Urban Transport Systems

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Theme 5: Transport needs and travel behaviour

Spatial differences in the trip generation and travel behaviour - empirical observations in the Tampere region[1]

1. Introduction

At the Tampere University of Technology there is an on-going project *Sustainable transportation system*, in which the purpose is to evaluate the possibilities of the changes in the transport supply and land use in achieving a sustainable transportation system and urban form. In the study also the location of different activities is taken into account.

The trip generation and travel behaviour in general depends on several things, of which the most important are the sosio-economic factors. The best known factors are generally age, gender, car ownership and occupation. These individual factors can explain most of the differences in daily travel behaviour. However, the differences partly depend on the availability of work places, schools and local or regional services. The importance of these spatial factors is not well known.

In this study several spatial or geographical factors, like the local service accessibility, have been studied in order to be able to explain the differences in travel patterns. Especially in the future, when the number of leisure time trips and personal business trips have been forecasted to increase, the importance of local service level will increase. The study is based on the travel diary data collected in the Tampere region during the years 1996-97. Tampere region consists of six local municipalities, which have altogether approximately 280 000 inhabitants.

The main purpose of the study is to define how local factors - so called spatial factors - affect on the trip generation and the travel behaviour. The basic hypothesis was, that on the areas,

[1] A draft version of this paper has been presented at the workshop of the Nordic Network on Modelling Transport, Land-Use and Environment, Trondheim, March 26 – 28, 1999.

where the local service level is low and distances to service areas are long, the number of daily trips is smaller. The travel diary data of Tampere region consists of information about ca. 32 000 trips with background information about the sosio-economic qualities of the individual. In addition, GIS-based information about the local service level and sosio-economic qualities of the population have been utilized as the basic information.

2. Classification of service level

2.1 Definition of service level index

The local service level depends on various type of services available on the area. In this study the focus has been on the trip generation properties of the service type. The service types generate different amount of daily trips: certain services are needed on daily basis – certain services on the contrary are needed merely on weekly or monthly basis.

In this study the services are divided into four different groups:

a) Services producing shopping and personal business trips
Grocery shops, perishables, kiosks, liquor stores, fabric and handicraft stores, clothing stores, draperies, shoe stores, furniture shops, home electronics shops, hardware stores, electrical goods stores, pharmacies, book stores and stationer's, jeweller's, watchmaker's, photography shops, opticians, flower shops, sports equipment shop, flea markets, car sales, car service stations, other retail trade, banking and financing agencies, insurance agencies.

b) Social services
Day nurseries, comprehensive schools, upper secondary schools, vocational schools, social service agencies, health care services.

c) Services connected to leisure activities
Recreation, cultural and sports activities, physical exercise services, accommodation activities, catering trade services, restaurants, bars, pubs, cafeterias.

d) Public transportation services
The local service level of public transportation.

Service groups have been weighted according to their relative impact on the trip generation. The weighting shown in table 2.1 is based on the travel diary data collected during November and December 1996. A area-specified service level index is assessed with a help of the local service level.

Table 2.1 The service level factors and their relative importance on the service level index.

service group	relative weight
services producing shopping and personal business trips	
retail trade of perishables:	
hypermarkets and department stores	23,41
supermarkets	
grocery stores	
specialized grocery stores	
kiosks	0,34
liquor stores	0,29
fabric and handicraft stores, draperies	0,34
clothing stores	0,49
shoe stores	0,19
furniture shops	0,26
home electronics shops	0,17
hardware stores	0,56
electrical goods stores	0,08
pharmacies	0,51
book stores and stationer's	0,44
jeweller's and watchmaker's	0,10
photography shops	0,21
opticians	0,15
flower shops	0,13
sports equipment shop	0,20
flea markets	0,34
car sales	1,53
car service stations	0,61
other retail trade	0,63
banking and financing agencies	5,43
insurance agencies	5,43
social services	
schools	8,07
social welfare services	5,43
health care services	2,46
services connected to leisure activities	25,08

The postal code areas on the Tampere City Region are divided into five different classes according to the service level index, household size, share of office buildings and housing, car ownership, population density and distance to the nearest community center. The area types are following:

