

# Co-ordinated land-use and transportation planning – Norwegian style

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PATREC Conference 5-7<sup>th</sup> of July on Transit Oriented Development.

## ***Obtaining the best or avoiding the negative?***

When some researchers are looking for the sustainable urban form they take on a very difficult task reflecting the difficulties defining sustainability, the difficulties of distributional effects and the different points of views regarding whether we are facing serious problems or not (cf. Williams et al. 2000 p.1, Gordon and Richardson 1997, Ewing 1997). The premise for this paper is that traffic causes environmental problems. These can be reduced by mitigating measures like noise barriers, or traffic reduction. In this paper the latter is the point of departure. Instead of looking for the best form I look into a planning effort to reduce the amount of car traffic in order to avoid as much as possible of the negative impacts related to the dominant mode of transportation, car traffic. This paper describes and evaluates how a small European city, Trondheim in Norway, tries to follow state guidelines and regulations in order to achieve environmental goals set by the state and goals of their own<sup>1</sup>. In their effort the Municipality of Trondheim is instrumental in developing a soft ware tool for analysing locations and changes in the transportation system. The questions raised in this paper are: Was the co-ordinated land-use and transportation successful? Did the new soft ware tool provide the planners with knowledge that could be useful in their analysis and recommendations?

## ***Act locally - the beginning of something new***

Late in 1989 the Royal Ministry of Environment in Norway, together with ten other ministries, state directorates, and state businesses, joined together in what was known as TP10, i.e. Transportation Planning in the ten largest urban areas in Norway<sup>ii</sup>. Trondheim, at the time the third largest urban region in Norway, was one of these areas. The task before the ten cities was to plan for less pollution from transportation, acknowledging that land-use should be a premise for the planning this time and not only a consequence of transportation planning as it had used to be in previous transportation planning. The background for this shift in transportation planning perspective was threefold:

- The Brundtland Report “Our Common Future” from 1987 calling for reduction in pollution with global impacts and the need for local actions stating that motor vehicles greatly influences environmental conditions (WCED, 1987:242)
- The increase in pollution related health impacts in the cities and in Oslo in particular
- The level of money being spent on supply-oriented transportation politics in times calling for public resources being used on public health and social affairs, was put into question.

The centrally guided planning effort generally recommended and included three strategies for all ten cities:

- Business as usual – transportation demand, a forecast of 40 % increase by 2005, was to be met by increased road capacity for personal car traffic.
- Increased public transit which in Norway outside Oslo means increased bus ridership, reducing car traffic by approximately 10 % from 1990 to 2005.

- The car reduction, or environment friendly, alternative, accepting a temporarily increase in car traffic, but all in all providing a level of car traffic in 2005 at the same level as in 1990.

In Trondheim the committee working with the TP10 transportation plan put forward among others these main goals in their report from February 1992:

- Reduced energy consumption and emissions from transportation
- Develop a land-use pattern that requires less transport and resources
- The public transit's share of transport should be increased
- The share of cycling and walking should be increased
- The built environment should accommodate increased public transit and cycling and walking by prioritising developments in the city centre, the main local centres with mixed land-use, and along the attractive public transit routes
- The transportation impacts of localisations of businesses and housing should be given more influence than before.

The central guidelines had set the national goal for CO<sub>2</sub>-output in 2005 to be at the same level as in 1989. Locally there was no goal for the reduction of the CO<sub>2</sub>-output in 2005. The local committee set the goal that the number of people strongly affected by traffic noise should be reduced by 50 % by 2005. The local committee recommended a proposal combining actions from the three strategies mentioned above, aiming for reduction in travel distances, and a transfer from car traffic to less energy consuming and more environmental friendly alternatives as bus, cycling and walking. The City Council's decision implied a rejection of this recommendation saying it was too oriented towards car traffic and road building. In practice this decision stalled the road construction within the city of Trondheim for a couple of years before the recommendations from 1992 were followed up.

### ***The situation in 1990***

The population of Trondheim, excluding the non-local students, was 137.400 in 1990. The number of work places in the municipality was 71.000. Table 1 illustrates the modal distribution in Trondheim in 1990 with approximately 61 % in cars, 9 % riding public transit and 31 % cycling and walking.

Table 1: Modal distribution (shares) in Trondheim 1990  
(Source: The Municipality of Trondheim et al., 1992, p.3)

| <b>The modes</b> | <b>Share of travel</b> |
|------------------|------------------------|
| Car – driver     | 46,1                   |
| Car – passenger  | 14,7                   |
| Public transit   | 8,5                    |
| Cycling          | 8,3                    |
| Walking          | 22,4                   |

The car ownership in 1990 was 377 cars per 1000 inhabitants with a forecast for 12 % growth in the period 1990-2005. The travel pattern by car had changed coming up to 1990 with a decrease of 7 % in traffic levels (VPD; vehicles per day) into the city centre. The main reason being a new shopping centre established 10 km south of the city centre. This shopping centre

was the largest in Norway at the time. But the general tendency for offices to establish themselves outside the city centre also contributed to the decrease. Table 2 illustrates the difference in modal split between a bank located in the city centre and a bank located in the same area as the new shopping centre.

Table 2: The modal split travelling to work in two banks depended upon localisation (Source: Lervåg 1990)

| <b>The modes</b>    | <b>Share of travel Centrally located bank</b> | <b>Share of travel Bank located 10 km outside of the city centre</b> |
|---------------------|---|--|
| Car – driver        | 26  | 69   |
| Car – passenger     | 16  | 13   |
| Public transit      | 37  | 11   |
| Cycling and walking | 21  | 7  |

The trip frequency in public transit was 154 trips per inhabitant per year in 1980 and 103 in 1990. The travel pattern in public transit is oriented towards the city centre with 60-70 % of all the trips starting or ending there. The buses had problems with queues on the main roads leading in to the city centre causing delays.

The land-use pattern in the city of Trondheim can best be characterised as dispersed but the growth outwards had begun slowing down regarding housing but was still increasing regarding offices, warehouses and shopping.

### ***Three transportation plans in the 1990s***

#### **The Plan for Public Transit in the region of Trondheim 1994-2005**

This plan produced in May 1994 focused on three measures for increased public transit ridership (The Municipality of Trondheim et al., 1995, p.15):

- Improvement of the existing public transit system
- Restrictions on car traffic, and
- Transit oriented land-use development.

The improvements for the bus system included new routes, increased frequencies of trips, right of way measures, and terminals. There were also discussions how to improve the existing tram line and regional train service.

The analysis in the plan concluded that there were small problems regarding road capacity and very few restrictions on the existing car traffic. Since the improvements for the public transit also could benefit from restrictions to the car traffic this was looked into. The accessibility for cars to the city centre could be reduced through (The Municipality of Trondheim et al., 1995, p.33):

- Reduced capacity on the entrance roads (e.g. the buses could be given their own lanes all the way into the city centre)

- A shift in the parking policies from minimum requirements of parking spaces per m<sup>2</sup> of new development to a maximum level of spaces
- A transformation of the existing toll road ring around the city to a system of road pricing.

Transit oriented land-use development was now being directly inspired by the Dutch ABC-principles (VROM 1991), but Trondheim had not yet developed their own, adjusted ABC-principles. But the plan called for all development to be concentrated to areas supporting a rational public transit system and developments should primarily take place no further away from the transit routes than 500 meters. Businesses and institutions attracting a large number of people should be located in the city centre or along the main entrance roads to the city centre. New housing projects should primarily be built in areas with a high quality transit supply, which means a departure each ten minutes during rush hours and twice per hour outside of rush hours, and a location maximum 300 meters away from a bus stop.

The transit oriented land-use development must be supported through the superior and detailed land-use plans, and this is suggested done through the use of National Policy Guidelines (NPG), regional and municipal land-use plans, e.g. requiring impact assessments regarding the need for public transit and parking in the different development projects.

