SPECIAL SECTION:
INTERFACE AND THE POST-INDUSTRIAL SOCIETY

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The following four essays are based on a workshop of the German Society for Media Studies (GfM) working group on Interfaces that took place during the annual conference of the GfM at the University of Siegen in September 2018. With six brief contributions – in addition to the papers published here, Sabine Wirth addressed "User Interfaces as 'Personal Tools'" and Sophie Ehrmanntraut discussed the development "from 'Human Factors Engineering' to 'User Centered Design'" – the working group responded to the main topic of the conference: 'industry'.

The fact that the call for papers of the conference gave the current speech of 'industry 4.0' a lot of room corresponded to the currently-held consensus that digitisation is an industrial factor of crucial importance for (social) value creation processes. In the late 1960s and early 1970s, however, the formation and commercialisation of human-computer interaction as a discipline coincided in time with sociological analyses that proceeded from the diagnosis of an end of the old type of industrial society and forecast the emergence of a post-industrial society. Books like Alvin and Heidi Toffler's Future Shock (1970), Alain Touraine's La Société Post-Industrielle (1969) or Daniel Bell's The Coming of Post-Industrial Society (1973) shaped a new understanding of the economic and industrial foundations of capitalism in the dawning age of computerised industrial production. The Tofflers tried to identify basic features of radical innovation in a post-industrial society, Touraine was mainly concerned with the future of the working class under post-industrial conditions and Bell attempted to outline the main features of a historically new value-creation regime that is based squarely on knowledge processes and the circulation of information via technologies of telecommunication. Since its inception, the term "post-industrial society" itself has evolved further into conflicted and widely-discussed notions such as the 'information society', 'knowledge economy' or 'network society.'

Primarily, the workshop examined the historical question what role interfaces (in all their forms) play for the contemporary diagnoses of the post-industrial. The critique of the military-industrial complex, of the technocratic society (Theodore Roszak), of one-dimensional man and the ideology of the advanced industrial society (Herbert Marcuse), of the society of spectacle characterized by passive media consumption (Guy Debord) – these were all issues in the 1960s and 1970s taken up by interface design and the empowerment gestures of computerization (e. g. through 'user-friendly interfaces', 'soft technology', 'intimate computing', the promised flexibility of 'being digital', and participation in egalitarian and meritocratic online communities). While the idea of an imminent or already completed end of industrial society circulated for several decades, interfaces are today a decisive component of computer-based or computer-supported value creation processes, both in the areas of production and consumption. Yet, future rarely comes as predicted. Beyond the hypothesis to consider interfaces as a key technology of post-industrial society, the workshop also reflected on the question in what ways interfaces transcend older

notions of post-industrial societies. The question was raised, in which way these older theories are no longer able to adequately grasp the situation of our era.

Against this background of different notions of a 'post-industrial' society, the respective theories and their advantages and deficiencies, the contributions of the working group discussed the role of interfaces in the development and criticism of a post-industrial society. In the first essay, Timo Kaerlein explores the historical connection between interface design and diagnoses of a post-industrial society. He argues that interfaces have become the equivalent of the assembly line or office workstation of industrial societies by connecting the mobile and flexible knowledge workers to the post-industrial production process. Interface design, if not limited to the field of human-computer interaction (HCI), can even be considered as the central site of value-creation in post-industrial societies, as Roland Meyer argues in the second essay. Focusing on the work of Gui Bonsiepe, he shows how already around 1970 industrial design began transcending the sphere of mass-produced commodities by focussing on the mediating layers between the user's experience and an increasingly complex world of invisible structures and processes. In the third essay, Jan Distelmeyer recalls the advantages of the multi-faceted interface concept, which are particularly evident in the (historical) coupling of the terms interface and conduction. Based on this, he approaches interface politics of post-industrial values by addressing the transition from object orientation to process orientation through the introduction of the iPhone. The fourth essay by Christoph Ernst closes by discussing a scene from Blade Runner 2049 which sheds a light on current imaginaries of the interconnection between coming types of natural user interfaces and their use in 'post-industrial warfare'.

Taken together, the four short essays explore the productivity of focussing on interfaces as central sites of transition between industrial and post-industrial regimes of value creation and organisation. It is here where the social practices of computer use and cultural imaginations about human-technology relationships in digitally networked environments offer themselves to critical scrutiny and historical comparison.

Jan Distelmeyer, Christoph Ernst,
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MOBILIZING POST-INDUSTRIAL SUBJECTS: HUMAN-COMPUTER INTERACTION AS AESTHETIC PRACTICE

By Timo Kaerlein

"Often against their own intentions, the pioneers of human-computer interaction find themselves at the forefront of the development of entirely new ways to control and programme the productivity of an increasingly mobile and flexible workforce."

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Sociologists such as Alain Touraine in France and Daniel Bell in the USA diagnosed the emergence of post-industrial societies at the end of the 1960s and beginning of the 1970s, precisely at the time when Human-Computer Interaction (HCI) was being established as a field of inquiry and the design of user interfaces was beginning to play a central role in computer science.[1] In this short essay I would like to put forth the argument that there exists an intrinsic relationship between what has been diagnosed as post-industrial modes of production and social organization on the one hand and the emergence of an explicit focus on designing user interfaces for connected computers on the other hand.

My argument is that the design of user interfaces acts as a technique of motivation and mobilization for post-industrial subjects and ties them to diverse value-generating mechanisms. Taking this argument one step further, interfaces can be analytically situated as the central nodes of contemporary regimes of productivity which are being described in terms of immaterial labour, data colonialism and heteromation, as I will argue in the concluding remarks.

Bell gives a succinct summary of what he understands as the main features of post-industrial society:

> *Broadly speaking, if industrial society is based on machine technology, post-industrial society is shaped by an intellectual technology. And if capital and labor are the major structural features of industrial society, information and knowledge are those of the post-industrial society.*[2]

In addition to the growing importance of the service sector for value creation, a new significance of knowledge processes for the production of economic added value can also be observed in post-industrial societies. Economic and social policy is thus faced with the historically new challenge of constructing infrastructures, which in addition to the classical transport and distribution of energy must now also ensure the circulation of information.

Touraine's earlier neo-Marxist argumentation, which asks for the future of the working class under post-industrial conditions, is only worth a side note to Bell,[3] while this question in particular could prove to be one of the most politically explosive today. Touraine, first in 1969, already very clearly described the phenomenon of a diffusion of the economic into all social areas, due to a decentralization and diffusion of value-creating processes from the factory floor or office building into the capillaries of society: "Growth results from a whole complex of social factors, not just from

1 Cf. Alain Touraine, *The Post-Industrial Society. Tomorrow's Social History: Classes, Conflicts and Culture in the Programmed Society* (London 1974); Daniel Bell, *The Coming of Post-Industrial Society. A Venture in Social Forecasting* (New York 1999); Alan Kay, User Interface: A Personal View, in: *Multimedia. From Wagner to Virtual Reality*, eds. Randall Packer and Ken Jordan (New York 2001), pp. 121–131; Jonathan Grudin, A Moving Target: The Evolution of Human-Computer Interaction, in: *Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications*, ed. Julie A. Jacko (Boca Raton 2012), pp. xxvii–lxi; Brad A. Myers, A Brief History of Human Computer Interaction Technology. *ACM Interactions* 5/2 (1998), pp. 44–54.