1. Central business district (CBD)
   small household size, small number of children, plenty of business activities, high level of service
2. Local community center (LCC)
   high level of service, local administrative services
3. Urban housing area (UH)
   high level of service, mainly housing, high population density
4. Suburb of high service level (HSS)
   high share of block of flats, high share of housing, high level of service, relatively low car ownership
5. Suburb of low service level (LSS)
   small housing, semi-detached housing, big number of children, high car-ownership, low level of local services
6. Sparsely populated non-urban area (SPA)
   high car-ownership, low population density, long distance to local community center, low service level

In figure 2.1 is shown the number of different area types and the share of population living on them. There is altogether 71 postal code areas on the region. Most of the areas belong to the suburbs and sparsely populated areas. However, almost 75 % of the population is living on the high service level areas.

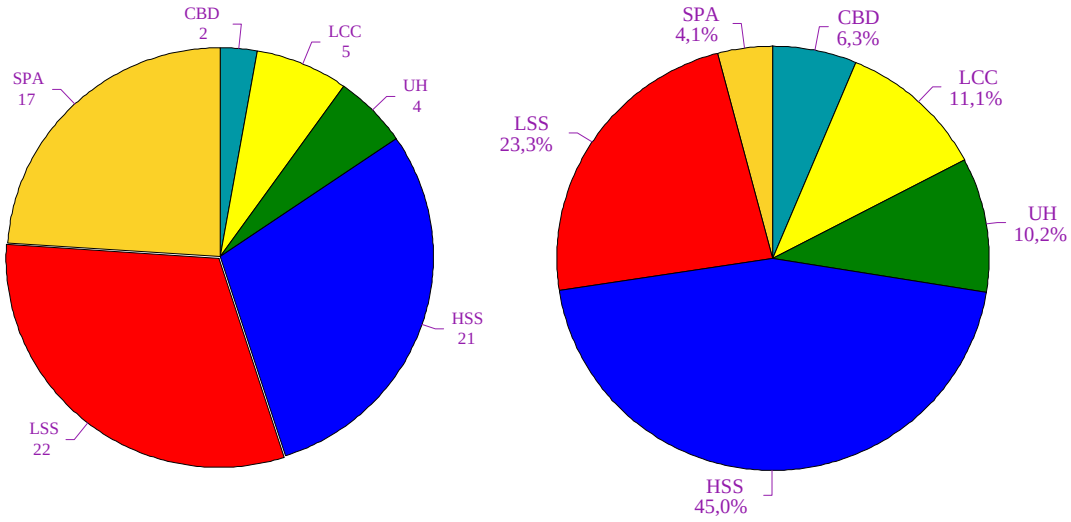

Figure 2.1 Number of different area types (on left) and the population living on them (on right).

In table 2.2 is shown some basic differences between the different area types. The differences are most significant in the service level and population density. Also the car ownership varies strongly between the area types. Lowest car ownership rates are found on the housing areas near the central areas and on the high service level suburbs.

Table 2.2 Average properties of the different area types in the Tampere City region.

area type	house-hold size [persons]	house prizes [mk/m2]	car density [cars/ 1000 inh.]	population density [persons/km2]	pensio-ners [%]	worktrip length under 2 km [%]	house-holds with children [%]	housing [%]	block of flats [%]	service level index
CBD	1,6	6053	393	4955	59	51	10	67	46	7702
LCC	2,3	3993	391	257	39	32	31	84	5	1306
UH	1,6	5839	306	5201	63	46	11	71	52	1817
HSS	2,2	4426	355	967	37	21	28	86	13	778
LSS	2,5	3904	390	530	32	20	36	90	5	257
SPA	2,6	3675	430	28	40	29	34	89	1	66

3. Trip generation

3.1 Number of daily trips

The number of daily trips varies strongly depending on the individual factors. The most significant factors are age, gender, household income, car ownership, household size and occupation. The differences in the trip generation for each age-group and gender are shown in figure 3.1. Also the trip generation by trip purpose varies between different individual categories.

