

Accessibility Analysis and Transport Planning

Challenges for Europe and North America

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8. Accessibility benefits of integrated land use and public transport policy plans in the Netherlands

Karst T. Geurs, Michiel de Bok and Barry Zondag

8.1 INTRODUCTION

Major investments in public transport in the Netherlands are often considered inefficient from a welfare economic perspective. Bakker and Zwaneveld (2010) show that of about 150 social cost–benefit analyses (CBAs) of public transport projects in the Netherlands conducted in the past decades, only one-third of the projects had a positive benefit–cost ratio. These public transport projects were typically not part of an integrated planning approach, and the CBAs examined the costs and benefits of the transport projects only. In particular, the role of spatial planning or spatial developments in these CBAs was ignored or not made explicit (that is, land use is assumed to be fixed or does not differ between project alternatives). In recent years, however, integrated spatial and transport planning has received more attention in Dutch national policy-making. In 2007, a national policy document, *Randstad Urgent*, was published, aiming to improve cooperation between national and regional governments and create a joint policy decision-making process for different spatial projects and transport infrastructure projects that are to be realized within the same region (Ministry of Transport Public Works and Water Management, 2007). The policy document focused on 40 projects within the Randstad Area, the most urbanized region in the western part of the Netherlands. The aim of this new approach is to speed up the decision-making process and increase the social benefit–cost ratio of the projects. In this chapter, we examine the RAAM project (‘Rijksbesluiten Amsterdam – Almere – Markermeer’), the largest integrated policy project included in *Randstad Urgent*. The project involves adding 60 000 dwellings and 100 000 jobs and major transport investments in the corridor between Amsterdam Airport Schiphol, Amsterdam and Almere, located 30 kilometres east of

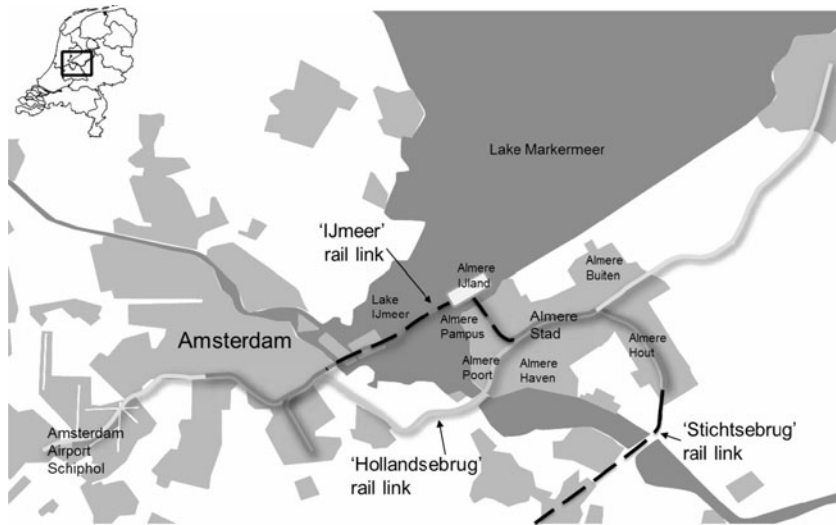


Figure 8.1 Main alternatives for improving the rail link between Amsterdam and Almere

Amsterdam (see Figure 8.1). Almere would nearly double in size from its current 190 000 to 350 000 inhabitants by 2030. Local governments developed three spatial policy alternatives for the development of Almere with tailored public transport investment programmes. Almere is a new town built on reclaimed land (a polder) with two bridges linking two motorways (A6 and A27) and a railway (parallel to the A6) linking to the mainland. These road connections are already severely congested and rail capacity is insufficient to increase train frequencies substantially. Doubling the population of Almere is not considered feasible without major infrastructure expansion. Transport investments are thus seen of crucial importance to the future population growth of Almere.

As part of the decision-making process, a CBA was conducted examining the social costs and benefits of (combinations of) three land-use alternatives and six rail project alternatives (Zwaneveld et al., 2009). A national system of road pricing was also examined. In the CBA, a stand-alone regional transport model was applied – as prescribed by Dutch appraisal guidelines – to estimate transport demand and travel time changes as input for the conventional rule-of-half measure of accessibility benefits.

