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ENERGY : A TELECOMMUNICATIONS - TRANSPORTATION TRADE-OFF - : SOME ISSUES

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ABSTRACT

The 1973-1974 energy crisis illustrated the need to address future resource shortages immediately and to consider possible short-term and long-term policies. With complacency still prevelant, failure to take heed of this 'warning' is misguided. This paper examines one possibility, a telecommunications - transportation trade-off, assessing its energy conserving capabilities and the wider ramifications of its potential introduction.

'ENERGY IS ETERNAL DELIGHT'

The immediate and wide-ranging impact of the 1973-1974 energy crisis demonstrated the need for an assessment of the present situation and a formulation of future policies. Most fundamentally, it illustrated the lack of detailed knowledge covering this topic, and it can be suggested that, in general, insufficient time has been given to a discussion of the resource limitations of the social and economic system. Attention here is focused on the transport sector which is dependent on petroleum for 99% of its energy consumption, a level which is increasing both in absolute and relative (to other sectors) terms. Furthermore, as today's anxiety over energy availability is centred on petroleum supplies and that there appears to be no possibility for the transport sector to change to another fuel base in the short-term, a cogent argument can be made for investigating ways of overcoming our dependency on this exhaustible resource. Interestingly, in the foreward of the book, 'A World of Scarcities : Critical Issues in Public Policy', Novick (1976) argues that

> 'The shortage is really in man's ideas and planning rather than the physical limits of non-renewable resources of our globe'.

The relationship between communication and the process of urbanisation is addressed in section two, paying special attention to likely effects of future developments in telecommunication technology. Discussion of areas of implementation in business and at home forms a foundation to consider, in section three, the wide-ranging opinion with respect to telecommunications acting as a substitute for travel in the future ; mention is made that telecommunications may, in fact, generate some movement. Thus, there is an obvious need to examine the wider ramifications of a suggested trade-off between telecommunications and transport, and, in section four, there is some illumination on possible alterations to

the present-day way of life. Specific concern is with potential increased strain on man, potential changes in the spatial configuration of urban areas, and certain significant equity issues. Following on from these questions, in section five there is a brief analysis of how the widespread introduction of telecommunications could be achieved.

Concern with such issues arises because societal development has mirrored the relatively cheap and abundant energy available in recent times. To a certain degree, in fact, man's history can be seen through his achievements in harnessing energy. Consideration of a telecommunications-transportation trade-off necessitates a futuristic outlook of the possible impact of telecommunications on society, something which has formed the basis for a number of well-known novels. For example, Edward Forster's 'The Machine Stops' projected a society in which movement had nearly ceased, and George Orwell's 'Nineteen Eighty-Four', containing broader ramifications, presented a nightmarish vision of the world divided into three totalitarian super-states, who are continually at war with one or both of the others. In the state of 'Oceania', the image that 'Big Brother is watching you' is maintained by the 'Thought Police'. To some extent, the majority of projections contain aspects which seem intuitively unconvincing, but the reader still seems to be left with unfading impressions that there may be a grain of truth in what has been written.

With these thoughts in mind, we progress to a discussion of some significant facets of the potential energy conservation arising from a trade-off between telecommunications and transportation. Although detailed information about the relative consumption of energy by transportation and by telecommunications is not available, there is some evidence to indicate possible savings in energy by expanding telecommunications. Nilles, et al. (1976), for example, cite one investigation which demonstrated that, assuming

all petroleum imports into the U.S.A. were consumed by motor cars, a switch of 11.8% of urban commuting to 'telecommuting' in 1975 would have removed the need to import petroleum.

2. URBANISATION AND COMMUNICATION

Relationships between the processes of urbanisation and communication deem it necessary to examine possible impacts of recent developments in telecommunications, extending beyond wholly energy-related issues to the broader societal implications.