2 Bell, *Coming of Post-Industrial Society*, p. xci.

3 Cf. ibid., p. 39f.

the accumulation of capital. Nowadays, it depends much more directly than ever before on knowledge, and hence on the capacity of society to call forth creativity. All the domains of social life – education, consumption, information, etc. – are being more and more integrated into what used to be called production factors."[4]

For post-industrial society, or as Touraine also calls it: *technocratic* or *programmed society*, the core problem is how to ensure participation in the social production process of knowledge and information. And it is precisely here, according to my thesis in all due brevity, that interfaces come into play: they operate as the equivalent of the assembly line or office workstation of the old type of industrial societies by connecting the mobile and flexible knowledge workers to the post-industrial production process, which is increasingly shifting towards the immaterial.[5] As Jan Distelmeyer has repeatedly argued, the "scope of the interface complex"[6] is decidedly not limited to the symbolic layer of user interfaces, but includes a diversity of connections in computerized environments. For instance, application programming interfaces (APIs) regulate the programmability and interoperability of platforms and third-party applications, thus translating the logics of post-industrial production into code.

At the user side of the interface complex, one can observe a characteristic blurring of the boundaries between work and leisure, because it is sometimes the same operating systems and end devices, possibly the same software, that are used to carry out everyday practices such as flexible work organization or time management. The designers of user interfaces are well aware of the historical threshold situation in which they find themselves: their idea of a post-Fordist work culture, expressed, for example, in Douglas Engelbart's vision of an augmentation of human intellect,[7] is, however, only partially consistent with the dream of capital stressed by Franco Berardi in all sharpness, of being able to mobilize the labour potential of a distributed workforce at any time and from any location.[8] Often against their own intentions, the pioneers of human-computer interaction find themselves at the

4 Touraine, *Post-Industrial Society*, p. 5.

5 This is not to say that physical labour and material infrastructures would not play a decisive role in post-Fordist regimes of production. Rather, the creation of added value involving digital media has to be situated in a complex relationship of dependence on more traditional forms of capitalist production, decidedly involving capital and labour. The diagnoses of post-industrial society tend to overlook this point. Cf. Yann Moulier-Boutang, Marx in Kalifornien. Der dritte Kapitalismus und die alte politische Ökonomie. *Aus Politik und Zeitgeschichte* 52–53 (2001), pp. 29–37; Enda Brophy and Greig de Peuter, Labors of Mobility. Communicative Capitalism and the Smartphone Cybertariat, in: *Theories of the Mobile Internet. Materialities and Imaginaries*, eds. Andrew Herman, Jan Hadlaw and Thom Swiss (New York 2015), pp. 60–84.

6 Jan Distelmeyer, Drawing Connections – How Interfaces Matter. *Interface Critique* 1 (2018), pp. 22–33, here p. 23.

7 Cf. Douglas C. Engelbart, Augmenting Human Intellect. A Conceptual Framework. SRI Project 3578 for Air Force Office of Scientific Research (Menlo Park 1962).

8 "In a certain sense, cellular phones realize the dream of capital: that of absorbing every possible atom of time at the exact moment the productive cycle needs it. In this way, workers offer their entire day to capital and are paid only for the moments when their time is made cellular." Franco Berardi, *The Soul at Work: From Alienation to Autonomy* (New York 2009), p. 90.

forefront of the development of entirely new ways to control and programme the productivity of an increasingly mobile and flexible workforce.

Contemporary diagnoses of the digital cultural economy, largely influenced by Italian autonomists such as in the debate around immaterial or free labour[9] and the emergence of a cognitariat[10], can be fruitfully connected to Touraine's problematization of the social struggles accompanying the fleshing out of post-industrial modes of production. Vis à vis a process of extensive rationalization and diffusion of value-creating activities into everyday life, one could expect knowledge workers to resist these developments as unreasonable demands and border transgressions between work and leisure time.

Thus, it seems necessary to aestheticize the regime of production in order to connect and affectively tie subjects to the post-industrial production apparatus. The user interface pioneers at Xerox PARC and elsewhere, despite being inspired to a large extent by countercultural imaginaries,[11] are dedicating themselves to this task with great ambition and lasting success. Their imagination and design of user interfaces can be described as an aesthetic practice in the sense of Andreas Reckwitz ("ästhetisch-imprägnierte Praxis"), i.e. as a convergence of processes of rationalization and aestheticization characteristic of late modern societies.[12] In Reckwitz' account, in particular, the creative apparatus firmly anchored in Western culture since the 1980s responds to the lack of affect and motivation of organized modernity and its employee culture oriented towards bureaucratic points of view. Contemporary user experience design answers to this challenge by giving aesthetic form to a regime of productivity that is thoroughly extended in time and space to encompass large domains of everyday life.[13]

The "factories of the mind"[14] hardly resemble the factories of industrial societies on the outside, yet they represent the central instance of value creation in post-industrial societies. Interfaces are the distributed terminals of their socio-

9 Cf. Maurizio Lazzarato, Immaterial Labor, in: *Radical Thought in Italy. A Potential Politics*, eds. Paolo Virno and Michael Hardt (Minneapolis 1996), pp. 133–146; Tiziana Terranova, Free Labor: Producing Culture for the Digital Economy. *Social Text* 63 (2000), pp. 33–58.

10 Cf. Franco Berardi, What does Cognitariat Mean? Work, Desire and Depression. *Cultural Studies Review* 11/2 (2005), pp. 57–63; as well as Moulier-Boutang, Marx in Kalifornien, on the premises and implications of cognitive capitalism as a system of accumulation that is mainly based on knowledge processes.

11 Cf. Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago 2006).

12 Cf. Andreas Reckwitz, Ästhetik und Gesellschaft – ein analytischer Bezugsrahmen, in: *Ästhetik und Gesellschaft. Grundlagentexte aus Soziologie und Kulturwissenschaften*, eds. Andreas Reckwitz, Sophia Prinz, and Hilmar Schäfer (Berlin 2015), pp. 13–54.

13 Cf. Timo Kaerlein, 'I can't remember ever being so in love with a color'. Smartphones und die Rhetorik des Intimate Computing, in: *Smartphone-Ästhetik. Zur Philosophie und Gestaltung mobiler Medien*, ed. Oliver Ruf (Bielefeld 2018), pp. 179–203. On the role of digital media in the ongoing expansion of data work in what he terms "capture" capitalism cf. Till A. Heilmann, Datenarbeit im "Capture"-Kapitalismus. Zur Ausweitung der Verwertungszone im Zeitalter informatischer Überwachung. *Zeitschrift für Medienwissenschaft* 13/2 (2015), pp. 35–47.

14 John Perry Barlow, A Declaration of the Independence of Cyberspace (1996); https://www.eff.org/cyberspace-independence, access: April 18, 2019, 18:30.

technical infrastructure and the core technology of participation in networked value creation processes, whether paid or unpaid. By linking economic, cultural and aesthetic logics with concrete subject designs and affect-constellations, they therefore represent a preferred object of criticism from a media studies perspective. It is at the site of the user interface where everyday practices of socializing, searching and navigating are captured and made economically productive.[15]

Sensorial interfaces with the world outside computers are extracting data from the environment that are then transformed into resources for value-creation processes.[16] Many of the transactions initiated and transferred via interfaces in fact do not initiate automated processes so much as to connect customers to legions of clickworkers or physical labourers via platforms that act as central registers for value exchange.[17] In all these instances, the role of interfaces – ranging from user interfaces via application programming interfaces on the software level to the hardware interfaces physically connecting network nodes with each other – requires more scrutiny on the part of media scholars interested in the ways value is created and distributed in post-industrial societies.

15 Cf. Terranova, Free Labor; Mark Andrejevic, Facebook als neue Produktionsweise, in: *Generation Facebook. Über das Leben im Social Net*, eds. Oliver Leistert and Theo Röhle (Bielefeld 2011), pp. 31–49.

16 Cf. Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (New York 2019); Mark Andrejevic, Theorizing Drones and Droning Theory, in: *Drones and Unmanned Aerial Systems*, ed. Aleš Završnik (Cham 2016), pp. 21–43; Nick Couldry and Ulises A. Mejias, Data Colonialism: Rethinking Big Data's Relation to the Contemporary Subject. *Television & New Media* 20/4 (2018), pp. 336–349.

