Traffic Engineer Meets Urban Planner

Local Traffic Performance: Development and Application of Integrated Urban and Transport Planning

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Summary

This paper describes the development of the Local Traffic Performance (LTP) approach and its accompanying design and calculation instrument. The LTP approach can be used at local level when developing new locations or for reconstruction of existing urban areas. The LTP strategy focuses on energy reduction in traffic and transport by means of smart infrastructure and planning of residential areas.

The LTP approach integrates traffic engineering, transport planning and urban planning. LTP achieves reduction of energy use in transport by means of smart and sustainable planning. As an instrument LTP uses a combination of transport modeling techniques and energy use assessment. LTP has been applied for over 30 developments in the Netherlands. LTP is strongly supported by local authorities. First results of applications of the approach show that a significant reduction of energy use and sustainable urban development can be achieved.

Introduction

Urban planners and traffic engineers do not always work as well together as we would like. To improve cooperation, the Local Traffic Performance (LTP) project tries to integrate the planning practices from both disciplines. LTP stimulates closer collaboration between urban and transport planners through mutual consultation and by means of mutual use of computational models.

Local Traffic Performance is an instrument for smart planning of transport infrastructure, and residential and zoning plan areas. Its aim is to reduce energy use in traffic and transport. It can be deployed at a local level by municipalities. LTP can also serve to enhance traffic safety, to increase the quality of urban development and to decrease noise emissions. LTP shows the consequences of spatial policy for new housing and reconstruction developments to all involved stakeholders already during the process of decision making. In short, LTP is a methodology for smart planning processes and uses modeling as a tool. This paper describes the new instrument and its first results.

Background

Transport accounts for over 50% of the energy consumption of the average Dutch household. A study by Janse (1997) into the relationship between environmental planning and energy consumption in traffic and transport indicates that environmental planning considerably influences energy consumption in traffic and transport. The study shows that various planning aspects on different scale levels influence energy consumption. In Figure 1 the influence is shown as the reduction in energy use that can be achieved by dedicated policies and as increases in energy use when no clear policies are developed.

Urbanization accounts for the greatest variations in energy use. Because urbanization is in particular influenced by long term national policies, on the short term energy use should be influenced on other scale levels.

On the local level the planning of new construction sites accounts for 6% of the variation in energy use. Depending on site characteristics, the site-specific reduction in energy use due to smart planning is expected be significantly greater (~30%). Thus, it is expected that energy conservation may be achieved with dedicated planning policy.

Urban Planning, Travel Behaviour And Energy Consumption

Some insights into the relationship between urban planning and travel behaviour were obtained from the Dutch Travel Behaviour Studyi. At the household level the relationship between car ownership and urbanization of the municipality of residence was analysed. Results show that (a) the percentage of households without a car increases with urbanization; (b) the percentage of households with one car decreases as urbanization increases and (c) the percentage of households with two or more cars decreases as urbanization increases.

At the individual level the relationship between car availability and urbanization was analysed. It was found that as urbanization increases, car availability decreases.

At the trip level the relationship between mode choice and urbanization was analysed. Results show that (a) car use decreases as urbanization increases; (b) use of public transport is relatively high in the urban areas (c) scooter and bicycle use hardly change with different levels of urbanization; (d) there is more walking in urbanized areas than in non-urbanized areas. The general conclusion is that mode choice is closely related to the degree of urbanization of the municipality of residence.

Energy consumption varies strongly with urbanization: households in non-urbanized municipalities use twice as much energy per day for travel than households in extensively urbaiinized municipalities. The relationship may partly be caused by the distribution of household types across municipalities. E.g., singles live relatively more often in the large municipalities and travel less often by car. Thus, the relationship between urbanization and car ownership and car availability also influences the relationship between energy consumption and urbanization.