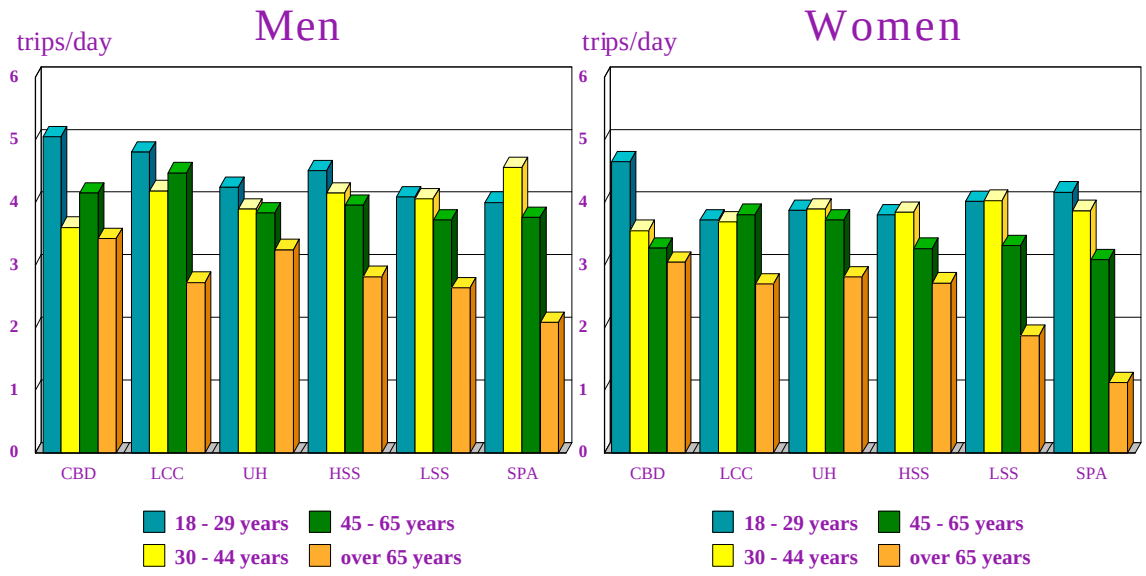

Figure 3.1 Number of daily trips on the different area types for men and women of different age.

In assessment of trip generation the trips are normally divided into home-based and non-home-based trips according to the origin and destination of the trip. Trips can also be considered to be divided into bound trips and unbound trips shown in figure 3.2. Bound trips are spatially and temporally bound trips – they most be done at a certain time to a certain place. Bound trip generation and choice of destination doesn't depend on the individual trip decision. However, the choice of mode depends on the individual factors also for the bound trips.

For the unbound trips there are usually genuinely several possible destinations and also the point of time can be chosen. The number of unbound trips depends strongly on the number of the bound trips because the mobility has limitations caused by the amount of available free-time. The unbound trips are also much more irregular and individual than bound trips. Unbound trips can be divided into two groups, of which the other consists of necessary personal business trips and the other of more unbound trips depending on the individual life style. Both unbound trip groups have free choice of destination, frequency and mode. The difference is that the personal business trips – for example shopping trips – are necessary and have to be made somewhere. Individual can make a free choice, which shop he visits and how often he makes the trip. The freer choice of destination and point of time also increases the amount of available modes. The life style trip generation depends on the available free-

time, recreational habits, hobbies and the number of social contacts. For life style trips the generation, modal split and the choice of destination are freer than for any other trip group.