17 Cf. Hamid R. Ekbia and Bonnie A. Nardi, *Heteromation, and Other Stories of Computing and Capitalism* (Cambridge, MA 2017).

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TAKING PART. TWO STEPS TOWARDS NETWORKED COMPUTERIZATION

By Jan Distelmeyer

"That is why the term interface is so fruitful today: It helps addressing a variety of efficacious operations – from the material basis of all sorts of computers and networks up to the educational and epistemological or ideological guidance by user interfaces showing and instructing me what to do."

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Step one: interfaces perform conduction

It is getting increasingly difficult to say what one is dealing with when dealing with computers and their aspired ubiquity. Especially because of their networked condition, the spread and diverse forms of computers – in all their stationary, mobile, embedded, sensor-supported, and increasingly quasi-autonomous (that is: programmatically evolving) modes – create a nearly overwhelming complexity. A simultaneity of highly effective modes of exhibited and unobservable power: As the obvious presence and handling of computers and their operative images (particularly visible through the spread of mobile computers such as smartphones) increases, so does the implementation of comparatively hidden processes of sensing, calculation, and conduction (emphasised e.g. in relation to smart cities, big data analyses, and machine learning) that is considered as "seemingly autonomous agents"[1] or the "becoming environmental of computation"[2]. The present computerization is characterized by the simultaneity of a special form of inaccessibility and functionality.[3]

It is precisely to address this widespread complexity that the concept of interface proves to be extremely helpful. Its own challenging complexity helps to approach that of the advancing computerisation and cybernetisation. Interfaces involve various apparatus and processes. They create and enable modes of connectivity and transfer in different and mutually related forms: between hardware and hardware, software and hardware, software and software, and between those interconnected hardware-software relationships and everything (bodies, things, environments) that is not a computer. This last form includes people who actively and consciously relate to computers – ranging from using or programming computers and developing machine learning systems to questions of design[4] and the relationship between software and ideology. With such operations we humans decide and learn from experience what this could be: a computer, its user, a network, or "the digital".

These different interface layers and processes are not only intertwined, but also share an indispensable basis: the conduction of electricity which enables signals to be transferred. This is why the conceptual history of the term interface

1 Jennifer Gabrys, *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* (Minneapolis 2016), p. 65.

2 Ibid., p. 4.

3 The suggestions and questions in this article are based on the presentation "Anteil nehmen. Interface-Prozesse des Netzwerks" at the annual conference of the German Society for Media Studies (GfM) 2018 in Siegen and on a more detailed paper entitled "From Object to Process. Interface Politics of Networked Computerization" in the proceedings of the conference „Interface Politics: After Post-Truth", in: *Artnodes Journal* 24 (2019).

4 On the concept of the interface in design theory around 1970, see Roland Meyer's essay in this issue. On interfaces as "diegetic prototypes" and imaging interfaces in future warfare, see Christoph Ernst's essay in this issue.

and its roots around 1870 – introduced by the physicists James and William Thomson (later Lord Kelvin) to describe the conduction of energy – is so enlightening.[5] William Thomson's research on electricity and "interfaces between media of different conductivity"[6] led among other things to his famous work with the transatlantic telegraph.

Today the term interface allows us to describe the computer's "interior telegraphy"[7] (its inner processuality and conduction of signals) as well as its connections and distributed networks, its embeddedness, and its multifarious relations to us in the form of dealing with user interfaces, for example. Thus, in contrast to terms and concepts aiming at mathematical rules (like "algorithmic"[8]) or a deliberately general description of global effects (like "technosphere"[9], "implication"[10], or "the stack"[11]), the concept of interface, with its specific intricacy and history (in the physics of the 19th century and since the late 1950s in computer technology and computer science[12]), places certain requirements on an analysis and thus grants it special possibilities: It demands and enables to remain alert to the different interface levels and their relationship to each other. Interfaces constitute the technical basis for any implication of computers in support of the proclaimed technosphere. And interfaces constitute the material (and industrial), aesthetical, as well as ideological basis for an understanding, what I can actually do with a computer.[13]

Hence, investigating the interface complexity means combining concrete and material questions of technology and (infra)structures with cultural, political, and epistemological ones. The question of interfaces leads to certain, isolable conditions and processes of conduction as well as to the complexity of the cooperation formed by them. This is its heuristic advantage and the challenge of *interface analysis*: The interface concept opens both an investigative horizon and a mode of analysis, which always asks for further interface levels and processes involved in the phenomenon I am currently investigating. What other interfaces are in play? What else is involved?

5 See Peter Schaefer, Interface: History of a Concept, 1868–1888, in: *The Long History of New Media: Technology, Historiography, and Contextualizing Newness*, ed. David W. Park, Nicholas W. Jankowski, Steve Jones (New York 2011), pp. 163–175; Branden Hookway, *Interfaces* (Cambridge, MA 2014), pp. 59–119.

6 Crosbie Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge, MA 1989), p. 212.

7 See Hartmut Winkler, *Prozessieren. Die dritte, vernachlässigte Medienfunktion* (Munich 2015), p. 294.

8 Antoinette Rouvroy and Bernard Stiegler, The Digital Regime of Truth. From the Algorithmic Governmentality to a New Rule of Law. La Deleuziana. *Online Journal of Philosophy* 3 (2016), pp. 6–27.

9 Erich Hörl, Introduction to general ecology: The ecologization of thinking, in: *General Ecology: The New Ecological Paradigm*, ed. Erich Hörl (London 2017), pp. 10–13.

10 Mark B.N. Hansen, *Feed Forward. On the Future of Twenty-First-Century-Media* (Chicago 2015), pp. 580–629.

11 Benjamin H. Bratton, *The Stack: On Software and Sovereignty* (Cambridge, MA 2016).

12 See Hans Dieter Hellige, Krisen- und Innovationsphasen in der Mensch-Computer-Interaktion, in: *Mensch-Computer-Interface. Zur Geschichte und Zukunft der Computerbedienung*, ed. Hans Dieter Hellige (Bielefeld 2008), pp. 13–15.

13 See Jan Distelmeyer, Drawing Connections. How Interfaces Matter. *Interface Critique* 1 (2018), pp. 27–28.

Where computers are at work, interfaces are at work – and even more so where they are networked. Against this background Christian Ulrik Andersen and Søren Pold speak of a metainterface: "Although the interface may seem to evade perception, and become global (everywhere) and generalized (in everything), it still holds a textuality: there still is a metainterface to the displaced interface."[14] In order to emphasize the enduring materiality, processuality, and the different (observable and unobservable) levels of interfaces, which also act when (user) interfaces disappear or become ubiquitous, it is advantageous, then, to further strengthen the concept of interface. Especially since the origin of this concept and its historical proximity to conduction literally request different modes of conduction to be taken into consideration.

My conceptual consequence is: *interfaces perform conduction*. The semantic field of conduction includes the physical meaning of transmission referred to in "the theory of electric conduction"[15] (or in the basic function of semiconductors), as well as the social, educational, religious and political meaning of leadership and guidance, to which such terms as political conduction or "algorithmic conduction"[16] refer. That is why the term interface is so fruitful today: It helps to address a variety of efficacious operations – from the material basis of all sorts of computers and networks up to the educational and epistemological or ideological guidance by user interfaces showing and instructing me what to do.

Step two: from file to programming flow

This first step – a brief reminder of the advantages of the multi-faceted and thought-provoking interface concept, which are particularly evident in the proximity of *interface* and *conduction*[17] – allows reflections on the interface politics of post-industrial values.[18] They arise in

14 Christian Ulrik Andersen and Søren Pold, *The Metainterface. The Art of Platforms, Cities and Clouds* (Cambridge, MA 2018), p. 10.