In the Mobilopolis project (PbIVVs, 1998) it was found that a 60% decrease in energy consumption and emissions could be achieved by smarter planning. Also a considerable decrease in the number of traffic accident victims could and a decrease in the noise level could be achieved by smarter planning. Furthermore, it was possible to create more diverse urban development images and atmospheres. In the long term, researchers predicted a decrease in the costs of (lighter) infrastructure.

The Current Practice

At this moment transport and spatial planning seem to be parallel processes most of the time and In many instances transport planning is an activity which takes place at the end of the proces. However, it is clear that there is a need for a comprehensive methodology for integrated smart transport infrastructure and spatial planning.

Since the start of its development in 1998 some thirty-five Dutch municipalities have used LTP on an experimental basis for housing developments. At this moment another ten municipalities have intentions to use the instrument. First results show that, depending on the development,

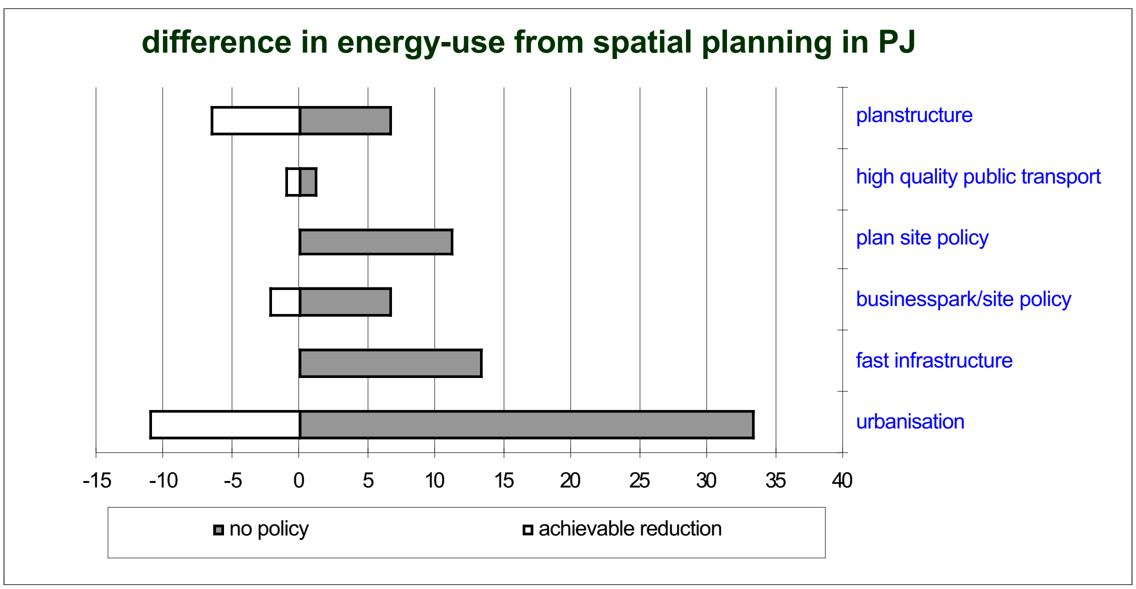

Figure 1. Difference in travel energy-use from forecasts for the year 2010 for the Netherlands

LTP saves between 5 and 35 percent energy use. Preliminary results were assessed and evaluated by CE Delft. CE concluded that for new housing developments the energy consumption can be reduced on average by 6% and for reconstruction sites by 4%. For new housing developments in the Netherlands this means a reductions of 478 TJ in energy use and 33,500 tons CO_2 emissions. These reductions can be achieved against relatively low costs and are expected to be sustainable.

Because of its effectiveness for improved urban quality, municipalities strongly support the LTP-approach during decision making. Through integration of urban and transport planning, LTP focuses on transport-related issues in an earlier phase of developments and keeps these issues well in focus. In an LTP-approach, traffic-related effects of network design and accessibility, the structure and design of developments, and even the location choice for developments, all influence the development of alternatives for urban and zoning plans. When using LTP, these issues are taken into account as early as possible when designing new developments. When LTP is applied transport planners and traffic engineers are pro-actively collaborating with urban planners. In this way transport planners contribute more to the design process, and are no longer reduced to evaluators using transport models. Consequently, urban planners do not consider the contribution of transport related expertise as a necessary nuisance any more. Also, traffic engineers no longer have to rely on makeshifts to achieve traffic safety or space for slow transport modes.