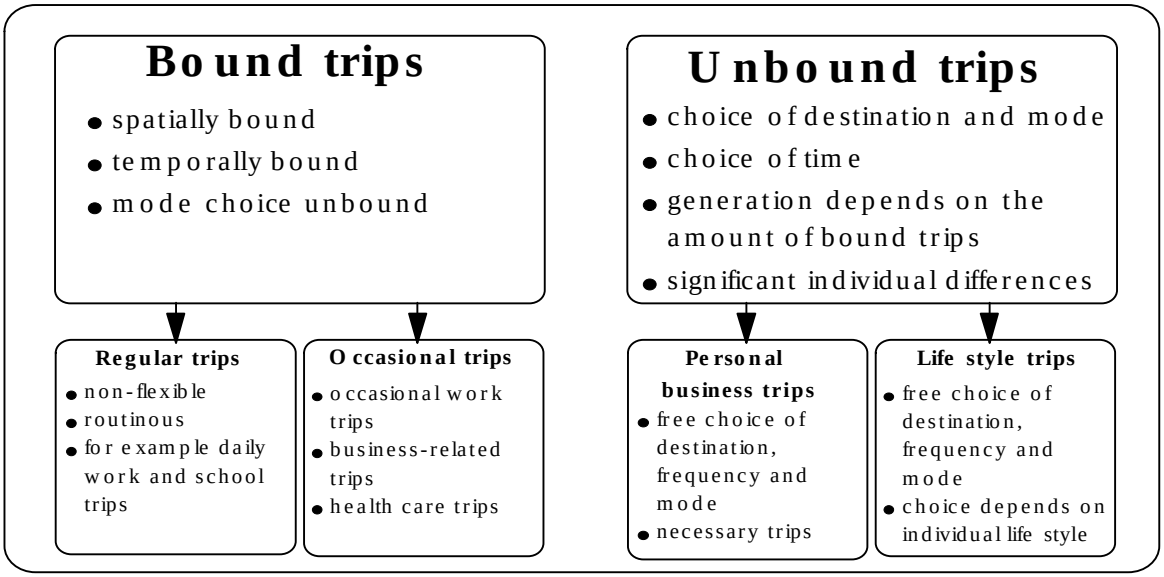

Figure 3.2 Trip classification according to the trip status.

Generally the trip generation varies also due to the local service level (figure 3.1). At the age-groups of 30 – 44 years and 45 – 65 years the differences in the number of daily trips is small between the different area types. One of the reasons is that their daily trips include bound trips, which don't depend on the accessibility to local services.

For 18 – 29 years old inhabitants the number of trips increases, if the local service level is high. The trip generation of the retired people depends on the first hand on the local service level. Differences between men and women are most significant at the age-groups of 45 – 65 years and over 65 years.

3.2 Home-based personal business trips

The number of home-based personal business trips is slightly lower on the areas, where the local service level is low. In figure 3.3 is shown the number of daily shopping and personal business trips, which are included in the unbound trips. In city center and at the high service level areas the home-based trip generation is bigger than at the low service level areas. Older people are in this case exceptional: home-based shopping trips are generally more typical to older people. Altogether, the differences in the number of home-based shopping trips is relatively even among the different area types.

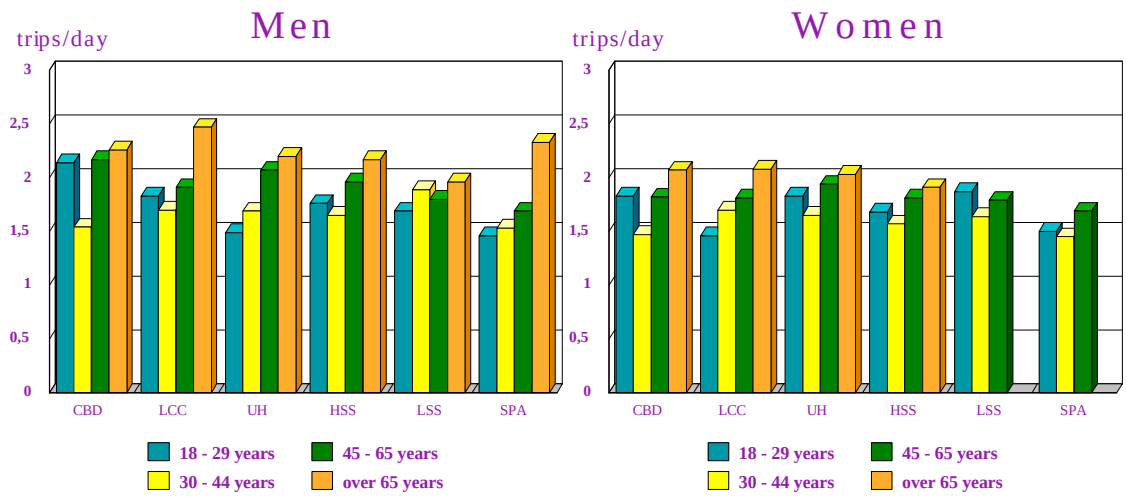

Figure 3.3 Home-based shopping and personal business trip generation on the areas.

