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# The Organisational Challenge to New Technology

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*This draft was part of a larger investigation of the interrelations between technological innovation, business process and strategic choice. We hope to make some of these materials available in the near future*

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Bureaucracy is nothing more or less than order in human affairs and discipline in workshop, office institution, and any place where administration is necessary to get things done...Without it, nothing gets done in any meaningful way. When things get done, records must be made. Work is divided, orders are given and received, and authority is distributed. Management is such an arrangement in which authority is used and work gets done. The situation is one both of discipline and self-discipline. (Nels Anderson, *Dimensions of Work*, New York, McKay, 1964, p. 56)

## INTRODUCTION

It is quite usual these days, for management gurus (Druker (1997), Peters (1997), Handy (1991)) to base their analyses of the ills of modern organisations and their recipes for renovation on a critique of bureaucratic forms of organisation. Bureaucracy, we are told, is inefficient, ineffective, inflexible, and incapable of coping with changing circumstances. The new digital information and communication technologies currently being developed will fundamentally change the conditions within which organisations will have to exist and, as a result, we will have to explore whole new organisational paradigms. While all of this may be true, we should not overlook the very evident fact that without the extensive bureaucracies around us, much of what we take for normal life would be impossible. The organisations we work for would not be able to pay us; the stores we buy our goods in would not be able to supply us; and the states we reside in would not be able to govern us. The question is not whether we will have bureaucracy in the new world being created through the new technologies but how much of it we will have and under what circumstances its needs will override those of others. Given this is the case, it would be as well before trying to assess the claims the authors mentioned just now and many others make about the likely forms which organisations will take over the next decade or two, to understand the set of circumstances within which bureaucracies arose and the characteristics which they took on in the face of those circumstances. Once we have that picture firmly in view, we will be able to make more sense out of the prognostications of organisational change which seem to abound in the management science literature these days.

## BUREAUCRACY AS FORMAL ORGANISATION

The most famous account of the origin and development of bureaucracy is undoubtedly Weber's analysis of the ideal type of formal organisation (Weber 1978, *Economy and Society*, vol 2, University of California Press). Before we get on to the detail of his account, we should reflect a moment on the exact nature of that formulation – *the ideal type of formal organisation*. Were we to do so, we would almost certainly avoid most of the more usual and more misguided criticisms aimed at Weber's analysis.

First, as with all of the rest of Weber's sociology, the interest in bureaucracy derives from a concern for the origin, development and consequences of a particular form of ratiocination, namely *rationalism*, the instrumental rationality associated with modern Western societies. Weber traces this rationality from its origins in the disenchantment of the world characteristic of the religion of the desert tribes of Israel (cf. Weber *Ancient Judaism*) through to its current manifestation in the social structure of modern society. Bureaucacy in modern society is of interest because it is the apotheosis of instrumental rationality. In non-Western societies, the bureaucracies which have appeared have been distinctively different. The modern bureaucratic systems which most interested Weber were those of Governments, the Catholic Church and large scale business enterprises. Hence, one of his major concerns was with the relationship between this organisational expression of instrumental rationalism and other ways in which the same rationalisation was expressed in political and legal systems, in the structure of the marketplace, and so on. (Weber ? Society Vols I and II) Modern bureaucracies were to be compared with the Governmental systems of Ancient Egypt, Mesopotamia, and Mandarin China.

Second, to enable the teasing apart of these differences, the description which Weber offers is an *ideal type*; that is of a picture or model of organisation which is deliberately abstracted from empirical conditions. Weber is not trying to describe any particular organisation, or even groups of organisation, but their formal properties. In that sense, the ideal type of bureaucracy functions in Weber's account in much the same way as the ideal type of the perfect market does in Adam Smith's *The Wealth of Nations*. In his usage, *ideal* is to be taken as *idealised* or *abstracted*. (Weber, *Economy and Society*, Vols I and II.)

Third, bureaucracy is defined by Weber as a form of *legitimate authority* for the exercise of power. He sees just three types of legitimation: those which are based upon personal authority – charisma, tradition and that which is based upon rational rules.

*The "validity" of a power of command may be expressed, first, in a system of consciously made rational rules (which may be either agreed upon or imposed from above) which meet with obedience as generally binding norms whenever such obedience is claimed by him who the rule designates. In that sense every single bearer of powers of command is legitimated by that system of rational norms and his power is legitimate only insofar as it corresponds with the norm. Obedience is thus given to the norms rather than to the person. (Weber, p 954)*

Bureaucracy is the form of authority defined by rational rules. By developing an ideal type and then using it to callibrate particular forms of bureaucracy, Weber wanted to be able to compare the actual complex systems of bureaucracy which have been found in different historical periods.

Finally, Weber's description is of a deliberately idealised type of *formal organisation*. Like those before him, Weber is very aware of the significance of the 'informal' (what he called the non-formal) in administrative and other organisations. He recognised that to get their routine work done, bureaucracies rely on non-formal relationships. However, his argument is that non-formal relationships do not define the particular social form of bureaucracy. It is their formal character which does this. So, for the purposes of describing that social form, the non-formal can be disregarded.