The political decision making regarding this public transit plan had an interesting twist to it. The politicians removed some of the actions that would improve the bus transit, e.g. separate bus roads reducing travel times and reaching more travellers with fewer routes, and increased the ambitions in public transit planning by saying that the goal for public transit should be an increase in ridership by 50 %.

### **The 1995 Transportation Plan**

This 1995 transportation plan built on the transportation plan discussed above, and a policy statement (City Council of Trondheim, case 83/1994) from 1994, confirming the goal mentioned above. The new passengers should come from car traffic and mostly from areas surrounding the main transit routes. The most important aspects of this 1995 transportation plan were:

- The level of subsidies to public transit should increase from 10 million NOK to 25 million NOK<sup>iii</sup> which was the 1993-level of economic support.
- Reduced parking places for workers in the city centre.
- The land-use development should facilitate a higher share of public transit and walking and cycling (“walcynng”). Development should be prioritised in the city centre and close to it, along the main transit routes and in the largest local centres with mixed land-use.

In addition to this it was decided to investigate the introduction of road pricing. To put the operational subsidies to the public transit into perspective the proposal for road construction was calculated to a cost of approximately 1.800 million NOK. Of this some 200 millions were for environmental aspects of the road such as noise reduction schemes, pedestrian crossings and cycle roads.

As a part of this plan the assessments of parts of the city were analysed with respect to the principles of putting the right businesses in the right place (VROM 1991). This preliminary work started in 1994 and was later to be expanded to the whole city and became more specific as part of the Programme for Environmental Friendly Transportation in Trondheim.

## The Programme for Environmental Friendly Transportation in Trondheim

The Municipality of Trondheim favoured a land-use policy of densification and wanted to fight sprawl. But it did not have a developed rationale for guiding businesses where to locate/relocate or where to locate new housing projects. The programme for environmental friendly transportation in 1994-98 developed guidelines for location of businesses based on the Dutch ABC-concept.

The Dutch principles for locating the right businesses in the right place (VROM 1990) outlines a policy where the accessibility of an area of the city is characterised as good (A), fair (B), or poor (C) respectively for public transit (trains) and cars. Then the task is to analyse the businesses and come up with a categorisation of which one fits into the different areas. E.g. businesses with high labour and visitor intensity should be located in areas of the city with good accessibility for public transit able to transport many people per hour. On the other side businesses relying on car transportation, having few employees, and even less visitors should be located in areas with poor accessibility for public transit, but good accessibility for cars, i.e. C-areas. In Trondheim we replaced the trains that constituted the public transit system in the Dutch model with a combination of accessibility for the buses and walking as illustrated in figure 1 below. In relation to the principles illustrated by the figure the municipality developed a map depicting where the different areas were and a table of which types of businesses were wanted in these locations.

Accessibility  
with bus transit  
and walking

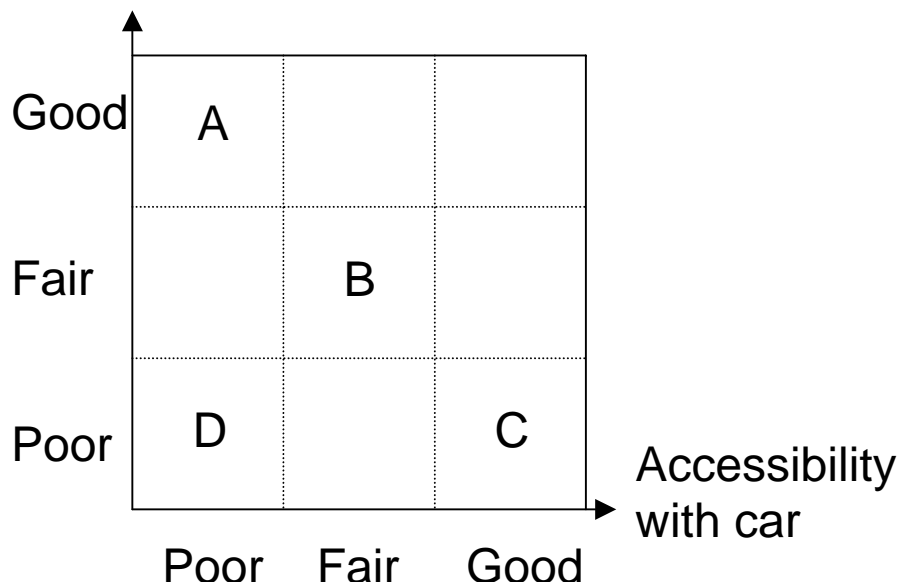
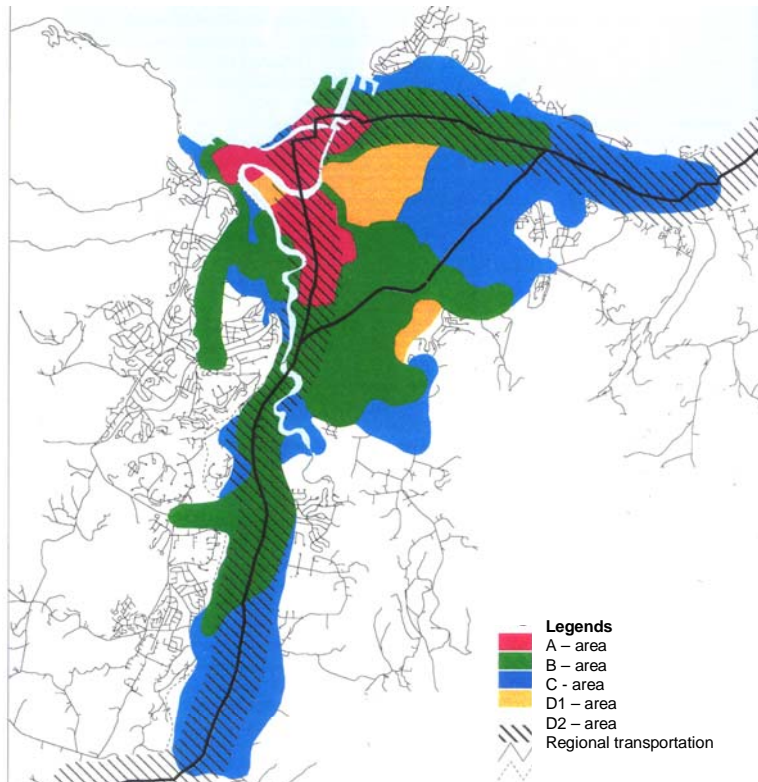


Figure 1: The ABC-table of Trondheim  
(The Municipality of Trondheim, 1998 p.12)

## ABC-map of Trondheim



A-area: Good accessibility for walking, cycling  
And public transit  
B-area: Average accessibility for environmental  
Transportation modes as well as for cars  
C-area: Good accessibility for cars, poor for  
other modes

D1-area: Central urban areas without main roads or  
main bus routes  
D2-areas: Urban areas with poor  
accessibility for all modes of transportation

Figure 2: The ABC-map for Trondheim  
(The Municipality of Trondheim, 1998:14)

The programme furthermore suggested that the level of car traffic to the A-areas should not exceed 35 % of the total number of travels, and not be more than 60 % to the B-locations. In order to achieve this there was a suggestion for maximum number of parking spaces in the different types of locations for different types of businesses. E.g. in an A-location the maximum parking spaces should be 0,4 per employee or 1,0 per 100 m<sup>2</sup> of floor space for offices, whereas institutions were allowed 0,4 parking spaces per employee or 0,7 places per 100 m<sup>2</sup> floor space.

This suggestion made their way into the municipal parking byelaws. There the minimum requirements for parking spaces per floor space and the requirement of financing new parking spaces when wanting to develop new buildings in the city centre, was replaced by a requirement for a parking plan to accompany the application for development. The plan for parking was assessed with regard to the suggestions of maximum parking spaces in the A- and B-localities as mentioned above. This shift in parking policies in the city centre was an incentive for densification in the city centre and several new projects were launched, especially housing projects.