Meier's (1962) exposition of 'A Communication Theory of Urban Growth', reflects the intrinsic relationship between the communication and urbanisation processes. 'It is no overstatement to assert that the people in urban areas are preoccupied with communications', and, particularly in the past when the tyranny of physical distance acted as a great impediment to human interaction, proximity facilitated easy face-to-face meetings. As communications' technologies advance, any necessary relationship between physical distance and total interaction will increasingly break down, and perhaps remove the city's fundamental function of facilitating information exchange. Webber (1973) and Wise (1971) reason that developments in communication systems are only one of a number of current forces which are simultaneously eroding the 'traditional' features of the city :

> '... it is fostering increasing cultural pluralism, it is triggering an unprecedented national integration that in turn will continue to erode the localism that has characterised human societies throughout history'. (Webber, 1973).

Recent technological developments in the fields of computers and electronics have resulted in a growth in the application of telecommunications for the absorption, conveyance and storing of information. This has been facilitated by the changing industrial structure which is becoming

increasingly service/information processing orientated. Present technology's practicability is, in general, not in doubt ; application is limited today partly because possible operators are unaware of the availability of such equipment. For example, Nilles (1979) recognises that the market, rather than the technology, is the uncertainty with respect to the future use of 'personal computers'.

Some authors, such as Hiltz and Turoff (1978), have suggested openings of extending this into the home ; parallels to computer conferencing may enable people to communicate to each other via terminals present in the house. An earlier example of taking such notions to an extreme is given by Wise's (1971) portrayal of an electronic evening together, in which travelling was not required, and by the situation where a perfect electronic simulation of an event, such as the quadraphonic recording of an opera, may be more satisfying than the 'real' experience itself. However, as nothing can exactly replace face-to-face social contact, one must question, in analyses of the opportunities for conserving energy, the true extent to which man will accept such changes ; there is much evidence on human relations development suggesting the close relationship with physical togetherness.

Perhaps some insight can be gained from the famous research of Mayo and his Harvard colleagues into the affect of social factors on employee motivation and satisfaction. The so-called Hawthorne experiment demonstrated that informal linkages played a significant role even in the context of the formal organisation, and active, not purely mechanical, participation generated interest among the workers. With respect to the potential increased employment of telecommunications by man, it begs the question of who/what is the means and who/what is the end. Is primary concern with what is good for man, or is it with the achievement of whatever is feasible technologically? With the possibility of an enormous change in the way of life through

the use of telecommunications, there is an inordinate need to assess the wide-ranging implications of various forms of social structure, which, obviously, are of paramount importance in our future survival.

Excessive developments of telecommunications are likely to cause immense problems as a sense of personal identification, privacy, and security is removed by a rather mechanical, machine-mindedness. As is widely recognised, the maintenance of a balance of human interaction in both 'proxemic' (small-scale) space and 'distemic' (large-scale) space is essential (Hall, 1966). The former seems impossible through the medium of telecommunications, and, therefore, whilst the telecommunications-transportation trade-off presents potentialities in energy conservation, it cannot be pictured as a panacea.

This issue of energy conservation via telecommuncations was raised when Dickson and Bowers (1973) drew a comparison between travelling for face-to-face gatherings and the employment of a videotelephone. Energy consumption through physical movement was depicted as greater than that used by a video-telephone, and energy utilised in the construction of transportation infra-structure (a feature often neglected) was also greater than the corresponding figure for a video-telephone system. Furthermore, the expansion of tele-communication applications would seem to be also environmentally beneficial in that air and noise pollution accidents, and so on would be reduced. In addition, an alteration to telecommunication technology would involve a change in the sort of final energy required; the need for electricity should enable coal to ameliorate the present, impending worry over petroleum supplies; (obviously, some adverse environmental impacts are probable from such a substitution).

However, as transport costs today represent a relatively small proportion

of total operating costs, there is little inherent force for a widespread change-over to the use of telecommunications. This illuminates that the practicability of any trade-off is wholly dependent on its acceptability, and, therefore, whether it is perceived to be in the self-interests of an individual, organisation, and so on.* Perhaps some sort of regulatory measures, such as petroleum rationing, or investment incentives for telecommunications equipment are required. Moreover, a more fundamental point is that although telecommunications appear to be more energy efficient than travel, once again it is apparent that other aspects of the ways of conducting our lives must be contemplated - today we are living in a motorised civilisation.