15 Vannevar Bush, Memex Revisited, in: New Media, Old Media. A History and Theory Reader, ed. Wendy Hui Kyong Chun and Thomas Keenan (New York 2006), p. 90.

16 Bratton, *The Stack*, p. 52.

17 In a comparable way James Ash speaks of „transduction". Ash combines the technical ("transduction refers to a process of 'convert[ing] one kind of energy into another kind of energy'") with the philosophical meaning ("[f]or Simondon, transduction is a process 'in which activity gradually sets itself in motion, propagating within a given domain, by basing this propagation on structuration carried out in different zones of the domain [whereby] each region of the constituted structure serves as a constituting principle for the following one'"). Thus, Ash understands "transduction" as "a process by which objects in interfaces are organized by designers to produce particular qualities for other objects in that interface and for the people using that interface" (James Ash, *The Interface Envelope. Gaming, Technology, Power* [New York 2015], p. 28). In contrast to this emphasis on user interfaces, the approach proposed here and its connection to 'conduction' emphasizes the multi-layered quality of the interface complex, which also includes Ash's understanding of interfaces as (infra-)structures and environments, in which objects are arranged and processes of transduction, transmission and mutual impact, take place.

18 On the design of user interfaces as a technique of motivation and habituation for post-industrial subjects, see Timo Kaerleins's essay in this issue.

the programmatic correlation between demonstration and seclusion: of interface operations difficult or impossible to observe (networked modes of computing and *autonomous agency*) on the one hand and the dissemination of operative images and depresentations (understood as an ongoing oscillation between displaying computer agency and at the same time concealing "the processual and material complexity involved"[19]) on the screens of the spreading smartphones on the other hand. I would like to make a few fragmentary proposals on how this correlation can be addressed and questioned. My approach is to start with the most popular, the most obvious, and the most tangible – with the front-end and its interface politics of depresentations, performed as an "interface *mise-en-scène*"[20].

A historical and persistently effective example to discuss post-industrial value creation processes is the shift from object-oriented to process-oriented interaction in interface *mise-en-scènes* since 2007. This shift is of great but hardly noticed importance for the status and functionality of the computers with which the value creation of platform or capture capitalism runs.[21]

The introduction of the iPhone and its first operating system marked a historic turning point in more than one respect. The interface correlation of screen, operative images, mouse, and keyboard, presented in 1983 by the Apple Lisa (enabled, of course, by the work of Xerox PARC), was replaced in 2007 by a touch-sensitive screen, operative images, and my body – promoted by Apple as "letting you control everything with just your fingers"[22]. Controlling means interfacing by modes of conduction: At certain parts of the capacitive touch screen marked by operative images, my physical contact leads to altered electrical voltage conditions or capacities. A touching act of conduction is the very start of the commands and program sequences attributed to these operative (conducting) images.

This enables a new performance of an interface *mise-en-scène* that is presented in a grid pattern on the so-called "home screen". This shows which apps are available to me *with just my finger* and furthermore how I handle this computer is primarily how I handle apps. The operative images of this interface *mise en-scène* do not depresent files or folders, but rather programs. And this, in my opinion, is at least as important as establishing the touchscreen: the change from object-oriented interaction to process-oriented interaction.

Now interaction no longer starts with objects such as folders or files that wait

19 Marianne van den Boomen, *Transcoding the Digital. How Metaphors Matter in New Media* (Amsterdam 2014), p. 36.

20 See Jan Distelmeyer, *Machtzeichen. Anordnungen des Computers* (Berlin 2017), pp. 81–92.

21 See Till A. Heilmann, Datenarbeit im "Capture"-Kapitalismus. Zur Ausweitung der Verwertungszone im Zeitalter informatischer Überwachung. *ZfM – Zeitschrift für Medienwissenschaft* 13 (2015), pp. 35–47; Dal Yong Jin, *Digital Platforms, Imperialism and Political Culture* (New York 2015); Nick Srnicek, *Platform Capitalism* (Cambridge 2017).

22 See Ripley M. Louise, Trickster Fiddles with Informatics: The Social Impact of Technological Marketing Schemes. *Journal of Systemics, Cybernetics, and Informatics* 6/1 (2008), p. 91.

for me on my desktop and may assure my status as owner or central reference figure of a *personal computer* and "N(YOU) Media"[23]. On the home screen everything begins with a program that I always have to select and start first to find my "digital objects"[24] in it – to get to my music, my photos, or my notes in the flow and regime of the installed program.[25] Not until 2017 the new operating system iOS 11 for iPhones and iPads provided a kind of comeback of the object with the new app named "Files", which in 2010 was preceded by the app "My Files" on Android systems. Object orientation returns here not as default (as with the desktop), instead as a program like and next to many others.

This interface *mise-en-scène* of smartphones and tablets of various brands, inspired and urged by the iPhone, has initiated and conducted a new way of dealing with computers. A new gesture and order of availability: not to proceed from objects (like a file) but from processes and programmatic structures depresented by operative images of apps. Of course, even in object orientation nothing works without the primacy of programs, because every file management system of a desktop environment like the "Finder" is nothing but a running program. But the gesture is different now. Process/program first: In the beginning, the mass/power of the programs dominates, from which I can choose, but which I do not own, move and create, as I did with my files and folders. My digital objects only appear under the condition of the program responsible for them. Instead of owning these programs, the goods of the software industry, I can acquire the right to their lawful use.

In addition, processes are also gaining in importance here, as many apps (already in 2007) depend on a running Internet connection. The advertised promise of the iPhone, "it ushers in an era of software power"[26], echoed by this new performance of process orientation, is closely related to another paradigm shift: to the always-on of widespread (and not only mobile) forms of permanently networked computers and their uninterrupted energy flow as well as their uninterrupted energy consumption. Although "the voracious energy consumption of digital systems and its current and potential interactions with climate policies raise many questions", as a study published in 2019 stresses, "the material footprint of digital technology is largely underestimated by its users, given the miniaturization of equipment and the 'invisibility' of the infrastructures used. This phenomenon is reinforced by the widespread availability of services on the 'Cloud', which makes

23 Wendy Hui Kyong Chun, *Updating to Remain the Same. Habitual New Media* (Cambridge, MA 2016).

24 With reference to Yuk Hui I understand digital objects in this context as materialized forms of a large amount of "data and metadata, which embody the objects with which we are interacting, and with which machines are simultaneously operating" (Yuk Hui, *On the Existence of Digital Objects* [Minneapolis 2016], p. 48).

25 The personal pronoun 'my' is a little misleading here, not only for copyright reasons, but also because of the special nature of digital objects. Nevertheless, I remain with it, because it helps to describe the gesture of the interface *mise-en-scène* in its transformation.

26 See Ripley, *Trickster Fiddles with Informatics*, p. 91.

the physical reality of uses all the more imperceptible and leads to underestimating the direct environmental impacts of digital technology."[27]

To be is to produce traffic. And its commodification is one of the most promising business models of post-industrial production processes. The iPhone is not only a paragon for the triumph of those mobile, sensory, and quasi-autonomous active computers called smartphones. It is also a role model for the contemporary computer, that is, or should be, always connected to the Internet – and thus to further interface processes of hardware and software, to cables, server parks, and last but not least the "protocol interface"[28].

As computer efficiency can therefore increasingly be outsourced via online services and "cloud" computing, the priority of incessant networking also allows the ongoing change in the status and location of the prioritized processes: programs, software. Software can now appear even less as a product to buy and own, as good and property, but as a processing and subscribable (outsourced) service, as Irina Kaldrack and Martina Leeker have argued.[29]

My very brief suggestion now is that these programmatic, structural, and ecological changes of networked computers have also been supported by the interface *mise-en-scène* since 2007. Since access to my data is only possible through an obvious entry into a running program (and software as a service), this shift from object- to process-orientation supports to habituate to new conditions of conduction – to new man-machine(-world) relationships in the *era of software power*.

