METROPOLITIAN ACTIVITY PROFILES - A NEW PERSPECTIVE ON DEMAND

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ABSTRACT

The changing nature of society affects the entire community, right down to the basic household structure and individual lifestyle choices The combination of time constraints, employment flexibility, and shifting household dynamics have created a large increase in non-home-based travel: children need to be dropped off at school on the way to work; shopping is combined with a social visit in the same neighbourhood; lunchtimes consist of grabbing some food on the way to the bank...
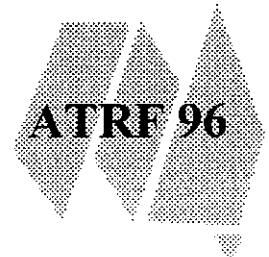
There are increased pressures to do as mush as possible whilst one is out of the home. Consequently, it is no longer acceptable to plan transport services and the location of community facilities based solely upon the characteristics of the night-time population (i.e. where people live). If we are to effectively plan for this changing travel behaviour, we need some understanding of peoples activity patterns over an entire day. To obtain this understanding, the Victorian Activity & Travel Survey (VATS) has been used to develop a 'daytime population profile' for the Melbourne Metropolitan region.

The construction of daytime population profiles is made possible by tracing the daily activity patterns of every person in the sample (about 15,000 people in each year of VATS data) By selecting specific times throughout the day (e.g. 1 p.m.),a spatial distribution of the population at the time can be illustrated. Furthermore, by linking this snap-shot back to the demographic characteristics of the people in the VATS sample, it is also possible to determine the demographic and activity profile for any region at any time of day

By combining the graphical and spatial displays, a comprehensive picture of the way in which a city functions can be formed. Such a picture can help transport operators to tailor their services to the changing nature of society's activity patterns.

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INTRODUCTION

There are increased pressures for people to do as much as possible while out of the home. Shifting household dynamics, time constraints, employment flexibility and workforce mobility have combined to create a large increase in non-home-based travel. Children need to be dropped off at school on the way to work; a shopping trip is combined with a social visit in the same area; lunchtimes consist of grabbing some food on the way to the bank....

Consequently, it is no longer acceptable to plan transport services and the location of community facilities based solely upon the location of the night time population (i.e. where people live). If we are to effectively plan for these changing patterns of travel behaviour, we need an understanding of people's activity patterns over an entire day.

This paper will describe the development of 'metropolitan activity profiles', which enable accurate estimations of population movements and activity behaviour over the course of a day to be made. Such development will help facilitate a deeper understanding of activity patterns in urban areas, thus improving the planning of transport and activity facilities in time and space.

SOURCE OF DATA

This study uses data from the Victorian Activity and Travel Survey (VATS) to obtain detailed information on trips made within the Melbourne Metropolitan region.

VATS is a continuous survey which, beginning in 1993, has collected information from about 5000 responding households in each of the 1993-94, 1994-95 and 1995-96 financial years. The projected survey length is five years, producing a total sample of approximately 30,000 households and enabling medium to long term changes in travel and activity behaviour to be monitored. Covering all 365 days of the year, VATS also allows seasonal variations in travel and activity patterns to be observed. This paper uses VATS data from the 1993-94 financial year.

The survey method, developed over many years by members of the TRC, is that of a mail-out/mail-back self-completion questionnaire. A series of four postal reminders improves the response rates obtained, and the use of other survey techniques - such as telephone interviews to clarify information on completed surveys, personal interviews of a sample of responding households to assess the quality of the reported data, and non-response interviews of a sample of those households who have not responded after the fourth reminder to ascertain the reasons for not completing the survey - improve the quality of reported data (Richardson & Ampt, 1995).

VATS records all travel by all modes by all people in the responding households - with special emphasis placed on obtaining the details of activities undertaken by respondents. It is believed that a better understanding of demand for travel can be obtained by understanding the demand for activities which give rise to travel.

As indicated in Table 1, detailed information is also obtained about the surveyed households and the demographics of the respondents. Those attributes shown in boldface are of particular relevance to the analysis reported in this paper.

