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Anthropology Today

COMPUTER-AIDED DESIGN/MANUFACTURING
PAUL RABINOW ON HUMAN GENOME PROJECT
1992 WORLD FAIR — PERCEPTIONS OF TIME
RITUAL'S CORE FOR MAURICE BLOCH
U.K. ETHNOGRAPHY MUSEUMS — PORN

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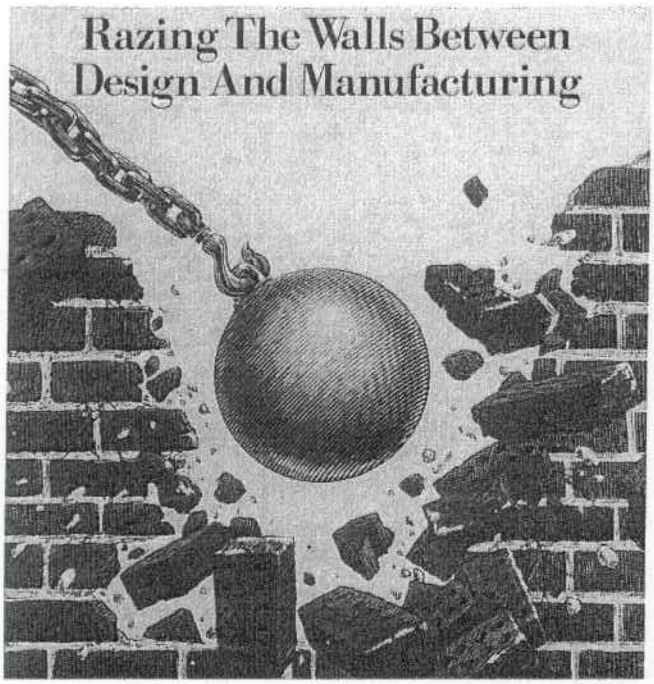

