) through at least one wearable device, that is, a body-worn computer that is always on, always ready and always accessible.

Body(nets) constitute new bridges between individuals and the environment – composed of humans and nonhumans, things and non-things. As such, we must ask what new socio-technical environments are being created. How are body and technology interacting and actively shaping one another to create a new hybrid entity or environment with its own specificities and dynamics?

As a concept, body(nets) are largely a product of the Information Age. They apply the Internet phenomenon, with all the hype that surrounds it, to the human body. Body(nets) are interesting entities in that they condense and make visible many of the tenets that rule contemporary Western societies: a desire for mobility, continuous access to information, personalisation, networking and control. Their imperativeness stems, at least partially, from the urge to bring the body up to speed with the new production demands of a society where digital information is the most valuable asset.[7]

As they (re)connect and mediate between body and environment, body(nets) transform, and are transformed by, all the elements involved in this interaction. Hence, body(nets) are not merely tools to be used, but active shapers of experience. A body(net) can be used, for instance, as a "reality mediator",[8] that is, it can alter, by enhancing or diminishing it, one's perception of the world. Steve Mann's *Eyetap* is perhaps the best example

of this.[9] The *Eyetap* transforms the eye into a camera and a screen where reality is projected. Reality is recorded through the movements of the eye and then it is projected on to the eye itself. This allows all sorts of manipulations, for instance its wearer can spend his/her nights reliving his/her mornings!

Body(nets), these new bridges, contain assumptions about that which they connect, and these assumptions affect their shape, the nature of their mediation and the behaviours they enhance or constrain. For instance, a body(net) that is equipped only with a transmitter allows its user to transmit data, but not receive it. If this transmitter is controlled by a third party, then the user has no control over the data flow. If the body(net) is equipped with a transceiver and is controlled by the user, then the user is able to control every piece of information that enters and leaves his/her personal space.

Due to the high degree of intimacy with the user, the body(net) becomes an extension of the self, a second brain. In fact, it has been argued that the 'always ready' capability of body(nets) leads to a new form of synergy between human and computer, with each hanging on to the other in a feedback loop.[10]

When extending the body, and creating new connections to the environment, body(nets) blur the boundaries between internal and external, between self and others. The individuals' body and cognitive abilities are extended, their boundaries no longer determined by skin, or even by the body's proxemics,[11] but by the artefacts that are part of his/her network, and respond to his/her presence.

Hence, a recurring futuristic vision of this tech/body/environment network is one in which the environment recognises and adapts to the individual. In this brave new world, individuals always feels at home, safe in any environment, with the environment actively enhancing this well-being. The environment begins to "morph into the figure of a software agent" that acts on the individual's behalf,[12] anticipating his/her wishes, desires and needs.

Imagine, if you will, an individual equipped with a shirt outfitted with biological sensors that measures the heart rate, body temperature, neural activity and respiration rate, among others, thus denoting, in principle, its wearer's mood, mental and physical state.[13] In this version of the future, if the individual's mood becomes gloomy the shirt can activate a room's soothing music player, alert a third party, or perhaps even inject a drug. It is conceivable that other uses will be found for this data. For example, it could be utilised by a health insurance company to determine that individual's premium. Or, the individual could start refraining from performing any kind of activities that would affect him/her in ways that might be understood by the shirt's sensors as 'depression' (for instance, watching a sad movie). What is measured, and how it is measured affects not only the individual's behaviour and the response of others to it, but also the very definition and experience of the emotion itself.[14]

Companies like VivoMetrics are developing products that do something of this sort. VivoMetrics markets its *LifeShirt System* (TM) as a tool for electronic care management. Its web site announces that rather than collecting a "snapshot" of a patient's health, the "*LifeShirt System's* embedded sensors and patient diary capture continuous data – a 'movie' of health". This continuous feature affords "an unprecedented, real-world view of the patient, providing researchers and clinicians with a more comprehensive understanding of how respiratory, car-

diovascular and other physiologic functions interrelate – even how they are affected by [that] patient's frame of mind – as well as the effect of specific therapeutic interventions".[15]