The impact of this programme was substantial because it provided the municipality with a new tool which it could use to easily assess transportation impacts of proposals for new developments, which will be illustrated by the IKEA case presented later. More important was the fact that the draft of a policy outlined in the 1998-report gradually was integrated in site plans and local plans, tested in this way, and then incorporated into the 2001 land-use master plan for the municipality.

### ***The development of the ATP-model***

Describing the Trondheim version of the Dutch ABC-policy I have anticipated the introduction and use of what is labelled the ATP-model<sup>IV</sup>, a land-use and transportation model, which in combination with other databases make a combined planning tool for impact analyses of e.g. locations of new developments and changes in the public transit, and assessments of people's transportation needs and accessibility to important institutions.

The background for developing the ATP-model, an extension of the module Network Analyst in Arc View, was twofold:

- The traditional transportation models do not illustrate the importance each new location has regarding the shift towards environmental friendly transportation.
- The traditional models are, or at least were at the time, not capable of analysing challenges connected to public transit and cycling.

The single new developments' effect on the overall transportation pattern in a city is small, and the result presented in a traditional transportation model analysing the effects of even a large development, give the message to the decision makers that it does not matter what you do, you will not be able to alter the overall travel patterns and reduce car traffic. A single reduction of car traffic drowns in the ocean of car traffic. To suggest parking restrictions or something else seems useless. But in reality it has taken the municipality of Trondheim a large number of small, and some large, steps to develop the 1990-situation with a high degree of car dependency. In order to improve the environment, people's health and provide economic resources for other sectors than the transportation sector, there must be a change in the direction of development and the community of Trondheim must start taking small and large steps in the new direction. In order to encourage such a change of direction a colleague, Henning Lervåg, felt that we needed a tool which could illustrate the impacts, and thereby, the importance of each new development. The ATP-model was the tool he was searching for.

In the ABC-approach, accessibility is an important concept. Button (1993, p.209) defined accessibility as:

*.. nothing more complicated than an index that reflects the ease with which people can achieve the various activities they wish.*

In our accessibility map we have combined one index of accessibility for public transit with one for walking. The index for accessibility for the alternative to car traffic is calculated using travel times for bus and walking. Travel time for bus is used when walking is not longer the fastest mode of travel<sup>v</sup>. Travel time by the buses is calculated the same way as for walking, i.e. as the average travel time for trips by every citizen to the city centre and other areas of Trondheim. This combined index is seen in relation to an index for car accessibility which is a calculation of the average time trips from every citizen to all others take. Then, parking restrictions are added to the time travelled to areas with such restrictions. All these calculations are done in the ATP-model. The patterns of travel times in Trondheim are illustrated in figure 3.

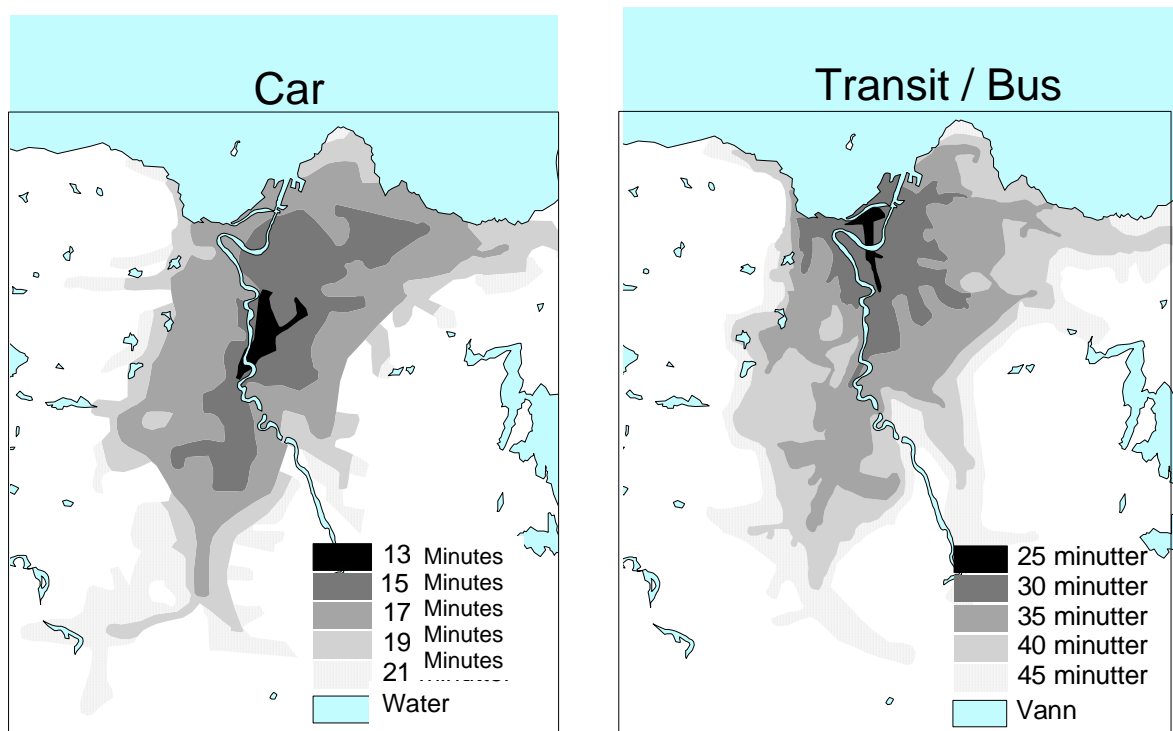


Figure 3: Travel time patterns with car (to the left) and the alternative to cars in Trondheim.  
(Source: Asplan Viak, 1999)

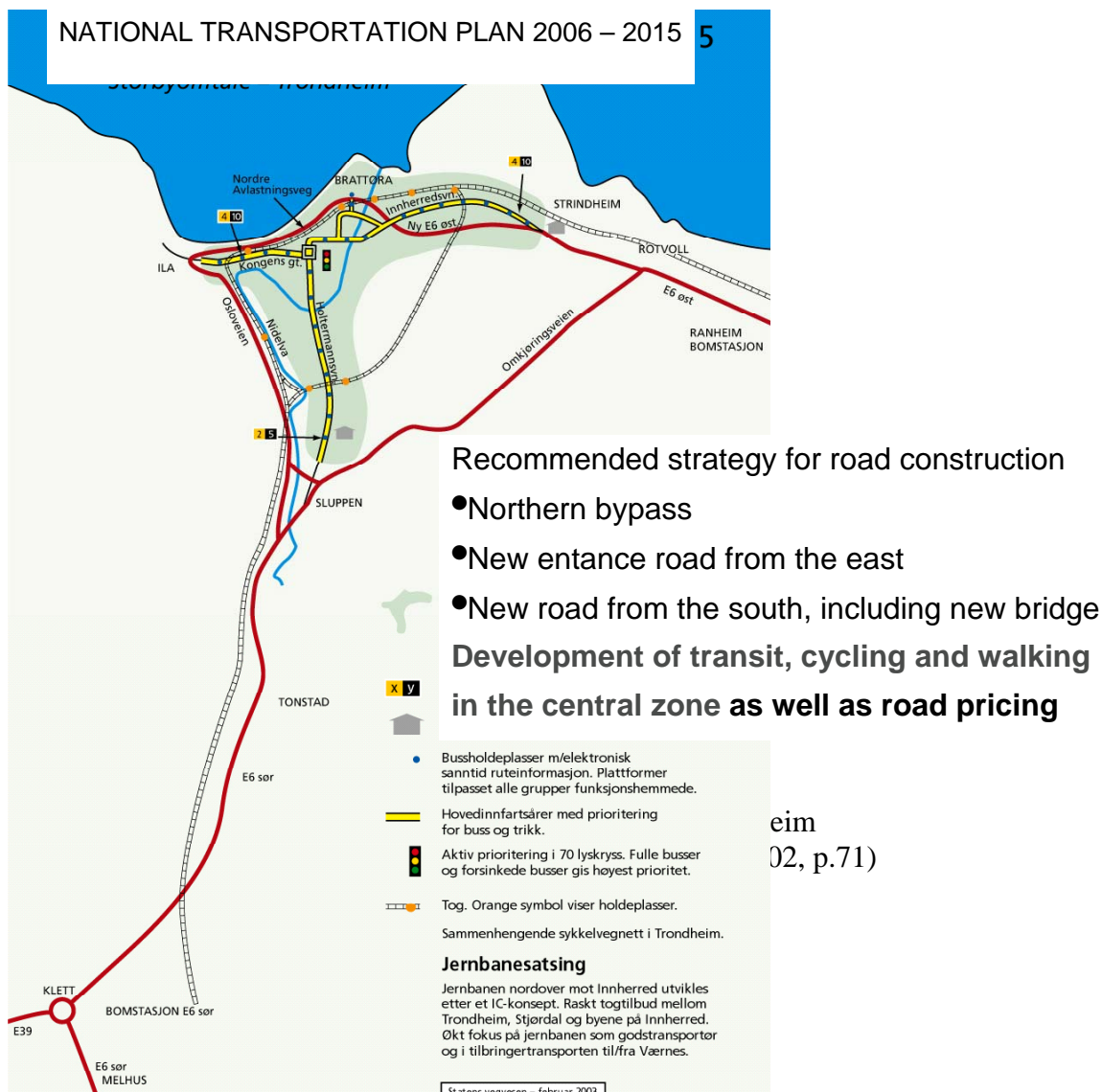
The model consists of two parts. First there are the transportation networks. There are four networks. One for car traffic, one for cycling, one for walking, and one for public transport which is used in combination with the network for walking in order to calculate door to door trip times. Secondly, there are the accessibility analyses. There are the calculation of travel time or distance, the range (e.g. of an institution), the population within a range or area, and finally the calculation of levels of accessibility.