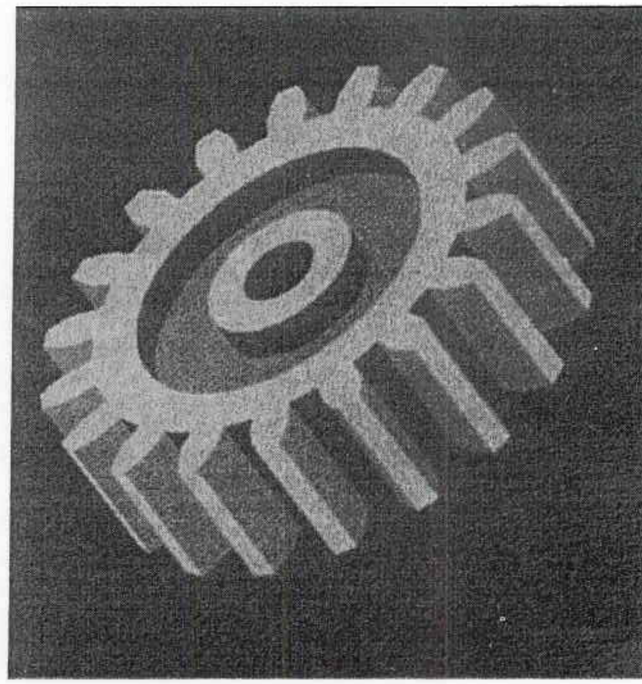

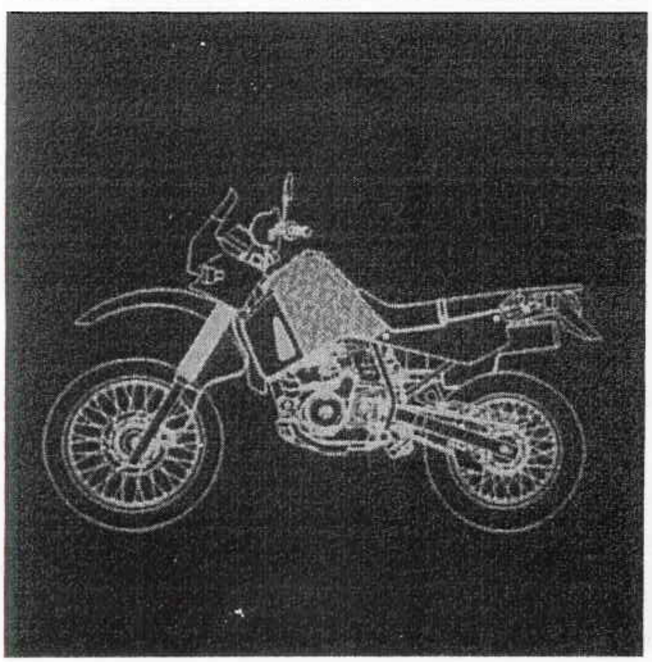

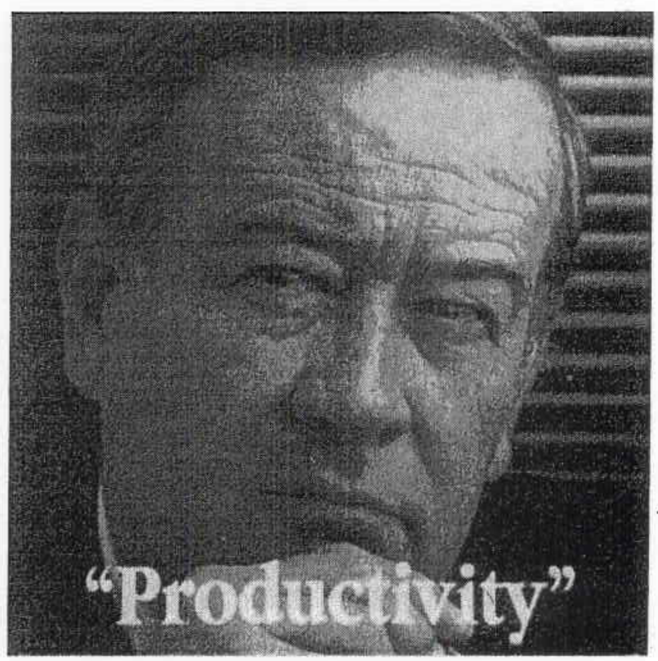

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Contents

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The great anteater's attractions

French-speaking anthropologists seem to preserve a characteristic style – it might be called the structural-existentialist, if that is not a paradox – during some recent forays into social criticism of the West. It's not everyone's cup of tea, but anthropology would be a weaker mixture without it.

One of France's leading anthropologists, Marc Augé, reported for last August's issue of *Le Monde Diplomatique* on a visit to Euro Disneyland, the controversial American entertainment park to the north of Paris which has been massively subsidized by the French state but is damned by many intellectuals and visited by fewer tourists than hoped for. Augé notes that the visitors include far more adults than children, who seem to serve mainly as a pretext for a visit, and an optional one at that. He concludes that Disneyland represents the quintessence of tourism: 'what we come to see does not exist; we discover there only the memory of our dreams. We live the experience there of a pure liberty without object, without reason, without a stake. We find there not America, nor our childhood, but the absolute freedom of a play of images in which everyone who rubs shoulders with us can inject what they want, and we shall never see them again'.

The terms of Augé's interpretation recall those of a dashing book recently published by a French-Canadian colleague, Bernard Arcand, about another form of popular pastime based on the excitation of fantasy, annulment of social space and linear time, provision of high-tech services for the 'lonely crowd' – but Arcand's book is about pornography[1], which at first sight is a different thing altogether from the Disneyparks (and nothing in the following should be taken as implying that any emanations of the Walt Disney Co. are less than 100% clean and decent). Both Augé and Arcand, however, have recourse to the idea that ours is the 'era of emptiness' – the title of a book on contemporary individualism (*L'Ère du Vide*) by Gilles Lipovetsky, who writes that 'God is dead, the great finalities are extinct, but *no-one gives a damn*, there is the joyful news, that is the limit of Nietzsche's diagnosis'. This might seem too commonplace a reflection on which to build an argument, but Arcand also gives an older quotation from Edgar Morin's *L'Homme et la Mort* which sums up the darker mood of 1940s existentialism, once so dominant in French intellectual life and so widely influential: 'There is nothing left of the universal, nor of the cultural. The individual is left alone in irrationality ... The breaking-up of participation leads to the fear of death, and the fear of death reinforces the breaking-up of participation. Solitude brings on the obsessive fear of death, and that fear closes in on the solitude'.

Arcand argues that though the iconography of Western porn has much in common with that of, for instance, the erotic reliefs sculpted in medieval Indian temples (and many tourists now read these reliefs as pornographic) there is the big difference that porn is marginal, a result of the specialization of roles and discourses, whereas in medieval India religion, art and sex were to a great extent integrated. Porn relates to sexuality as the Disneyparks relate to our sense of legend, myth and fiction, insofar as these are relegated to the marginal sphere of leisure. In fact, though both pornography and the Disneyparks are big businesses, many Euro-Americans find both of them tedious.

