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BEYOND ENGINEERING

Software Design as Bridge over the Culture/Technology Dichotomy

In his book “Le geste et la parole”, the paleontologist André Leroi-Gourhan sketched the evolution of Homo sapiens as having left the domain of biological advancement in order to continue – with an accelerated pace – in the field of language and technology. While many of Leroi-Gourhan's proposals have not aged well, his concept of humanity being shaped by a man-made web of objects and symbols – of machinery and discourse one might say – has been a powerful image in a time when the idea of the tool as neutral artifact is still an important paradigm. In the last decade, however, there has been a resurgence of academic interest in technology not purely as a means to an end but as a cultural force. Together with this shift in perspective on the role of technical artifacts in our high-tech collectives, we see, more specifically, an increased awareness of the “toolmaker” as the supposed *locus* of technical progress. Every age seems to have an epitomical figure of technical creation: the craftsman for the Middle Ages, the inventor in the Industrial Revolution, and the engineer in the 20th century. Late capitalism has introduced a new figure: the designer as the toolmaker of the information age.

The last two decades have produced a plethora of literature on the new way of creating technical objects; from product design to Web design, from industrial design to experience design, design is everywhere but no two definitions are the same. As a consequence, the term refers less to a clear-cut concept or methodology; it rather functions as a means of differentiation. Software design¹ for example is not a well-defined practice; it is a way of saying that what is being done is somehow going beyond the well-defined practice of software engineering. Behind the term “design” actually lurks a multiplicity of quite different ways of creating, shaping, and maybe even using.

In this article, we will first consider the growing cultural significance of software in order to establish a motive for having a closer look at software production. We will show how new practices of technical creation are connected to and stimulated by this curious artifact, the computer, the *Universal Machine*. We will then argue that because culture and technology have become increasingly difficult to distinguish, we must reevaluate the way in which we create tools, think about culture, and regulate technical creativity.

¹ The term was first coined in Kapor (1986).

1. HYBRID PRACTICES

In industrial societies there remain few tasks that are not in one way or another dependent on computers. Our communication and information routines have shifted in large part to a computer-based network infrastructure of globally connected computers, the *metamedia* (Kay and Goldberg, 1977) of our time. Classic electronic media like television and telephony are currently passing onto the universal protocol of TCP/IP², becoming yet another piece of software that runs on the Internet. Creative work, game play, social intercourse, information search and management – so many of the things we do in our everyday lives have become directly connected to digital tools and networks (Castells, 2000). We are steering towards a unified digital environment in which computer hardware and software define possibilities for action as well as conditions of expression.

Interest in technology within the humanities has historically been limited. When considered, technical artifacts have been assimilated into the industrial complex and treated as producers of *capital* rather than of *meaning*. But the dense entanglement between human and non-human we witness today increasingly calls for perspectives that zoom in at the micro-level and theorize not only the great developments of how “society and culture” relate to “technology”, but first and foremost the increasingly hybrid everyday practices that are the content of human affairs.

In reference to de Certeau (1980), we can describe these practices as ways of doing that embed actions in a dense network of meaning, provide a rationale for why something is done, and sketch a proper way of doing it. There is a non-discursive dimension to such an *art de faire* (motor movement, objects, spatial settings, etc.), as well as a strong discursive element (morals, laws, rules, narratives, etc.). These two aspects are woven together by continuous action. Collins and Kusch (1998) have detailed how the atomic particles of practices, actions, can themselves be theorized as series or trees of micro-acts, coalescing motor movement and meaning. And Actor-Network-Theory has shown (Latour, 1999) that actions are not properties of individual agents, but of chain linking human and non-human “actants”, combining each ones “program of action” to form hybrid actors. If we understand practice as an embedding of action in time and habit, in these views, the discursive dimension of an *art de faire* cannot be severed from its non-discursive, mechanic counterpart.

When applying this view, we see that in general, and with ICT in accelerated and enlarged form, machines are responsible for always larger parts of the action trees or action chains, rendering actions intrinsically hybrid. As a consequence, our practices have become riddled with the work of machines, in many cases without us even noticing. Software – the prime interest of this article – now goes even deeper than “classic” technology because many of the tasks being delegated to *logical* machinery are *semantic* in nature. Among other things, algorithms now filter, structure, interpret, and visualize information in an automatic fashion, performing tasks previously reserved for humans.

