PROTOTYPE TRANSPORT AND URBAN DEVELOPMENT CONCEPTS FOR THE AUSTRALIAN MULTI-FUNCTION POLIS

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INTRODUCTION

The Multi-Function Polis (MFP) concept was put forward to Australian Ministers at the Australian - Japan Ministerial Committee by Minister Tamura of Japan. Once the concept had been introduced, the Japan Ministry of International Trade and Industry (MITI) and Japanese private-sector participants developed a pre-feasibility study - the MITI "Basic Concept" paper which was presented to Australian Commonwealth and State Governments in September, 1987 (MITI, 1987). It represented both a search for industries of the future, and the formulation of a planning and development model which could have international application. The Australian response was to agree to join with the Japanese to further examine the concept on the proviso of a Cabinet decision which listed nine principles governing Australia's participation.

The phrase "multi-function polis" (MFP) is meant to encapsulate the notion of an ideal city in which a variety of social and economic activities can occur in a balanced manner so as to achieve the best aspirations of Twentieth Century living. The joint Australian - Japanese Government proposal for a MFP provided an opportunity to examine the way in which a new city might resolve the relationship between new economic activities, future lifestyles, and the sustainability of development in sensitive environments. The basic idea is to plan and build a city which avoids current urban problems and responds to new technological advances in industry, in an environmentally-acceptable way - described by the Japanese as the "City of the 5th Sphere". The feasibility study consultants - Andersen - Kinhill (MFP Joint Secretariat, 1989a) interpreted these ideas by proposing that the MFP respond to three basic city themes - the Renaissance City, the Biosphere City, and the Technopolis.

The MFP concept was examined primarily from an economic and social perspective (MFP Joint Secretariat, 1989b; 1989c), and, until the involvement in 1990 of the National Capital Planning Authority (NCPA), to advise the Australian Department of Industry, Technology, and Commerce on certain aspects of the development of the proposal, little work had been done on its possible urban form. For the whole period of the joint feasibility study nobody had a clear idea of what it should look like. The Authority's work on a MFP urban development concept is described by Hamilton (1991, p. 176) as "the repair job": "the feasibility study has provided a 'vocabulary' of urban planning without any 'grammar' ..To make up for this and other omissions, the National Capital Planning Authority was commissioned to give the polis some form".

Its findings were published in July, 1990 (National Capital Planning Authority, 1990). This paper is based primarily on the unpublished working papers that relate to the formulation of a preferred urban development concept. The closest to this kind of research in Australia is the work of the Cities Commission (1975) on new structures for Australian cities. Section 1 provides the necessary background to show how the urban development concepts were developed and evaluated. Section 2 shows how the

transport goals and objectives implicit in various relevance. The land-use/transport analyses that helped establish the preferred concept are outlined in Section 3. Finally, Section 4 relates the work of the National Capital Planning Authority in the site selection process, and gives an update of work in progress on the MFP-Adelaide concept, which was selected by the Australian Government in 1990.

1. URBAN DEVELOPMENT PROTOTYPE

In March, 1990, the National Capital Planning Authority was briefed by the Commonwealth Department of Industry, Technology and Commerce (DITAC) to advise on certain aspects of the development of the proposed MFP, such as its general feasibility as an urban development model, the possible spatial attributes and urban design qualities of such a city, the generic characteristics which should be built into its design, possible locational parameters, and broad levels of costing and programming. The Authority was also asked to develop a set of principles and criteria which could assist the Commonwealth Government in the evaluation of various proposals being lodged by the States, in accordance with the Australian Governments' nine principles. The broad objectives of the Governments of Australia and Japan, are set out in Table 1.