3. TELECOMMUNICATIONS - THE SUBSTITUTE FOR TRAVEL

The degree to which energy savings may accrue is, obviously, dependent upon how efficacious telecommunications can unfold as a substitute for personal contact. The literature mirrors a full spectrum of feelings on this topic. At one extreme, there is a belief that new telecommunications technology may enhance the efficiency of processing information but will have little impact on the city's way of functioning. On the other hand, there is the suggestion that the tyranny of physical distance will be completely erased and telecommunications will connect everybody together. A full continuum of viewpoints, of course, exists between these limits.

It must be realised that telecommunications cannot act as a substitute for all travel. For example, whilst it offers assistance in the direction of reducing the number of trips to participate in meetings, it would seem

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* I am grateful to Professor Jack Nilles for expanding on this point from his personal investigations.

to have little opportunity to reduce aggregate goods movement. Whilst telecommunications presents a medium for repetitive, routine occupations and information conveyance, it seems unlikely to be able to offer a conducive environment for bargaining requiring personal contact. In addition, it is doubtful whether certain activities which incur travel, such as shopping and leisure pursuits, will be replaced by telecommunications, and they may increase in incidence as society becomes more leisure-orientated.

It would, however, appear that an extensive utilisation of telecommunications in the information industries would reduce energy consumed during travel, both to and from work and within working hours. People could work at neighbourhood information processing units ; a network of local centres covering the urban area, connected by telecommunications, would reduce the distance between home and work. Energy savings could be further increased if fully-occupied local, public transport systems operated, replacing the privately owned motor car. One outgrowth of such alterations in urban form would be to reduce the congestion on the roads, particularly during the rush hours. This would not only have positive effects on polluting exhaust emissions, but would also increase the energy consumption efficiency of the vehicles as the traffic flow would improve. Taking the argument further (although it is not likely to be extensively introduced prior to the 1990s) 'Telecommunications for Metropolitan Areas : Opportunities for the 1980s' foresees people's homes becoming a cottage industry type 'communications and information centre'. (Marsh, 1979). Such a thought, however, is not alien to contemporary academics, authors, doctors, journalists, politicians and so on, who do a relatively large proportion of their work at home. Greater knowledge of the local availability of goods, services, jobs and so on for residents may be one example of how information processing efficiency may assist in the direction of energy conservation.

There is a more significant aspect which requires stressing. It is of fundamental importance to appreciate that although the telecommunications-transportation trade-off option does offer a way of reducing certain travel, it also generates a demand for contact through other media, (and therefore increases energy consumption).

For example, as the demand for transport continues to expand, the increasing use of the telephone, which acts as a substitute for some face-to-face meetings, has not caused a significant decrease in aggregate travel (Short, et al., 1976). In addition,

> 'The expanded 'conceptual space' which electric media provide can also be related to man's movement. No doubt, being aware of more different places increases the urge to travel to those places to realise one's expectations and to match the awareness with experience'. (Wise, 1971, p. 27).

In fact, the inherent characteristics of telecommunications mean that

> '... it is erroneous to believe that this new dimension, allowing the possibilities of substitution for movement, will mean the transplantation of one phenomenon for another'. (Wise, 1971, p. 27).