3.3 Non-home-based personal business trips

The trip generation for the non-home based personal business trips shows clearer dependence on the local service level. At the areas, where the local service level is low, the number of non-home-based shopping and personal business trips is higher. This is partly due to the trip chaining – at the areas, where the service availability is low, several destinations are visited on the same route. In figure 3.4 is shown the number of non-home-based shopping and personal business trips at the different area types.

Also for the people living at the city center, where there is many kinds of activities, the number of non-home-based trips is bigger than on the suburban areas. The short distances between the services and shops increase the amount of short non-home-based trips.

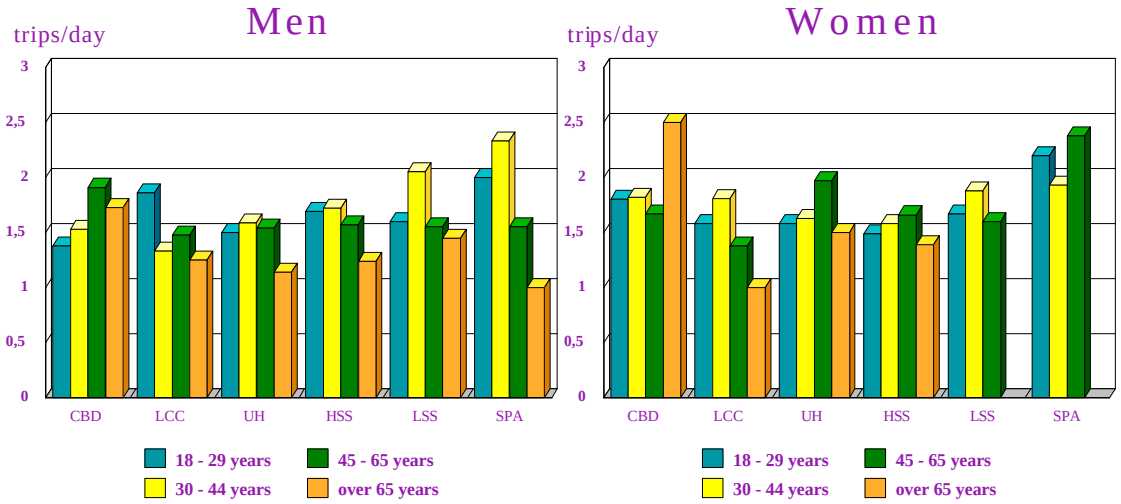

Figure 3.4 Non-home-based shopping and personal business trip generation on the areas.

4. Trip chaining

4.1 Share of home-based trips

The number of home-based trips varies only slightly on the different area types. For the shopping and personal business trips there are some more significant differences between the different area types. Approximately half of the shopping and personal business trips are home-based for the people living on the city center and on the high service level areas. On the sparsely populated areas the share of the home-based shopping and personal business trips decreases to 43 %. In figure 4.1 is shown the share of home-based and non-home-based shopping and personal business trips on the different areas.