The aim of this chapter is to examine whether spatial planning can have a positive impact on the accessibility benefits of integrated spatial and public transport projects. Two methodological issues were explored,

in addition to the current practice, to study these impacts. Firstly, a national land-use and transport interaction model, called Tigris XL, was used instead of a stand-alone transport model. Secondly, accessibility benefits were calculated following the logsum measures, in addition to the standard rule-of-half calculation method.

The Tigris XL model was first used to validate population and employment projections for Almere and the surrounding region under the proposed growth scenario. The combination of land-use plans and supportive public transport investment plans creates a typical planning issue which can best be evaluated with an integrated land-use and transport interaction model (LUTI). These models are praised for their ability to evaluate land-use and transport planning in an integrated and consistent modelling system (e.g., see Simmonds, 2004; Waddell et al., 2007); however, there are few applications of empirically estimated LUTI models.

The logsum accessibility measure seems to be getting more attention in academic research (e.g., see De Jong et al., 2007; Geurs et al., 2010), but is seldom applied in practical appraisal studies. Applying the logsum method requires a disaggregated type of transport model. The Tigris XL model includes the disaggregated National Transport Model (LMS) as transport model of the Netherlands, and was used in an earlier study to estimate accessibility benefits of land-use and transport policy strategies using the logsum accessibility measure (Geurs et al., 2010). Computing the logsum measure using the Tigris XL framework allows an estimation of the accessibility benefits of the different land-use policy alternatives proposed for the expansion of Almere, as compared to a reference land-use scenario.

Section 8.2 describes the modelling framework and how accessibility effects are calculated. Section 8.3 describes the land-use policy planning scenarios for Almere. Sections 8.4 and 8.5 present the model results for the different scenarios based on population and employment developments and accessibility impacts. Section 8.6 examines whether there are synergies in accessibility benefits between the land-use policy alternatives and rail investments. Finally, section 8.7 discusses the results and presents conclusions.

8.2 METHODOLOGY

Brief Description of Land-Use–Transport Interaction Model Tigris XL

Land-use and transport policies both affect accessibility for firms and residents. A land-use and transport interaction model is capable of calculating accessibility changes resulting from land-use and transport strategies. This includes the mutual interactions between land use and transport over

time, the outcome of which is different than the sum of the two measures evaluated individually. In this study, changes in accessibility are calculated by the Tigris XL model, an integrated land-use and transport model developed for the Transport Research Centre in the Netherlands (RAND Europe, 2006; Zondag, 2007).

The Tigris XL model is a system of submodels (or modules) that includes dynamic interactions between the models. The modelling system consists of modules addressing specific markets. Its land-use model comprises the land market, housing market, commercial real-estate market and labour market. These modules are applied with time steps of one year, which enables the user to analyse how land use evolves over time. The land-use model is fully integrated with the National Transport Model (LMS) of the Netherlands, and both the land-use and the transport model interact every five years. Tigris XL operates at the spatial resolution of local transport zones (1327 zones, covering the Netherlands).

Core modules in Tigris XL are the housing-market and labour-market modules. These modules include the effect of changes in the transport system on residential or firm location behaviour, and in this way link changes in the transport system to changes in land use. The parameters for both modules have been statistically estimated. The residential location choice module has been estimated by household type on a large housing market survey conducted once every four years in the Netherlands with over 100 000 households participating. The parameters of the firm (simulated as jobs) location choice module have been estimated on a historical dataset (1986–2000), including employment figures by seven economic sectors at a local level.

A land and real-estate module simulates supply constraints arising from the amount of available land, land-use policies and construction. The module can be used for different levels of government influence, ranging from complete regulation to free market conditions, and various feedback loops between demand and supply are possible. A demographic module is included to simulate demographic developments at the local level. At the regional or national level, the model output is consistent with existing socio-economic forecasts.

The LMS calculates the changes in transport demand and accessibility. The LMS consists of a set of discrete-choice models for various choices in transport (including tour frequency, transport mode, destination and departure time). These choice models can be based on the microeconomic utility theory, enabling the derivation of utility-based accessibility measures. In this chapter, we focus on the accessibility benefit measures which can be calculated following the rule-of-half or the logsum method.