TABLE 1   Summary of VATS Data

Household Details	Person Details	Activity and Travel Details
Household Size	Age	Place Type
No. of Visitors	**Sex**	**Purpose/Activity**
Family Structure	Relationship	**Geocoded Location**
Dwelling Type	Country of Birth	**Mode of Travel**
Owned/Rented	Driver's Licence	Car Details
No. of Bicycles	Employment Status	Roads Used
No. of Vehicles	Education Status	Parking Details
Vehicle Details	Occupation	PT Ticket Type
- Make	Industry	**Arrival Time**
- Model		
- Year	Income	**Departure Time**
- Private, Company or Government Car		**Travel Date**
Geocoded Location		

METHOD OF ANALYSIS

The construction of a daytime population profile is closely related to a literal understanding of the VATS data. On every day of a survey year, the residents of a selection of households are asked to record all the trips and activities they undertake over an entire day. For every trip, detailed information is obtained on the:

- origin and destination of the trip - which are then geocoded
- purpose of the trip
- mode of travel
- time of travel (start time of trip, arrival time at destination, departure time)

By converting this data into a GIS format, the travel of a single respondent could be traced through time and space over the day. Conceptually represented on a computer screen, this would appear as a dot moving around a map. An examination of the first year of VATS data (1993-94) shows that, from the 5043 responding households, 13,546 people made almost 44,000 trips within the Melbourne metropolitan region. Importantly, one can trace where each person is at any time of the day. Therefore, using this sample, the location of the Melbourne population can be represented at any time of day, as illustrated in Figures 1a and 1b.
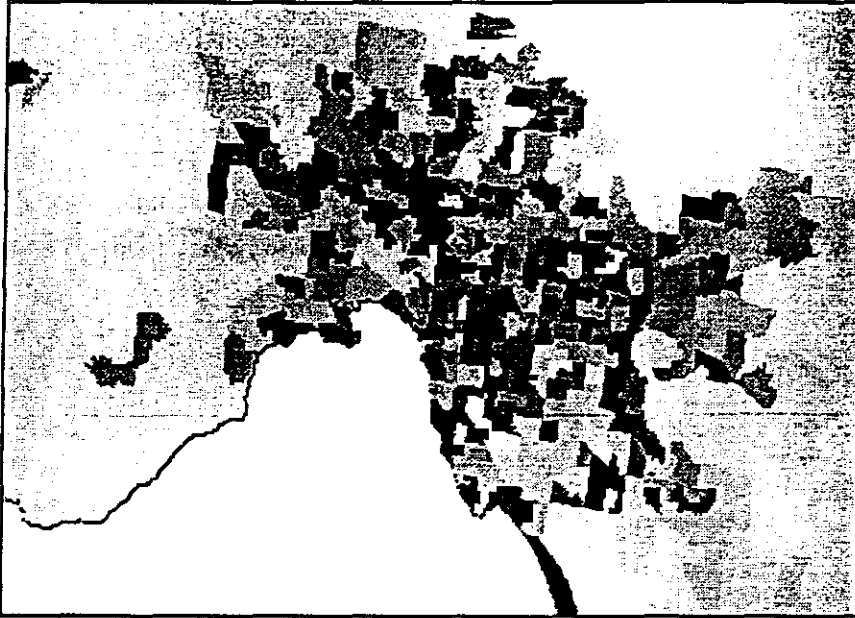
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Figure 1a   Location of the   Population at 4.00 a.m.
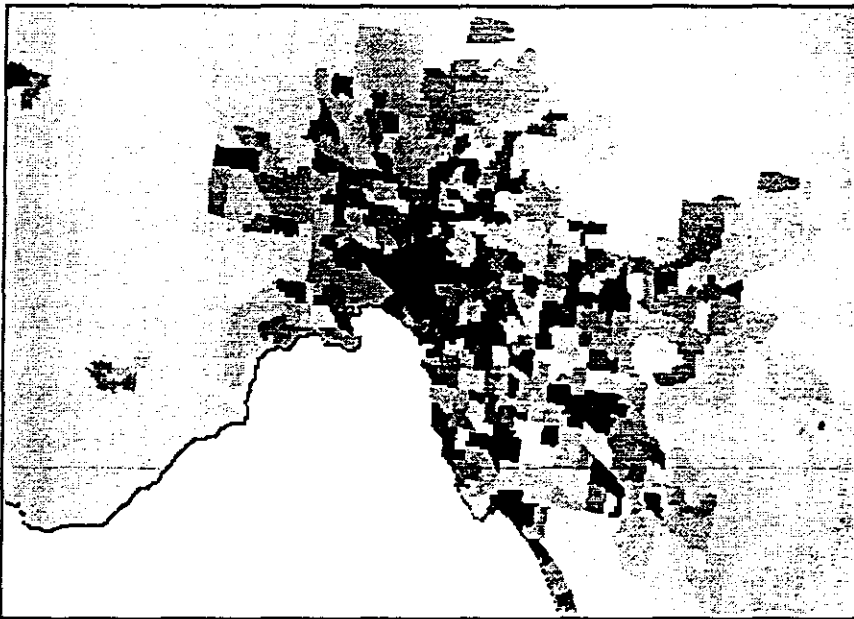