1. Le Jaguar et le Tamanoir: Vers le degré zéro de la pornographie, Boréal, Montreal, 1991, C$29.95. The Brazilian ethnography referred to later in this article derives from Curt Nimuendaju as interpreted by Thomas F. Portante, a student of Arcand's, under the inspiration of Lévi-Strauss. An English translation by Wayne Grady will be published in September 1993 by Verso.

Bernard Arcand also gives more conventional attention to various ethical aspects of pornography relating to gender, violence, censorship etc.– in a book originally designed to show the dean of his social science faculty that anthropology was relevant to the 'modern world'.

For Arcand, a well-known ethnographer of South American Indians, the spirit of porn is represented by the great anteater as it appears in the rituals of the Sherente Indians of central Brazil. The anteater has a long muzzle with minimal mouth, and its anus is completely hidden by lips, so that it is thought of as blocked-up and self-sufficient. Its sexual organs are tiny and also concealed; it is generally seen alone, and its grey-black coat and lack of teeth make it a symbol of old age; it eats what is normally regarded as putrefied, and its own meat is extremely tough. The anteater 'offers the image of a small quiet life where it has no appetite except for a few ants, an undemanding life where is asks nothing of others and would do no harm to anyone'. Yet it is a fierce, strong beast whose forepaws can lacerate not only tree-trunks and termite-nests but also a human skull.

The Sherente hold an occasional ceremony in which men dressed as anteaters are symbolically killed by men dressed as jaguars. The jaguar is agile, powerful, all-seeing, sociable, highly-sexed – standing for all the qualities which a Sherente woman would like to see in her husband and which a shaman needs in order to perform miracles. In effect, the Sherente recognize the anteater's attainment of a kind of tranquil immortality – which they reject in favour of risk, excitement, sociability and predation. They do so because societal reproduction matters more than individual survival.

The question Arcand poses is, are the Sherente's priorities the same as ours, for the dangers of any community's dying out now seem outweighed by those of overpopulation? Possibly masturbation, castigated in the Bible as the sin of Onan and generally despised in most cultures, is becoming the Western paradigm of sexuality, the partner being reduced to a catalyst.

To bring together the findings of Augé and Arcand, it may be that porn in the special sector of sex, the Disneyparks in the special sector of leisure, represent a triumph of individualism, a denial of death. For this model to work, the nuclear family must be taken as an individualist unit. Cameras are important to both experiences but they are used to make what T.S. Eliot called a 'wilderness of mirrors', not to make images which strengthen personal relations over time and space through awareness of mutual knowledge. It would seem that the worthy aims of ecological equilibrium, control of sexually transmitted diseases, and political equality may all be actually favoured by the anteater's practice of spiritual constipation.

Such attempts to defy mortality are likely by and large, Arcand argues, to be profitable to investors, but ultimately limited by the inability of our technology to cheat death or, as yet, to create children. Traditional commitments to face-to-face reciprocal relationships as the primary source of meaning are not, then, quite obsolete, even though such commitments are heavy laden with the risks and asymmetries which the Sherente accept as the price of an exciting and worthwhile life.

Perhaps we may sum up Arcand's insight (originally the Sherente's) as an acceptance that the borderlines between relationships of symbiosis, parasitism and predation are always porous. Pornography and the Disneyparks are projects to escape this fact of life, projects which will enjoy increasing support but which will also continue to be vigorously opposed. As for those who profess expertise in the 'social', thinking about the extent of fantasy in human relations should foster some humility among them when they use that adjective. □

Jonathan Benthall

Human agency in CAD/CAM technology

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In the United States, the natives routinely portray their society in part by distinguishing it from their technology. Americans understand and characterize technology as an external phenomenon, or more particularly as an autonomous force (Teich 1990). From this perspective, technologies develop according to their own internal logics within specialized technical communities whose deliberations are essentially opaque and presumably free of cultural content. Technology becomes an independent variable and society a dependent product.

It is an irony of American culture that this fixed separation frequently grounds a social commitment to technology as the solution to social problems. The distinction helps give engineers, for example, the authority to abstract 'technical' problems from 'social' problems, attempt to solve them in the rarefied realm of technical discourse according to localized considerations reserved for that realm (e.g. 'logical' coherence), and then apply the technical 'solutions' back to society. Engineers can boast that many problems have technical solutions and then complain about the barriers imposed by a purely social 'politics', as when they throw up their hands and say, 'It's all politics'.

By standing outside of society, American technology occupies a strategic position as a vehicle for social change. Technologies possess the agency to have 'impact' on society, yet their internal features are generally excused from overt public deliberation and decision making. Accordingly, engineers and inventors acquire the power to engineer and invent society as well as technology, as do other individuals and groups who successfully incorporate into their own identities the pursuit of social change as technological development.