Others, currently in the workings, are oriented towards everyday lifestyle applications. Lifestyle applications are believed to be the 'killer app' that will turn wearable computers into everyday apparel. Paradoxically, there is also a consensus that until these applications look and behave like actual clothing they will not be accepted by the general public and become mainstream items.[16] *MIThril*, a prototype being developed by the Massachusetts Institute of Technology, offers an example:

A full-fledged personal computer network woven into an individual's clothing, *MIThril* will learn the preferences of its owner by watching behaviour and taking note of habits. It will manage a personal datebook and know where its owner should be even before departure. And by pre-emptively scouring web sites, it will constantly be updating the best way to tackle the next task. Suppose a beach party is on the schedule, *MIThril* will know this because the event is in the calendar and there's a note on a to-do list that says, for example:

Pick up beer.

When the system observes its owner getting on a bike, it immediately seeks the best directions to the party by way of a packaged goods store – taking into account that its owner hates heavy traffic. After calculating all of this information, *MIThril* displays a map to the beach on the owner's glasses without even being asked.[17]

The emphasis is on anticipation, pre-emptive action. The body(net) knows the individual as well (or better) than he/she knows him/herself. It acts on the individual's behalf without the need for conscious input. The possibilities for control and loss of privacy, although not explicitly mentioned, are certainly a possibility. Among the more subtle effects we could imagine, for instance, the creation of invisible entities – spaces or activities – that are not modelled into the body(net) and thus become intangible.

Other areas that are currently explored are those of work, to increasing the ease and efficiency of hands-free task performance and security, to enhance (in the case of soldiers) or diminish (in the case of criminals) physical abilities. After the events of September 11, 2001, investment and interest in the area of security has increased exponentially.

In their article, "Basic Concepts in Wearable Computers and Augmented Reality", Barfield and Caudell project that in the future "[the networked] computers [on our body] will monitor our physiological state, perform the duties of a secretary and butler in managing our everyday life, and protect us from physical harm".[18]

Others, however, are not so enthusiastic and warn of the dangers of this merger. For instance, in 1999 Critical Art Ensemble criticised the invasion of the body by biotechnologies, arguing that it creates a "flesh machine" ruled by the same values as all other machines: efficiency and productivity.[19] Peter Weibel made a similar point in his essay, "Virtual Worlds: The Emperor's New Bodies", when arguing that the successful implementation of virtual reality models is accompanied by a mechanization of the human.[20] Elsewhere I have also discussed the issue of the losses that accompany the merging of the human body with technology.[21]

However, in this paper I propose that we think of body(nets) as environments, thus shifting our attention from the effects of the merger of body and technology to the

process of mutual shaping, or "translation", in Callon's words,[22] of the different actors involved in it.

In this way, body(nets) are understood not as the sum of body and technology but as a qualitatively new entity. As body and technology actively shape one another, new practices are created that sustain the body(net) and give it existence. The roles and characters of the actors involved change, and with them the ways in which we relate to the world and to ourselves.

When analysing the processes of mutual shaping that occur within a socio-technical environment, we become aware of the process of its construction, of the strategies used to convince (or force) different actors into their places and identities. The relational character of the project is exposed and so are the visions and goals of the participating actors.

This facilitates the recognition of the sociological theories that are inscribed into each technology,[23] the social relationships that it materialises, the identities that it makes vital and those that it replaces and relegates to invisibility.

The desire for accountability and visibility in socio-technical projects runs counter to the common assumption that the greatest sign of the adoption of a technology is its disappearance into the background: a technology is considered adopted when we no longer think about it.[24]

I propose that we open up and question these black boxes, make them visible again, not as isolated artefacts but as socio-technical environments, constituted of relationships among different entities that rely on them for their identity and, sometimes, even existence.

Title inspired by the book *Shaping technology/Building society studies in socio-technical change*, edited by Wiebe Bijker and John Law (MIT Press, 1992, Cambridge, MA).

NOTES

1. Callon, Michel "Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St. Brieuc Bay" (in *Power, Action and Belief: A New Sociology of Knowledge?* Routledge & Kegan Paul, 1986, London, UK).