² Transmission Control Protocol / Internet Protocol are the communication protocols that unite all the different networks that make up the Internet.

From a practical standpoint, we can understand this process of hybridization along two axes: new actions and practices are becoming possible (drawing on a virtual canvas, video communication across oceans, real-time data-mining, etc.) and existing actions and practices are done in new ways (different in form, style, speed, efficiency, difficulty, range, etc.).

In this sense, software is responsible for extending, both quantitatively and qualitatively, the role that technology plays in the everyday practices that make up modern life. Culture and technology are intertwined at the micro-level – to the extent that even the analytical separation of the two becomes highly problematic (Latour, 1999). Is the separation between a discursive and a non-discursive level still possible when computer programs analyze email, news bulletins and scientific publications in order to decide which ones to bring to our attention and which ones to silently discard? When the visibility of an opinion becomes a question of algorithms?³ Meaning is deeply embedded in the non-discursive – in software itself. Technology is not only surrounded by discourse, it is discourse. Although we do not share Heidegger's hostile stance toward technology, his understanding of the tool as an ontological agent, as a way of “Entbergen” (revealing), is still worth considering. In “Gestell” (enframing), the discursive and the non-discursive conflate; it is both object and logic – a *diagram*, in the terms of Foucault, but with the difference in nature between the two planes largely gone. The lesson we take from this is diametrically opposed to Heidegger's position: involvement instead of withdrawal.

We would like to argue that technology affords not one but multiple ways of revealing being, and that the way we create technical artifacts – and software most importantly – heavily influences the cultural role they will play. Tools are not neutral; they integrate and propagate human values (Friedman, 1997). But these values are not necessarily those of technocratic reasoning as Heidegger would have it – the whole gamut of human apprehension is possible. Software brings technology closer to us than ever before and it is time to look at the practices that spawn what has become an important part of the constitutional fabric of our cultures.

2. SOFTWARE, DESIGN AND OPEN SOURCE

Since the advent of digital computers in the late forties and especially the marketing of the consumer PC in the eighties, they have come to be ubiquitous. But while the terms “computer” and “technology” have almost become synonymous and the basic technical principles have remained the same for the last sixty years, there remains an aura of vagueness around these machines. Herein actually lays their power. Computers themselves are functionally underdetermined; they need software to turn them into complete devices with distinct functions. While the hardware, the *Universal Machine* (coupled with peripherals like input/output devices, networks, etc.), is the necessary mechanical base layer, the “specific” machine – a series of

³ The Slashdot communication platform (<http://www.slashdot.org>) for examples uses an elaborate system for attributing symbolic capital and modulating the visibility of individual messages.

functions and procedures that manipulate information and, with proper connection, matter and energy – is the result of programming. Alan Turing (1948) stated that,

"The importance of the universal machine is clear. We do not need to have an infinity of different machines in doing different jobs. A single one will suffice. The engineering problem of producing various machines for various jobs is replaced by the office work of 'programming' the universal machine to do these jobs."

These words mark not only the technical novelty but also another reason for the cultural significance of IT: somebody who buys a computer today gets not only the physical apparatus, but also gains access to a seemingly infinite world of logical machinery. These software programs spring from a burgeoning environment where work styles nowadays go well beyond the classical methods of engineering or even beyond the "office work" mentioned by Turing. But before we can have a closer look at these practices, we must first review some qualities of software.

2.1 Properties of Software

While there has been a continuous reflection of what software actually is, this problem is still far from being completely understood. Despite the stability of mathematical foundations since Turing, Church, and Shannon, the final judgment of what we can really do with software is still out. As society changes, software changes and every day there are new applications that surface around the globe. It is possible, however, to specify some of the basic properties of *logical machinery*.

Unlike other technological objects, software is immaterial. It is similar to language concerning structure and similar to technology concerning effect. Written like a text, it functions like a machine. Latour (1992) pointedly observes by paraphrasing Austin that "how to do things with words and then turn words into things is now clear to any programmer." The classical distinction made in engineering between designing (drawing the blueprints) and building (assembling the physical structure) does therefore not translate well into software programming: according to Jack W. Reeves (1992) the source code compares to the design but building is nothing but the automatic translation of source code into machine language by a compiler program. In contrast to classic (hardware) engineering, software is thus expensive to design – it takes a lot of time – but cheap to build. From an economic perspective, we can even speak of an apparatus of production unlike other areas of technology, specific to the creation of software: except for the price of the computer, producing software is basically free, time becoming the essential cost factor. In that sense, software is again closer to literature or music than to industrial production – the workstation is the factory floor. This greatly facilitates for people to shift from consumers to producers.