This technological determinism has its limitations, however, as a native theory of social change. By positioning technology as a force external to society, it offers a limited view of how technologies might acquire human agency and function as actors within society. Over the past three years, I have conducted an ethnographic study in the United States of a technology called CAD/CAM, or computer-aided design and computer-aided manufacturing. Beginning in the early 1980s, a prominent nationalistic interpretation of

The fieldwork reported here was conducted with the support of National Science Foundation Grant #DIR-8721941. I thank Joseph Dumit, David Hess and Linda Layne for their critical comments.

* A double session at the 1992 meetings of the American Anthropological Assocation in San Francisco and a 1993 Advanced Seminar at the School of American Research will explore possibilities for a 'cyborg anthropology'. Cyborg anthropology, the term coined by Joseph Dumit, calls attention to the cultural production of human distinctiveness by examining ethnographically the boundaries between humans and machines. Bringing cultural anthropology into conversation with science and technology studies (STS) and feminist critiques of science, it takes the relations among knowledge production, technological production and subject production to be a crucial area of anthropological research.

CAD/CAM technology identified it as crucial to resolving a national identity crisis, i.e., restoring America's economic competitiveness in the world. According to the nationalist script, CAD/CAM technologies promised to streamline product innovation in American industry by merging together the distinct engineering activities of 'design' and 'manufacturing', thus enabling American companies to increase their 'productivity' by responding more quickly and effectively to changing consumer demands.

Pursuing this nationalist objective, however, involved linking it to other, more localized objectives. Three distinct technologies emerged instead of one. Each technology is endowed with the agencies of a different set of engineering activities, and together these technologies empower design to the exclusion or detriment of manufacturing. By examining how technologies such as CAD/CAM acquire and redistribute human agency within society, anthropologists can offer an important source of cultural criticism, one that begins by blurring the sharp distinction between humans and machines which grounds native technological determinism.

Transcribing human agency into technology

Through most of its history, the discipline of cultural anthropology has reproduced the cultural separation between technology and human society in its everyday work. Traditional anthropological attempts to understand technology tended to fall into two general categories, each taking up technological determinism into its discourse by treating technology as an external force. The first offered variations on the theme of materialist reductionism, viewing technological development as the prime mover of all cultural change. Most prominent was Leslie White, who argued that 'the technological factor is the determinant of the cultural system as a whole' (White 1949:366). The second offered case studies of the 'impact' of Western technology in 'developing' societies. For example, Lauriston Sharp described how introducing steel axes to the aboriginal Yir Yoront had 'hack[ed] at the supports of the entire cultural system' (1952:88). Also, Pertti Pelto explored how introducing snowmobiles in the Arctic had brought about 'sequential transformations in economic, social, and other aspects of culture' (Pelto and Muller-Wille 1972:199; Pelto et al. 1968).

During the 1960s and 1970s, the rise into prominence of theories of cultures as shared and bounded symbolic systems (Ortner 1984), e.g. as 'systems of symbols and meanings' (Schneider 1968, 1969) or as 'meaningful orders of people and things' (Sahlins 1976), distinguished technology and society by externalizing technology from cultural accounts of human action. Trained during this period, I learned to identify shared cultural meanings on the model of a linguistic grammar, i.e., as distinctions or categories presupposed by different actors across a range of contexts. I remember vividly reading in students' proposals for fieldwork the required statement, which now sounds silly: 'I will examine the widest possible range of actors and contexts'.

Although the image of bounded cultures did not prohibit anyone from looking for shared meanings in technology, I know from personal experience that technology was widely viewed as inherently boring, i.e. significantly uninteresting in conceptual terms. I came to believe, however, that cultural accounts of technologies did not find favour because accounting for the shared meanings of technologies offered only trivial insights while following diverse meanings was confusing conceptually. At the time, raging debates were taking place within Western nations over such technologies as nuclear power. Exploring the categories that different actors attributed to technologies across a range of contexts would have led one away from the image of internally homogeneous, bounded cultures and toward images of intracultural diversity with variable distributions of power.