In addition to the digital representation of the four transportation networks we use addresses and building data, digital censuses, and employee data connected to both the work place (employer) and the residence. This means e.g. that it is possible to plan for car pooling in a

detailed manner suggesting who could travel together to work. In the work done in Trondheim there have been analyses in this kind of detail considering the calculation of range, i.e. the number of people living within a distance from a station (the case of population basis for city train). Because of protection of individual's right to privacy and there are also restrictions regarding who can use this kind of data and you need permissions from the Tax Directorate and The Data Inspectorate. So in studies where there has been a need for working with the home to work trips, the analysts only have worked with nodes in the census districts as "home" addresses, but with the specific street addresses for their destination (the case of hospital location). This kind of detailed data provides the Municipality of Trondheim and other Norwegian municipalities with an opportunity for analysis and action with great accuracy.

### The Municipal Land-use Master Plan 2001-2012

In the land-use master plan the principles discussed since 1994 fell into place (The Municipality of Trondheim 2001). The business activity was suggested concentrated in three axes with slightly different profiles in the three areas. The housing development was to take place within the existing areas to the highest degree possible, pointing to five areas where densities could be especially high. The areas for business and housing development overlap since mixed use is wanted to develop urban areas with life all day, to encourage less car traffic than the clear cut functional city generates. These areas are within what is labelled the public transit zone in Trondheim (cf. figure 4).



The regulations in the master plan built on the ABC-principles described in the 1998-report, but were not quite so specific. E.g. it says in § 6.2 that employee intensive and visitor intensive businesses ought to locate in areas with good accessibility for pedestrians and public transit users. And specialised shops and services for the region ought to be located in the city centre (The Municipality of Trondheim, 2001b:3). Furthermore the regulations said that the density of dwellings in the areas designated for mixed urban development should be 100 dwelling units per hectare (cf. Dittmar et al. 2004 p.17). The land-use plan included three out of four steps suggested by Kenworthy and Newman (2000 p.115) to change the “car city”; focus development around the transit system, discourage further urban sprawl and build new urban villages.

Concerning parking the regulations are designed in a manner trying to make the competition between the city centre and areas outside the public transit zone more equal limiting the ground space that can be used for parking. The paragraph says (The Municipality of Trondheim, 2001b:4):

*When developing for business it is allowed only to use a limited part of the plot for parking on the ground. The shares allowed are:*

- 15 % for offices, universities and research
- 25 % for retail and services.

*This requirement does not refer to developments of smaller businesses with a need for up to 10 parking spaces.*

These regulations are put into the land-use plan in order to adjust the trip generation to the different businesses downwards, and in this manner make it more tempting to apply for dispensation from the regulations in the land-use master plan regarding land-use purpose and plot ratio. The limitations on parking also reduce the attraction of peripheral locations compared to those within the public transit zone. The businesses wanting more parking spaces can set up parking houses of course, but the cost for this will probably make it unrealistic.

The principles of this master plan are now integrated in the transportation planning, e.g. the input that the municipality made in the National Transportation Planning process finalising the regional input by 2002.

### ***Examples of policy implementation and use of the ATP-model***

#### **The relocation of the District Road Authority and parts of the university**

The District Road Authority (DRA) was located in a B-location (bordering to a C-location) at Sluppen. Sluppen is 150 meters from the main highway through Trondheim and the accessibility with public transit is fair. In the Sluppen area there were some industry and transportation businesses, but this is gradually changing to offices. The distance from Sluppen to the city centre is 4 km and since it originally was an industry area the parking available was very good. The DRA has some 130 employees and quite a number of visitors, both from the urban region and from other parts of the county. The original plan from the middle of the 1990s was to relocate in the Tunga area which is a C-location close to the main bypass outside Trondheim (European Road no 6, i.e. E6). Tunga has poor accessibility for travellers by public transit, and is also the least accessible area in average for the inhabitants of Trondheim for car traffic. The municipality argued against this advocating that the state authorities should

follow up on the state guidelines of co-ordinated land-use and transportation planning from 1993 which said (The Ministry of Environment 1993 p.4):

*In regions or areas where the density of the population provides a basis for public services as an environmentally friendly and effective form of transport, it is necessary, when planning the spatial pattern of development and the transport system, to attach special importance to conditions that encourage public transport.*

As part of their argument were also the improved accessibility the DRA would achieve in the city centre for all visitors disregarding which kind of mode they were travelling with. The likelihood for a modal split with a high degree of environmentally friendly trips was also pointed out. The examples of the banks were used as a prediction for what would be achieved. The DRA finally settled for the location in the city centre. Table 3 illustrates the effect this had on the modal split for the employees.

Table 3: The modal split travelling to work in District Road Authority depended upon localisation (Source: Lecture by Steinar Simonsen of the DRA 2005)

| <b>The modes</b>    | <b>Before: Share of travel<br/>Office with no parking<br/>restrictions, 4 km from the<br/>city centre</b> | <b>After: Share of travel<br/>Office with strict parking<br/>restrictions located in the<br/>city centre</b> |
|---------------------|---|--|
| Car – driver        | 63  | 20*  |
| Car – passenger     | 10  | 11   |
| Public transit      | 10  | 33*  |
| Cycling and walking | 17  | 30   |

\* In addition: Park & ride: 6 %

I doubt that the environmental arguments were the ones that the DRA put most emphasis on. The regional state authorities were in a process of coming together in the same office building in the city centre and it was natural that the DRA followed the others to this location in order to make this restructuring process as successful as possible.

Restructuring processes in businesses and e.g. universities can be used to relocate to a more transit oriented area, e.g. the city centre. When NTNU was established one such restructuring took place, gathering all the mathematical and natural sciences in one building (of 60.000 m<sup>2</sup>). This new building meant moving 80 employees from a B to an A-location. The new building was approved because it did not require any new parking spaces. In fact the area where the Natural Science building was put up lost a little over 100 parking spaces.