The Rule-of-Half Measure of Accessibility Benefits

The conventional approach to measuring accessibility benefits of transport strategies is to use the rule-of-half measure as an approximation of Marshallian consumer surplus. The rule-of-half equation computes the total change in user benefits as the sum of the full benefit obtained by original travellers and half the benefit obtained by new travellers or generated traffic. This can be calculated by multiplying the average number of trips between a base scenario (0) and a scenario with a project (1) by the difference in (generalized) travel costs:

$$\Delta E(CS_n^{ROH}) = -0.5 \sum_{z=1}^Z \sum_{j=1}^J (GC_{zj}^1 - GC_{zj}^0) (A_{zj}^1 + A_{zj}^0) \quad (8.1)$$

where GC is generalized cost; z is the origin location ($z = 1, \dots, Z$); j the transport mode/destination alternative ($j = 1, \dots, J$); and A the number of trips.

It is important to note that the rule-of-half measure of consumer surplus assumes that all accessibility benefits accruing to economic agents can be attributed to generalized cost changes within the transport system. The literature points out that the rule-of-half results in incorrectly measured welfare effects of land-use policy plans (e.g., Neuburger, 1971) and of transport strategies that lead to land-use changes (Bates, 2006; Geurs et al., 2006; Simmonds, 2004). To capture these benefits, a method is needed that not only values the changes in generalized costs, but also values accessibility benefits due to changes in location and the relative attractiveness of locations. For a more elaborate discussion, see Geurs et al. (2010).

The Logsum Measure of Accessibility Benefits

Here, we briefly describe the derivation of logsum accessibility benefits from Tigris XL. For a more detailed description, see Geurs et al. (2010). See De Jong et al. (2007) for an overview of literature on the logsum approach. The logsums in the Tigris XL model are derived from the LMS. A disaggregate transport model is required to apply the logsum method. It should be noted that this method can also be applied to stand-alone transport models of a disaggregated type. Based on the LMS, these logsums are computed for tours (round trips) at the individual level, and express a traveller's utility from a choice set of travel alternatives. This choice set contains five different transport modes (car driver; car passenger; train; bus, tram or metro; walking or cycling) available to all 1327 possible destinations. The logsum for each origin zone z in the Tigris XL model is

computed from the travel alternatives to all destinations and transport-mode combinations j for each person type i (490 person types segmented to 5 household income classes, 2 gender classes and 49 age classes), and travel purpose p :

$$L_{piz} = \log\left(\sum_j \exp(\mu_p V_{pijz})\right) \quad (8.2)$$

where V_{pijz} is deterministic or observed utility for person i in zone z , choosing mode and destination combination j for travel purpose p ; μ_p is the logsum coefficient for travel purpose p (this coefficient appears here because we are using a nested logit model for each travel purpose). The utility component in the transport mode and destination choice models of the LMS in a simplified form can be specified as:

$$V_{zjip} = \beta_p T_{zj} + \chi_{ph} \ln(C_{zj}) + \delta_p D_{pj} + \dots \quad (8.3)$$

where T is travel time (comprising various components with their own coefficients), C the travel cost, and D a variable representing the attractiveness of the destination zone (destination utility) for a specific activity (for example population, employment, shopping, number of students at schools and universities). The cost coefficients χ differ between travel purposes, but also between income groups h per travel purpose. The cost variable enters in logarithmic form, reflecting cost damping with increasing travel distances. Standard applications of the rule-of-half include changes in T and C (together forming generalized travel costs), but not in D from equation (8.3). It is, however, not inconceivable also to include changes in D in the rule-of-half, but this can be done more easily by using logsum changes (Geurs et al., 2010). Note that changes in departure times and route choices are also taken into account in the logsums indirectly through iterations between the transport mode and destination choice models and traffic assignment models in the LMS.