Things have now changed. Over the past decade, theoretical developments in both cultural anthropology and the sociology of technology render all aspects of technological development eminently susceptible to anthropological enquiry and critique. In the first place, cultural anthropologists are asking less about how cultural structures shape action and more about how agents produce culture. Diversity in cultural meaning is the rule rather than the exception; stabilized categories are a social accomplishment; and the redistribution of power relations is integral to the process of meaning construction rather than simply a final outcome. Finally, anthropologists' concern for their role in a postmodern world has produced heightened sensitivity to the constructed nature of boundaries between humans and machines and generated interest in understanding the cyborgs in us all.*

Extensive developments in the sociology of technology have reconceptualized technology from an autonomous force to a social product through two key conceptual moves. The first recasts technological content as the product of social judgment. For example, John Law's concept of 'heterogeneous engineering' describes technological development as the convergence of heterogeneous mixes of factors and considerations. The second move brings technological artefacts into the arena of social action as participants with agency. For example, Michel Callon (1986) has described how giving agency to an electric car entailed constructing the entire infrastructure within which the vehicle would function.

Drawing on these developments, anthropological investigations of technology can follow how technologies come to serve as both the products and the producers of distributed cultural meaning and power by transcribing human agency into object form. I examine the transcription of human agency into CAD/CAM technology by following how actors move themselves around in relation to other actors and cultural objects, i.e. by 'positioning' their 'identities'. Identities refers to the configurations of categories that distinguish actors and objects from one another. Acts of 'positioning' bring identities to life as both a condition and a product of action. For example, Americans may position technology as external to their society, but they also routinely position themselves in relation to specific technologies as a strategy for distinguishing themselves from others.

I use the term 'agency' to refer to the act of positioning itself. CAD/CAM developers and users transcribe human agency into their technologies by abstracting informational content from engineering activities, translating it into binary code, and then reinserting the empowered technological agents back into those activities as active participants. Transcribing agency into CAD/CAM technology gives it the power to position, to move itself around in relation to other agents. The positioning of CAD/CAM technology is more complex than a native determinist account would have it because in positioning the new technology agents also reposition themselves (see also Downey 1992a, 1992b, 1993).

Nationalism in CAD/CAM

During the 1980s, efforts to save America through technological development frequently built upon a rhetorical strategy that asserts: (1) the American 'nation' is threatened by economic defeats at the hands of international competitors, especially Japan; (2) the key problem is declining 'productivity' in industry, understood as output of product per unit labour; and (3) technological development is the best means for increasing productivity. The turn to technology is a Western phenomenon, most prominent in the United States, and contrasts significantly with the Japanese style of innovating through incremental rather than broad-brushed solutions. By linking 'productivity' to an economic interpretation of the American 'nation', this strategy redistributed the agencies and repositioned the identities of both at the same time. Productivity gained national, rather than purely economic, significance, and the nation gained a new form of technological salvation.

Numerous elite groups in industry, government, universities and professional engineering societies have worked to realize this vision. Cooperative ventures in research and development that would have horrified Americans during the 1960s and 1970s, e.g. collaboration between IBM and Apple Computer or federal support for multi-company coalitions developing semiconductors, have experienced almost no popular opposition, complaints about conflicts of interest, or fears about domination by a monolithic capitalist Establishment.

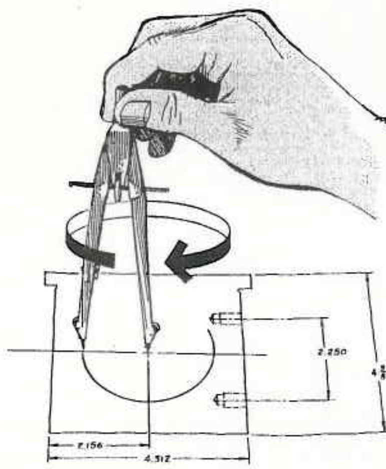
Coming from elite, official groups, the rhetoric of nationalism offered legitimacy to the use of CAD/CAM technology to enhance productivity (see the montage of masculinist advertising images on the *front cover*). Prior to 1980, CAD/CAM technology was simply one component of the field of 'interactive computer graphics', which involves using the computer to manipulate pictures and models of objects. CAD/CAM proponents repositioned interactive computer graphics by linking it to engineering design and manufacturing. Making pictures and models transcribes the agencies of engineers into the forms of computer graphics. Each of the three technologies – 2D drafting automation, 3D wireframe and surface modelling and solid modelling – is a technological transcription of engineering activities.

2D drafting automation

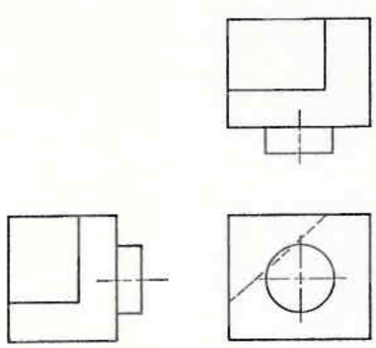
2D drafting automation is positioned to increase the productivity of a design activity but not to link together design and manufacturing. 'Drafting', or engineering drawing, is the activity of representing product parts in terms of 'views' in 'two dimensions', such as the 'top view', 'front view' and 'right side view'. Automating the drafting process involves transcribing drawing practices into computer graphics programs and then inserting those programs back into the drawing activities. 2D CAD/CAM is constructed on the image of a drafter at a drawing board (*see figures 1-3*).