From object to process, from file to programmatic flow: The development that dealing with a computer should become more and more synonymous with dealing with a network can thereby appear both productive and natural. Just as my digital objects are now only and ostentatiously present in the flow of various and responsible programs, my data is increasingly no longer stored on my computer, but in the distributed and conducted computer network and its formations of platforms, services, and the like. This network – interface processes, programmatic systems, and circuits all of which tend to remain hidden and perhaps perceived as comparatively immaterial[30] – seems to be more than and at the same time increasingly identical with my computer. In this I am to take part.

With regard to a post-industrial economy based on many traditional forms of industry, a whole series of questions arise from this interface politics, three

27 The Shift Project, *Lean ICT: Towards Digital Sobriety*, 2019, https://theshiftproject.org/wp-content/uploads/2019/03/Lean-ICT-Report_The-Shift-Project_2019.pdf, p. 10.

28 Alexander R. Galloway, Black Box, Black Bloc, in: *Communization and Its Discontents: Contestation, Critique, and Contemporary Struggles*, ed. Benjamin Noys (New York 2012), p. 243.

29 Irina Kaldrack and Martina Leeker, There is no Software, there are just Services: Introduction, in: *There is no Software, there are just Services*, ed. Irina Kaldrack and Martina Leeker (Luneburg 2015), pp. 9-10.

30 See Sebastian Gießmann, *Die Verbundenheit der Dinge: Eine Kulturgeschichte der Netze und Netzwerke* (Berlin 2014), p. 427.

of which I would like to conclude here: If I own neither the network nor the programs containing my data, how can I claim ownership of my data? To what extent is ownership on and through platforms tied to and established by interfaces (their industry, performances, and matter)? Which deeply material and energy-consuming infrastructures enable immaterial work in capture capitalism?

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FROM ARTEFACTS TO INTERFACES: GUI BONSIEPE AND THE RE-DEFINITION OF INDUSTRIAL DESIGN, C. 1970

By Roland Meyer

"Thus, not only the Opsroom, but also the dosing mechanism of a sowing machine could now be understood as an interface: it had to be readable and understandable, it had to convey a sense of the possible uses of the machine and provide access to its operative resources, and in doing so, it structured a common sphere of communication and interaction between people and their artefacts."

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A comprehensive conceptual history of the notion of the interface, tracing the transdisciplinary itineraries of the term between such diverse fields as fluid dynamics,[1] cybernetics and computer science,[2] media and communication studies,[3] architectural and design theory,[4] remains to be written. In such a history, the years around 1970 would mark a decisive threshold moment. Not only are the late sixties and early seventies a time of intensive research into Human-Computer Interaction, the development of the first Graphical User Interfaces (GUI) and the beginnings of personal computing. Around 1970, the concept of the interface also begins to enter the field of design theory, and, as I would like to argue in the following, it is there where some of its implications regarding the transformation from an industrial to post-industrial society are most clearly spelt out. By adopting the concept of the "interface", design theory accompanied, in part even anticipated a more general economic shift from a mode of production centered around physical artifacts to one increasingly concerned with processes of signification and communication.[5]

Given the trajectory of this transformation and the hyper-capitalistic dynamic it has fueled in recent decades, it is not without irony that the first time the notion of the interface is put at the center of design theory is on the pages of a book promising the transition to socialism: *Design im Übergang zum Sozialismus*, written by German industrial designer and theoretician Gui Bonsiepe and published in 1974 as the programmatic first volume of a newly launched book series on *Design Theory*.[6] Herein Bonsiepe, who was trained at the Hochschule für Gestaltung (HfG) Ulm, recounts his recent experiences in Chile, which he had to leave after the military coup of September 11, 1973. The book tries to develop a theoretical framework which encompasses the variety of design projects he and his collaborators had pursued in the previous years, from consumer technology to agricultural machines and new forms of data visualisation. With introducing the term *interface* to cover these diverse fields, Bonsiepe, as I would like to show, not only defines a new field of activity for designers but rather sets in motion a more fundamental redefinition of industrial design and its role within society. What follows, then, is a spotlight on

1 On the origination of the term in fluid dynamics, see Branden Hookway, *Interface* (Cambridge, MA/London 2014), pp. 59–119.

2 On the history of the concept in computer science, see Hans Dieter Hellige, Krisen- und Innovationsphasen in der Mensch-Computer-Interaktion, in: *Mensch-Computer-Interface. Zur Geschichte und Zukunft der Computerbedienung*, ed. Hans Dieter Hellige (Bielefeld 2008), pp. 11–92.

3 For a comprehensive overview of the debate in media studies, see Jan Distelmeyer, *Machtzeichen. Anordnungen des Computers* (Berlin 2017), pp. 22-35.

4 For a design historical approach to the notion of the interface, see John Harwood, *The Interface: IBM and the Transformation of Corporate Design 1945–1976* (Minneapolis/London 2011).

5 On the notion of the post-industrial society, see Timo Kaerlein's essay in this issue.

6 Gui Bonsiepe, Design im Übergang zum Sozialismus. Ein technisch-politischer Erfahrungsbericht aus dem Chile der Unidad Popular (1971–73), in: *Designtheorie. Beiträge zur Entwicklung von Theorie und Praxis des Industrial Design*, Bd. 1, eds. Bernhard E. Bürdek et al. (Hamburg 1974).

Cybersyn operation room. Source: Gui Bonsiepe, *Del archipiélago de proyectos : diseño industrial en Chile 1971–1973* (La Plata: Nodal – Nodo Diseño América Latina, 2016).

nalised factories throughout the Andean state were supposed to be sent to the capital where they would be automatically collected and electronically processed. Visualised and displayed at the various screens of the opsroom, these data, together with statistical models and computer simulations, should allow a group of planners assembled in the operations room to grasp the current economic situation in real-time and to react accordingly towards impending crises.[8]

collective access to these data visualisations and to foster rapid decision-making processes. The interface, thus, here appears as a semiotic-material hybrid: a non-verbal language translating processes and entities that elude immediate perception into visually apprehensible and symbolically readable symbols, as well as a media environment, a spatial apparatus that establishes new relations between human bodies and media technologies and enables the effective manipulation of these symbols.

7 Bonsiepe, Design im Übergang zum Sozialismus, pp. 13, 206f. See also Bonsiepe's later description of the project in: *Entwurfskultur und Gesellschaft. Gestaltung zwischen Zentrum und Peripherie* (Basel, Boston and Berlin 2009), pp. 35–62.

8 Cf. Eden Medina, *Cybernetic Revolutionaries. Technology and Politics in Allende's Chile* (Cambridge, MA and London 2011).

9 Bonsiepe, Design im Übergang zum Sozialismus, p. 206.

10 Ibid.

For Bonsiepe, though, the concept of the interface was not limited to data processing systems. Rather, he used it as a theoretical tool in order to redefine the scope of industrial design as a discipline: "Industrial design does not deal with the entire universe of industrial artefacts, but only with those with which man enters into a direct operative and/or perceptive relationship, i.e. products of the class of 'interfaces'."[11] From today's point of view, such a statement may seem surprising, since most of the designs presented in the book, for example those for agricultural machines or kitchen utensils, hardly qualify as "products of the class of 'interfaces'". But what was it that constituted these "industrial artefacts" as "interfaces" in Bonsiepe's view?

Bonsiepe has reformulated and expanded his theory of interfaces in the 1990s,[12] but its core idea was already present in the 1974 formulation cited above: Instead of reducing the task of the designer to aesthetic form-giving of technically engineered and industrially mass-produced artefacts, in his view the design process should focus on the "relationships" between people and objects. Industrial design, in this perspective, acts in the *in-between*, devising the intermediate, both material as well as semiotic layers necessary to provide human subjects access to the increasingly complex world of technical artefacts they live in.