Figure 1b   Location of the   Population at 12 noon

Figure 1a shows the spatial distribution of the population at 4 a.m. on an average weekday, with the darker regions representing higher population densities. This is the image on which much of Melbourne's planning is currently based - the night time or 'census' population. Figure 1b provides us with a very different, yet intuitively more correct, view of Melbourne - with the CBD showing up in the middle of the map as a clear activity hub. These contrasting images highlight the problem of using only a static night time population distribution to describe population densities in a region.

By taking 'snapshots' of the population at different times, one can see, by animation, the flows of people across Melbourne. An appreciation of this dynamic population behaviour is the foundation on which metropolitan activity profiles are constructed.

CREATION OF ACTIVITY AND DEMOGRAPHIC PROFILES

Since the actual numbers of people at any place and time can be extracted from the population density plots, population fluctuations for individual regions within Melbourne can now be examined. For instance we know that at 4 a.m. the population in the Melbourne local government area (LGA), pictured in Figure 2, is approximately 40,000 people. By 12 noon, this has increased to about 300,000 people.
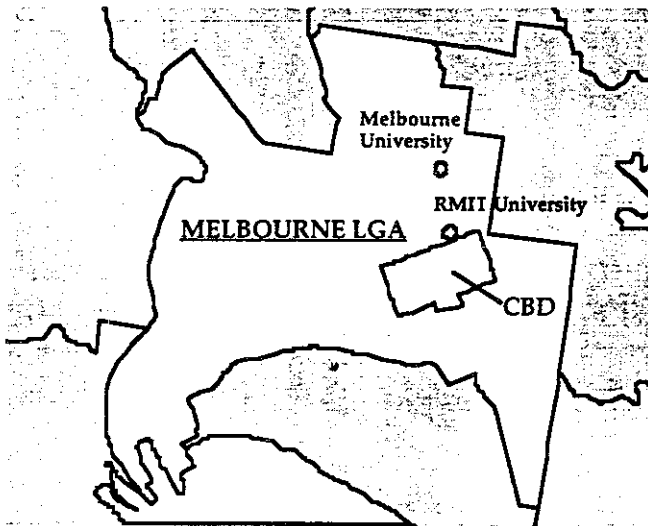

Figure 2   Melbourne LGA

As Figure 3 illustrates, the linking of population counts at every hour of the day allows a *daytime population profile* to be created. Underlying the simplicity of this analysis is valuable information upon which government and planning authorities can normally only speculate. From Figure 3, one can immediately see that the most people in the Melbourne LGA at any one time is at 2 p.m., when the population swells to about 310,000. Furthermore, by recording who is entering and leaving the study area, one finds that 450,000 *different* people visit the Melbourne LGA on an average weekday.
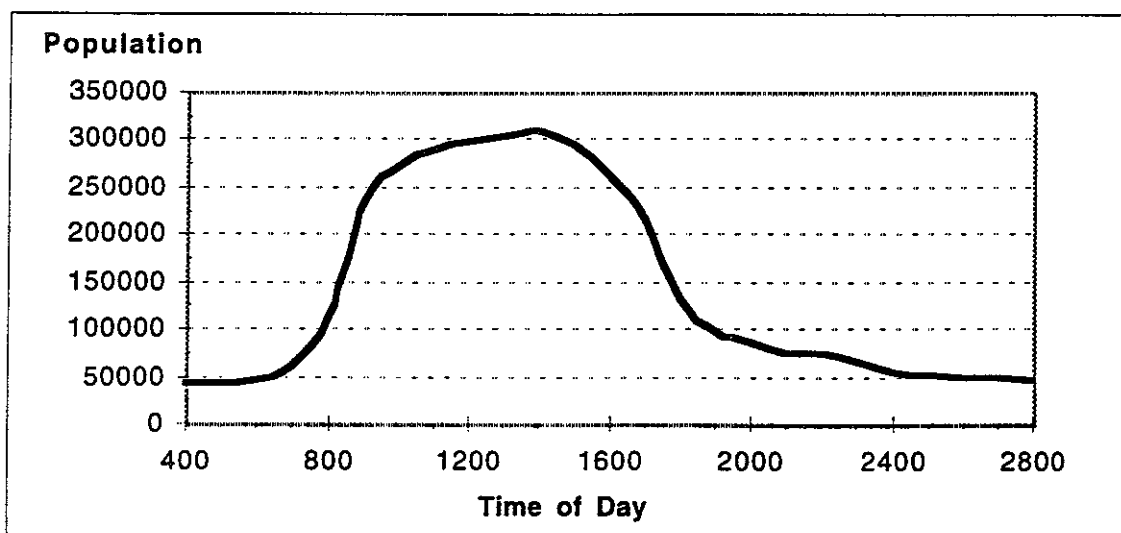