### WEBER'S IDEAL TYPE OF BUREAUCRACY

The ideal type of modern bureaucracy is defined by a number of characteristics:

1. Areas of responsibility and jurisdiction are defined by rules. This leads to an attitude within which bureaucratic activities take on the status of "duties". Second, authority tends to be stable and rule defined. Third, access to the bureaucracy (and hence, remember, to the exercise of legitimate authority) is through routes defined by the rules.
2. The system is essentially one of monocratically organised subordination and supervision—the quintessential form of time management.
3. Management of the system is through the deployment of written documents or "files". The combination of a set of officials, the technology for managing files, and the files themselves constitutes a "bureau".
4. Entry into the bureaucracy depends upon the acquisition of relevant expertise. The bureaucracy is a system of specialisations expressing an administrative division of labour.
5. Compared to other systems, the performance of activities in modern bureaucracies is a full time occupation with office holding being defined as a "vocation" — a term which has a particular relevance in Weber's Sociology..
6. The execution of activities is regulated by the rule set which is stable, learnable and exhaustive. Knowledge of the rules is itself an instance of technical expertise.

The upshot of these characteristics is to create an administrative system which epitomises instrumental rationalism and its "mechanistic", "modern" outlook.

*The fully developed bureaucratic apparatus compares with other organisations exactly as does the machine with non-mechanical modes of production. Precision, speed, unambiguity, knowledge of the files, continuity, discretion, unity, strict subordination, reduction of friction and material and personal costs — these are raised to the optimum point*

*in the strictly bureaucratic administration, and especially in its monocratic form. (Weber, p 973)*

*In contrast to the "notable" performing administrative tasks as an honorific duty or as a subsidiary occupation (avocation), the professional bureaucrat is chained to his activity in his entire economic and ideological existence. In the great majority of cases he is only a small cog in a ceaselessly moving mechanism (ibid. p. 988).*

As I have indicated already, Weber's concern is with the conditions for the emergence of bureaucratic forms. This is the constellation of conditions which I called instrumental rationalism and which is associated with the modern outlook and the capitalist mode of production. However, those conditions are not, of themselves, completely determining. Not every capitalistic organisation is necessarily bureaucratic. Indeed, it might well be argued that entrepreneurial ventures *cannot be*. What then are the structural conditions for bureaucracy? The place which bureaucracy holds in Weber's account of authority will provide an initial clue to his thinking here. Bureaucracy is conceived in contrast to personal (charismatic) and traditional (or patriarchic) authority. It derives from familiarity and expertise with generalised rules not with local particularities. Bureaucracy will emerge, then, when administrative positions are allocated on the basis of this generalised capacity and abstract knowledge and where local conditions require administrators to ensure that this is the primary basis for legitimation.<sup>1</sup> The genesis of management as a career with licensed managers circulating through organisations applying generalised management techniques independent of the actual specific context of the processes to be managed, both induces bureaucracy and serves its needs. Their effectiveness as bureaucratic managers derives, in very large measure, from the fact that they are (in Merton's phrase, Merton, ?, 195?) "cosmopolitans", with no local ties and unlikely to remain long in any one position. It also derived from the relative strength of countervailing forces such as those of local work group practices to resist the imposition of general managerial techniques (see below).

In sum, Professional managers create professional management systems — i.e. bureaucracies.

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<sup>1</sup> Gouldner in *Patterns of Industrial Bureaucracy* describes a case where a manager creates bureaucratic forms of administration in order to legitimise his succession to the executive roles when taking over from the family owner of a business

## STUDIES OF BUREAUCRACY

Detailed studies of traditional office and administrative work remain few. The ones we have are largely adjuncts to investigations of other phenomena such as local politics, transformations in the class and status system, the divorce of ownership from control in capitalist enterprises, labour relations, and the substitution of capital for labour. The best remain the classics of Dalton (1932), Blau (1964), Crozier (1957, 1967) and Gouldner (1957). All these studies stress the variety to be found within bureaucracies, a variety which reflects adaptation to local contingencies and socio-economic conditions. All also stress the importance of understanding "bureaucracy's other face" (Blau 1964) – the patterns of local social relationships which exist within and alongside the formal organisational arrangements. I will return to the importance of this "other face" in a moment.

While it may have been the case the administrative systems created earlier this century to satisfy the need to hold and process centrally huge numbers of paper files were excessively bureaucratic, surely one would have thought advances in management philosophy and information systems have rendered that form of organisation otiose and hence the features outlined by Weber empirically substantiated in the studies just mentioned are disappearing. Etienne Wenger's (1991) recent and brilliant study of insurance claim processors shows this to be far from the case. Data processing and electronic computationally stored databases have created a novel form of what C. Wright Mills (*White Collar*, OUP 1956) called "the managerial demiurge". Naturally there are some obvious and deep differences between Wenger's processors and earlier 'black coated workers' (Lockwood 1957) – a more relaxed California dress code and changed gender representation being the most important, nonetheless at root the work situation of the white collar worker remains much the same. The work is repetitious, clearly circumscribed by rules and hence pre-programmed, poorly paid and felt to require very low levels of skill. Recruitment does not pre-suppose or demand any familiarity with the work and all the skills necessary are provided through brief, on-the-job training. Such training emphasises the formatted character of the work and the need to follow the procedures laid down. Automation of transaction processing on-line report forms and other paperwork, has only increased this formatted and rule bound character. Fields have to be completed before one can scroll windows; information to be included has to take particular forms. Rules extend to attendance at work, length of breaks and conversations, and even the layout of desks. The whole creates an atmosphere of discipline and surveillance which Wenger analogises to school. Indeed, he also makes much play with the consequential infantilisation of processors.