How LTP Works

Model studies show that mode choice and travel distances are the main factors influencing energy use in transport. LTP is based on a combination of behavioural, transport and urban planning principles, which leads to a rational transport system (PbIVVs, 1998). The perceived image of a street when driving a car, riding a bike or walking influences the way in which people experience their environment. This image can influence travel behaviour to a strong degree. Long, wide lanes may entice speeding. Cyclists, who have to wait too long for traffic signals, do not only wait, but may also experience cycling as a second rate transport mode. LTP actively considers these issues.

Within the LTP-approach traffic engineering tries to establish optimal functional use of transport modes. In other words, the aim is that travellers will automatically favour the most suited modes, i.e. most energy efficient and sustainable modes, for particular types of travel behaviour and mobility. Of course, this can be achieved by assuring that the most energy efficient and sustainable modes also have the lowest impedance for certain travel behaviours.

Connection and access are the leading principles for design of infrastructure. Areas where pedestrians and cyclist should have priority (approximately 800 x 800-meter areas) should be connected by cycle paths/roads. The bicycle should be the mode for access of a 4 x 4-km area.

Transport planning within LTP allows all modes within the system, but gives priority to slow modes on lower levels. Of course, this does not mean that cars cannot be used. For longer distances and destinations further away, cars can still be the most efficient mode. And also for short distances and certain travel purposes a car may be the required mode. The LTP-approach is concerned with generalities and allows exceptions to its rules.

The distinction between connection and admission for different modes also is the starting point for urban planning. For this, a clear distinction between scale levels is important. To guarantee space and priority for slow modes on a lower level, LTP uses a “reversed design method”. This means that space is first allocated to pedestrians. Next, the cycle network is allocated space and car and public transport infrastructure are projected last. This approach leads both to spatial diversity and improved spatial quality. However, LTP translates these premises into as few design regulations as possible, for urban planning is designing and creating discipline in which aesthetics and identity are major anchors. Therefore, LTP still allows for a unique solution for each local design problem.

Within LTP the integration of traffic engineering, transport planning and urban planning leads to a combination of rational logic and emotional associations, which in combination establish a solid base for sustainable design.

LTP Computations

When LTP is applied traffic engineers may be seen as acting as coaches in the design process from start until the end on the various scale levels, and in particular during development of plan alternatives and during iterations of the plan process. In short, a much more intense collaboration between urban planning, traffic and transport than was the case before.

In practice LTP pilot projects prove to be very diverse. In some projects the traffic engineers only contribute to workshops, while in other projects they are involved during the complete design process.

To apply LTP, first clear support from the involved authorities must be obtained. The authorities must decide to implement the LTP-approach. Finally, authorities must also establish the goals and target levels, indicating how they want the development to rank in comparison to national benchmarks.

All assumptions and starting points underlying LTP computations are put down in guidelines for implementation. These guidelines assure that during all phases of the design process the LTP computational assumptions are re-entered as design requirements, with support from authorities.

For design alternatives, which are developed during this process, an “LTP-value” is computed. The LTP-value expresses energy use per household for the development. The LTP-value allows a plan for one city to be compared to other plans for other cities.

Vehicle-kilometers establish the computational basis for the LTP-value. To compute an LTP-value two different methods were developed. For small LTP-applications a simple computational method was developed. This KISS model is based on a car transport model, which is available for most cities within the Netherlands. The effects of design and other measures are calculated using elasticities. This allows only computation of the effects of individual measures e.g. infrastructure changes. The KISS method allows global estimates of the effects of different plan alternatives.

However, the second computational method, using a multi modal transport model, is preferable.