Figure 3   Average Weekday Population for the Melbourne LGA

Activity Profiles

Remembering that for each of these 450,000 people, we know not only *where* they are at any time but also *what* they are doing, the curve in Figure 3 can be broken down to display the activities undertaken by these people at different times of day - thereby creating an *activity profile* (Figure 4).
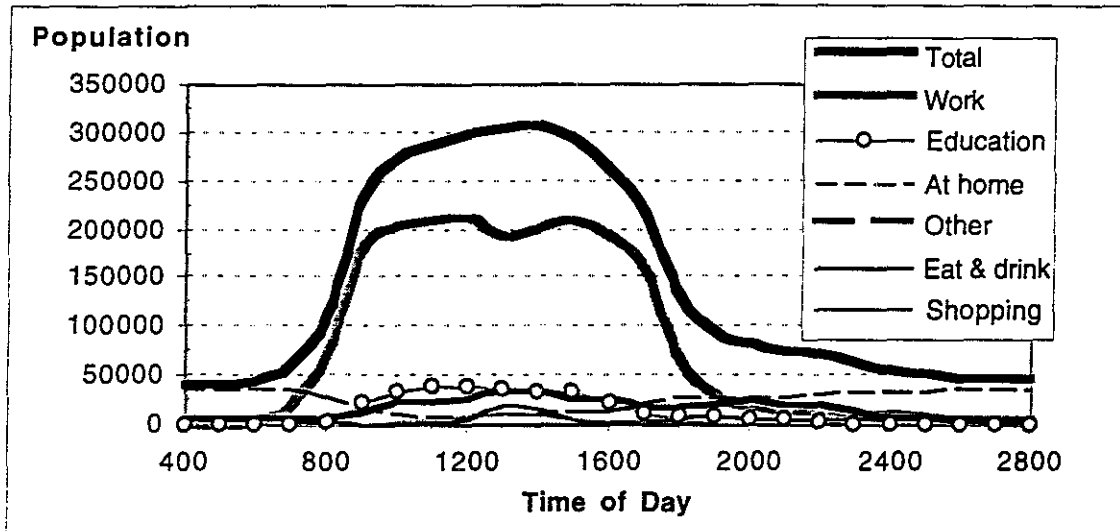

Figure 4   Weekday Activity Profile for the Melbourne LGA

As expected, given that the CBD falls within the Melbourne LGA, the primary purpose of people within this area on a weekday is 'to work'. This work curve strongly governs the shape of the population profile, with sharp rises and falls registered in population during the morning and afternoon peaks. The location of two universities in the Melbourne LGA, as shown in Figure 2, explains the large number of trips for education.

It should be noted that the dip in work activity at about 1 p.m. is not associated with people leaving the city, since the overall population continues to rise slightly at this point. A more likely explanation is found by observing the associated rises in the 'eat & drink' activity, as people leave their workplaces to go to lunch, and 'other', which includes categories such as 'personal business' (e.g. banking). (Note: although only the six main activities have been listed in Figure 4, the 'other' category can be broken down into 25 major activity classifications, including entertainment, recreation, sport, religious activities, health visits, volunteer work and so on).