Table 1
Major Objectives of the Governments of Australia and Japan with the MFP

Australian Objectives	Japanese Objectives
• Future wealth creation shared with all Australia through: (a) internationalisation of Australian business; (b) increase focus on the Asia-Pacific region; (c) development of international trading positions in valued-added manufacturing and services; and (d) strengthening connections between research and development and downstream markets • Enhancement of international co-operation • Enhancement of Australian cultural life • Maintenance of the unique Australian environment	• Enhance Japan's world image through solving world problems • Internationalise Japanese skills and thinking • Pave the way for the "Pacific Era" • Produce technological advancement • Increase international co-operation • Create new life style forms

The National Capital Planning Authority was not commissioned to design the MFP but to provide more specific information on its possible urban form and function. The Authority established a Technical Team comprising of some of its own staff together with consultants representing the relevant professional disciplines involved in the urban planning and development process as specified in the acknowledgements to this paper. The broad methodology of this work was to: (a) review the literature already available on MFP and identify elements relevant to its development as a city; (b)

review the literature on existing urban developments, identifying opportunities and problems for future planning; (c) examine possible innovations in urban systems and assess their potential impact on future city form and function; (d) develop a concept for the MFP addressing these issues; and (e) develop a set of strategic principles to assist future work on the development of the MFP.

The resulting concepts were discussed at a workshop in May, 1990, that was attended by eminent Australian professionals and representatives from the Japanese Domestic Committee, the MFP Joint Secretariat, MFP Australian Research Pty Ltd, the Commonwealth Departments of Foreign Affairs and Trade, and of Industry, Technology and Commerce. Arising from these discussions at this workshop, a refinement of the concepts was published (National Capital Planning Authority, 1990). That report describes the issues and opportunities, then identifies and describes several realistic development options, analyses four prototype MFPs as urban development concepts, identifies locational criteria relative to existing Australian cities, and provides a framework for evaluation according to the priorities established previously for urban principles and locational factors.

It is impossible to develop urban development prototypes without recourse to the history of urban design. In modern cities, possibly the most significant elements relating to the form of their development have been movement systems. The three fundamental options for the structure of urban areas, as determined by major movement systems, are the radial, grid and linear arrangements. Variables such as the scale of development, density, activity mix and staging strategies, when applied to these options, produce a wide range of potential MFP alternatives - whether located as a relatively self-contained community, developed adjacent to an existing urban area, or developed within an urban area. Throughout the 20th century, town planners, architects and urban designers have advocated a range of solutions for new communities. The thinking of Howard, Le Corbusier and Lloyd-Wright correspond to the three most common models used to describe city form. Howard presents the decentralised and discrete "Garden City" built at low densities; Le Corbusier is a formalised high-rise model, based on widely separated buildings set in a landscaped park; and Lloyd-Wright presents a city based on very spaciously disposed low-density and semi-rural environments.

In addition to these idealised planning approaches, other forces have influenced city form: industrialisation produced specialised building types and provision for these types in the physical planning of cities reinforced concepts of functionalism in which segregated zones, distinctive environments, and technology were given expression in what cultural historians refer to as "modernism". "Post-modernism" stems from the realisation that technology cannot create sustainable societies nor relationships to the environment. A post-modern view would take leisure and environmentally sympathetic lifestyles as one starting point for developing new urban concepts (see, for example, Krier, 1979) in response to community and business pressures to revitalise older cities.

For the Australian MFP, the main prototypes considered were two types of development at the metropolitan fringe and two inner-city developments. The inner-city types assume that some activities would not be located within the MFP because of environmental or spatial limitations, and that there would be a high degree of interdependence on the surrounding or adjacent city. The prototypes were: (a) a loose collection of small residential satellites linked to a central work/leisure recreation centre (c.f. Silicon Valley, California);(b) a typical, planned, suburban development, either in a "fringe" location or on a separate site (c.f. Campbelltown, in the Sydney metropolitan

area); (c) a substantial infill site closer to the city core with development at medium densities; and (d) a high density, inner-city development.