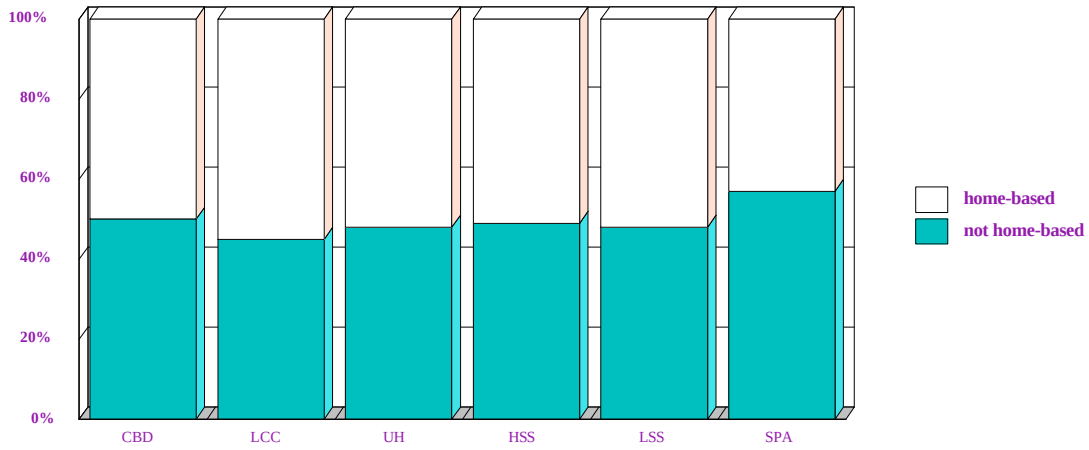

Figure 4.1 The relative share of the home-based and the non-home-based shopping and personal business trips.

4.2 Trip chain lengths

The local service level has significant effects on the trip chain lengths. Usually the bound trips are the first trips of the day. Unbound trips like shopping trips are usually the first or the third trips of the day.

In figure 4.2 is shown the trip chain lengths on the different area types. Approximately 65 % of the people living in city center make only home-based trips. At the sparsely populated area the share is also 65 %. Approximately 60 % of the people living at the suburb areas make only home-based trips. Therefore the trip chains are generally longer on the suburban areas. The non-home-based trips are most common for the age-groups of 18 – 29 years and 30 – 44 years. Over 65 years old people make only seldom other than home-based trips.

The most typical daily trip routine consists of two home-based trips: from HOME to OTHER THAN HOME to HOME. This routine is most typical especially on the low service level areas. Several home-based trips in chain are most typical at city centre and the high service level areas. Longer chains, where there is several destinations before returning to home, tend to be most common at suburban areas. Long and exceptional chains are included in the last group, which is dominating in the city centre and sparsely populated areas.

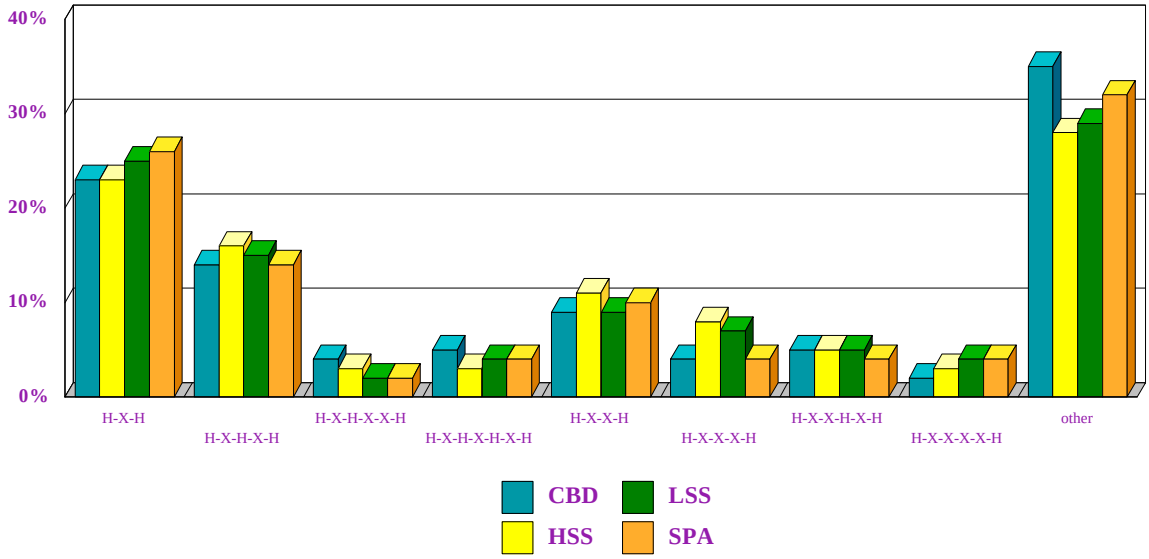

Figure 4.2 The typical daily trip chains (H = home, x = other than home).