Thus, not only the *Opsroom*, but also the dosing mechanism of a sowing machine could now be understood as an interface: it had to be readable and understandable, it had to convey a sense of the possible uses of the machine and provide access to its operative resources, and in doing so, it structured a common sphere of communication and interaction between people and their artefacts. By becoming a designer of interfaces, the industrial designer thus ceases to be preoccupied with the mere aesthetic form of the artefact, and rather begins to design new forms of access and use.[13]

By introducing the notion of the interface into design theory, Bonsiepe deliberately broke with a (late) modernist conception of design very much centered around the notions of *form* and *function*.[14] Especially in post-war Western Germany, the ideal of industrial design was considered to be what Max Bill, the first rector of the HfG Ulm, famously coined "Die gute Form" (*the good form*).[15] The designer, in Bill's view, was responsible to give every artefact, "from spoon to city", its definitive, appropriate form, both practical and beautiful, reflective of its function and in accordance with the eternal laws of aesthetics. For Bill, this was nothing less than a profoundly ethical task, whose ultimate goal was to bring "civilisation" and "culture" into "harmony".[16] Whereas the "good form"

11 Ibid., p. 39.

12 Gui Bonsiepe, *Interface. Design neu begreifen* (Mannheim 1996).

13 Ibid., p. 20.

14 Bonsiepe, *Entwurfskultur und Gesellschaft.*, p. 155.

15 Max Bill, *Die gute Form: 6 Jahre Auszeichnung "Die gute Form" an der Schweizer Mustermesse in Basel* (Winterthur 1957).

16 Paul Betts, *The Authority of Everyday Objects. A Cultural His-*

aimed at an organic unity of form and function, realised in the single artefact and visible in its physical appearance, Bonsiepe's concept of industrial design as interface neither begins nor ends with the isolated artefact, but encompasses the whole network of material as well as symbolical relations which it is part of. Rather than just aesthetically expressing the already determined function of a given technical artefact, the interface opens up a new space of possible uses and functionalities, thus undermining every attempt to distinguish between form and function in the first place.

Bonsiepe's redefinition of industrial design can be seen as the conclusion of a debate that had been going on in German design discourse since the late 1950s. At the HfG Ulm, where Bonsiepe first studied and later teached, the role of the designer in the process of industrial production was intensely debated, not least out of a fear that it was becoming increasingly marginalised. In the affluent German consumer society of the "Wirtschaftwunder" era, the role of industrial design threatened to sink into a mere superficial aestheticisation, the role of the designer being reduced to adding surplus exchange value to otherwise exchangeable products. Bill's "good form" was initially presented as an antidote to this process, as it gave German designers an ethical ideal that could clearly be put forward against the commercial "styling" primarily identified with commercial American industrial design.[17] But during the 1960s, it became more and more clear that the question of the "good form" now definitely belonged to a bygone era of industrial production.

One of the first to notice this was Swiss sociologist and design theorist Lucius Burckhardt. In several articles in the late sixties, Burckhardt pointed out that recent technological developments had made the ideals of modernist design more or less obsolete. Pliers and coffee pots, Burckhardt wrote ironically in 1967, could perhaps still be designed in correspondence to the modernist ideals – but in the era of transistors, more and more artefacts structurally eluded any attempt to reconcile their visible form und their technical function. A tin box full of wires, transistors and batteries, Burckhardt writes, could just as easily be a musical instrument as a calculating machine. In these and other cases, no longer the visible "appearance" of elements, but their "invisible" organisation determines their function – which in turn is conveyed to the user solely via external control elements: "Because of the buttons we have to press, we know what kind of apparatus it is, and if we don't know these buttons [...], if they don't tell us anything, then this apparatus remains alien and useless to us."[18]

Rather than giving an aesthetic form to an already determined function, de-

tory of West German Industrial Design (Berkeley, Los Angeles and London 2004), p. 154.

17 Ibid., pp. 139–177, esp. p. 152.

18 Lucius Burckhardt, Bauen. Ein Prozess ohne Denkmalpflichten (1967), in: Lucius Burckhardt, *Wer plant die Planung? Architektur, Politik und Mensch*, eds. Jesko Fezer and Martin Schmitz (Kassel 2004), pp. 26–45, here p. 43.

sign here defines and enables possible uses, by providing symbolic means of communication, material devices of manipulation, and establishing a perceptive and operative relationship between a human subject and a technical artefact. Although he does not use the term interface, what Burckhardt describes is not unlike what Bonsiepe will conceptualise a few years later: the replacement of design as an art of form-giving by design understood as a practice of mediation and communication.

Around 1970, in an increasingly complex world, determined by immaterial structures and invisible processes rather than material forms and visible appearances, design could take on a new role which would go beyond the mere styling of surfaces. Rather than just increasing the commercial exchange value of mass-produced artefacts, it could now set itself the task of generating new use value by focusing on the interface between the everyday environment of the user and a sphere of technical artefacts whose functional dimension increasingly eluded sensual experience. In stark contrast to Bonsiepe's revolutionary dreams of the seventies though, this redefinition of industrial design hardly made it into a weapon of political liberation and the overcoming of cultural, technological and economic dependencies.[19] In retrospect, one could argue, the shift of design theory from artefacts to interfaces rather paralleled and even anticipated a more general economic transformation in late-capitalist societies, where the main site of value production also began to shift from the factory to the logistics, advertisement, service, communication and financial departments – thus, exactly those sites where new relationships between commodities and their consumers, in a certain sense: new interfaces, were being designed and established.

19 Bonsiepe, Design im Übergang zum Sozialismus, p. 13.

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NATURAL USER INTERFACES AND THE IMAGINATION OF POST-INDUSTRIAL WARFARE: A BRIEF LOOK AT BLADE RUNNER 2049

By Christoph Ernst

"Blade Runner 2049 gives us a hint how to imagine the future of warfare. According to the film, post-industrial society will be a 'post-human' society."

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I. Imagining interfaces and future warfare

If user interfaces can be considered as a key technology of the 'post-industrial' society then this is true for the 'post-industrial condition of warfare' as well. The relevance of interfaces in military technology and, vice versa, the importance of military applications for the development of interfaces is very well known. It is hardly news to consider user interfaces as an integral part of warfare. Nevertheless, current debates on "autonomous weapons systems" (AWS)[1] give us the opportunity to take a fresh look on this relation.

It can be argued that in military contexts user-interfaces are currently transformed into tools for second-order observations of highly integrated automatic operations. According to the available information, 'autonomy' in self-acting weapons is still limited to very specific tasks. Thus, the real issues with 'autonomy' concern 'teamings' between human actors and machinic actors.[2] The problem is how to develop man-machine-relations which are able to make the best out of the respective cognitive abilities of both types of actors. The design of effective interfaces is crucial to tackle this problem.[3]

As David Kirby has shown, the development of user interfaces it related to the development of "diegetic prototypes" in science fiction-films. For Kirby, diegetic prototypes such as the famous interface in *Minority Report* (US, 2002) are "[…] depictions of future technologies [to, CE] demonstrate to large public audiences a technology's need, viability and benevolence. […] These technologies only exist in the fictional world – what film scholars call the diegesis – but they exist as fully functioning objects in that world."[4]

Currently, so called "natural user interfaces" (NUIs) are regarded as the next step in the evolution of user interfaces. The idea is to abandon devices like the keyboard or the mouse and to use the "natural" interaction of our bodies (hands, voice) with the physical world as a basis for input-output-relations.[5] Following these ideas, I want to briefly sketch a scenario in which military force is controlled via a highly integrated coupling between autonomous NUIs and AWS.