## **The location of IKEA**

The international furniture retailer had tried to locate in Trondheim for at least a decade without finding a satisfactory site. The people in the region therefore travelled some 500 km to Sundsvall in Sweden to buy IKEA's goods. From the point of the municipality it was natural that IKEA belonged in Trondheim and not elsewhere in the region. Around 1995, State regulations prohibited new establishments of retail, including furniture stores, in the city centre.

The Municipality of Trondheim first found out in discussions with the Ministry of Environment, that city centre meant CBD and areas close to CBD, not every site in central parts of the municipality. Secondly, the municipality in 1999 analysed the accessibility to the different sites available regarding accessibility for travels by bus, car and walcyng. When it

was established that IKEA, as a car oriented DIY furniture store should be located outside the most central parts of town, the municipality's task was to assess the attributes of the different sites. Out of the six alternatives two had poor or very poor accessibility with both car and bus. Out of the remaining four one site had poor accessibility regarding walking. The three that was left had similar advantages and disadvantages, e.g. considering when the site was available for development.

Finally, the choice was between Tunga and Vestre Rosten (cf. figure 5). When analysed the Vestre Rosten alternative is the better one regarding accessibility for all modes of travel, and this site's proximity to other retail was better than Tunga. Despite this Tunga was the choice. Two factors decided that Tunga was selected. First and foremost it was the choice of IKEA who wanted to stand out alone and not be part of a larger regional retail area like Vestre Rosten was. Secondly, the Tunga alternative was closer to the city centre than the Vestre Rosten alternative, so the City Council argued that this made it more likely for retailers in the city centre to experience spill over from IKEA shoppers.

An interesting aspect of the planning permission process was that IKEA had to contribute financially to the bus routes in the area in order to obtain a building permit. This was part of a development deal which is becoming more and more used in Norway too, but not with this kind of content.

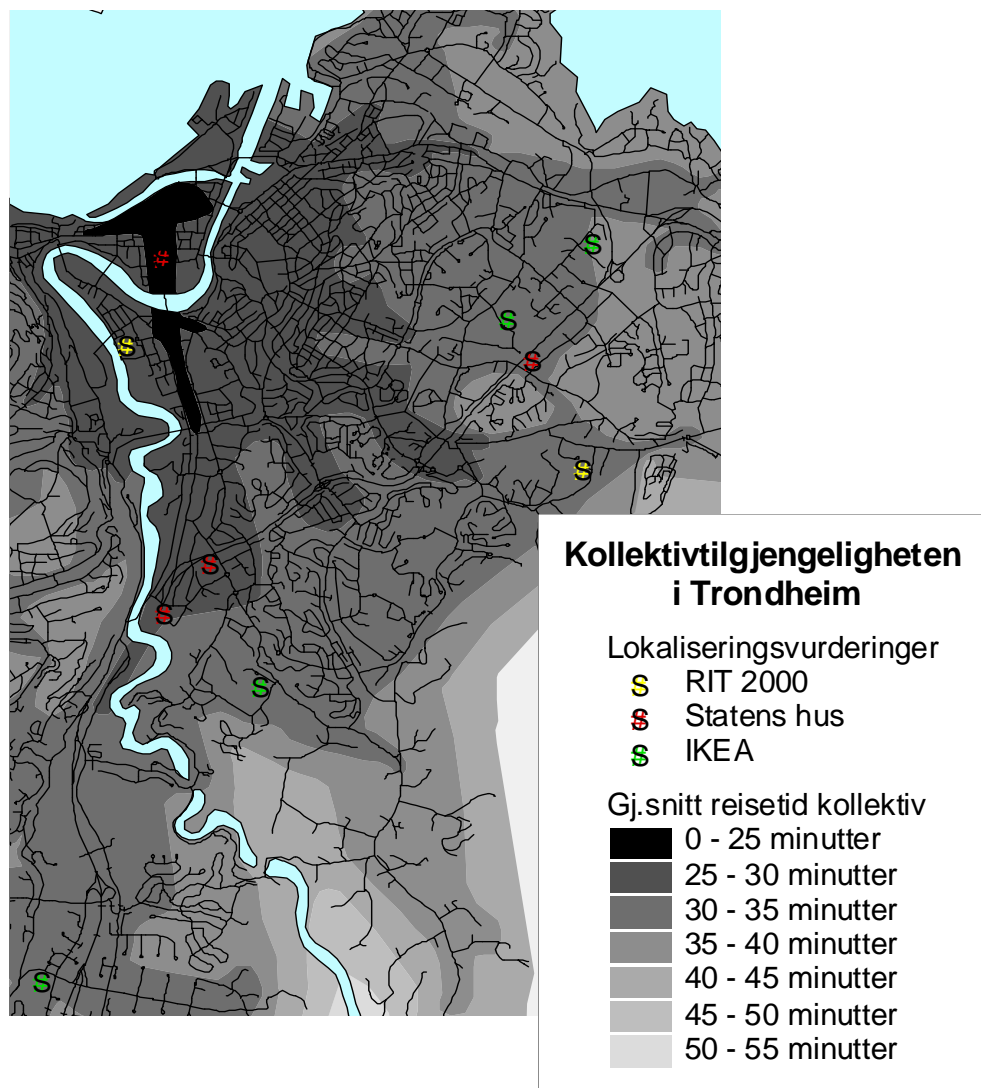


Figure 5: Accessibility by buses in Trondheim with respect to potential IKEA (green), hospital (yellow) and DRA (red) sites. (Minutter=minutes)  
(Source: The Municipality of Trondheim, 1999:10)

### The relocation of the University Hospital

In Trondheim we have the regional hospital which also is a university hospital located close to the old Norwegian Institute of Technology, i.e. the engineering faculties of today's Norwegian University of Science and Technology (NTNU). In 1995 it was decided to expand and renew the hospital in the same area as it was located. The local newspaper in 1999 questioned this and their campaign for assessing the wisdom of this decision led to an in depth study of the cost and urban development aspects of the chosen alternative in 2001/2002. The chosen alternative, Øya, was compared with respect to locating the hospital at Dragvoll utilizing some of the other main campus of NTNU for hospital purposes. The university activities at Dragvoll were to swap with the hospital and be moved to Øya.

In the analysis of these two alternatives, the municipality used the ATP model to investigate among other things the range of ambulances and the traffic changes on the main roads and

public transit. The two locations meant that within nine minutes of driving the ambulances could reach respectively 85 % and 74 % of the population from Øya and Dragvoll.

The other analysis I shall mention is the traffic changes. The planners knew the numbers of employees and where the employees lived and could anticipate where the visitors came from. On this basis one could calculate how many trips that were made and which mode that were chosen, and on which routes and roads the trips would take place. Since there are several uncertainties in the assumptions made, there was no need for the planners to use the employees' specific addresses. It was enough to know in what census district they lived. The forecast was based on the empirical evidence regarding the modal split in today's hospital location, and the new location, possible bus supply and distances from residential areas and employees housing locations (cf. table 4).

The aggregated number of trips were graphically presented and calculated resulting in a 27 % increase in car traffic work (vehicle km per day) if the hospital moved from Øya to Dragvoll and the university moved in the other direction. The ridership on the buses would be reduced by some 450.000 travellers per year. This would increase the costs by between 7 and 11 million NOK, i.e. between 1/3 and 1/2 of the annual subsidies received in 1999.