Positioning 2D technology between drafters and their drawings modifies the identities of everyone and everything involved. For example, accepting 2D technology means replacing such drafting instruments as 'T-squares', 'compasses', and 'French curves' with various types of 'input devices' (keyboard, mouse etc.), 'display devices' (various types of cathode ray tubes), 'output devices' (printer, plotter etc.), and 'manuals' for 'hardware' and 'software'. Drawing 'points', 'lines', and 'circles' is replaced by inputting graphical 'primitives' and 'attributes' through combinations of programmed 'transformations' and 'control routines'. Drafters do not have to 'write' their programs as lines of computer code, because the 2D programs all name their commands and options using the old vocabulary of points, lines, circles, etc. But the precise relationships among these old terms change in the shift from drawing board to computer scope. These relationships also vary from program to program.

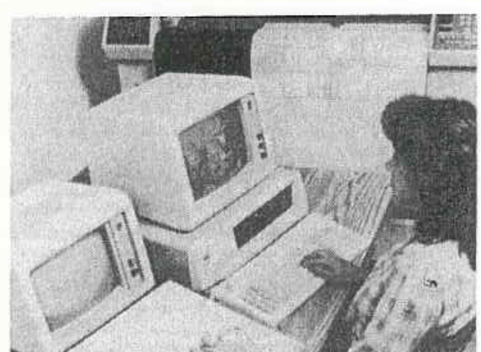
Drafting automation has been the most popular CAD/CAM technology by far. Using 2D programs can increase dramatically the speed of repetitive tasks, such as making changes to drawings. However, within the nationalist script 2D technology is incomplete. Drafting automation is not positioned to integrate design and manufacturing, for the model of a drafter at a drawing board captures and transcribes none of the practices on the manufacturing side of product development. Fur-



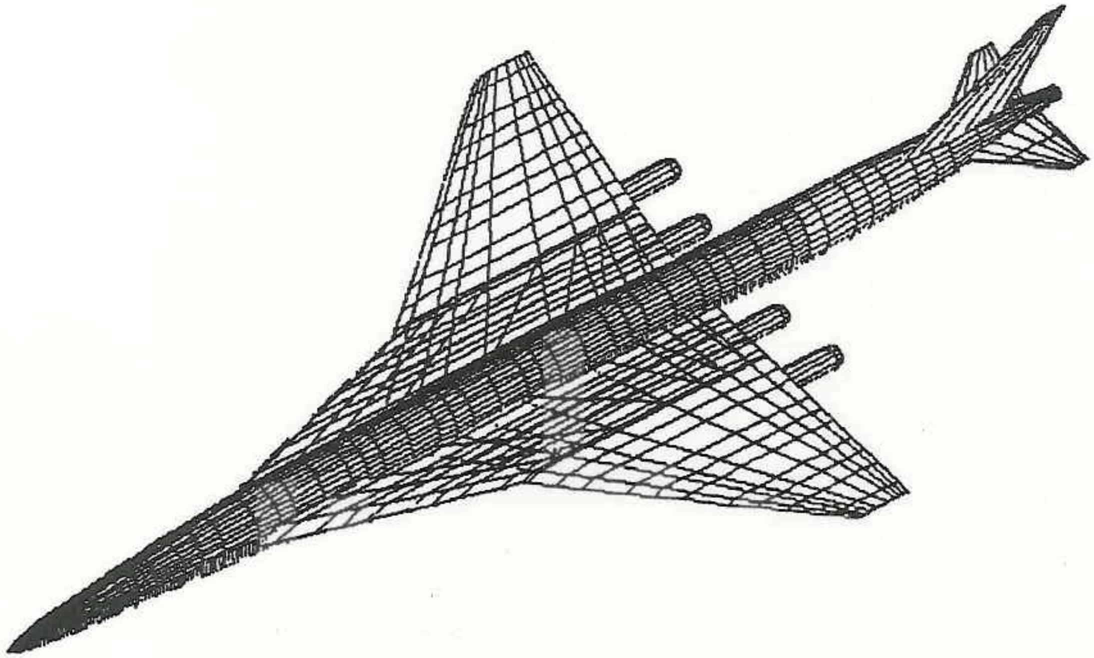
*1. **2D drafting**: from a training manual. The original caption reads: 'The compass is used for drawing circles'. Note the presence of the human hand.*