Wise (1971), in an exploratory analysis of the 'Impact of electronic communications on metropolitan form', offered tentative estimates of the magnitudes of 'induced' and 'substituted' movement in the future metropolis (see table 1). It was judged, for example, that commuting would fall by 20%, but social travel (as leisure time would be greater) would increase by 30% as a proliferating desire to participate in non-home-based recreational activities would offset induced home entertainments based on advanced electronic equipment. (Note, also that increasing automation, in general, may increase unemployment). Interestingly, Wise (1971) predicted an overall increase in travel with the influx of telecommunications; he concluded that

> 'Although the use of telecommunications will substitute for movement in many instances, the substitution does not

SPECULATION ON THE TYPES OF SUBSTITUTION IN THE FUTURE METROPOLIS

RELATIVE INDEX OF TRIPS BY PURPOSE	INDEX: 1965	INDUCED MOVEMENT	SUBSTITUTED MOVEMENT	NET CHANGE IN FREQUENCY OF TRAVEL BY PURPOSE	RELATIVE INDEX OF TRIPS BY PURPOSE FOR THE 'ELECTRONIC FUTURE'
FROM HOME					
JOURNEY-TO-WORK	21.6	-	-20%	-20%	17.3
PERSONAL BUSINESS	16.8	+10%	-10%	0	16.8
SOCIAL RECREATION	16.6	+40%	-10%	+30%	21.6
SHOPPING	15.0	-	-5%	-5%	14.4
EDUCATION	8.0	+20%	-5%	+15%	9.2
NON-HOME BASED	22.0	+10%	-10%	0	22.0
	100.0 trips				101.3 trips

TABLE 1. (Wise (1971, p.29))

> occur without an equally important expansion in the number of trips made. It can, in fact, stimulate physical movement in many ways, both directly or indirectly ...' Simply, '... electronic communications may alter the purposes of travel but not necessarily the frequency'. (Wise, 1971, p. 30; italics in the original).

4. SOCIETAL RAMIFICATIONS

As changes in the way of life seem likely, it is essential to consider the significance of the role of telecommunications, not only with respect to any possible energy savings, but also with respect to the broader implications for the structure of society. For example, in their illumination of the societal impacts of the possibilities of a telecommunications-transportation trade-off, Nilles, et al. (1976) were anxious to spotlight that the best course of action may not necessarily be to follow 'traditional' ways of life. Yet take heed of the US National Research Council's warning in their report, 'Telecommunications for Metropolitan Areas - Opportunities for the 1980's :

> 'By providing ready access to information and assistance of all kinds, the home communications information system would improve the quality of life for a majority of people ; but it could just as easily become a force leading to the break-up of society ...' (quoted by Marsh, 1979, p. 239).

In a world of growing stress and anxiety, it is obviously of particular importance to ascertain the degree to which the enlarged communicative capacity of telecommunications will place additional strain on man. It is this facet in which both Meier (1973) and Toffler (1970) are especially interested, and it is pertinent to quote from them at length. Meier (1973, p. 362) speculated that

> 'At this stage, some may ask 'Why continue to research, develop, organise, urbanise and threaten with overload? Why not stop now? Such questions forget that the increasing scarcity of natural resources must be counterpoised by new knowledge and its large-scale application. Without it, given man's present trajectory, the Malthusian catastrophe becomes inevitable. Those

> casualties would be real, painful and large-scale, while communications stress wounds only the will among those who are normally born affluent. There is no way for the metropolis to turn back'.

Moreover, it must be realised, following Toffler (1970, p. 311), that

> 'Change is not merely necessary to life; it <u>is</u> life. By the same token, life is adaption. There are, however, limits on adaptability. When we alter our life style, when we make and break relationships with things, places or people, when we move restlessly through the organisational geography of society, when we learn new information and ideas, we adapt; we live. Yet there are finite boundaries; we are not infinitely resilient ... When this capacity is overwhelmed, the consequence is future shock'.

Recent patterns of growth in urban areas has been largely structured by transportation, and it has been proposed that telecommunications could act as a catalyst in a restructuring of society. (see, for example, McLulan, 1964; Nilles, <u>et al</u>., 1976; and Wise, 1971). Wise (1971) reiterated a familiar notion that the motorised civilisation's influence on urban spatial configurations has nearly checked, and quoted McLulan (1964, p. 225), who stated

> 'If the motorist is technologically and economically far superior to the armoured knight, it may be that electric changes in technology are about to dismount him and return us to the pedestrian scale'.