Table 4: The modal split travelling to two alternative locations of the regional hospital (Source: Asplan Viak Trondheim 2001)

| <b>The modes</b> | <b>Share of travel<br/>Centrally located hospital<br/>(2,4 km outside the city<br/>centre)</b> | <b>Share of travel<br/>Hospital located 6,3 km<br/>outside of the city centre<br/>(estimates)</b> |
|------------------|--|---|
| Car – driver     | 34   | 57  |
| Car – passenger  | 9  | 9   |
| Public transit   | 32   | 18  |
| Cycling          | 2  | 3   |
| Walking          | 23   | 13  |

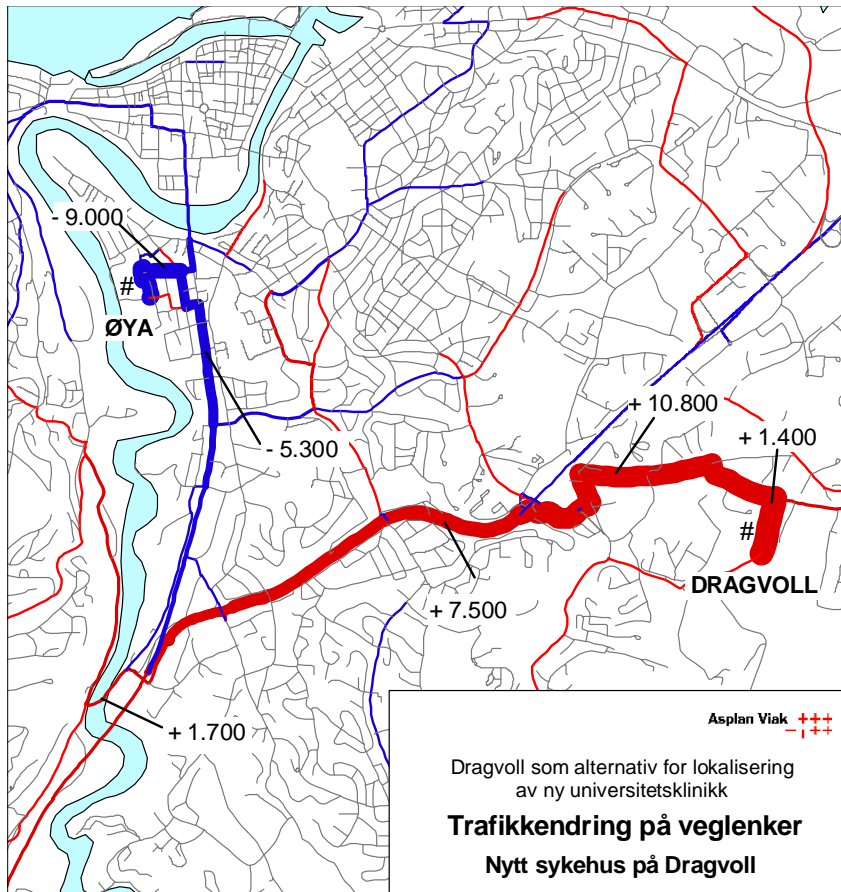


Figure 6: The Changes in car traffic to Øya (reduction in blue) and to Dragvoll (increase in red) due to relocation of the hospital.  
(Source: Asplan Viak Trondheim, 2001:30)

### The basis for a city train line

In Trondheim we have a train line surrounding the city due to German World War II needs. With some additional line construction it would be possible to establish a train circulating around the city (see figure 4). The plan for this was launched in the planning done in 2001 for the National Transportation Plan. This construction is estimated to 40-50 million NOK. The operational cost would also be substantial.

The crucial question was; would there be enough passengers to accept a proposal to implement this city train project? The ATP-model helped in the analyses. The analyses included both the present situation and a forecast for 2020. The employer/employee register in Trondheim provided the analysts with the number of people living and working around the stations. Subtracting for the people working and living in the same station area the number of work trips were calculated based on the current rate of travellers with public transit, the travel time with train compared with buses and cars and admitting a rail-factor which is a reflection of the higher standard of transportation the travellers experience on train, light rail and street cars<sup>vi</sup>.

The potential of travellers by train to work, including the non local students not recorded as residents of Trondheim, totalled to 1.650 people within a 500 meter radius around the stations.

If we add the people living the people living from 500 to 900 meters from the stations and work within 500 meters from other stations, and those who live within 500 meters from the stations and work from 500 to 900 meters from other stations, the total number of potential travellers is 5.900. This is 5.900 out of a population in Trondheim of around 170.000 including the students with temporary stay in the city. As a comparison the Regional Railway Authority made a different assessment of the basis for the city train using the ATP-model. They summed up all inhabitants within a range of 1 km from all the stations and all the people working within 1 km from the station irrespectively of where the inhabitants worked or where the employees lived. This added up to approximately 93.000 potential travellers according to the railway authorities. In my mind it illustrates how the ATP-model can be misused.

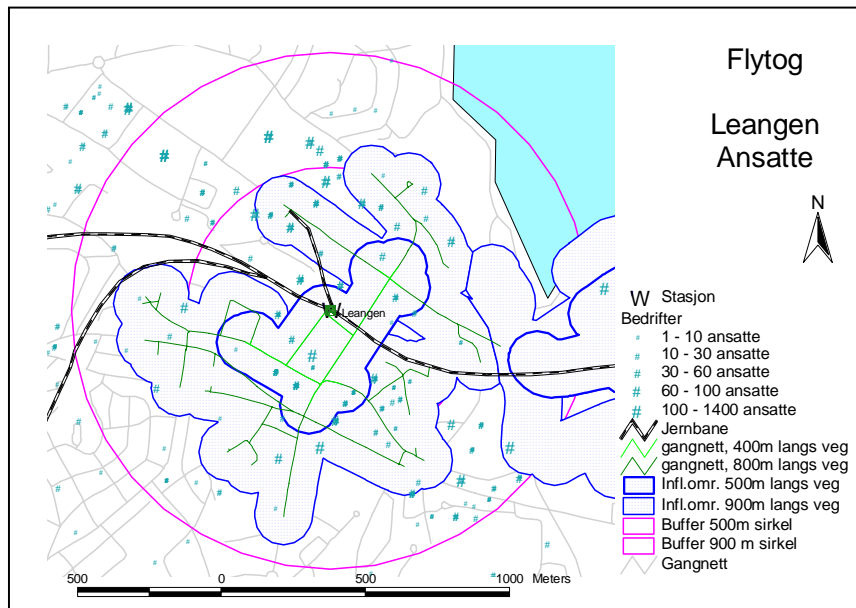


Figure 7: The ATP-model registers the number of employees and inhabitants in the areas around the stations on the city train (Source: Asplan Viak Trondheim 2003 p.22)

## ***The car traffic prevails and there is a need for more restrictive measures***

### **The goals from 1990 are not reached**

The traffic has increased by approximately 26 % in Trondheim from 1992 to 2004<sup>vii</sup>. This means that the level of particles in the air, CO<sub>2</sub> emissions and noise levels have increased. CO<sub>2</sub> emissions are not reduced to the 1989 level as stated as a goal in 1992, but have increased with approximately 15 %. In 1990 3400 residential units had indoor level of noise above 35 dBA. In 2000 the number of units was 4150. This is an increase of 22 %. The goal in 1992 was that no residential units should experience indoor noise levels above 35 dBA by 2005. It is therefore not likely that the goal of reducing the number of people that feel strongly affected by noise by 50 % from 1990 to 2005 will be reached.

The goal from 1992 was to increase public transit's share of the total number of trips per day. In 1994/1995 it was specified that the growth should be 50 % by 2005. The reality is a growth from 1995 to 2003 by 11 %. The number of trips per year per inhabitant has increased slightly from 103 in 1990 to 106 by 2003.

The goal was that land-use should facilitate public transit, cycling and walking. The land-use has developed in two different directions throughout the last 20 years. Both businesses and housing spread in the 1980s, but then housing started to be demanded more and more in the central areas in the 1990s. At the same time housing production lagged and was built in the more decentralised parts of Trondheim. The businesses have also experienced a certain degree of centralisation, especially the service sector and certainly banking, insurance and their services/consultants. Table 5 illustrates that the level of employees in the public transit area has increased.