Transport models are used to make solid mobility forecasts while taking other influences from outside the plan area into account. For instance, the construction of a new ramp to a motorway near the plan area may influence the travel behaviour of residents much stronger than the increase of the frequency of public transport or increased parking fees in the centre within the plan area. For sound computation of energy use of a plan area it is necessary to have a detailed model of the plan area. This means that zones should not exceed about 250 dwellings.

The LTP computational instrument is integrated within a transport-modeling environment. It consists of a single input module and an evaluation module. At this moment it is being used with two existing transport models OMNITRANS (Goudappel Coffeng, 1999) and QUESTOR (AGV, 19..). It can also be used in combination with TRIPS.

The computation instrument allows:

* Changes in the spatial design and infrastructure of the plan area
* Mobility calculations with a simultaneous multi modal transport model
* Energy calculations with an energy module

Urban Planning with a Transport Model

The LTP-instrument allows planners change the spatial design and infrastructure of an area using a graphical interface. Functions and densities of areas can be manipulated interactively, for instance, by changing the number of houses or the amount of floor area for shops. The variables defining the zones are now interactively related to the variables defining the mobility. So now also the influence of the price for housing (as an income indicator) and the type of employment are accounted for in LTP and can be used as a planning tool.

Of course also the traditional transport planning tools are incorporated. Infrastructure for different transport modes can be added, deleted, relocated and redesigned. Junctions can equipped with controllers or changed into roundabouts. Also the attributes of links, e.g. speeds and capacities can be interactively changed.

The energy module is used to calculate the energy use for mobility to, from or within the plan area. To calculate energy use, the module takes into account vehicle speed, factors for cold start, vehicle characteristics like mass, wheel friction etc. The energy module is integrated within OMNITRANS and can be run with other transport models like QUESTOR and TRIPS.

Development Of LTP Accompanied By Research

The application of LTP assumes a relationship between local, environmental elements and travel behaviour. The development of the LTP approach and the calculation instrument is also accompanied by dedicated research (Meurs, Haaijer and Zandee, 1999). This research focuses on the relationship between the characteristics of home and the neighbourhood on mobility and examines the relationship between elements of the spatial structure and transportation demand patterns, e.g. the number of trips, the modal split and the length of trips. The particular focus of this research lies on spatial elements near the home location, for example the location of parking lots, the place where bikes are stalled, the size of the house, the orientation of the house with regard to the transportation system, speed regulations and the distance to other facilities. Research on the effect of these elements of the spatial structure has to incorporate other influences on mobility. This is important when one is interested in the net effects of spatial structure. The following variables are included:

- Individual and household variables. These variables, for example the number of workers per household, income and educational attainment, have a strong influence on mobility;
- Location characteristics, e.g. distances to railway stations, distances to the city centre.

Data are gathered in a panel survey. Respondents of the Time Budget Survey of 1990 are re-interviewed in 1998. The following groups are chosen:

- Households who moved home between 1990 and 1998;
- Households who did not moved home but the spatial structure changed;
- Households without changes.

The first results show strong effects of the local spatial structure on mobility. Results will be presented on the conference.

Results

The first LTP applications were focussed on VINEX-locations, which are large-scale housing developments in the Netherlands. At this moment LTP is also applied for reconstruction of existing urban areas and also development of industrial sites. As stated, the LTP approach differs from one location to another. Pilot locations vary from 300 to 20,000 dwellings and vary also on planning phase. Consistently, plan alternatives that were developed using the LTP approach are taken into consideration during the decision process, and the LTP-value is used as one of the criteria for decision making.

This section describes the results of LTP. First we will focus on the case of Vathorst. Second we will show the results of thirteen LTP-applications. Finally, the possible overall effect of LTP application will be discussed briefly.