1 Nehal Bhuta, Susanne Beck, Robin Geiß, Han-Yan Liu and Claus Kreß (eds.), *Autonomous weapons systems. Law, ethics, policy* (Cambridge 2016).

2 Lucy Suchman and Jutta Weber, Human-machine autonomies, in: *Autonomous weapons systems. Law, ethics, policy*, eds. Nehal Bhuta, Susanne Beck, Robin Geiß, Han-Yan Liu and Claus Kreß (Cambridge 2016), pp. 75–102.

3 Christoph Ernst, Beyond Meaningful Human Control? – Interfaces und die Imagination menschlicher Kontrolle in der zeitgenössischen Diskussion um autonome Waffensysteme (AWS), in: *Die Maschine: Freund oder Feind? Mensch und Technologie im digitalen Zeitalter*, eds. Caja Thimm and Thomas Bächle (Wiesbaden 2019), in print.

4 Cf. David Kirby, The future is now: diegetic prototypes and the role of popular films in generating real-world technological development. *Social Studies of Science* 40 (2010), pp. 41–70, here p. 41.

5 For a definition of NUIs see Yvonne Rogers, Helen Sharp and Jenny Preece, *Interaction Design. Beyond Human-Computer Interaction* (Chichester 2015), pp. 219–222, here 219.

The example to illustrate those ideas is a scene from Denis Villeneuve's *Blade Runner 2049*, in which a NUI is presented as a "diegetic prototype". In part, the implications of this scene are anticipated in the reflections on post-industrial warfare in the book *War and Anti-War* (1993) by Alvin and Heidi Toffler.

II. Looking back at post-industrial warfare

Alvin and Heidi Toffler were among the most important theorists on the post-industrial society and its relation to warfare. In 1993 they stated, "the way we make wealth and the way we make war are inextricably connected."[6] Applied to warfare, what happened in Kuwait and Iraq in the Gulf War 1991 was a symptom of what they called the "third wave" in human economic production. In the book they tried to show that the criteria of a post-industrial society could be applied not only to means of economic "production" but to military "destruction" as well. According to this premise, the Toffler's identified the following analogies between a 'post-industrial-style' of usage of information and communication technologies (ICT's) and the way the US-forces operated during the war of 1991:

1. Knowledge processed by networked computers (information) was the "central resource" of the war.[7]

2. "Value" was not created by sheer quantity of numbers (tanks, planes etc.) but as an "intangible" size which emerged from the interplay between different factors.[8]

3. The goal was to create "finer and finer precision [with, CE] more and more selectivity" in the use of force.[9]

4. Military personnel was better educated in order to operate the fielded "smart" weapons and to deal with the increasing complexity of military technology.[10]

5. Because of their education, soldiers were able to improvise in an effective way despite the confined limits of military hierarchy.[11]

6. The overall efficiency of all components (people, weapons, logistics etc.) was maximized by computers, the whole effort was (relatively) cost-efficient and provided "more bang for the buck."[12]

7. ICTs strengthened bottom-up decision-making and created the possibility for more decentralized military hierarchies (e. g. in the context of special operations).[13]

8. ICTs were merged into one gigantic complex logistic system, were every ele-

6 Alvin Toffler and Heidi Toffler, *War and Anti-War* (New York 1993), p. 73.

7 Ibid., pp. 79–82.

8 Ibid., pp. 83–84.

9 Ibid., pp. 83–85.

10 Ibid., pp. 85–88.

11 Ibid., p. 88.

12 Ibid., pp. 88–89.

13 Ibid., pp. 89–90.

ment of the war was accounted for.[14]

9. The "electronic infrastructure" was the largest created in previously known military history.[15]

10. The allied force was no longer a military "machine," but a "system with far greater internal feedback, communication, and self-regulatory adjustment capability," in short, it was a "thinking system."[16]

From hindsight, some analogies are disputable. Regarding the influence of computers, the Toffler's reproduced in part the propaganda of the US-military. However, the conclusions they drew in *War and Anti-War* are not wrong. Some aspects of them are even prophetic.[17] A good example is the chapter on "Robot Wars".[18] What is today an important debate, the Toffler's did foresee in some parts. For example, they mentioned already the problem of "humans in the loop"[19]: "[b]y extension, one can envision even more complex integrations of helicopters, ships, tanks, and ground-support planes into a single 'robotic organism' under the control of tele-operators. The imagination conjures up an all-robotic battlefield."[20] If we consider interfaces in the above mentioned sense as "diegetic prototypes," how is the scenario of a "robotic organism" depicted in current science fiction movies?

III. Imaging interfaces for future warfare

Denis Villeneuve's 2017 film *Blade Runner 2049* offers us a scene in which an automatized battlefield and the control of military force via NUIs becomes tangible (00:59:45-01:01:50).[21] The main character of the movie, K (Ryan Gosling), has been shot down with his flying car in the ruins of a destroyed city. As we learn, K's actions are under surveillance by Luv (Sylvia Hoeks), a replicant, created by Niander Wallace (Jared Leto), CEO of a powerful replicant manufacturing company. Luv operates as his right hand and is tasked with the mission to keep a watchful eye on K's actions.

In the scene, K is attacked by hostiles. Outnumbered by his attackers, suddenly precise missile strikes occur. The missiles are literally 'raining' on his opponents, killing all of them. A moment later we see Luv, sitting relaxed in an armchair, getting her nails done. Looking

14 Ibid., pp. 90–91.

15 Ibid., pp. 91–92.

16 Ibid., pp. 92–93.

17 Their analysis of the analogy between economy and warfare provided a basis for the influential 'network-centric warfare'-doctrine which was developed in the mid-1990s. See Arthur K. Cebrowski and John J. Garstka, Network-Centric Warfare: Its Origin and Future. *US Naval Institute Proceedings* 123/1 (1998), pp. 1–11.

18 Toffler and Toffler, *War and Anti-War*, pp. 125–136.

19 Ibid., p. 129. See for this discussion and the necessary literature on the subject Ernst, Beyond meaningful Human Control.

20 Toffler and Toffler, *War and Anti-War*, p. 130.

21 *Blade Runner 2049*, Denis Villeneuve, USA 2017, DVD Sony Pictures Home Entertainment.

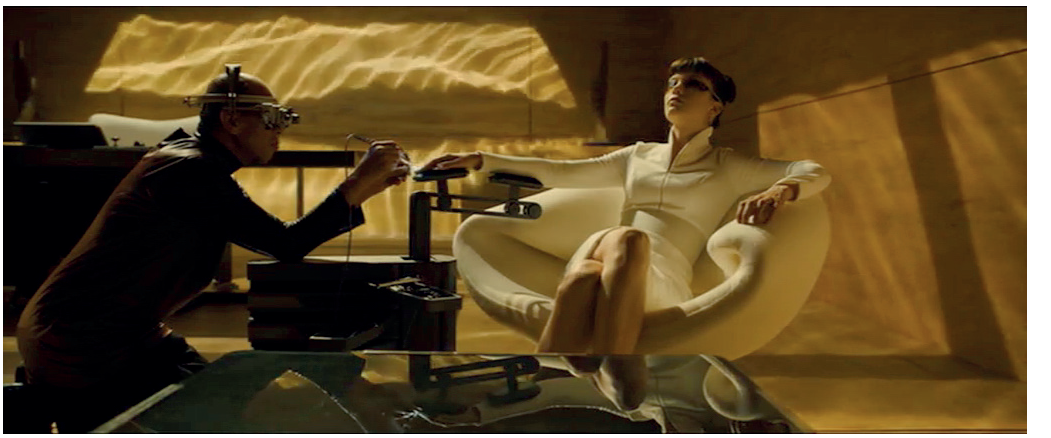

Fig. 1: Screenshot from Blade Runner 2049, Dennis Villeneuve, USA 2017, DVD Sony Pictures Home Entertainment.

upwards in the light, she wears mixed-reality glasses. The glasses are a combination of a head-mounted-interface augmented reality interface and a voice-controlled NUI which is integrated into a setting that seems private, but is in fact her workplace. The interface is a wearable, voice control makes it multimodal. In her glasses are the events at K's site visible as a superimposition.