The programmed, production-like character of the work is reinforced by the payment systems which value throughput and quality of completed claims. The need to maintain levels of production and quality creates stresses which in turn induce secondary adjustments (Goffman *Asylums*, Penguin 1961) of a "non-participatory" kind. Many of these appear as the effect of Merton (1957) called 'the bureaucratic personality'. Processors focus exclusively on the local context, on their

team and their office, and have very little sense of identity with the company as a whole. They maintain a clear division between work and non-work. Further, they delimit their interest in their work to just that information which they "need to know". They have no concern with the broader understanding of the place of their work in the whole structure of activities. As is to be expected, given the character of the work itself, there is an objectification of the contents into "cases", a similar phenomenon as seen in hospitals and elsewhere (Eliot Friedson 1975 *The Profession of Medicine*. Dodd Mead New York). Although Wenger does go on to stress the ways in which these secondary adjustments form the basis for the processors' "community of practice" and the deeply innovative ways in which they deal with novel situations and with the need to apply the rules to particular cases (Zimmerman 1971 *The practicalities of rule use in Douglas Understanding Everyday Life*, RK&P, pp 221-38), nonetheless at the structural level, the parallel with the world of Parisian insurance clerks described by Crozier almost 40 years earlier is striking.

*Relations between colleagues are not without influence on atmosphere, but it certainly appears that our office workers remain relatively isolated and on the reserved side, that they have practically no relations outside work, and that they do not form blocs at work. The superior-subordinate dialogue is, in the end, of greater importance in determining work atmosphere than interactions between colleagues.....The administrative world is certainly a world deeply influenced and penetrated by attitudes and behaviour patterns of the managerial classes.....The number of hierarchical levels and the distribution of roles among these levels engenders an atmosphere characterised by lack of realism and fear in human relations, which in turn provokes the need for control and reinforces, in a sort of vicious circle, the organisational system that gives rise to it. (Crozier. *The World of the Office Worker*, pp. 131-2)*

Indeed, this might almost be Knights (1990) a summary of the batch system of manually processing insurance claims which has only recently been replaced by the kind of technology which Wenger describes.

This "vicious circles", which Crozier mentions, are created by the interaction of four aspects of classic bureaucracies: (a) extensive impersonal rules; (b) centralised decisions; (c) strata isolation and concomitant group pressure on the individual; (d) the existence of parallel and ambiguous power relationships around areas of uncertainty; that is those emerging domains within which the rules have not yet been formally specified. As he summarises it:

*By and large, the common underlying pattern of all the vicious circles that characterise bureaucratic systems is this: the rigidity of task definition, task arrangements, and the human, relations network results*

*in a lack of communication with the environment and a lack of communication among groups. The resulting difficulties.....are used by individuals and groups for improving their position in the power struggle within the organisation. Thus a new pressure is generated for impersonality and centralisation, the only solution to the problem of personal privilege. (Crozier. The Bureaucratic Phenomenon, p. 194)*

### THE UNDERLIFE OF BUREAUCRACY

Crozier's view is indeed a bleak one: loss of meaning of work; minimal communication in work; minimal association outside of it. And, although more contemporarily expressed, this is still the world of Wenger's claims processors. Yet, as both Crozier and Wenger readily accept, the *anomie* implicit in the bureaucratic personality does not fully describe the life of the organisation, even where the organisation has legitimate control over the whole range of an individual's life (Goffman, 1961). There is also bureaucracy's other face (C. Page 1948, Bureaucracy's Other Face, Social Forces XXV pp. 88-94). This is the world of goldbricking, make work, rule bending, banana time and all the other rites, rituals and social practices which enable people to adjust to the dominating effects of centralised control. But these practices do not simply open up social space. They also are the devices by which, Donald Roy (195?) in breach of the rules, members of organisations conform to the rules, in getting things done, in ensuring consistency of workflow etc etc. Numerous studies have identified these ways of *making out*. (Bittner Keeping the Peace, Van Maanen 1986, Handleman 1976). Wenger picks out the ones he noticed in the organisation he studied (Alinsu) by calling them modes of achieving "identities in participation". Others talk of the informal group and the informal organisational culture (Pettigrew, Frost, Moore et al (198?, 198?) or of organisational slack (Simon and March 196?). In each case, the descriptions offered provide a *functional* rationalisation for the apparently dysfunctional activities in question. It is here that the essential flaw in the formalised instrumentalism at the heart of the application of scientific management techniques to administrative activities (and others too) is to be found. As Peter Blau trenchantly put it as early as 1964:

*To administer a social organisation according to purely technical criteria of rationality is irrational, because it ignores the nonrational aspects of social conduct. (Blau Bureaucracy in Modern Society, 1964, p. 58)*

It seems we are only now (and to judge from Wenger's account by no means universally) coming to recognise that blunder and to seek organisational forms which more fully match the duality of organisational life.



What the new communication technologies are doing because they exacerbate the flux in the organisations environment is bringing us face to face with this blunder.