The Case Of Vathorst

Vathorst is a VINEX site in the Netherlands. VINEX sites are compact housing unit sites, which are built to alleviate housing shortages in or near many of the major cities in the Netherlands. In total approx. 600.000 dwellings will be realized in the next 10 years. In the case of Vathorst 10.000-13.000 dwellings will be built and a large business area will be developed. Vathorst is a planned suburban area surrounding the city of Amersfoort, a medium size city in the Netherlands. The LTP methodology was used in the planning process and the LTP instrument was used to assess the alternative area plans.

The Planning Process

In the case of Vathorst several traffic engineers participated in the planning process during a period of more than a year. The LTP methodology was used to create alternatives at the level of the structure plan, the development plan and the zoning plan. This is important because it appears that good ideas are sometimes “forgotten” during the development of new locations. For instance, in the past some large housing areas were built without sound bicycle infrastructure and without efficient public transport although the original plans did contain them. Of course, high car-dependency of residents was the result.

The planning of Vathorst itself was organized as a series of creative design sessions in which urban planners, urban designers, traffic engineers and transport planners participated. In total sixteen different area plan alternatives were developed during this process. The mobility effects of all area plans were determined using the LTP-instrument. This was, in the case of Vathorst, based on a multi modal transport model. Within the planning area of Vathorst 40 zones were distinguished. In total, the model encompasses 1,100 zones. Two of the most extreme area plans will be discussed in the next paragraphs.

Vathorst: Sustainable Area Plan

The idea of this plan is twofold:

1. Maximize the use of slow modes and public transport following the complete LTP planning methodology. Thus, slow modes were given absolute priority in developing the area. Roundabouts and crossing with bicycle priority are used to achieve this. Also smart bicycle routing was applied. In contrast, cars have limited access between the zones in this plan. Two railway stations are located in the area, using an existing line with a high level of service to the most important destinations. The main road is projected at the edge of the area;
2. Minimize travel distances. This is done by optimizing the home-work distances: i.e. home- and work locations are close together in this plan. Also, the shopping area is close to the residential areas and also close to one of the railway stations.

Vathorst: Car Friendly Area Plan

In contrast to the sustainable area plan the use of private cars is optimized in this plan and the use of slow modes and public transport is minimized. This is done by:

- Creating extra highway access and full possibilities for car use between zones in the area. Roundabouts and crossing were designed without priority for slow modes. Only one railway station with a low level of service is planned.
- Separating home and work locations and moving the shopping area to the edge of the area. These areas have enough parking lots.

Results

The difference between the sustainable area plan and the car friendly area plan is highly significant. A difference of 16% in daily energy use for transport between the two plans was found. This difference was reached by reducing travel distances and by encouraging the use of slow modes and public transport. The effect of both principles is more or less the same. The case of Vathorst shows that LTP methodology may lead to lower energy use.

Results From Other Locations

The same principles as for Vathorst were applied to other locations. The first results show a really strong influence on the quality of the plan and on the energy used in transport due to the plan. Figure 2 shows the differences between the two extreme area plans in energy use for thirteen locations in the Netherlands.

The amount of saved energy differs between these thirteen pilot projects. These differences are mainly due to the phase of the plan and the variables that could be influenced within the plan. Clearly, LTP will be more effective when it is applied from scratch and when more variables can be influenced.

In the Veenendaal-pilot the structure of a new urban residential area with about 2.500 dwellings could still be influenced, while in Zutphen this structure was already fixed due to existing city-borders and existing infrastructure.

Interesting results were found in Haarlem, where an existing urban area built in the sixties with a lot of wide infrastructure is being redeveloped. In the sustainable plan one entrance to the area, now a 2x2 motorway, is reduced to a cycle lane entrance. It gives the community the opportunity to gain quality in new office-buildings, new housing and green areas. These results show that also redevelopment sites can gain from LTP.