5. Trip lengths

5.1 All trips

At the low service level areas the car ownership is significantly higher than on the high service level areas. Distances to the work places effect on the average trip length. When the trip lengths are compared, the low local service level areas generate the longest trips. In figure 5.1 is shown the average trip length including all the daily trips on the different area types. The average trip length for women is clearly shorter than for men. Specially over 65 years old women make trips mainly on their local area. The differences between the area types are bigger for the age-groups that make many bound trips than for the age-group that is not tied to certain destinations.

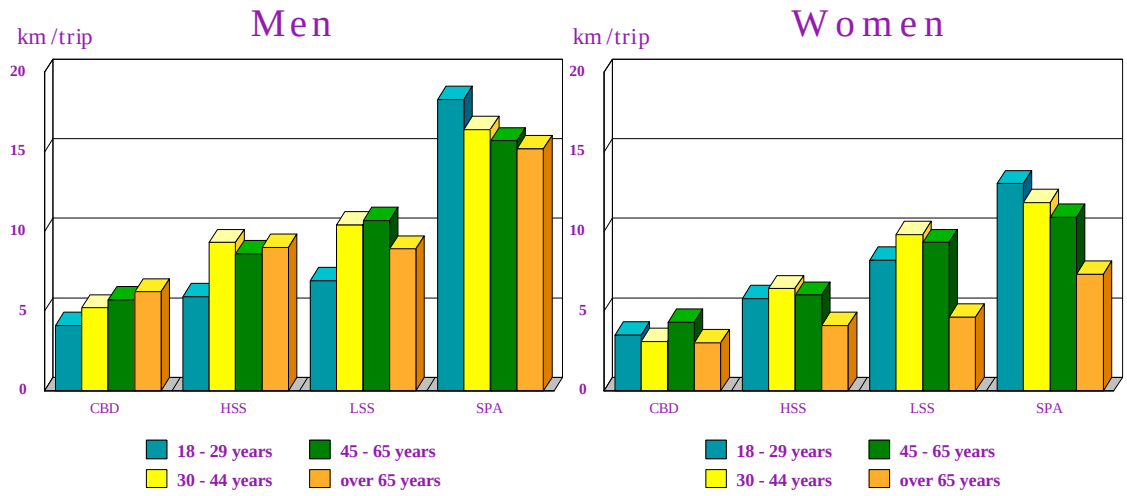

Figure 5.1 The average trip length on the different areas.

5.2 Home-based shopping and personal business trips

In figure 5.2 are shown the trip lengths for the shopping and personal business trips. These trips are not bound to a certain destination and therefore their length is not as clearly dependent on the distance to the city center than the bound trip lengths. Home-based shopping trips are approximately 30 % shorter than the average trip lengths on the low service level areas. On the high service level areas the shopping and other personal business trips are over 50 % shorter than the average trips.

In general, the women's trip lengths are much shorter than men's. In the case of home-based shopping trips the women's trip length is bigger than men's except for the women over 65 years of age.