### THE SEARCH FOR THE NEW ORGANISATION.

The rationale for bureaucracy is stable, efficient and calculable administrative outcomes. As the environment within which the bureaucracy subsists changes so the organisational structure has to adapt. Failure to adapt will lead to inflexibility, maladjustment, error and ultimately dissolution – the woes with which we started. According to Crozier, because of the relative lack of internal and external communication, bureaucracies are unable to predict change and so gracefully adjust to it. Instead, if they adapt at all it is through rapid mutations which lead to high levels of turbulence and anxiety.

*In a normal case,....(t)here is a constant feedback of information that permits and even obliges the organisation to take account of its errors and to correct them. We shall describe as 'a bureaucratic system of organisation' any system of organisation where the feedback process, error-information-correction, does not function well, and where consequently there cannot be any quick readjustment of the programmes of action in view of the errors committed. In other words, a bureaucratic organisation is an organisation that cannot correct its behavior by learning from its errors. (Crozier p.187 Bureaucratic Phenomena)*

Where the process of change is continuous, bureaucracies are, by definition, both inefficient and ineffective. Many have argued this to be the prevailing condition of modern societies, In an early discussion of what he termed "the end of the stable state", Donald Schon (1970) commented

*.....while technological change has been continuing exponentially for the last two hundred years it has now reached a level of pervasiveness and frequency uniquely threatening to the stable state. And while all technology is more or less disruptive, the implosiveness of the vein of technology mined in the last half-century has made it uniquely disruptive. (Schon 1970 p. 27-8)*

On Schon's argument, then, the loss of stable state can be thought of as a function taking at least two arguments, the technological and the organisational - the latter involving both the organisation of innovation and the development of adaptive organisational systems. Reactions to the new condition express the same two elements. Enterprises and Local and Central Governmental agencies have sought to use technology to create new organisational forms. In manufacturing we have seen what are called "post-Fordist" production systems using automation and intelligent

control systems to replace labour-intensive assembly lines, JIT and allied techniques, lean distribution, and so forth. Within administrations, the same movement can be discerned in ?? management, self organising work groups, high performance work systems and the like, although it has been slower to evolve.

In seeking to apply computational and associated technologies to automate as much as possible of the information management function of administration, many managers were essentially reacting in an extrapolative or dynamically conservative way. They were seeking to re-attain the previously existing equilibrium by continuing existing practices in new ways. Change was not to involve structural transformation but simply to deliver gains through economies of speed and scale which would allow the organisation to cope with its changing environment. As Knights (1990) points out for the insurance industry these initial primary gains are easily identified. Automated and networked systems will allow increased transaction speed, reduced errors, faster billing, universally accessible data, instantaneous updating of centrally held information. In addition, by allowing processors to control their own work load, they are expected to have an increased sense of autonomy and responsibility and with it a reduced level of frustration. The same first order gains have been set out for electronic mail and communications systems supporting group decision making (Sproull and Keisler(198?) (1992) Wallace Brave New Workplace), computerised crimes reporting (Harper 1990) and many more. Any measurement system for determining the relative productivity gains of any innovative or other technology – or indeed and business practice itself – is an operationalisation of a model or theory of the emergence of value. That is to say, such a system is premised on some account of how the combination of the various factors of production creates the added value of the product. This combinatorial gain provides for added-value as the emergent property of the process of combination. In classical Economics, since this combination is brought into being by the provision of Capital, then it is to Capital which the return on added-value should return. Against this view, of course, are those such as Adam Smith and later Marx, who argued that use value (net added value) derived from the application of labour power. Whichever account one holds, the added-value is extracted (which is why Marx thought of it as "exploitation") as "profit" of some kind or other. The point of productivity measures is to determine how much contribution any specific practice makes towards the creation and realisation of this profit.

In the classical model, productivity derives from the efficient use of capital and is expressed as the ratio of value inputs to value outputs. To enable comparisons, these are expressed in a common metric (price/cost). So productivity is, crudely, the ratio of the cost of production to the price of goods sold, aggregated for the foirm as a whole. The approach which is adopted is to treat the

production process as analogous to a mechanical system. The aim is to invert the laws of thermodynamics by having greater output value than the value of inputs (hence the problem of defining where the value came from). This can be achieved, again in the classical model, by *minimising* the costs of production (the value of inputs) and/or by *maximising* the level of output.<sup>2</sup>

The model applies very directly to production and extraction industries, where it is possible to measure (actually *count*) output because the outputs are tangible. It is also possible, although not quite so easy, to apply the notion to service industries. Where it simply breaks down is when it is applied intra-organisationally to the administrative and non-directly productive components of the firm. And yet it is here that the claim is being made that computers can offer great gains in efficiency.<sup>3</sup>

Strassman suggests that to determine the contribution which computation has made to management, we need a way of measuring management added value™ and hence of constructing an index (Return on Management) for comparing firms which have made such investments. The argument is, simply, that the capacity to defy the laws of thermodynamics and generate added value derive from a management's ability to reverse the entropy law in information systems. That is, management is able to add value to the information it receives through interpretation, contextualisation and so on. Overall, then, managerial efficiency is expressed by a relative reduction in the consumption of information (entropy) for any level of organisation.

The question is: Has all the investment in computing enhanced management's power to achieve these information gains? His survey (pp 86ff) indicate that (not surprisingly) things are hardly that straightforward. From the spread of firms which Strassman studied, his overall conclusion is that those with a high return on management generally invested less in computing. But there are several sub-conclusions to be placed alongside that.