The activity profile shown in Figure 4 has been developed by extracting the weekday trips from the VATS data. The same methods can be used to examine weekend travel patterns. For instance, by focussing on the Saturday travel to the Melbourne LGA, a very different profile is generated (see Figure 5). In contrast to the sharp population variations associated with weekday peak hour travel, there is a steady build up of people across the day, peaking at about 3 p.m.
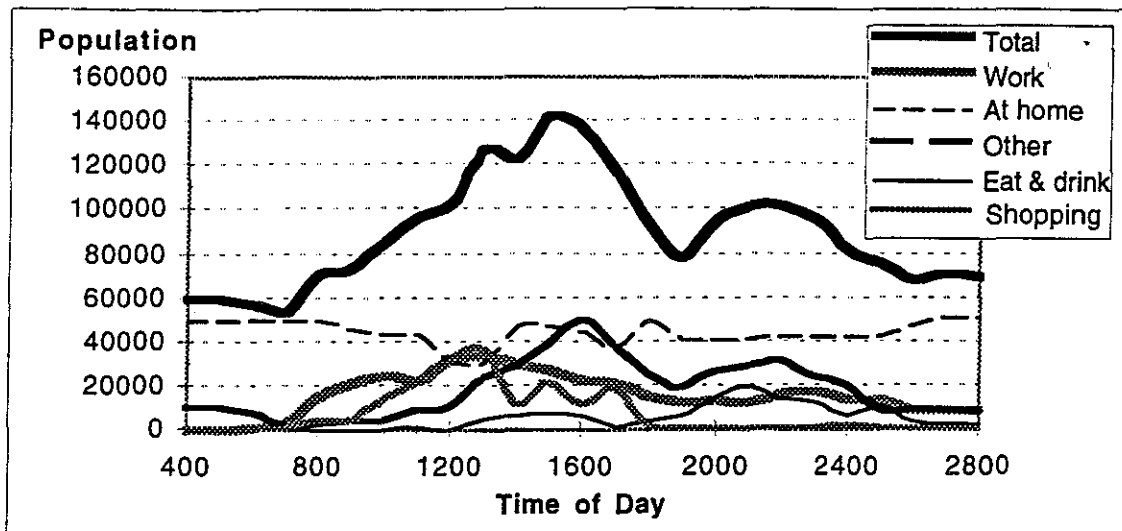
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Figure 5   Saturday Activity Profile for the Melbourne LGA

Due to retail trading during the day and hospitality-based trading in the evening, work once again features as a major activity. However, the 'other' category is the most influential on the Saturday profile - with social and recreational activities combining with 'eating and drinking' to create an evening peak which lasts until past midnight.

The build up of 'other' during the day is due primarily to the watching and participation in sport, whilst the effect of weekend trading is clearly highlighted by strong shopping numbers.

Demographic Profiles

Recognition of the importance of activity profiles inevitably generates more specific questions, such as 'Who of these people travelling to the city is eligible to use concessional fares?', 'Are the weekend shoppers of a different socio-economic background to those during the week?', etc.

The flexibility in generating activity profiles provides the potential to answer such questions. Every trip made can be linked to the person who made the trip, and the associated demographic data. Therefore, by shifting the focus of the activity profiles from *"what activities are performed"* to *"who was performing the activity"* one can create a range of *demographic profiles*. Figure 6 demonstrates this by plotting the gender distribution in the Melbourne CBD for an average Saturday. It can be seen that women are more numerous than men in the Melbourne CBD during the morning (possibly due tto the high number of female part-time workers in CBD shops on Saturday morning), but that men outnumber women in the afternoon and at night (when drinking and night-clubbing are popular activities).