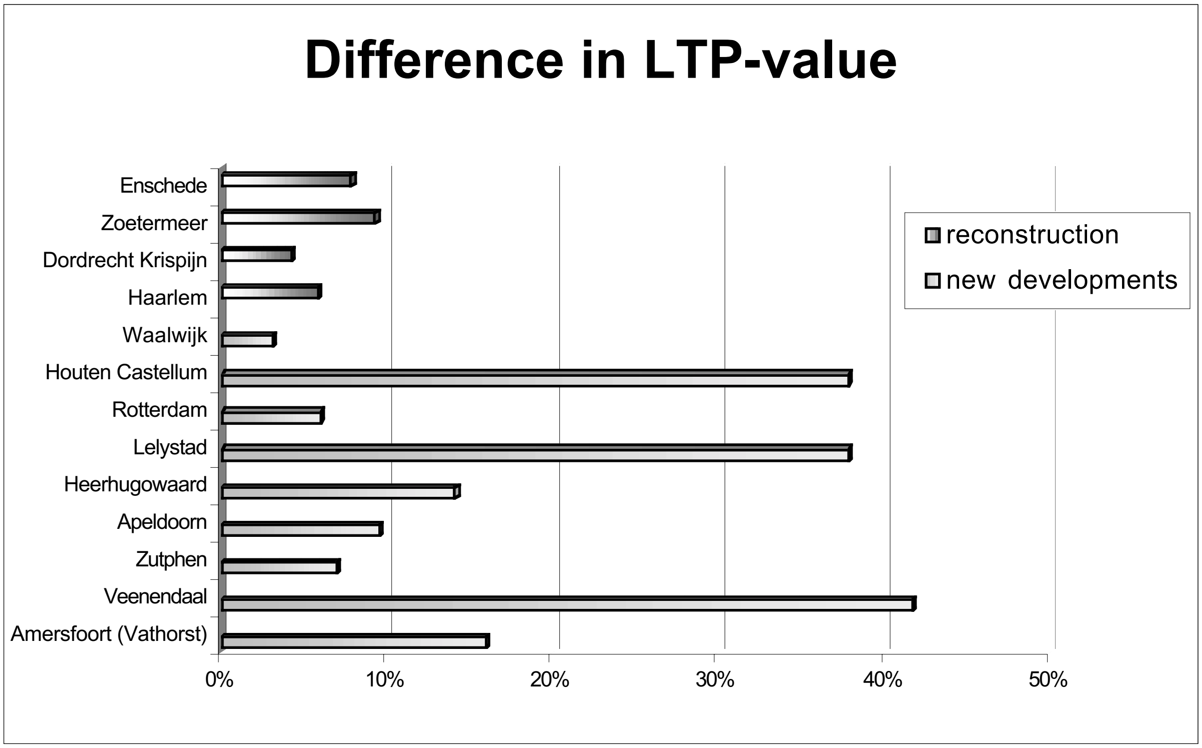

Figure 2. Results of LTP in 13 projects: projected decrease in % energy use compared to the car-friendly plan

Possible Overall Effect

Many communities have shown their interest in this new way of planning. In addition, the joint creative sessions, with urban designers, traffic engineers and transport planners using the LTP-instrument appears to be stimulating.

The first results of the thirteen locations may be extrapolated to assess potential benefits to the total energy use for travel in the Netherlands. When the LTP approach would be used for all new developments and as a planning policy in the Netherlands, it is estimated that between 5 and 7 % of the yearly energy use for transport might be saved.

Closing Remarks

When this paper was written, the LTP instrument was still undergoing intense development. In addition, the LTP strategy is being tested in practice in a number of new test cases. The experience that this produces will be continuously incorporated into the general LTP approach and in the LTP instrument. The LTP approach will therefore lead to further integration of the urban development and the transport planning approaches. The development of the LTP approach is based on the ambition of effectuating a serious decline in the demand for energy for transport purposes and, in doing so, to make an important contribution to reduce CO2 emissions. In addition, the application of the LTP strategy results in less local pollution and to improved traffic safety. In short, the LTP approach leads to an improved environment in urban areas. This makes it an interesting instrument for all members of city legislative bodies who involved in town and country planning and environmental issues.

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