*2. **2D drafting**: a 2D drawing in three views: can you visualize the object depicted by combining the three views?*



*3. (far right) **2D drafting**: a drafter working on both a keyboard and a drawing tablet. The computer image is transcribed into the printed drawing included in the background.*



*4/5. **3D wireframe/ surface**: a sequence of equations which forms part of a standard method for 'optimizing' a design (above, surface model of an airplane) according to sets of engineering specifications.*

Find $\bar{S}$ to maximize β

Subject to

$$\nabla F(x) \cdot \bar{S} + \beta \leq 0$$

$$\nabla G_j(x) \cdot \bar{S} + \theta_j \beta \leq 0 \quad j = 1, 2, \ldots NAC$$

$$\bar{S} \cdot \bar{S} \leq 1$$

where

$$\nabla F(x) = \nabla W_g, \quad \nabla G_j(x) = \nabla V_R - 0.5 \nabla V_W,$$

and $G_j(x) = V_R - 0.5 V_W$

thermore, redistributing agency through 2D technologies can even separate drafters and drafting activities from the other design activities of engineers. For example, in one firm I observed, engineering managers sought to maximize the output of expensive CAD equipment by having operators use it two shifts a day and on weekends, while design engineers worked only weekdays. Also, competition between drafters and engineers for use of the CAD equipment was high until the engineers obtained additional equipment that was better suited to some of their mathematically-based activities.

3D wireframe and surface modelling

The technologies of 3D wireframe and surface modelling also have little connection to manufacturing, for these are endowed with the agency of 'engineering analysis', a mathematically intensive activity exclusive to design. 3D technologies present visual 'models' of discrete objects suspended in three dimensions. A wireframe representation of an object constructs it as a collection of lines depicting the object's 'edges'. A surface model represents an object as a set of curved surfaces, which may or may not be linked together to produce a closed object.

The image of an airplane presented here is a surface model that some informants use to represent their CAD/CAM research group. Since it is a surface model, engineers could add shading or colour to give the image a sculptured look. The model could also be presented as a wireframe by using lines only to portray the edges of its components.

Moving from 2D to 3D transforms a drawing into a model because it adds a great deal of engineering information to the representation. Design engineers are interested both in the graphical picture and in the geometric data about the picture that are stored in the computer. They use these data to 'do analysis' on the model, which involves inserting the model into theoretical systems of 'forces'. For example, using additional data about materials, engineers analyse the surface model of the airplane by calculating its 'volume', 'weight', 'centre of gravity' (location of the balance point), 'moments of inertia' (a measure of how easy it is to rotate the object in different directions, e.g. it is easier to roll an airplane over sideways than end over end), etc. They further link the geometric model to theories of 'aerodynamics' (how moving objects interact with airflow), propulsion (how engines produce changing forces) etc., to identify shapes that meet design limitations in each area. The equations presented visually represent the agency involved in calculating acceptable shapes. By including these equations in the computer program that generates the geometric model, engineers empower the program with the agency to find acceptable shapes.

By possessing the agency of engineering analysis, 3D technologies intersect with activities in research and development ('R&D'). As a consequence, 3D technologies tend to find use among engineers in larger corporations and in university research, who already tend to use computers for analysis activities. Also, since 3D technologies tend to be added to existing analysis activities, the burden of developing and modifying programs in wireframe and surface modeling falls much more on the shoulders of engineer-users than is the case with 2D technologies, in which commercial vendors compete to sell 'packages' to automate drafting.

3D representations make it possible for engineers to consider more than one type of analysis simultaneously, thereby concentrating more and more design functions at earlier and earlier points in the design process. Thus, although 3D technologies extend beyond drafting into other design activities, these do not seek to merge design activities and personnel with activities and personnel in manufacturing. In fact, some informants have reported that the use of 3D CAD/CAM sometimes raises suspicions and fuels concerns in manufacturing circles about the hegemony of engineering design.