A critical review of these conventional form of urban development vis à vis the aims for the MFP and the intentions described in its Feasibility Study (MFP Joint Secretariat, 1989c) lead to the realisation of the limitations inherent in all four forms. Table 2 shows that the inner city and suburban models for the MFP present major deficiencies and limitations. A new, and innovative response, was required, although there is no existing prototype that meets this specification. (Some of the North American and English new towns are closer to it than anything developed at the town or city scale in Australia). The concept is called the preferred urban development concept and its attributes are contrasted with the other four urban forms in Table 2. The higher the score at the foot of Table 2 then the closer the urban development concept to the MFP aims.

Table 2
Evaluation Comparing the MFP Prefered Model with Alternatives

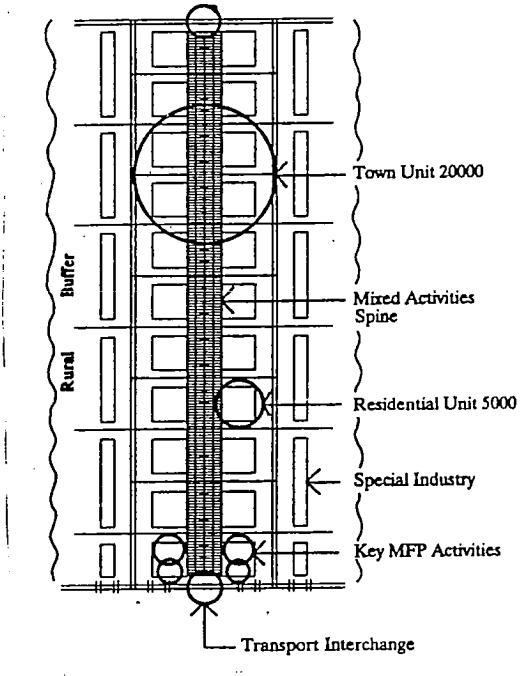
MFP Aim	Urban Development Concept				
	Suburban	Planned Suburban	Inner-city medium rise	Inner-city high rise	Preferred
Human scale		*	*		*
Family living	*	*			*
Social exchange					*
Job accessibility			*		*
Urban vitality			*	*	*
Sites for industry	*	*			*
Building innovation		*	*	*	*
Infrastructure			*	*	*
Energy saving					*
Waste disposal		*	*		*
Total	2	5	6	3	10

* positive attribute

Figure 1 illustrates the recommended concept that emerged from the work of the National Capital Planning Authority Technical Team: a linear city with development densities somewhat higher than the average Australian city. The key structural elements are: (a) a major transport interchange at the main arrival point; (b) a general activity spine with a concentration of activities along it, supported by public transport; (c) residential living areas; (d) towns; (e) open space corridors between the living areas and towns; (f) peripheral employment precincts; (g) a rural buffer zone; and (h) movement systems. The best option for achieving the MFP aims is a single city on a single site. This is a relatively self-contained new community of 100,000 people, adjacent to an existing city or metropolitan area, at a somewhat higher than Australian average

density. The quarter-acre block - 10 dwelling units per hectare - is a common yardstick in Australian urban development, although lot sizes for conventional single dwellings have, in recent practice, ranged from 550 to 700 sq m (18 - 14 dwelling units per hectare).

Figure 1
Multi-Function Polis - Main Structural Elements of NCPA Concept



Source: National Capital Planning Authority, 1990, p. 45

2. TRANSPORT SYSTEM GOALS AND OBJECTIVES

Systems planning and engineering stresses the importance of defining goals and objectives before any analysis, design or evaluation of alternatives can be undertaken. In our work, the identification of transport and land-use related issues was highly problematic because there existed no planning authority, no residents (nor potential residents), no committed investors, and, significantly, no media debate about urban form. The approach adopted was to review emerging critical transport issues in the USA (*Transportation Research News*, September-October, 1987, pp. 3-14) and in Australia by the Institution of Engineers Australia, National Committee on Transport (Young, *et al*, 1989) and to distil more specific transport objectives from what had been written about the MFP.