Like knowledge and information, software can be shared without tangible loss for the giver. The Internet transports and copies computer code as simply as text, sound, or images; algorithms, program libraries, and modules pile up at different sites, contributing to what could be seen as the equivalent of a fully equipped workshop with an unlimited spare parts inventory attached to it, accessible again at the cost only of time and skill. A general-purpose programming language like Java

nowadays comes with thousands of ready-made building blocks and writing code is often closer to playing Legos than to the laborious task of manipulating memory registers it used to be.

Unlike the products of industry, a computer program is always tentative, never really finished or “closed”. Classic machinery also has to be tended to, calibrated, and repaired, but with software the provisional aspect is pushed to the extreme. One mouse click and an entire subsystem can be copied into another program and the output of one piece of software can instantly become the input of another. We do not want to encourage in any way the view that holds everything digital as fluid, chaotic, and auto-organized, but there remains the fact that the freedom from most physical constraints renders software easier to manipulate and handle than hardware objects. The only constraining factors are time and skill. This relative freedom is one reason for the production of software in practice being so unlike engineering by the book.

2.2 Software Design as Heterogeneous Practice

According to IEEE Standard 610.12, software engineering is “the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software.”⁴ The attempt to translate the strategies and methods of classic engineering into the area of software has never been entirely successful and has been criticized from different directions. We cannot possibly summarize all the different views expressed in this complex and long standing debate, but there are several main positions of criticism that can be distinguished:

One argument holds simply that programming is based less on method than on skill, that it is craftsmanship rather than engineering, and that “in spite of the rise of Microsoft and other giant producers, software remains in large part a craft industry” (Dyson, 1998). The main question for design, then, is not how to find the proper methods but how to acquire the appropriate skills.

Another position argues that software engineering has its place but that specific methods and strategies cannot be directly imported from traditional engineering, because software is very much unlike bridges and houses (Reeves, 1992). Debugging for example should therefore not be treated as a hassle to be eliminated by mathematical rigor, but as an essential part of creating computer programs.

Finally there are those who believe that software engineers should be supplemented by other professions, in particular by software designers who take inspiration from architects rather than engineers because buildings and software “stand with a foot in two worlds—the world of technology and the world of people and human purposes” (Kapor, 1996). In this view, building a computer program is then not so much about technical problems, but about how to bring users and tools together in a meaningful way.

Independently of these different views remains the empiric observation that the actual practice of creating software rarely resembles the top-down engineering models like the *lifecycle*- or the *waterfall*-model where the process of going from neat requirements to a working program is thought of as a advancing in clear cut

⁴ See: <http://standards.ieee.org/catalog/olis/se.html>

stages. The “real world” of software development is most often described as “messy, ad hoc, atheoretical” (Coyne, 1995), as consisting of “bricolage, heuristics, serendipity, and make-do” (Ciborra, 2004), or as the result of “methodological and theoretical anarchism” (Monarch, 1997). While this does not automatically make software production “art”, as Paul Graham (2003) suggests, we have to accept that the engineering ideal is just that: an ideal. The actual practice commonly has to go – in different ways – beyond engineering. Two important factors have to be taken into account: changing problems and increasing complexity.

The problems software is supposed to solve are becoming more “cultural” and less “technical”. If computers were still doing what they did during the 60s (namely number crunching and data storage) there would probably be no discussion about software engineering or design. With computers now performing semantic and social functions this has changed. Methods like *participatory design* or *end-user development* try to integrate the fuzziness of specifications by integrating future users into the construction process itself.

The complexity of software is increasing rapidly and that makes it always more difficult to plan a program in every detail before starting to write code. It is often impossible to foresee problems early on and plans and models have to be changed, tests have to be made, specifications have to be changed in the actual construction process. Agile methods like *extreme programming* and *rapid-prototyping* strive to make complexity more manageable and transform the top-down waterfall into a long series of iterations.

The properties of software itself, the distribution of those properties into space by the Internet, and the changing technological landscape are slowly eroding the modern ideal of a neat separation between technology and culture, between detached rationality and human motivations. This argument is endorsed by a closer look at the diverse landscape of software production. As an example, we will therefore briefly analyze the *open source* scene in order to show how a whole new array of actors, strategies and practices can emerge in a situation where material cost is no longer a limiting factor.