First, the high achievers tended to spend less on systems to support management and more on operationally defined systems, especially *mission critical* systems. However, where there was investment in managerial support systems, for high achievers, this generally was accompanied by a commensurate reduction in management overhead, a condition which was absent in other groups. Additionally, overachievers tended to be smaller, have shorter spans of control and lines of communication.

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<sup>2</sup> For an extensive review of the place of the laws of thermodynamics as the model for marginalist economics, see Philip Mirowski *More Heat than Light*.

<sup>3</sup> There is an important point to note here and that is the separation of embedded computation from what we might think of as "document processing" and its equivalent. The value of investing in embedded computation in "smart tools", computer integrated manufacturing, robotics and the like can all be measured in the standard ways. Strassman is concerned only with measuring the value of investment in computer systems to support administration and management.

The most significant conclusion of Strassman's study, though is summarised on p 156.

*Overachievers can rarely sustain their elevated profitability positions...To sustain abnormally favorable results calls for a steady stream of innovations so that you can hit a few that produce spectacular results. Extraordinary achievements are possible only by taking large but calculated risks. The overachiever winning strategy is to invest in adventurous applications while plowing technology profits into a steady stream of cost reductions. Overachievers know how to cut costs ruthlessly and without delay.*

However, it is not clear that gains in efficiency are necessarily identical to gains in effectiveness (Bair 1991), (Kling & ??)

While some of these first order gains have been achieved, a number of secondary effects can also be discerned. Kling (198?), for instance, has noted that in some cases introducing automation has led to job expansion rather than de-skilling, while Huutanen and Lemo (1992) report that satisfaction with newly introduced automated systems varies with age and hence experience of the system which was replaced. Keisler and Sproull (199 ? ) note that the character of organisational social and work relations change after the introduction of electronic mail, while Harper (1992) observes that the introduction of HOLMES the computerised crime record system has had significant effects on crime clear-up rates but in quite unexpected ways.

### THE PRODUCTIVITY PARADOX

Despite the arguments set out just now, what is surprising is the extent to which the investment in computational technology cannot be justified by clear evidence of the gains made. Indeed, the secondary effects (and the somewhat anecdotal evidence for them) predominate the discussions, so much so that Kling and Iaconno (198?) talk of an 'ideology of computerisation'. It is this ideology which has led to the massive investment in computational and communications technology within the service sector (Attewell 1991) and the extensive computerisation of administrative and office work. However, despite this investment the documented productivity gains remain meagre, less than 1% per annum in the service sector throughout the 1980's.

A number of reasons for this apparent low rate of return and for the difficulty in measuring productivity effects have been suggested (Kraut et al., Attewell and Rule 198?, Hirschheim 1987, Bair 1991)

1. The introduction of the technology is somewhat disruptive of existing patterns of work organisation so that direct before and after comparisons are not possible. Furniture may

be moved, work groups re-configured, layers of supervision and ancillary workers removed. Indeed, systems are often introduced as part of a crisis strategy in response to the need to reduce labour costs. Hence the gains may have already been discounted. Tasks may be accomplished faster but at greater overhead cost using phone and email rather than face to face conversation. This may lead to communications being more 'shaped' and 'deliberate' (Murray (????) on email "talk"). Finally, the time gains may be deployed increasing the presentational quality of the final product which may or may not add to its effectiveness (Bair 1991).

2. Technology has its own Parkinsons' law. Demand for services (storage space, cpu power) expands to fit the infrastructure available. This creates a demand for overhead expenditure to manage, maintain and enhance the systems. Additionally, new systems are "customised" (Mackay 1990) to be backwardly compatible with the old. Thus electronic systems, for instance, do not replace paper files but duplicate them.
3. Once a system is installed, there is the treadmill of upgrades and hence the constant need for learning time, loss of skills associated with early versions and the like. This loss of skill may be accompanied by a loss of valuable user innovations rendered obsolete by changes to the system.
4. Automation implies a degree of centralised management. This can be expanded by the introduction of the cult of "managing by facts" and "managing by numbers" whereby computational resources are expended in collecting and collating data of the systems functioning.
5. Finally there is the phenomenon of relative expectations. Because it is now possible easily to include detail which once would have taken many hours to find, sift and reproduce, this detail is included.

Closely related to the above rising expectation is the expectation that quality of working life will improve. This does not always happen. Indeed, the user may find their work less satisfying and more stultifying because it is more programmed and less challenging. As Kraut et al found, after the transition, key groups such as supervisors may have to depend on non-technical skills since their basis for authority has been replaced. Additionally, there is the funnel mentality in which the maxim "if something can be done on the workstation then it should be" seems to apply.

### **NEW TECHNOLOGIES: NEW ORGANISATIONAL FORMS**

The shift from paper processing to automation which Wenger (1991) and Knights (1990) describe conforms to the centralising paradigm which Stinchcombe describes (Stinchcome 1990). Efficiencies of time and scale are taken in reductions of labour costs created by the through-put and quality gains. Fewer processors means fewer supervisors. Hence organisational structures are "de-layered" (to use the perverse neologism). The computational systems which were brought in to achieve

these results are just as centralised and centralising as the paper-based technologies which they first replicated and then replaced.