The MITI basic concepts are explicit only about the external transport links to and from the MFP (MITI, 1987, pp. 53-55). There are two alternatives to road access - a commuter airline and private planes between the nearest international airport, or magnetic levitation high speed (300 to 500 km/h) rail. High quality external transport is vital because of the MFP as a "5th sphere" city: access for international visitors, the convention centres; its resort industries; and its international education and training exchanges. There are inferences scattered throughout the basic concept report that urban spatial structure be predicated on walking as the predominant transport mode - a point reinforced by the description of the "resort academy complex" (MITI, 1987, p. 38). Table 3 summarises these implicit transport and travel characteristics.

Table 3
Transport and Travel Characteristics Implied in to MITI Basic Concept for the MFP

MFP Feature	Implied Characteristics	
	Transport	Travel
External Transport Links	Maglev commuter air	Convenient to international airport and metropolitan region
Close location of activities	Walking/cycling, public transport	Minimise distances
Participation by handicapped person	Pedestrian/public transport access for handicapped	Increased mobility and travel by handicapped
New resort industry	-	Additional recreation/social travel
Communications technology	-	Increase in working at home, less travel and peak spreading
Medical care	-	Telecommunication links between home and medical centre to reduce travel

Drawing on the MITI concept, the Spatial Attributes Paper (MFP Joint Secretariat, 1989b) summarised the MFP in a general way as: urban integration to achieve human scale and interaction, with walking distances between home, work and recreation at an acceptable level; accessibility to an international airport; and the use of advanced transport technology to overcome the tyranny of distance to a more remote MFP site. Several points about transport and urban form are made:

(a) the MFP can demonstrate new urban form and stimulate urban design and technology transfer;
(b) urban areas should be primarily, and exclusively, accessible by foot, with intensive vertical layering of uses;
(c) future personal transport systems could be re-built around personal vehicles and guideways and could be tailored to provide fast, safe, transport;
(d) the future of the private motor vehicle will be linked with electronic sensing devices;
(e) public transport has not been noticeable successful in the past 20 years;
(f) separation of vehicles and pedestrians and freight delivery by different levels;
(g) inter-flora marketing concept for ordering and delivery; and
(h) state-of-the-art engineering services that should be environmentally benign.

Despite inherent contradictions in the MITI report and Spatial Attributes Paper, the Joint Steering Committee adopted a unified MFP concept as one site in a metropolitan area (or a small number of sites in one, or more, major metropolitan area) with architecture that facilitates face-to-face interaction and urban areas accessible by foot (MFP Joint Secretarial, 1989c, pp. 16-18). The Feasibility Study provides "preliminary verbal sketches" and offers three distinct guidelines as an intermediate step linking the MFP concept to the principles, rules and scenarios of its ultimate design". From these it was possible to suggest some design principles and derive their transport/travel implications. Table 4 summarises eight design principles for the MFP and implications for travel and transport.

Table 4
Design Principles and Transport Travel Implication for MFP

Design principle	Transport/travel implications
Environmentally sustainable and healthful urban development	Minimise number of vehicle trips, reduce vehicular emissions, and reduce fuel use
Correct existing environmental defects	Existing motor vehicle technologies are unsuitable
Active programmes of innovation	Easy adoption of beneficial transport technologies over time
Fits its function	Spatial organisation and travel requires sustained monitoring and tuning
Adaptable and easily manipulated	Flexible transport that is open to development as circumstances change
Resilience and reversibility	Cost of future reversions in use should be factored into initial accounting for MFP
Legible, intelligible and memorable	Easy orientation of transport channels. Clear spatial structure. Good network of appropriate paths
Broad and Efficient Means of Access	No single mode of transport but unifying concern for appropriate speed, comfort and efficiency

Source: based on MFP Joint Secretariat, 1989c, Section 2, pp. 22-29

3. LAND-USE/TRANSPORT INTERACTION

Whilst the transport goals and objectives for the MFP led us inevitably to the conclusion that homes, workplaces and other land-use activities should be conveniently located in relation to each other we needed a way of comparing the travel implications of different urban forms. No behavioural data were available. Therefore, we adopted mathematical programming techniques (Section 3.1) and obtained optimal desire-line traffic patterns and minimum trip lengths. These were confined to journey-to-work travel, but the technique is of general applicability for other journey purposes. The results proved to be valuable during the May 1990 workshop to focus discussion on the potential travel savings of different urban development concepts.