2.3 The Open Source Scene

On one level, the term “open source” refers to a certain way of handling and sharing computer software.⁵ It implies that programs are not just available in machine code, but in source code – text files written in a programming language accessible to human beings. But to qualify as open source, it is essential that the public is allowed to modify and redistribute the product. On another level, the term refers to communities⁶ built around this notion of openness and sharing that is responsible for a considerable amount of today’s software production. For nearly every type of program there now is an *open source* equivalent.

⁵ We are referring here to the open source definition given by the Open Source Initiative (<http://www.opensource.org/docs/definition.php>)

⁶ The *open source* scene is far from homogenous and there is some infighting between the very political *Free Software Movement* and the rather pragmatic *Open Source Movement*.

The *open source* scene is rather diverse, but it is possible to sketch an ideal type of how it functions. Most importantly, it is impossible to imagine open source without the existence of the Internet. Platforms like sourceforge.net, along with mailing lists and newsgroups, are the tools used to organize and coordinate a globally dispersed and mostly voluntary workforce. A project usually starts with an embryologic program written by an individual or a group which is released under an *open source* license, to people who are invited to participate in its development. If it can stimulate enough interest, a lively process is set into motion: following the “release early, release often” maxim, versions of the program are regularly published on the Web where anybody interested can add code, report bugs and fix them. Which features and fixes are integrated is usually decided by a moderator (group or individual), supplemented by a community process very similar to scientific peer-review. The very linear structure of classic engineering is thus translated into a rapid succession of coding/building/debugging, where requirements specification, interface design and user testing are concurrent and subject to constant change. Collaboration is the main “tool” to tackle complexity. The Internet-based development platforms provide the infrastructure for a project’s representation, for communication between its participants and for the coordination of bug tracking and code maintenance. They are the media that render possible what could be called a “virtual factory” where a diverse and dispersed public channels their collective intelligence.

The *open source* scene also distinguishes itself from traditional engineering in social norms and general mindset. Mathematical rigor is valued less than an open and involved communication style. Similar to other (youth) subcultures, the demonstration of skill (and not diplomas) is the main source of symbolic capital. Inclusiveness, discussion, collaboration and the open circulation of information is more important than the clear-cut attribution of tasks, positions and responsibilities.

On an institutional level, the *open source* scene has become an important element in the socialization and education of programmers. The lively and helpful online communities allow for getting help and learning from achieved individuals. The accessible code landscape and participatory culture make for a powerful learning environment for all levels of skill. While engineering is traditionally connected to the somewhat authoritarian institutions of school and university, the open source community supplements these forms by offering a learning-by-doing environment based on playful imitation and autodidactic skill acquisition.

To show that *open source* products are an important part of the software landscape, we will briefly discuss three examples: the *Linux* operating system, the *Apache* Web server and the Internet browser *Firefox*.

Linux started out in 1991 when a Finnish student, Linus Torvalds, wrote a very basic kernel program – the core of any operating system – as a hobby project and released it on the Web, inviting others to participate. Since then, *Linux* has developed into a modern, robust and complete operating system and now probably is the only serious competitor for Microsoft Windows left. It is available for free and constantly maintained and extended by a community of thousands of programmers

around the globe. Most Fortune 500 companies now use *Linux*, as well as the public administrations of Vienna, Munich and Paris. One reason for this success is cost, but other factors come into play, including reliability, platform independence and the possibility to directly fix bugs without having to go through a vendor company.

The *Apache* project was initiated in 1995 and has since then steadily grown to become the dominant Web server application with a market share of over 69%.⁷ *Open source* and available for free, it is developed and maintained under the guidance of the *Apache Software Foundation*, a non-profit company that helps organizing the development process, assures legal support for the community and protects the brand. *Linux* and *Apache*, coupled with the free database system *MySQL* and an *open source* programming language, *PHP*, form the most common platform (called LAMP) for dynamic Web applications.

The *Firefox* Web browser grew out of code released to the community in 1998 by the ailing company Netscape. After several rather unsuccessful products, the *Mozilla Foundation* released *Firefox* in the end of 2004 as version 1.0. Carried by strong critique of Microsoft's *Internet Explorer* for its various security leaks, the open source browser has captured considerable market share⁸ in 2005. It is also a good example for how the open source community allows for the participation of non programmers. Through *Bugzilla*, a tool for tracking bugs, anybody can report errors and ask for features in future releases. Skilled users may extend the browser through plug-ins without having to get to know the code of the main application. *Firefox* is finally not just a piece of software but also a community providing logos, t-shirts, images and wallpapers as well as an entire viral marketing campaign.