Table 5: The location of the employees  
(Source: The Municipality of Trondheim 2005 p.7)

| Year | Number of employees in the city centre | Number of employees in the public transit area | Total number of employees in Trondheim |
|------|--|--|--|
| 1990 |  |  | 71.000                                 |
| 1995 | 14.850 (20 %)                          | 36.900 (49 %)                                  | 74.000                                 |
| 2000 | 16.600 (22 %)                          | 37.400 (50 %)                                  | 75.500                                 |
| 2003 | 18.300 (22 %)                          | 42.400 (52 %)                                  | 82.000                                 |

Figure 8 illustrates the geographical distribution of employees in Trondheim according to the administrative districts of the municipality. The employees basically work in areas with bus transit, but there are many working along the eastern by-pass road and in the north of the city too many work places are located too far away from the main bus routes. In figure 9, where all new business developments in the period from 1983 to 2001 is shown, the dispersal of some especially large work places is characteristic.

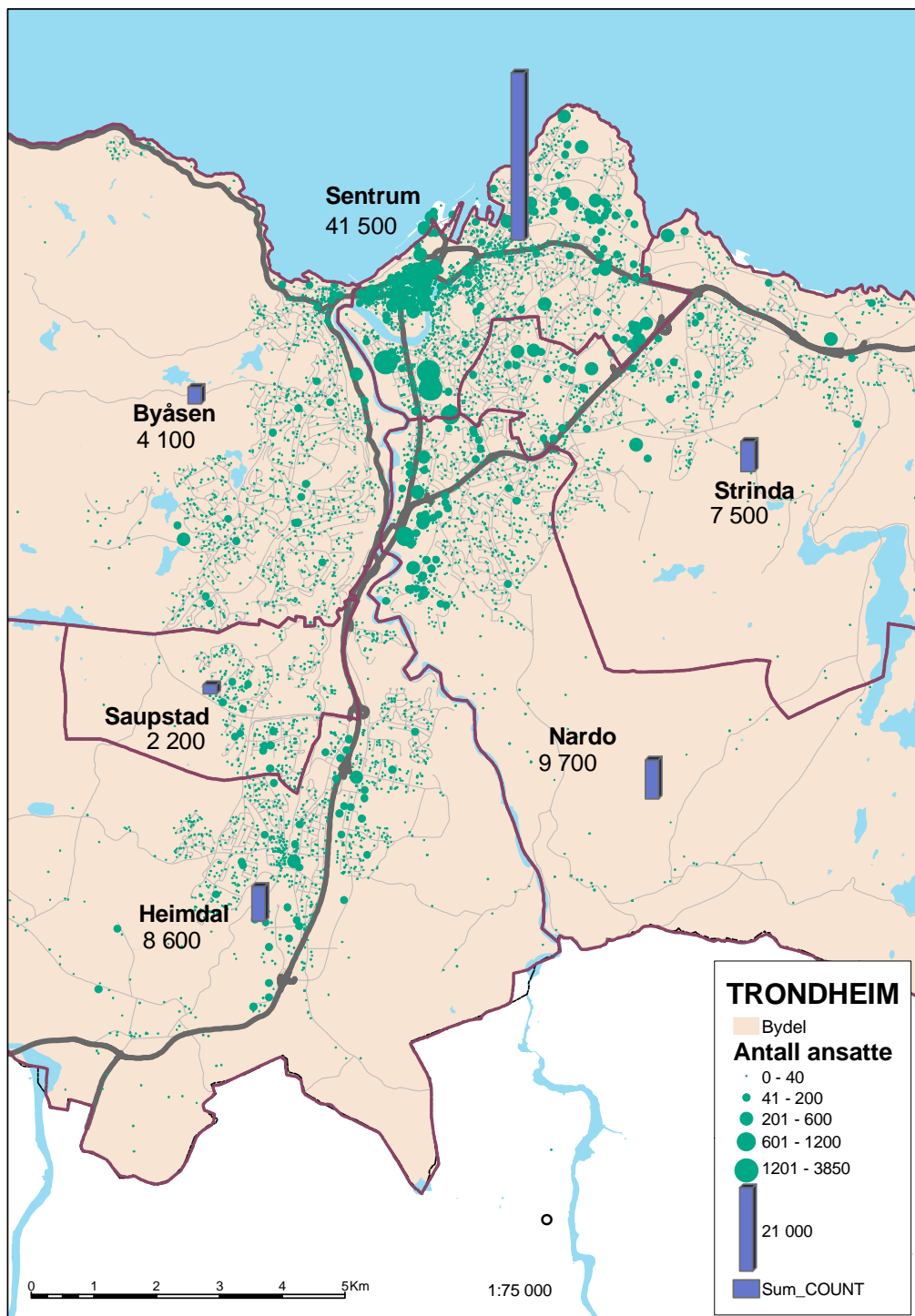


Figure 8: The number of employees in Trondheim 2001  
 (Source: Leknes and Lervåg 2005)

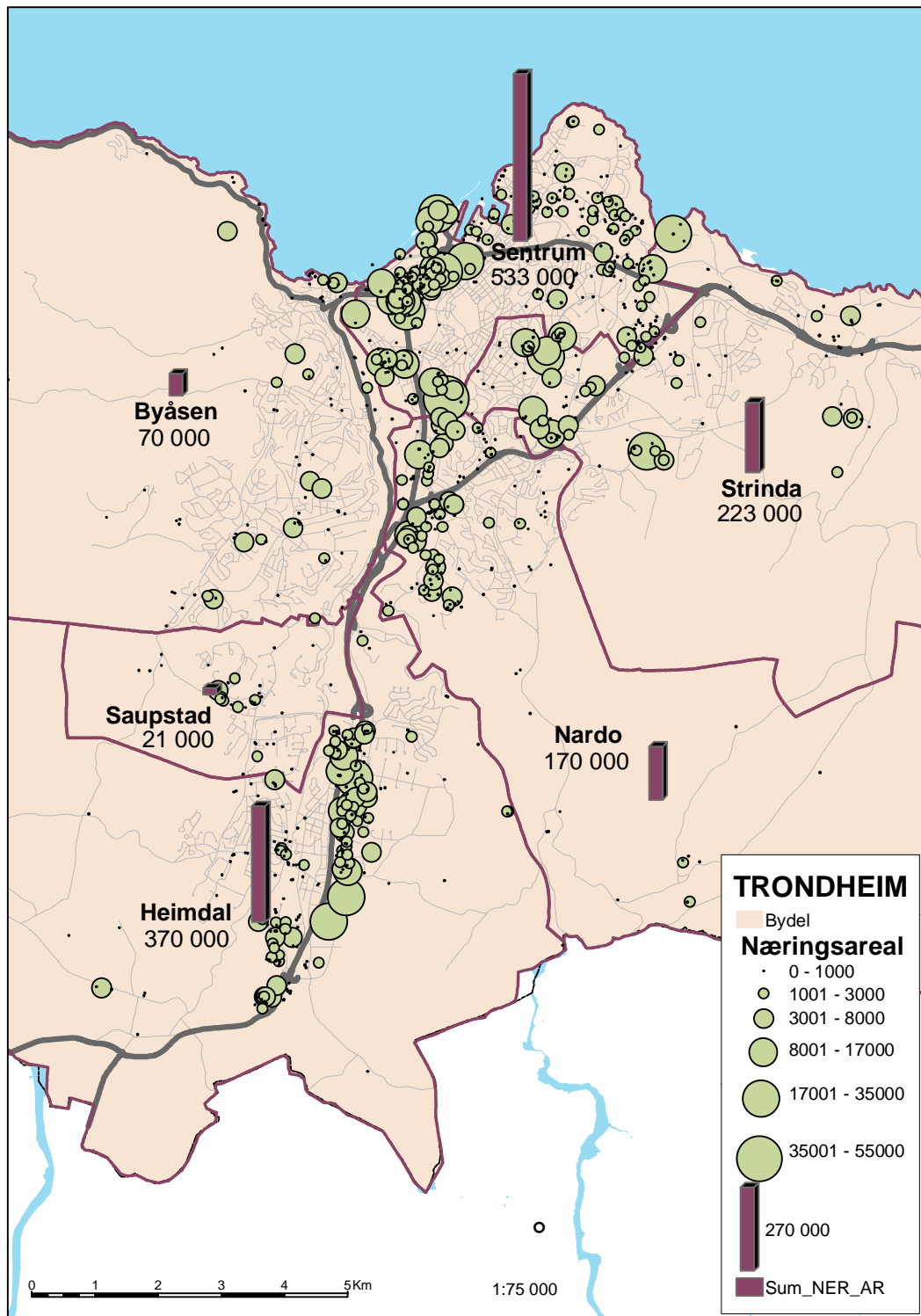


Figure 9: The location of all new business developments in Trondheim 1983-2001 (Source: Leknes and Lervåg 2005)

If we compare table 1 with table 6 we can see that car travelling has decreased from a share of 60, 8 % to a share of 58, 2 %. Apparently a positive development, but trips by car as driver have increased and the share of trips as passenger has decreased. Environmentally friendly modes have increased their share from 39, 2 to 40, 2 %. People have shifted away from cars to buses and motor bikes and they have shifted from walking to buses and cycling which we know has increased through this period. But, some previously walking and riding cars as passengers have bought cars and now drive themselves.