3.1 Mathematical Programming

In the absence of any information about the characteristics of likely residents or workers in the future MFP, and their attitudes to the use of different transport modes and preferences for residential location, a simple proposition of land-use and transport interaction was studied. Urban development prototypes were compared in terms of their potential to keep person-trip kilometres at a minimum, especially for the journey-to-work.

The objective function in the primal (Z) is:

$$\text{Min } Z = \sum_{i=1}^{m} \sum_{j=1}^{n} Q_{ij} T_{ij}$$

subject to

$$\sum_{i=1}^{m} Q_{ij} = E_j$$

$$\sum_{j=1}^{n} Q_{ij} = R_i$$

$$Q_{ij} \geq 0$$

where,

Q_{ij} = number of work trips from zone i to zone j;

T_{ij} = distance from zone i to zone j;

E_j = total number of jobs located in zone j; and

R_i = total number of workers living in zone i.

Standard computer programs were used to solve the problem for three different land-use distributions and distance matrices: the inner-city; and exurban prototype; and the inner-city site.

3.2 Linear City

The spatial structure of the preferred concept - the linear city illustrated in Figure 1 - may be represented as macro-zones for the location of homes and workplaces. The application of mathematical programming techniques leads to a pattern of home-to-work flows that minimises the total amount of travel. There would be approximately 63,000

person-trip km of travel within the MFP (mean trip length of 1.6 km), plus 10 per cent of workers travelling externally (say 20 km on average) with 90,000 person-trip km. The total minimum amount of travel is approximately 153,000 person trip km (a mean trip length of 3.4 km).

3.3 Exurban (Silicon Valley Prototype)

Without any Australian site-specific information available to us at the time, the exact spatial representation of a low-density, diffuse, model was difficult. However, for comparative purposes, one scenario was structured around the New South Wales Government's multi-nodal proposal (MFP Joint Secretariat, 1989c, p. 4-3). We assumed that all workers seek attractive and spacious residential environments in the Blue Mountains to the west of Sydney. Furthermore, we assumed that two thirds of the jobs are in the MFP located to the south of Werrington (western Sydney), one third around Homebush Bay (including Macquarie University and the CSIRO Laboratories at Ryde) and one third close to the CBD of Sydney (University of Technology Sydney and major hospitals). The internal jobs in the residential zones of the MFP are 10 per cent working at home and 10 per cent working locally.

A simple zonal representation of prototype of this is three residential zones and three external zones for MFP employment activities. The application of optimisation techniques gave a total minimum amount of travel of approximately 1.7 million person - km of travel (mean trip length of 38.8 km) - over 10 times the linear form in Section 3.2).

3.4 Inner-City Site

The analysis was not undertaken for an high-density inner-city site because all residences are located on the one site. Journey-to-work travel distances to existing employment locations both in the city centre, and surrounds, and further afield, will be a function of the distance of existing activities and the proportion of workers from the MFP travelling to each.

Taking the Victorian Government's proposal for a MFP on the Docklands site (to the east of the Melbourne CBD) the distances to various destinations can be calculated. A number of linkages are mentioned in the proposal, and these would form the basis of further calculations: Monash University Medical Centre; Eliza Hall Institute, Telecom Research Laboratories, Ludwig Institute for Cancer Research, University of Melbourne and associated Hospitals, Lincoln Institute; CSIRO at Highett; Royal Melbourne Institute of Technology; Footscray Institute of Technology; and the Howard Florey Institute. A substantial proportion of MFP jobs would be located on site with very small walking distances. These would be off-set by longer journeys across the metropolitan area according to the possible linkages mentioned above. No calculations are presented here because these linkages are far too speculative.