(Note, however, that the present power of the road lobby, especially in the U.S.A., may delay McLulan's (1964) suggested change-over).

As Nilles, <u>et al</u>. (1976) demonstrated, a telecommunications-transportation trade-off will have a significant impact on urban structure and land-use. Specifically, it has been argued that telecommunications will reinforce the on-going tendency towards an urban pattern of poly-nucleated centres. The multi-centred spatial configuration, (described by Schneider (1978) as 'the city of the future'), comprising of a hierarchy of different sized centres, has a number of advantages and disadvantages (see Schneider (1978) for more details). Suggested advantages include compatibility with market

trends, and general notions of functional self-sufficiency and urbanity. Assuming that alterations in residential and work locations result in their close proximity, aggregate travel requirements, and therefore energy consumption, will fall. With respect to equity, residential relocation may present the opportunity to dissolve the inner city concentration of low-income households. The generation of value from the development of the outer centres, for example, could subsidise this household dispersion. Whilst such propensities may help ameliorate inner city problems they may offer a danger to a continued functioning of the city centre (Weiss and Burby, 1976). Perhaps more fundamental is the planning operability of such a venture; the large spatially contagious areas required for such development are not a natural outgrowth of a large number of owners of small pieces of land. In fact,

> 'The general lack of an organised, effective and vocal constituency for the polycentric concept has been largely responsible for its relative lack of priority and study' (Schneider, 1978, p. 43),

and more research is obviously needed in this direction.

Such notions of neighbourhood work centres (at the intra-urban scale), in which a whole network of suburban locations would be directly linked both to other similar centres and to a central focus, reducing aggregate commuter travel and therefore energy consumption, have already been outlined. In contrast, Goldmark's (1972) 'New Rural Society' presents a way of reconciling and integrating urban and regional scales as the chosen growth points are a region's small rural settlements and not its centre.

Thus, telecommunications has been seen as one of a number of factors behind alterations in urban spatial structure. Whilst in many ways this viewpoint is correct, it has been usually been represented somewhat restrictedly. Telecommunications render greater locational pliability, and do not, therefore, impose themselves locationally on any individual or organisation. Both increasing geographic centralisation and decentralisation are feasible; it is its potential flexibility for policy-makers which

is of paramount importance.

There is a growing literature examining the relationships between energy and urban form (for a more detailed discussion of this topic see Beaumont, 1979). Attention focuses on overall efficiency, attempting to minimise the aggregate energy consumption of urban passenger travel, and any consideration of egalitarianism is tacitly implied. For example, Dendrinos's (1978) linear programming formulation did not depict inequality as a 'social cost', and Sharpe's (1978) cost-benefit (TOPAZ) structure took no account of important distributional issues; a notable exception is the paper by Edwards and Schofer (1975) in which both energy consumption and accessibility are deemed important, although there is a failure to go beyond a general recognition of the relationship between energy consumption and accessibility, and a demonstration of energy efficient urban forms which are acceptable, in that they do not adversely affect accessibility. Once again, there is indication that multi-objective decision-making is significant, and the minimisation of energy consumption, per se would be misguided.

Equity is an aspect, which in the future, through the application of telecommunication technology, may become a greater social problem. Although the distributional implications of telecommunications are unclear, there is concern that such developments will cause increasing disparities, and Webber (1973, p. 303) speculated on whether it is probable that

> '... the very considerable benefits (of telecommunications) will be distributed to those who are already well off, leaving the less advantaged relatively the worse for the improvement'.

Spatial and social segregation has already reared its ugly head through the problems of class and race, and as the new communications systems permit locational flexibility, problems of cultural pluralism could be augmented (Webber, 1973), particularly if the perplexities of minorities are not

addressed (Gray, 1973). Moreover, infrastructural investments in the various centres could result in an equalising of opportunities over space, if, and only if, the new technologies are equally obtainable by all. Actually, increased inequality is likely, especially in the short-term, as diffusion of the innovations through society will take time (Katzman, 1974).