Table 6: Modal distribution (shares) in Trondheim 2004)  
(Source: The Municipality of Trondheim, 2004 p. 12)

| <b>The modes</b> | <b>Share of travel</b> |
|------------------|------------------------|
| Car – driver     | 49,1                   |
| Car – passenger  | 9,1                    |
| Public transit   | 10,7                   |
| Cycling          | 11,8                   |
| Walking          | 17,7                   |
| Others           | 1,5                    |

When we compare the results of the environmental situation and public transit share of the transport to the goals stated in 1992 and 1995, the co-ordinated land-use and transportation planning has not been successful. The goals have not been reached.

### **Some tentative explanations of the results**

The results are somewhat surprising. The economic development has been such that car ownership has increased and car use has increased. The private car ownership has increased from 376 cars per 1000 inhabitants in 1990 to 392 in 2000 (473 cars of all types). The price of gasoline has been stable. The level of subsidies provided for bus transit was reduced from 1993 to 2003. In 1993 it was 25 million NOK per year and in 2003 it was 10 million NOK. The level of subsidies in Trondheim had in 1999 been reduced 10 % of what it was in 1986 (measured by bus km produced per year). The reduced level of subsidies have contributed to a 25 % absolute increase in ticket prices from 1991 to 1999. These facts would make you expect an even higher share of car travelling and a reduction in bus trips.

The fact that businesses has tended to concentrate more in the bus transit zone in the recent years than before favours the bus comparatively to the car since there now is a more restrictive car parking scheme implemented in this area. This is supported by Strømme (2001, p.241, 243) who found that the share of public transit increased in areas with parking restrictions. But car trips as drivers have increased in spite of this. This is due to the increased ownership of cars. The explanation is also to be found in the ever increasing travel to work distances, which means that walking is less of an option and the car is the preferred alternative if parking is available. If parking is not available the bus and cycling are viable options in Trondheim since it in Norwegian terms has quite high population density, 2400 inhabitants per km<sup>2</sup>, and the public transit system is relatively good in Norwegian terms. Since there have been quite a lot of housing projects in central areas this could be contested. The housing projects in the city centre have, however, had old and young people with lower car ownership rate than the average citizen as their target group, and these projects have therefore probably

contributed to bus travelling and cycling and less to car traffic than the projects in the periphery (Næss 2003, p.259).

The development in Trondheim support Simmons and Coombe (2000) when they say that a more compact city development could have impact, i.e. reduced car use, in particular locations and that it leads to a radial pattern of commuting rather than a localised one.

The increase in cycling is probably due to enhanced consciousness about health, improvements of cycling roads, and the fact that there now are studded cycling tires making cycling a year round transportation mode.

Another factor contributing to the slower increase in car traffic than expected is probably the toll ring. There is an expectation of a 5 % increase when the ring is lifted 1<sup>st</sup> of January 2006.

Looking closer at what have happened in the last 15 years the planning has had some success. It has, if not turned the development around, which was wanted in 1992, slowed down the previous development. This is partly a result of some correct decisions about localisation of major institutions and businesses where the local ABC-policy and the ATP-model played a part. It is also true that the politicians, if they had wanted to, could have obtained more if they had chosen to use e.g. road pricing as a new tool for balancing the car traffic to the needs of the city and to the environmental capacity of the different areas.

### **What was Norwegian about this?**

There are features in the process described that is international I think. The import of good practices from abroad, the way we imported the Dutch concept of the right business in the right place. The discrepancy between goals set in 1992 and results reached 10-15 years later could probably be recognized by others. I also think the gradual, or incremental, introduction of different means of action through studies, then introducing different types of actions in transportation plans and finally, these actions ending up as overall policy measures in co-ordinated land-use and transportation plans or master plans is a typical type of progress made in car dependent societies.

What was Norwegian about this process then? The way that a national effort was politically started in 1992 and followed up by other social democratic ministers throughout the 1990s as a loose top-down framework which even right wing and liberal city councils adjusted to, as the City Council of Trondheim did. The construction of networks and the use of, in this case, ESRI soft ware to calculate trip length and other characteristics is not Norwegian, but the existence and possibility to use an address based employer/employee record in combination with the ATP-model is probably unique to Norway.

### ***Epilogue: The Ministry of Communication and Transportation is not satisfied***

In 2004 the Ministry of Communication and Transportation introduced a reward to the six largest cities if their performance regarding the traffic development was positive, meaning that bus ridership was increased on the expense of car traffic. The amount available for the six largest cities was only 75 million NOK. In 2004 Trondheim received 10 million NOK and applied for 26 for 2005. Trondheim received 10 million for 2005 and as the only city did not increase their share whereas the other cities increased their amount by 40 to 90 %.

The ministry's criteria and arguments are not easy to understand, since Trondheim had achieved as good results as the other cities. The answer the City Council of Trondheim received made it, however, obvious that the ministry emphasised the future actions of the cities. The other cities all have toll road systems gathering income for road building and public transit and as a by-product reduce the level of traffic a little. In Trondheim the existing toll road ring shall be dismantled by the end of 2005. It is expected at least a 5 % increase in traffic because of this. Trondheim did not have any other short term new, or stronger, actions restricting the car traffic which the ministry had called for. The long term actions which seem to have given some positive, but not substantial results in the past, i.e. the densification of the land-use and the restrictive parking policies, did not impress the ministry.

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## Notes

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<sup>i</sup> The material presented here is known to me through consulting work for the Municipality of Trondheim done together with Henning Lervåg in Asplan Viak Trondheim in the period 1992-1998 and as an adviser to both Asplan Viak and the municipality after I became professor in 1998.

<sup>i</sup> The information from this process reproduced here is found in The Municipality of Trondheim et al., 1992: The Transportation Plan Trondheim the Main Report 1992-2005, and in the guidelines published by the central secretariat lead by the Road Directorate.

<sup>iii</sup> The exchange rates are: 1 NOK= 0,08 £, 0,16 \$, 0,20 AUD, 0,12 €

<sup>iii</sup> ATP stands for Areal=land-use, T=transport and P=planning. The model was developed by the consultants Asplan Viak Trondheim Ltd. (operating internationally as Norplan)

<sup>v</sup> The reason for not including the cycle mode is its seasonal variations in Trondheim.

<sup>vi</sup> There is no empirical support for such a rail factor in Trondheim.

<sup>vii</sup> This less than the expected 40 % increase which were the Road Directorate's recommended presumption for the forecasts from 1990 to 2005 in the analyses done as part of the transportation planning in the ten largest cities in Norway in the period from 1989-1992. The source for the growth rate is information from the toll road company (personal information by Kåre Viken). This gives a growth rate of app. 2 % per year in the period. In the last 6 years the registration has improved and they showed an average growth rate of 2, 16 % per year.