More recently, the computational ideology has shifted towards promoting distributed systems. Emphasis is now placed on the communicative capacities and increased power of a network of computational devices. As processing power is distributed around the network, and hence moves out towards the user, some have argued that the same devolutionary logic will apply to the organisations which deploy these new technologies. Handy (1990), for example, sees three new modes replacing the hierarchical superstructures of most large organisations. In each case, the forcing function creating these new modes is technology. Heller (1990) insists

*The two forces (changes in technology and office function) are working in tandem: the new hardware and software make it possible, and in many respects essential, to change to the new methods of working, to shift away from the old office which (like everything else in organisational life) is a product of historical accident. (R. Heller, Culture Shock. Hodder and Stoughton 1990 p.20)*

What Heller is particularly concerned to point out is the extent to which the communicational aspects of the new approaches shift the application arena away from data processing to information organisation and communication, the classic management functions. No matter who performs these functions (and part of the implication of the "de-layering" is that more and more they will be distributed too) working roles will be much less structured, information and other office systems more integrated, and create an intensity or information denseness which has to be itself managed. In Heller's phrase, design has to be directed to maximising "the architecture of effectiveness".

The views we have considered thus far see the possibility of a networked or "reticulated" (Pava 1986) organisation being created through distributed computational systems and replacing hierarchy with "teaming" is a clear break with that described in Weber's ideal type. Heller describes the situation within Rank Xerox in the following somewhat starry-eyed manner

*Team management "to implement change" is symbolised ...by three pyramids, each in three sections. The first consists, from apex to base, of roles and responsibilities, business processes and activities. Again, from top to bottom, these processes are changed by business development planning, business systems requirements and quality improvement. They lead to the middle pyramid: from apex to base, they are business priorities, strategic value/maturity analysis, and frequency/quality analysis. From here the final pyramid can be constructed: revised roles*

*and responsibilities at the top; then changed business processes; then restructured essential activities (p. 140)*

This vision was the outcome of recognising that Rank Xerox' response to the challenges it faced could not consist of technology alone

*The crux of the office revolution is that culture, or corporate philosophy, must be revolutionised as well. To exploit the potential of information technology for itself and its customers, the management had to lead the cultural revolution, which goes beyond hardware and software technology into the changed working relationships and attitudes that the technology enables. (p. 139)*

However, in many ways, startling and exciting though this move is, it is in truth simply an extrapolative step. It recreates many of the old organisational ways within the structure of the new. Bold though it might seem, it misses the deeply innovative opportunities on offer. In so doing, it is likely to lead to another expression of the productivity paradox just outlined.

The challenge we face is not to retrofit old organisational ways to new technological possibilities (the RX model) but to design new organisational forms and new technologies in tandem. Many forms of networked organisation pay less than lip service to “bureaucracy’s other face” because they are only concerned to ensure information flows within the formally constituted parts of the organisation and hence they are prone to failure. (Miles and Snow. *The Causes of Failure in Network Organisations*. Californian Management Review, Summer 1992 pp 53-72.). To maximise the value to be offered by both the formal and the informal we have to move from thinking about information networks and their technologies to thinking about the world of work and its associated environmental computation.

## ENVIRONMENTAL COMPUTATION

Anyone with only a passing familiarity with journals such as *The Harvard Business Review* and *The Sloan Management Review* can testify that the hyperbole of Heller and Handy has now become conventional wisdom. What is claimed to be a revolution in thinking is taking place in Corporate Boardrooms and Executive Office suites throughout the Western world. Driven along by the need to adapt with increasing rapidity to ever changing marketplaces, Corporations (especially global Corporations) are undertaking major structural re-organisations. No matter whether they choose to re-constitute themselves around major market-specific business divisions (as Xerox, IBM and others have done) or in some other way, invariably, or so it seems from the descriptions which are given, the purpose of these changes is to transform the organisational culture. Whereas the ambition of previous transformations of organisational form was to increase efficiency through increased

throughput, now the ambition is to turn the "lumbering giant" or "ponderous Leviathan" into a nimble, adaptive entrepreneurial, time-based, customer focussed, learning organisation. This list of positive values gives a hint of the diagnosis which provoked this campaign. Compared to their competitors (almost invariably their Far East competitors) these companies feel themselves currently to be inflexible, hidebound and ossified. They exhibit all the traits associated with what earlier we called the bureaucratic personality rather than the entrepreneurial.

The change in organisational culture is seen as both the cause and the consequence of the structural changes which are in hand – what Xerox in its own re-organisation, refers to as the "hardware" changes. According to their proponents, these latter mean a great deal more than flattening hierarchies by reducing the levels of intervening management and pushing down responsibility and authority to those who take the effective actions. They involve releasing the innovative, creative capacities penned up and stultified by bureaucratic organisation. (Brown, J.S., 1992 *Reinventing the Corporation* ???).

As with earlier transformations, the argument has two elements. Innovations in computation and communication technology are to be used as a lever for change. (Brown, J.S. *Reinventing the Corporation*. Harvard Business Review 1991). Technology enables the hardware changes: the hardware changes create the possibility of changing the "software" – the culture. Obviously, technological innovations have been used in this way many times in the past. In fact, modern administrative structures are founded upon innovations in building and paper technologies. However, the transformations occurring at this juncture may be as significant in the long term as those which were associated with the invention of the printing press or the internal combustion engine. (Brown, J.S. *Reflections on the Document*, 1992 )

The technologies in question here are those which form part of the thrust towards environmental or ubiquitous computing (Weber 1991). These terms describe a technology arena where the process of digitization is forcing the convergence of current computing, telecommunications and paper technologies. The applications which will emerge to take advantage of this convergence will radicalise our conceptions in many areas, not the least being what is to be counted as a document as well as what will count as the substrate on which documents may be thought to be written..