This basic example can be expanded to include demographic features such as age, ethnicity, income and education background, or combined with activity profiles to display the travel and activity behaviour of any particular demographic group.
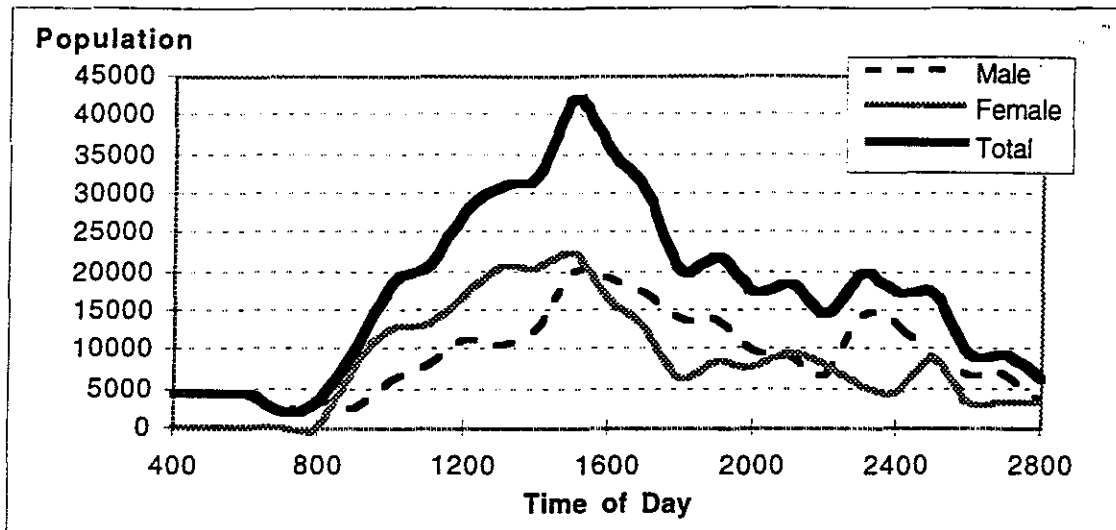
Figure 6   Saturday Sex distribution for the Melbourne CBD

ACTIVITY PROFILES BEYOND THE CENTRAL CITY

The central city combination of high population fluctuations and a large activity base make the region ideally suited to analysis by activity profiles. Can similar benefits be obtained by applying the same methods at a suburban level?

Figure 7 illustrates the activity profile of Whitehorse, a suburban LGA located 15km east of Melbourne. Importantly, the total population of Whitehorse remains virtually constant throughout the day. This feature could be seen as vindicating the view of those planners who believe that consideration of only the 'home' population is required. It does in fact appear that as residents leave their homes (indicated by the 'at home' curve dipping down at about 7 a.m.), they travel to the primary activities of 'work', 'education' and 'other', which all increase proportionally at the same time.
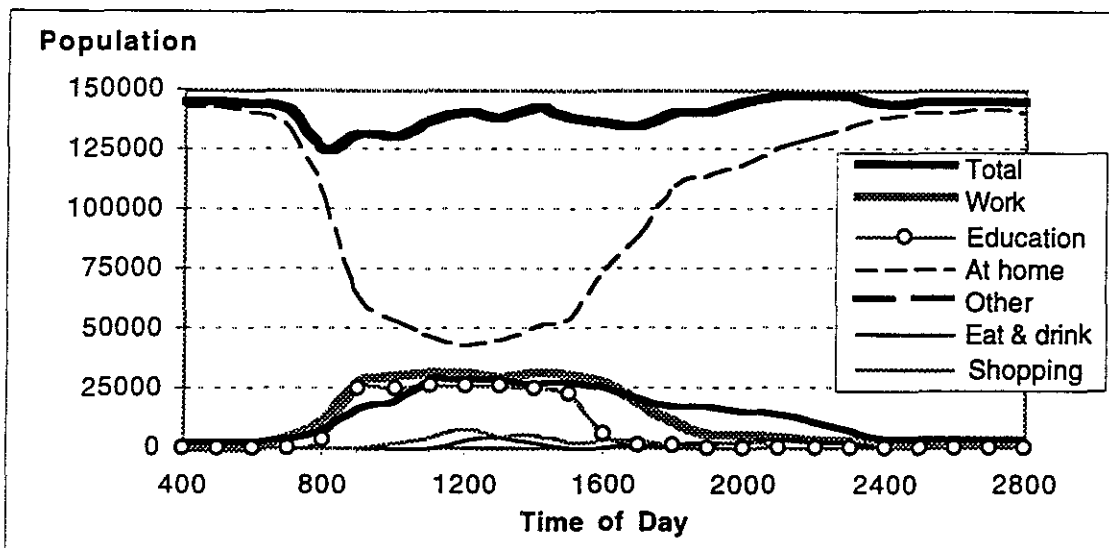

Figure, 7   Activity Profile of the Whitehorse LGA

However, further examination of this curve reveals that of the 140,000 different people who are in Whitehorse during the day, 80,000 are non-residents. The implications of this are twofold: knowledge of where these non-residents have travelled from allows transport planners to estimate inter-LGA people movements, whilst the knowledge of why people are coming into a region (and conversely, where residents are travelling to satisfy specific needs) assist in the provision of services at a local government level.