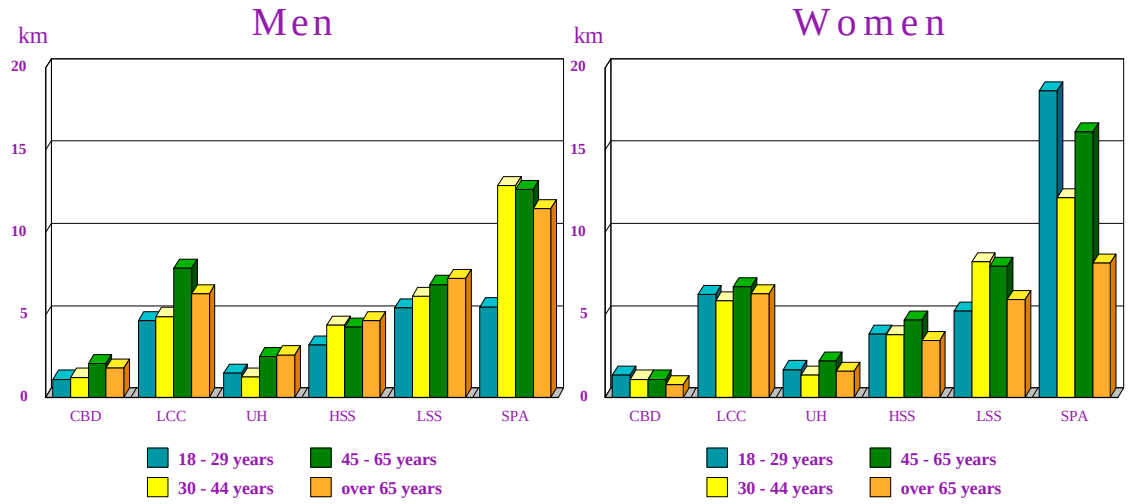

Figure 5.2 The average shopping and personal business trip length on the different area types for the home-based trips.

5.3 Non-home-based shopping and personal business trips

The non-home-based shopping and personal business trips are generally longer than the respective home-based trips. In figure 5.3 is shown the trip lengths for none-home-based shopping and personal business trips. On the low service level areas the home-based shopping trips are longer than the non-home-based trips due to the longer distance between home and available services.

The differences between the trip lengths of the home-based and none-home-based trips are clearest for the high service level areas, where the home-based shopping trips are shorter than the non-home-based trips. Non-home-based trips of women are shorter than the non-home-based trips of men.

The differences between the area types are smaller at the group of non-home-based unbound trips. The non-home-based trips are less spatially bound trips than the home-based.

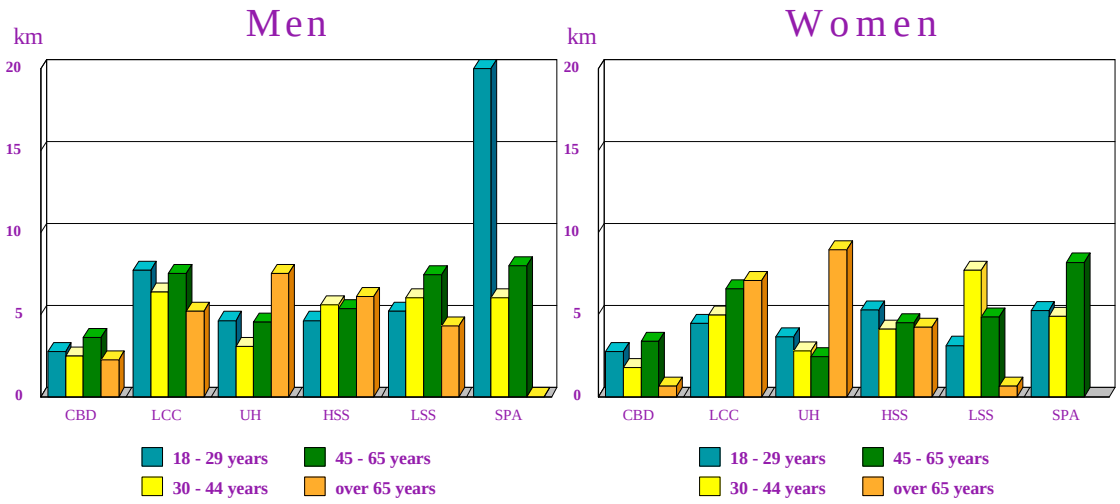

Figure 5.3 The average shopping and personal business trip length on the different areas for non-home-based trips.

6. Conclusions

The main conclusion of the study is, that the lower trip generation on the low service level areas is partly due to the trip chaining. The travel pattern on the low service level areas far from the services typically differ from the travel pattern of similar individual categories in the high service level areas. The trip chains are typically longer and the daily trips are planned in advance due to the lower accessibility to services.

The individual qualities, for example age, gender, household size and car ownership, remain the most significant explainers for the trip generation. However, the spatial factors and accessibility measures can offer valuable complementary information of the trip generation and trip chaining for the transport models.