The immediate drivers for the convergence on environmental computing are, of course, the developments in the low cost, high bandwidth interconnectivity (ISDN and RF) and the remorseless downward march of the processor cost/power ratio. Now we can think not just in mips but in bips at your fingertips.

At the user level, there seem to be four significant dimensions to ubiquitous computing. First, computing can be conceived just like a utility: it is everywhere and on tap. The network surrounds you. Indeed, it defines an ecology of artefacts which the user can relate to in a number of different



ways. Thinking of it this way is why it might be preferable to think in terms of environmental computing.

Second, within the computational environment, one's computation is effortlessly transportable. Either one can carry one's favoured device and continue to be connected. Or one's environment can always be ready to hand.

Third, this computation is available at almost any scale one can use it - from the wall sized to the post-it sized. It is, or can be, scattered around like confetti and just as taken for granted as paper. Since this is so, the workstation will cease to be the centre of our computational world.

Fourth, the applications which use this computation will present information in a variety of modes using a variety of media. Only a few of them will appear anything like the standard workstation window we currently love to hate. Given this and the previous point means that we will have to break with the paradigms we have developed for designing workstation based interfaces.

What kinds of novel approaches will be facilitated by environmental computing? Here the choice is obviously open. EuroPARC, for example, has picked out three. They are: merging the paper and electronic worlds enabling direct interaction within both; merging the electronic and social worlds to allow co-participation in both; and merging the electronic and everyday worlds to allow natural activity in both. Applications demonstrating these approaches are Digital Desk (Wellner and Newman 1992) - a system for interacting with paper and electronic documents; RAVEN and its associated systems (Gaver et al) - a user controlled media space; and the use of ParcTabs for prospective memory (Sellen 1992).

We intimated earlier that any technological possibility was capable of being used in one of two ways. It could be used to extrapolate (to use Allan Kay's term) existing activities and applications; or it could be used to innovate wholly new ways of doing and thinking. As I have already indicated, much of what is currently happening in user interface design and especially the use of distributed systems within organisations looks more like extrapolation rather than innovation. That is, it expresses a *paper-centric, workstation focussed funnel mentality*.

The applications which are most likely to take advantage of environmental computing are those which are designed with a number of prominent concerns in mind. First they will rely heavily on the embodied skills which we have simply in virtue of our being the kinds of creatures we are. Second, they will seek to gain advantage from the fact that most of what we know, do and learn about in our daily worlds is shared with others. We are not Cartesian-users but social actors. This means that the proper object of our design should not be artefacts or technologies for manipulating data, but systems to support ways of knowing and sharing.

Third, closely related to the above and possibly the most important of all, we have to design for processes not products; adaptation not artifact. We have to presume that the processes we are seeking to support will change and the technologies we offer must be plastic enough to reflect those changes.

### **THE NEW PRODUCTIVITY CHALLENGE**

What will control the choice between innovation and extrapolation: between new ways of doing old things, or new paradigms? I believe that in very large measure this will be the measures of value we use in relation to these technologies. If we evaluate them in terms of productivity as that is conventionally conceived, we are almost certain to take the extrapolative route. On the other hand, a new productivity paradigm might enable us to be innovative.

Our current models of productivity derive, as we all know, from the application of scientific management principles to production processes. Under the somewhat maligned Taylorist approach each job is divided into its atomic tasks and procedures sought to increase the efficiency and effectiveness with which each carried out. The ambition is to eradicate wasted time and wasted effort in order to increase overall output. This way of thinking sometimes known as "Fordism" naturally focuses on the substitution of technology for labour.

In a related discussion, we have seen that Fordism has been applied within document and information processing in numerous ways. Most recently by attempts to automate as much of the data handling processes as possible. In designing these transaction processing systems and office systems we have generally extrapolated from conventional ways of carrying out these activities in the paper-world to the electronic world thereby achieving massive learning gains, of course, but also encouraging potentially debilitating misconceptions as well.

The dilemmas we face in applying post-Fordist technologies within the service sector derive from the fact that the step from production to administration is not a straightforward one. The strategies which work in one will not necessarily apply in the other. Most importantly, the relationship between labour and technology is not the same. In production systems, technology and labour are factors of production and hence substitutable for one another. Hence the logic of automation predominates. In information processing systems, technology is a means of production (a tool). It follows that automation as a strategy for managing the denominator of cost of production can only have limited applicability. This is the primary reason why what early we called "the productivity paradox" seems so intractable. Despite massive levels of investment in computationally based technology, the service sector has not experienced a commensurate increase in productivity. Indeed increases in productivity measured in standardised ways remain embarrassingly low.