The *open source* scene shows that methods and strategies in technical production cannot be divided from the social, economic and cultural environment they are stimulating and getting stimulated by. The *culture of engineering* is but one of many possibilities. Computers have made technical creativity accessible to a larger and more diverse audience than other technologies ever have. From writing code to creating levels for computer games, there is a wide scale of possible involvement for every level of skill. While the new modes of creation are in many ways similar to earlier forms of hobbyist culture they are different in a very important aspect: the three programs we presented are not just niche products but highly competitive artifacts of great quality that hold strong market positions. We call this extension of production and distribution processes an *extended culture industry*, where "consumers" are not only modifying products but are changing parts of the apparatus of production.⁹ There are of course many commercial actors playing a role in the *open source* scene – IBM, Novell, Intel, and others take an active part in financing and developing. However, the intertwined networks of production that span between companies and individuals go nonetheless beyond the mono-

⁷ Netcraft ServerWatch October 2005, <http://www.serverwatch.com/stats/article.php/3554746>

⁸ In Europe Firefox is ranging up to 34% in Finland and 24% in Germany; see XiTi Browser Survey, September 2005, online: <http://www.xitimonitor.com/etudes/equipement11.asp>

⁹ Already Walter Benjamin (2002) called for such a shift from adapting the products of cultural industry to adapting the apparatus of production itself. This shift turns readers and viewers into participants.

directional processes Adorno and Horkheimer were criticizing so severely (Adorno and Horkheimer, 1944). The idea has been contagious and phenomena like *Wikipedia*, blogging or the countless music labels on the Web take the *open source* principle to a larger context of cultural production. Computers and the Internet can be seen as enabling technologies that give users the opportunity to extend the culture industry and to participate in the production of cultural artifacts, stimulating the social dynamic we witness today (Jenkins, 2002).

While engineering is often seen as a neutral, detached and “objective” way of problem-solving, the collaborative and auto-organized design process that marks the *open source* scene does not strive to separate the social and cultural aspects of technological creation from the actual task of designing and writing code.

These developments are not aimed at replacing the traditional and more organized institutions of work, education, and research; what we witness today is a trend toward enlargement, supplementation and plurality. With reference to an influential article written by Eric Raymond (1998), we could say that the bazaar is not replacing the cathedral; it is blossoming in the city streets around it.

3. BRIDGING THE CULTURE/TECHNOLOGY DIVIDE

So far, we have made two separate arguments: first, we tried to show that software plays an increasingly important role in our everyday lives, accentuating culture as a hybrid of technology and discourse. Second, we stated that software has come to be developed in heterogeneous and contradictory environments where creative practices flourish outside of the classical institutions and methodology of engineering. In the third part of this article, we want to briefly discuss these two arguments in relation to their impact in three different areas: the humanities, technology, and policymaking.

3.1 *The Humanities Discourse*

Traditionally, philosophy and cultural theory have subscribed to a view of technology as something external to – or at least different from – society and culture. In this perspective, the practice of creating a technical artifact is very dissimilar in nature from processes of symbolization, e.g. the writing of law or literature. The first is supposedly oriented toward the material domination of our “lifeworld” (*Lebenswelt*) through efficiency, while the second is concerned with the social (law) or cultural (literature) dimension of human existence. This separation has the convenient effect of exempting thinkers of technology from any need for technical knowledge because “techno-science” always produces but more of the same, the true challenge lying in the discovery of the essential dynamics between the strata – an endeavor reserved to the masters of symbolization. But there is a very dangerous side to this outlook: subtracting the dimension of *meaning* from technology implies the subtraction of *responsibility*. If the creation of technology is not understood to be a deeply cultural, social, symbolic, and political activity, there

is no reason for the creators to adopt any ethical and political stance toward their work beyond the question of physical harm to others. We believe that in a time when logical machinery takes part in so many of the practices that make up our lives, we need concepts that are not only aware of “effects” of technology on culture, but which recognize that technology *is* a form of culture – embodying not just the homogenous logic of *Gestell*, but continuously differentiated into a plurality of forms, practices, values and power struggles.