4. MFP - ADELAIDE SITE SELECTION

The National Capital Planning Authority was asked to develop a set of principles and criteria which could assist the Commonwealth Government in the evaluation of the various proposals being lodged by the States, in accordance with the broad objectives of the Governments of Australian and Japan in accordance with Australian Government's principles. Official proposals were received by MFP Australia from the

Governments of New South Wales, Victoria, South Australia and Queensland. Two proposals were received from Queensland - one in the Brisbane - Gold Coast corridor, and one by a private consortium in the Cape York/North Queensland Economic zone. In June, 1990, the Authority convened an expert group. The workshop was convened to discuss the various proposals submitted by the States and to arrive at broad conclusions, to discuss the relative merits of the MFP options - a single city, single site or multiple sites - and to summarise the strengths and weaknesses of each proposal.

On 19 August, the Minister for Industry, Technology and Commerce, Senator Button, and the South Australian Premier, Mr Bannon, announced jointly that the Federal Government had accepted the report of the Joint Steering Committee which recommended the detailed study of MFP-Adelaide. Furthermore, they would appoint a management committee and establish a review panel as part of a National Community Consultation Program. The decision on site selection is explained fully by Hamilton (1991, pp. 183-204) and Glendenning (1991) describes the design concepts for the Adelaide MFP.

The core site in Adelaide is four discrete parcels of mainly undeveloped land totalling 2,343 hectares centred on the Gillman area, about 15 km north-west of the CBD. After six months of extensive study; a report (MFP-Adelaide, 1991) assessed whether the site was suitable for urban development, developed a design concept, assessed the commercial feasibility of developing the site, and assessed the impact of a MFP on the South Australian economy. The urban development concept - no more than a set of principles at this point in time - is a mosaic of villages separated by forest, lake and open fields and linked with each other, Adelaide and the world by new transport technology and telecommunications. Each village of about 600 m by 600 m would include a wide range of functional spaces with mixed land uses to promote pedestrian and cycle usage. The villages have been designed with a new form of personal, in-village, transport (solar/electric powered vehicles such as those used in Switzerland or being tested in southern France) in mind, with motor cars parked in secure, serviced interchanges on the periphery of each village (MFP-Adelaide, 1991, pp. 3-43 to 3-45). Development within the core site could be serviced by a major public transport system such as O-bahn, light rail, or some other advanced transit system.

CONCLUSIONS

It is clear that if cities, especially Australian and North American ones, are to change for the better in terms of modern social and environmental concerns, there must be a different, more radical, approach taken to residential density, transport, mix and distribution of activities, and infrastructure. In considering a suitable urban development model for the MFP a number of choices emerge. What is the best type of urban form and structure? Are there any existing city types that we can turn to for ideal models? Consideration of these questions led us to examine several realistic development prototypes to see whether or not they can offer an appropriate solution for the MFP, given its broad goals and more specific transport objectives. Urban development concepts are analysed using various criteria and one of the assessments was the likely amount of person travel in the city. Mathematical programming techniques were used to demonstrate the minimum amount of travel subject to specified land-use constrains.

In providing a framework for evaluation of the State Governments' proposals, (National Capital Planning Authority, 1990, pp. 81-87) a MFP concept had to avoid the

emerging social and environmental problems of existing urban settlements. More specifically, it had to address: low density sprawl; long and costly journey-to-work and fossil fuel usage; accessibility to activities and services and equity; pollution from vehicle exhausts; congestion; and safety and movement in the public realm. MFP-Adelaide was selected for further feasibility study, and this paper has indicated the broad convergence of ideas on appropriate urban structure and transport. The crucial challenge will be whether programmes and structures incorporate a unified response to urban problems and produce innovative solutions that have applications elsewhere.

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