The application of the increasingly sophisticated technologies emerging from the convergence I outlined earlier carries a secondary irony. The motivation for investing in technology was and is in part, remember, de-bureaucratisation. However, what we are now in danger of creating is a glass cage to replace the iron cage of bureaucracy within which the instrumental rationalism of scientific management had imprisoned us. Under the new dispensation, the iron cage of hierarchy and specialisation, rule-boundedness imposed specialisation, and centripetal information flows is to be replaced by teaming, participation, empowerment and accessibility. What might well emerge, though, is a different kind of cage - a glass cage whose barriers are technologically facilitated. Instead of teams we get collectivisation; instead of participative innovation we get populist conservatism; and instead of broadcasting of information to give accessibility we get a 'broadgleaning' which allows for increased surveillance. (See Sewell and Wilkinson for a discussion of the latter in relation to TQM/JIT techniques.)

As I say, I do not see the glass cage as an inevitable outcome. However, to prevent it we will have to re-think fundamentally our ways of measuring the effects and purpose of technologies in these kinds of settings. This does not mean becoming totally unconcerned with costs and value-added, quality and many other business-directed requirements. However, we do not follow a decompositional strategy for their assessment (the logic of the atomic task) and instead look contribution at the overall level, we might discover the utility of what March and Simon call "organisational slack". The existence of organisational slack, - apparent inefficiencies, peripherally justifiable activities and what Donald Roy once called "the black arts" of making out and goldbricking (creating 'idle time') are what allow organisations to handle change and adapt to new conditions. One of the design principles for our emerging technologies might, therefore, be contribution to organisational slack and hence to the persistence and adaptability of the organisation. This might make them appear locally to be inefficient or unnecessary and so foolish technologies, but from the point of view of the organisation-over-time their value would be very different. Technologies designed with this in mind might well contribute to the avoidance of what Miles and Snow 1992 have identified as the causes of ?? in network organisations.

A non-decompositional productivity paradigm might encourage us not to focus on task but to focus on experience. As we can see in the exemplar technologies listed above we are now able to manipulate our categories of experience (especially time and space and with VR technology substance too) to create enclaves of organisational slack - social spaces and non-linear temporalities.

## CONCLUSION

- ° The route from bureaucracy to modern forms of organisation has been one motivated by the same instrumental rationalism which gave us bureaucracy. It was the search for efficiency and cost-effectiveness.
- ° The strategies adopted caused us to expel labour from the information production process but without any obvious increase in productivity. This is the extrapolative step.
- ° By all accounts, the challenges we now face require responses of a wholly different magnitude. Marginal efficiencies and cost controls “managing the denominators” will not deliver the transformations required. An innovative step is required.
- ° This is usually described in terms of the need to focus on “time to market” to “speeding up the organisational clock-time” (in Xerox speak) and release innovative capacities and organisational learning.
- ° Environmental computing is a family of technologies which might contribute to this strategy.
- ° However, since the contribution which these technologies might make may actually be hidden through the task decompositional, behaviouralising strategy associated with our standard ways of evaluating the productivity of technologies, we will have to re-shape those measures.
- ° The simple task of replacing efficiency by effectiveness will not itself be enough unless we have sense of the level of organisational activity for which this effectiveness is to be described for. The organisation as a functioning unit not as a cluster of particles. This might make participation and involvement as important to assess as output and cost. That will mean shifting from performance to engagement as the domain of assessment. With computational systems (especially user interfaces) this might mean moving from cognition to experience as the theory for hci and from task to meaning as the research topic.

## REFERENCES

- Anderson, Nels *Dimensions of Work*, New York, McKay, 1964, p. 56)
- (Druker (199?),
- Peters (199?),
- Handy (1991))
- Weber ? Society Vols I and II
- Adam Smith's *The Wealth of Nations*.
- Dalton (193?),

Blau (1964),  
 Crozier (195?, 196?) and  
 Gouldner (195?)  
 Etienne Wenger's (1991  
 C. Wright Mills (*White Collar*, OUP 1956  
 Lockwood 195?  
 Goffman *Asylums*, Penguin 1961  
 Eliot Friedson 1975 *The Profession of Medicine*. Dodd Mead New York  
 Merton (195?)  
 Zimmerman 1971 *The practicalities of rule use in Douglas Understanding  
 Everyday Life*, RK&P, pp 221-38  
 Crozier. *The World of the Office Worker*, pp. 131-2  
 Knights (1990)  
 Crozier. *The Bureaucratic Phenomenon*, p. 194  
 Goffman, 1961  
 Page, C. 1948, *Bureaucracy's Other Face*, *Social Forces* XXV pp. 88-94  
 Roy, D. in *breach of the rules*  
 Bittner *Keeping the Peace*, Van Maanen 1986, Handleman 1976  
 Pettigrew, Frost, Moore et al (198?, 198?)  
 Simon and March 196?  
 Blau *Bureaucracy in Modern Society*, 1964, p. 58  
 Crozier p.187 *bureau phenom*  
 Schon 1970 p. 27-8)  
 Knights (1990  
 Sproull and Keisler(198?) (1992) *Wallace Brave New Workplace*  
 Harper 1990) and many more.(  
 Strassman  
 Bair 1991),  
 (Kling & ??

Kling (1925

Huutanen and Lemo (1992

Keisler and Sproull (199 ?

Kling and Iaconno (198?)

(Attewell 1991)

Kraut et al.,

Attewell and Rule 198?,

Hirscheim 1987, Bair 1991

Murray (???) on email "talk").

(Bair 1991

Mackay 1990

Wenger (1991)

Knights (1990

Stinchcome 1990

Handy (1990)