There fortunately is a growing amount of empirical work on technical production and large software projects now frequently include social scientists. However, looking at the heterogeneous field of software design we should ask whether our concepts of technology are adequate to grasp the heterogeneity of possible attachment. The humanities could take up the task of broadening our still very restrained technical imaginary and lead the way towards modes of production that facilitate finding other liaisons between human and non-human than those marked only by domination, efficiency and convenience.

3.2 *The Technologist Discourse*

If we recognize software design as a pluralistic and fractured practice which takes part in shaping the fabric of the world we live in, we have to rethink our stance not only as theorists, but also as creators of technology. Terry Winograd and Fernando Flores wrote nearly twenty years ago that “we encounter the deep question of design when we recognize that in designing tools we are designing ways of being” (Winograd and Flores, 1986). A dialogue between the different groups implicated in designing software is necessary in order to foster awareness of the cultural dimension of their work. This is already somewhat in the making: a part of the *open source* community has adopted an explicit stance on the political issues surrounding their technical efforts and the software design community is making a strong effort in linking up with the humanities.

The field that is lagging severely behind is education. There is still very little discussion between the technical departments and the humanities, and the current curricula are fit for producing neither the “culturally-aware technologist” nor the “technically-aware theorist”. Herein lies the true challenge of bridging the dichotomy between culture and technology: bringing the more inclusive understanding of technology that is currently emerging to the places where it could actually have an effect.

3.3 *Policies*

The third area of our discussion is policy – and luckily, there is already a very lively debate going on in this area, especially around the questions of software patents and *open source*. The discussion however is strongly centered on economic and juridical questions, treating the cultural aspects as mere collaterals. The recognition that the creators of technology, operating outside of the classic paths of established industry, are an important part of civil society that actively produce cultural resources is

eminently missing. Only when we understand writing software as one possible way of participating as a citizen can the political issues be properly addressed. The state, as the arbiter in the ongoing battle around software patents, will have to decide whether the amorphous coder communities sprawling on the Web that put their work at the disposition of the public domain are of special value to society and therefore worth protecting against the overwhelming financial capacities of the established commercial actors. The new design practices that we tried to present and theorize in this article are by no means inevitable; although the Universal Machine is a strong base for the social and cultural activities surrounding them, the free flourishing of technical creativity is a fragile thing that can easily be reduced to the place of mere hobbyist dabbling, as it was the case with many other technologies. There (still) is democratic potential in the new metamedia and we will have to decide whether we want to nurture it or not.

4. CONCLUSION

We have entitled this paper “beyond engineering”, because the term “engineering” has come so much to stand for the technocratic separation between a sphere of technology and a sphere of culture, society, and politics; for a mindset that treats the creation of technical artifacts as a detached and orderly process, closer to calculation than to creativity. The modern ideal of engineering as a politically and culturally neutral process – unspoiled by human motivations and uncontaminated by morals and emotions – appears today as rather anachronistic. A closer look at software *design* shows that there are multiple and heterogeneous methods, strategies, and mindsets guiding the creation of programs, systems and applications. Our short analysis of the *open source* scene is evidence that extensions to classic methodologies, alternative routes, collaborative approaches, and auto-organized forms of workflow are not only possible but effective.

We believe that the fluctuations in how technical artifacts are created are not just minor adjustments but necessary adaptations to the changing place of technology in our societies. As technology slowly infiltrates always the practices that make up our everyday lives, culture *stabs back* by invading the terrain of production, bringing all its contingencies, contradictions, and complexities along. There never was a clear separation anyhow, but the level of interpenetration has reached new heights. The immaterial qualities of software, distributed into space by the global infrastructure of the Internet, affect an increasing number of people, users as well as designers. We have called the resulting space of production, distribution, and consumption an *extended culture industry* where the boundaries between consumers and producers are blurring and social and technical forces are intertwining closely.

But while there is some understanding of how to channel social forces in a democratic fashion, it is still unclear of how to achieve the same for the technical part of the hybrid. It now seems evident that in high-tech societies the creation of tools and objects plays an important role in shaping cultural practice, expression and imagination; it is a highly cultural gesture. Looking at the similarities between language and software not only can help us understand the nature of our currently

complicated techno-social situation; it can also make us see that freedom of technical creation is a form of freedom of speech. It is the duty of the humanities to work out what that could mean.

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