It is interesting to note, that the missiles come right out of the 'clouds.' While there is some debate on the web, which weapon platform is used in the scene, the whole point of the scene is to conceal the weapon system (the 'cloud'). The movie doesn't show drones, airplanes, or helicopters as the weapon-platforms. When K looks up in the air to figure out who helped him, all we get is an indexical point of light in the sky. In military terms, Luv is commanding a 'close air support'-mission (CAS). The firepower is highly precise and well-adjusted. For CAS this is important because there is, like in the scene, close contact between one's own troops and foreign troops. Furthermore, the scene depicts a low intensity conflict with irregular forces, a typical feature of the "new wars" (Herfried Münkler) since 9/11. Yet, we don't see humans at work. Instead, we can assume that automatized robotic systems are used. Why is the interface – Luv's mixed-reality glasses – interesting?

What distinguishes the interface in this scene is the absence of any form of explicit display of information- or control-elements. There is no 2D or 3D geometry visible, no coordinate system, no diagrammatic elements to organize the command & control-relation between user and the objects targeted by the weapon system. The interface is completely transparent and 'naturalized', reacting to voice command but otherwise operating independent from further human control. Luv has all time in the world and the weapon system does the work for her.

This absence of gesture-based control and visualisation of target acquisition is a remarkable feature of the interface. It reminds us of the difference between bodily engaged usage of devices, be it a

computer, be it a car, and bodily disengaged usage of automatized services, as it is e. g. the case with voice-controlled assistants like Amazon's Alexa. In the theory of traditional graphical user interfaces (GUI) 'spatialisation' was regarded as the driving factor of interface design.[22] Direct manipulation by pointing gestures is replaced in the scene by a proactive interface, which can be referred to as 'invisible computing' or even 'ambient intelligence'.[23] The AWS is selecting the targets, choses the adequate weapons, and offers this as a 'service' to Luv. This kind of self-organisation and cooperation obviously takes place in a highly integrated, automatized manner in order to relief Luv from any coordinating activities. We even can consider the interface to be part of a 'liquid operation' or 'operational flow', which is expressed in the scene by shadows of moving water all over the walls.[24] But to what extent is this interface a "diegetic prototype" for interfaces of future warfare?

The movie doesn't show us the teaming between human cognitive abilities and AI-based machinic cognitive abilities. The reality of this interaction is simply presupposed. In fact, the depicted NUI is as real as it can get at our current point in time. Such sophisticated NUIs are certainly conceivable, but are not yet ready for the mass market. To come back to Kirby's criteria, the diegetic prototype visualised in the movie shows the viability of the technology and the need for it, but not its 'benevolence'. Yet, this is exactly the point. The NUI strongly resembles a military application for a real-world interface like Microsoft's *HoloLens*-glasses. Given that, maybe it is no surprise that in November 2018, one year after the release of the film, Microsoft signed a $479 million contract with the US-military in order "to use the new HoloLens in a platform that 'provides increased lethality, mobility, and situational awareness necessary to achieve overmatch against our current and future adversaries.'"[25] In case of *Blade Runner 2049*, Hollywood was one step ahead. The movie gives us a scenario in which – on the level of interface metaphors – such an interaction between humans and automatized or even autonomous machines of war is

22 From the perspective of cultural theory see e. g. Janet H. Murray, *Inventing the medium. Principles of interaction design as a cultural practice* (Cambridge, MA 2012), Johanna Drucker, *Graphesis. Visual forms of knowledge production* (Cambridge, MA 2014).

23 José L. Encarnancao, Gino Brunetti and Marion Jähne, The interaction of humans with their intelligent environment, in: *Mensch-Computer-Interface. Zur Geschichte und Zukunft der Computerbedienung*, ed. Hans Dieter Hellige (Bielefeld 2008), pp. 281–306.

24 This flow might even be seen as a metaphor for the interface in general, as the notion of "interface" originally comes from the dynamics of liquids. See Peter Schaefer, Interface. History of a concept, 1868–1888, in: *The long history of new media. Technology, historiography, and contextualizing newness*, eds. David W. Park, Nicolas W. Jankowski and Steve Jones, (New York 2011), pp. 163–175. See for a further elaboration with regard to the idea of "conduction" Jan Distelmeyer's text in this volume.

25 April Glaser, Microsoft workers say the company is war profiteering, and they've timed their protest to hurt. *Slate* (February 2019), https://slate.com/technology/2019/02/microsoft-workers-protest-hololens-pentagon-contract.html, access: January 4, 2019, 15:30; Joshua Brustein, Microsoft wins $480 million army battlefield contract. The military plans to purchase as many as 100.000 HoloLens augmented reality devices. *Bloomberg* (November 2018), https://www.bloomberg.com/news/articles/2018-11-28/microsoft-wins-480-million-army-battlefield-contract], access: January 4, 2019, 16:30.

already a 'seamless' and 'liquid' reality. Interface-based 'teamings' between man and machines are the normal case.

Looking back at the Toffler's analogies between the Gulf War of 1991, the 'information society' and its economy it is obvious which aspects of the analysis are compatible with the movie and the particular future depicted in it. Future warfare will be a privatised service, run by the big players of the tech industry (like e. g. Microsoft). Using state of the art-NUIs, a wide range of AWS will be ready at voice command. The user, in our case Luv – a fully qualified and extremely 'smart' operator –, has not to care about the operational performance of the weapon. She can lean back and let the AWS do the work.

Certainly, the military would appreciate such a scenario. It appears, that humans are still in the 'loop'. This is a criterium to fulfil normative requirements regarding 'human' warfare in the age of AWS.[26] The only problem is, that Luv is not a human but a replicant, operating as the right hand of the company leader. Luv is, as Wikipedia informs us, a "bioengineered android".[27] This illustrates where the post-industrial situation the Toffler's described back in 1993 already has been transgressed in the fictional film – and most likely will be transgressed in reality as well. *Blade Runner 2049* gives us a hint how to imagine the future of warfare. According to the film, post-industrial society will be a 'post-human' society. The way war is conducted in a post-human society is in large parts warfare on the basis of AWS. However, this means we have to transgress the differentiation between 'operators in the loop' on the one side and 'robots' on the other side as well. And this means to challenge at least one of the premises in the Toffler's book. As an interface user, Luv is not the kind of human "tele-operator" controlling the machines the Toffler's talked about back in 1993. Neither are the 'troops' she saves. K is a replicant and he is accompanied by Joi (Ana de Armas), a holographic artificial intelligence. As a replicant, Luv is a metaphor for a new type of "smart player"[28], challenging a simple differentiation between man and machine in the process. The "thinking system" in the scene consists of man-machine-interactions, but not in the way it was imagined back in 1993. The interfaces of the future will link hybrid 'users', weaving together "human-machine assemblages".[29]

As a conclusion, we can see the significance of post-humanism for interface-theory (and of interface-theory for post-humanism). Scenarios like the one from *Blade Runner 2049* can be regarded as a reason to rethink the differentiation between humans and computers, thus re-conceptualising the understanding and relevance of interfaces for the relation between man and machine.

26 Ernst, Beyond meaningful human control.

27 Wikipedia (English), Replicant, https://en.wikipedia.org/wiki/Replicant, access: February 4, 2019, 12:00.

28 Encarnancao, Brunetti and Jähne, The interaction of humans, p 289.

29 See for further literature Suchman and Weber, Human-machine autonomies, p. 78.

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