The ability to study suburban centres is enhanced when one remembers that all the profiles observed have been constructed from 'dots moving around a map'. Hence, an analysis need not be restricted to local government areas, as has been the (arbitrary) focus of this paper. The integration of GIS methods into the study allows for the profiles to be created for any region, including uniquely defined areas. This capability provides an opportunity to study specific sites, such as a strip shopping centre.

TRAVEL PROFILES

This paper has concentrated on the activities which people undertake at the end of trips. However, it is also possible to concentrate on the trips undertaken to get to those activities. Instead of extracting information on peoples' activities, the same methods described above can be used to extract the travel *between* activities - providing, for instance, variations in traffic intensity over time and space (Roddis and Richardson, 1996). An example of the type of output obtainable from such an analysis, using the same VATS data as used above, is shown in Figure 8. This shows the intensity of traffic flows (in kilometres of travel per square kilometere) across the 24 hours of an average weekday.
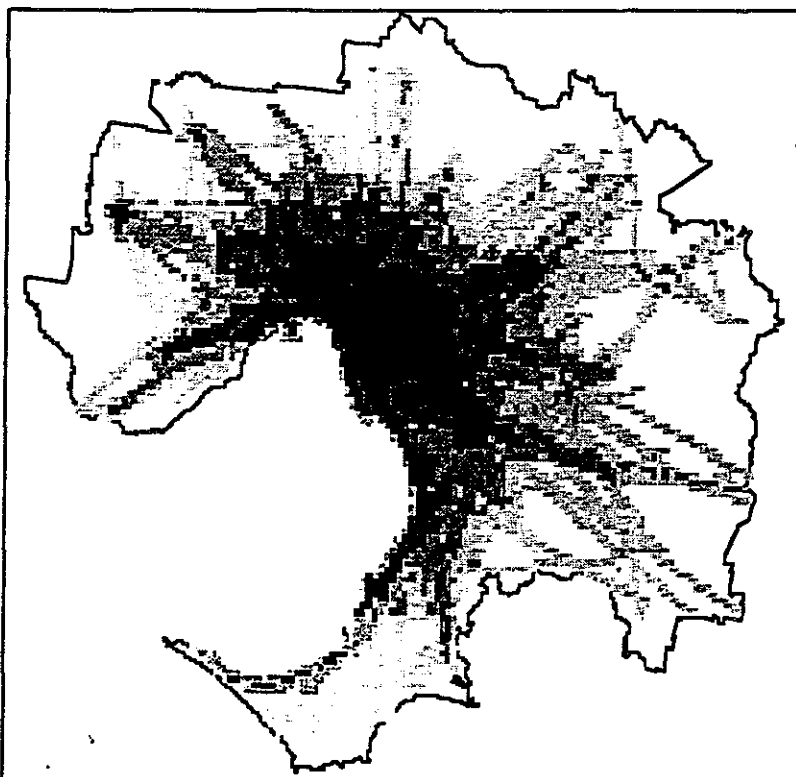

Figure 8   Daily Traffic Intensities on an Average Weekday

While Figure 8 shows the total daily traffic intensity, it should be realised that the same spatial and temporal disaggregation as applied in the earlier sections of this paper can also be applied here. Thus traffic intensities maps can be generated for each hour of the day (and animated, if required), or traffic intensity profiles can be calculated for a specific area. The results of such an analysis should not be construed as a simple vehicle count, since the advantages of access to the detailed demographic data still apply. Knowing not only where a vehicle was at any time of day, but also the type and age of the vehicle, the number of passengers, the purpose of the trip and the driver demographics, would be of assistance to those interested in the fields of pollution and emissions control, safety research and basic traffic management.

Furthermore, since information is gathered on *all* modes of travel, studies can vary from an examination of pedestrian and cyclist corridors to a patronage analysis of the complete public transport system.

CONCLUSION

The population of any region is not a static, homogenous mass. Nor should any planning authority treat it is as such. The dynamic nature of our communities and their increasingly complex lifestyles should be reflected in a more intuitive approach to planning.

The development of activity profiles recognises the need for a deeper understanding of population movements, across the entire day, by determining:
- *where* people are travelling,
- *who* is travelling and
- *what* people are doing

The flexibility in generating profiles for any combination of activity or demography, for any specified region, provides a powerful tool to those planning transport services or community facilities in this new environment.

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