This discussion of the likely differential impacts of telecommunications technologies, particularly remembering the likely differential ability to adapt to any future energy crisis, leads onto a discussion, in the next section, of the possible ways of introducing such developments.

5. IMPLEMENTATION FACETS.

Of fundamental significance is the fact that the 'power' of the new technologies will be restricted to a small number of organisations, which suggests that the benefits will be unevenly distributed. This issue is especially relevant since little government action has been taken with respect to corporate power, and there is little likelihood of alterations in the spread of advantages, at present, as it would need a self-devolution of interests.

This question must be addressed immediately, as the ubiquity and power of telecommunications technologies is rapidly expanding; Wise (1971), for example, gave an early illumination of its irreversibility and insatiability. The successful implementation of this new media will be largely dependent upon its general acceptability. Appreciating this position, Gerbner, et al. (1973) set to work to consider the implications of an expected new upsurge in industrial, political, and cultural power resulting from advances in communications technology. The result was an excellent, wide-ranging and highly instructive volume entitled 'Communications Technology and Social Policy'; they realised that

> '... the consequences of the new communicatons technologies-

> economic, political, social and cultural - will be enormous,'

but, however, they were unsure

> '... whether their net effects will be optimal or even beneficial in satisfying needs, or whether society might prefer to pursue a different course if it were aware of and could select from alternative paths'.

Possibly greater significance is the suggestion that

> 'Perhaps more than at any other time in our history, information and control over communications can be directly associated with economic and political power'.

The new technologies provide a potential not only for changing the structure of present power relationships but also for substantially expanding the aggregate power of those in control of communication and information systems. It is, therefore, of vital importance that the employment of these new technologies should be considered with respect to policy promulgation and the supposedly manifest limitations of the existing institutional structure.

Information distributors' power influence was inspected in Chisman's (1973) 'Politics and the New Mass Communication'; misleading predictions were refuted and the sense of security was portrayed as an obfuscating mirage which could cause a complacent attitude towards existing problems. In asking for caution, Chisman argued that it was impossible to know what effects telecommunications would have on the political process, whether they be advantageous or disadvantageous.

Whilst appreciating this point, a fundamental question is: advantageous/disadvantageous for whom? For example, does telecommunications technology offer a means to enhance corporate power? It has been proposed that a coordinated, uniform system probably requires one main supplier. One argument opposing this monopolistic viewpoint is that such a position would permit control of (and, therefore, perhaps, the ability to lower or higher) the rate of incorporation of the new technology. (For a more comprehensive

discussion of these points see Gabel, 1973).

Furthermore, whilst there is some evidence that telecommunications will facilitate greater organisational centralisation of control, it is also a viable proposition that there will be the reverse effect, presenting greater functional freedom to go with the increased locational flexibility. This is an area which requires immediate attention with respect to future policy, because it is the frame through which action and response essentially occurs.

6. DISCUSSION

If the trade-off between telecommunications and transportation was to be purely founded on the criterion of minimum energy consumption, travel would become infrequent. Sufficient details, however, have been outlined to demonstrate that a broader perspective must be taken to analyse this particular option; it is only another alternative available to assist overcome impending crises. Hopefully, sufficient justice has been given to a topic, whose apparent viability for assisting in the direction of energy conservation, specifically, and for altering social-economic-political processes, in general, obviously deserves and needs further research. Whilst appreciating that modal change, car-pooling, the manufacture of more energy-efficient motor cars, development of the electric car (particularly for short trips and as a second family car), improved driving, and so on will assist energy conservation in the transport sector, it is clear that telecommunications should become an important facet of such discussions. Specific fields requiring immediate attention are the potential effectiveness of telecommunications; for example, the employment of various visual linkages, and the general acceptability and implications of the medium, an aspect which will ultimately determine its success or failure.

Whilst telecommunications will not solve our energy problems, they do present an addition foundation on which to approach the future.

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