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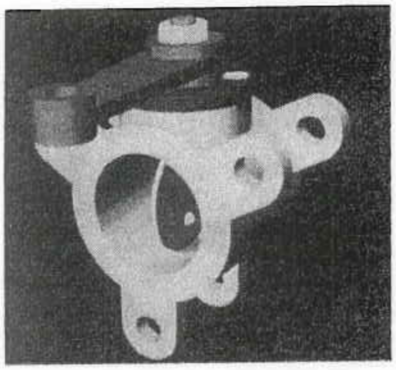
6. ***Solid modelling**: a solid model constructed using the method of constructive solid geometry. All the intersections are very sharp, for this method cannot represent smooth corners or 'fillets'.*



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Solid modelling

Not only has the technology of solid modelling not been positioned to fulfil the nationalist script, it has been much more successful in areas unrelated to industrial productivity, e.g. animation in movie films and simulators for pilot training. As a form of 3D modelling, solid modelling also manipulates discrete objects. It differs by representing these objects as solids rather than as wireframes or surfaces. For example, the method of 'constructive solid geometry' builds models by adding and subtracting 'primitive' solid forms, such as 'spheres' and 'cubes'. Consider for example, the model illustrated here of a pipe valve constructed of chunks of 'cylinders' and 'rectangular solids'.

Solid modelling appears at first glance to be the perfect integrative agent for merging design and manufacturing activities, since it is the representational form closest to the concrete objects that manufacturing processes manipulate. However, solid modelling tends to lack crucial features of the activities in both design and manufacturing.

On the design side, solid models are very useful for making sure that the product parts have enough space after these have been designed, i.e. for 'interference checking'. However, solid models are extremely difficult to modify in the light of the results of analysis. They do not intersect easily with the activities of either design engineers or drafters.

On the manufacturing side, engineers tend to turn to computers with a 'process' orientation, seeking help in monitoring, controlling and supporting manufacturing processes. Manufacturing engineers are interested in such areas as 'cost estimating', 'quality control' and 'production planning'. Although solid models may link the geometric representation of a part to instructions for specific manufacturing 'cutting' operations, such as 'milling' and 'machining', such models usually possess none of the other agencies in manufacturing beyond cutting.

Blurring the boundaries of anthropological discourse

By concentrating design activities at earlier and earlier points in time, the development of 2D and 3D CAD/CAM technologies are positioned to enhance the activities of engineering designers and drafters in product development. The power of an engineering designer increases in proportion with each engineering capability added to the graphical image. As product development activities move 'upstream', so the identity and concerns of engineering design are extended 'downstream' into other areas. This outcome differs significantly from the utopian image of national integration that draws on technological determinist presuppositions and that has helped legitimize CAD/CAM development. Endowing interactive computer graphics with the agencies of engineers has proven successful only where those agencies involve manipulating pictures and models of objects. Merging design and manufacturing requires inventing new agencies that go far beyond the manipulation of objects.

By following how technologies acquire and redistribute human agency within society, anthropological enquiry can overcome the discipline's unstated reliance upon a presupposed cultural distinction between technology and society and follow sociologists of technology in viewing technologies as active participants in social life. Writing about human agency within technology does indeed threaten to externalize one's analysis from normal human-centred anthropological discourse, but avoiding such agency also inhibits the analysis from offering interpretive understanding of technology in society. In my judgment, the response must not be to ignore human agency in technology but to challenge the existing forms of discourse. A crucial first step in blurring the human-centred boundaries of anthropological discourse is to grant membership to the cyborg image, i.e. to recognize in our writing that human actors routinely produce themselves and their machines as part human and part machine, and that machines have positioning strategies too.

It is increasingly clear that human agency serves in the world today as but one contributor in a system that is growing, complex, diverse and yet interconnected. The extent of such interconnectedness has been made plain by both the decline of challenges to capitalist hegemony and the empowerment of information technologies through the combined agencies of computers and communications technologies. If the world system is not systemic but diverse, e.g. if capitalism is not singular but plural, the interaction of capitalisms, then it is safe to say that no one person or framework understands it. Instead, understanding it must come in pieces, exploring the variable production of such pieces through diverse strategies in diverse environments. One need reflect only on the multiple pathways to nuclear warfare that dissolving the Soviet Union has produced in order to realize that ignoring agency in technology places too great a restriction on contemporary enquiries into the human condition.

The anthropological study of human agency in technology can also serve as a critical voice that outlines the limitations of native technological determinism. Anthropological criticism can help humans in society recapture their agency by identifying the social judgments that constitute technological developments as indeed social judgments. For example, Americans might find more satisfying solutions to their identity crisis if they asked 'What is the nature of this identity crisis and what are the implications of dealing with it in alternative ways?' rather than 'Which technologies will help America win?' Rather than asking 'Which technologies can best stimulate productivity?' they might ask 'Is developing new technologies to stimulate productivity the most desirable course of action?' While focusing on how to adapt to technology developments that are themselves taken for granted, Americans sanction significant social changes, such as the rise of joint ventures in R&D and other cooperative activities among government, industry and universities, without the kind of overt public debate that genuinely identifies and assesses their implications. By examining the empowerment of technology with human agency, anthropology can also empower itself. □