2. For more on 'technology as environments' see McLuhan, Marshall *Understanding Media: The Extensions of Man* (MIT Press, 1964, Cambridge, Massachusetts) and, McLuhan, Marshall and Eric McLuhan *Laws of media: The New Science* (University of Toronto Press, 1988, Toronto).

3. See Marvin, Carolyn *When Old Technologies were New* (Oxford University Press, 1988, New York) for an interesting, descriptive analysis of the introduction of the telephone and the shaping of the socio-cultural environment.

4. Callon, Michel and John Law "After the individual in society: Lessons on collectivity from science, technology and society" (in *Canadian Journal of Sociology* Vol. 22, No. 2, 1997) p. 172.

5. Latour, Bruno "Technology is society made durable" (in *A Sociology of Monsters: Essays on Power, Technology and Domination* Routledge, 1991, London/New York).

6. In the scientific and popular literature body(nets) are often referred to as 'wearable computers'. I prefer the term body(nets) because it shifts the attention from the anatomy of the technical artefact to the shape of its network.

7. Critical Art Ensemble "Links and Synchronisms on the Flesh Frontier" (in *Readme!* Autonomedia, 1999, Brooklyn, NY).

8.   Mann, Steve *Cyberman* (movie) (*The Nature of Things* series, directed by Peter Lynch, CBC Television, 2001).

9.   See Mann, Steve *Eyetap* (http://eyetap.org/defs/intro.html).

10. Mann, Steve "Wearable Computing: A First Step Toward Personal Imaging" (in *IEEE Computer* Vol. 30, No. 2, 1997) and Frishberg, Manny "What to Wear: Why Not a Computer?" (in *Wired News* http://www.wired.com/news/gizmos/0,1452,55669,00.html, 10 October 2002).

11. The body perceives the close space around it, its 'aura', as being part of the body. To this space Hall, E.T. *The Hidden Dimension* (Anchor Books, 1982) gives the name "proxemics".

12. Suchman, Lucy "Refiguring interactivity at the interface" (Paper presented at the workshop on *Absent Presence: Localities, Globalities and Method* 10-12 April 2002).

13. Barfield, Woodrow, and Thomas Caudell "Basic Concepts in Wearable Computers and Augmented Reality" (in *Fundamentals of Wearable Computers and Augmented Reality* Lawrence Erlbaum Associates, 2001, Mahwan, NJ).

14. For more on this topic see Suchman, Lucy "Replicants and Irreductions: Affective encounters at the interface" (Paper presented to the European Association for the Study of Science and Technology, August 2002, York, UK) and Dror, Otniel, "The Scientific Image of Emotion: Experience and technologies of inscription" (in *Configurations* Vol. 7, No. 3, 1999) p. 355-401.

15. VivoMetrics' web site: http://www.vivometrics.com/site/system.html

16. See Post, R., and M. Orth "Smart fabric, or washable computing" (in proceedings of the *First International Symposium on Wearable Computers* 1997) and Woodrow Barfield *et al* "Computational Clothing and Accessories" (in *Fundamentals of Wearable Computers and Augmented Reality* Lawrence Erlbaum Associates, 2001, Mahwan, NJ).

17. Wood, Christina "I, PC" (in *Popular Science* http://www.popsci.com/popsci/computers/article/0,12543,198188,00.html, 14 March 2002).

18. *Op. cit.* 13, p. 24.

19. *Op. cit.* 7.

20. Weibel, Peter "Virtual Worlds: The Emperor's New Bodies" (in *Ars Electronica: Facing the Future* MIT Press, 1999, Cambridge, MA).

21. Viseu, Ana "Simulation and Augmentation: Issues of Wearable Computers" (in *Ethics and Information Technology* in press).

22. *Op. cit.* 1.

23. Madeleine Akrich "The De-Scription of Technical Objects" (in *Shaping Technology/ Building Society Studies in Socio-technical Change* MIT Press, 1992, Cambridge, MA).

24. Hence the efforts of ubiquitous computing and embedded computing, efforts to hide the 'computational' character of artefacts while maintaining their physical shapes. For more on this see Viseu, Ana (*op. cit.* 21).