The logsums are translated into travel times by the time coefficients β_p , and into costs by external values of time, VoT . The travel time coefficients are purpose-specific and are estimated for the mode and destination choice model in the LMS. The values of time, VoT_{ph} , per travel purpose p and household income category h , in equation 8.4 come from stated preference research, and represent the officially recommended values for transport appraisal in the Netherlands. The monetary value of the accessibility of zone z for a person of type i who belongs to household income group h is computed as follows, with β_p being in time units:

$$CS_{piz}^L = V_o T_{ph} \cdot \frac{1}{\beta_p} \cdot L_{piz} \quad (8.4)$$

For accessibility evaluation, the accessibility benefits are computed over all actors in the transport model by multiplying the accessibility value by the number of people A_{piz} in population segment i that make a tour for purpose p from zone z (or, more exactly, the number of tours in this population segment for this purpose from this origin):

$$\Delta E(CS_{piz}) = (1/\alpha_n) \left[A_{piz}^1 \ln \left(\sum_{j=1}^{J^1} e^{V_{nj}^1} \right) - A_{piz}^0 \ln \left(\sum_{j=1}^{J^0} e^{V_{nj}^0} \right) \right] \quad (8.5)$$

where the superscript 1 refers to the situation with the policy to be evaluated and the superscript 0 to the situation without the policy (reference).

The application of the logsum method has a number of advantages over the rule-of-half measure of accessibility benefits. The most important advantage for this chapter is that the logsum is capable of providing the accessibility benefits from changes in the spatial distribution of activities, due to transport or land-use policies, where the rule-of-half method ignores the changes in destination utility (see Geurs et al., 2010 for a more detailed discussion). Another advantage of the logsum method is that it uses a more precise non-linear demand curve, while the rule-of-half method assumes a linear demand curve. This is not the most important advantage, however. In theory, when land use is fixed, an accessibility benefit approximation based on the rule-of-half will differ only slightly from the more exact logsum measure when computed at the same level of aggregation (for example, see for a comparison, Bates, 2006).

8.3 INTEGRATED LAND-USE/TRANSPORT SCENARIOS FOR ALMERE

Reference Scenario

The case study for the growth scenario of Almere consists of a reference scenario and three different spatial development scenarios for the simulation period 2010 to 2030. These scenarios are translated to Tigris XL input in the form of housing programme (yearly demolition, reconstruction and greenfield development by zones) and industrial site development (office space and industrial sites).

The reference scenario (without the additional land-use and transport projects for the Almere region) incorporates the existing planned housing

developments and national road and rail investments for the period up to 2020. The reference scenario is a business-as-usual scenario in which Almere still is expected to grow, but at a modest level. The reference scenario assumes that the number of houses in Almere increases by 30 000 houses in the period 2010–2030, while an increase of 60 000 houses is assumed in all Almere cases. Furthermore, there are already substantial infrastructure investments planned in the Almere region. Planned road investments include motorway capacity increases between Amsterdam and Almere, as well as rail investments allowing a doubling of train frequency between Amsterdam and Almere from six to 12 trains per hour. A national road-charging scheme is also assumed to be introduced in 2015 in most project alternatives. The road-charging scheme involves the abolishment of existing road taxes and 25 per cent of vehicle purchase taxes and the introduction of a kilometre charge, consisting of usage-based charge (4 eurocents per kilometre) and a congestion charge on the main motorway network. This kilometre charge was part of Dutch national transport policy at the time the CBA was conducted, but has been subsequently dropped by the cabinet which took office in October 2010.

Almere Growth Scenarios

Three alternative land-use scenarios were developed by the municipality of Almere, each containing a dedicated supportive public transport investment programme: the westward-oriented Almere Water Town scenario, the eastward-oriented Almere Polder Town and the ‘combination’ scenario Almere Town of Water and Green.¹ To disentangle the effects of land-use changes and public transport investments on accessibility, the three ‘reference’ land-use variants have also been examined with the same spatial developments, but without the supportive public transport investments. See also Chapter 9 for a more detailed description of the housing locations in the land-use scenarios.

Almere Water Town scenario

The spatial development in Almere Water Town is very much oriented towards a land development programme to the west of the existing town of Almere. This land development project consists of land reclamation in the IJmeer/Markermeer, directing the focus of urban development to the western part of Almere. The land development project comprises 15 000 dwellings and 7 000 jobs on new reclaimed land (an artificial island called Almere IJland) and 20 000 and 10 000 jobs inside the dikes (Almere Pampus). In addition to the housing production on reclaimed land areas, part of the housing production target takes place in the existing town

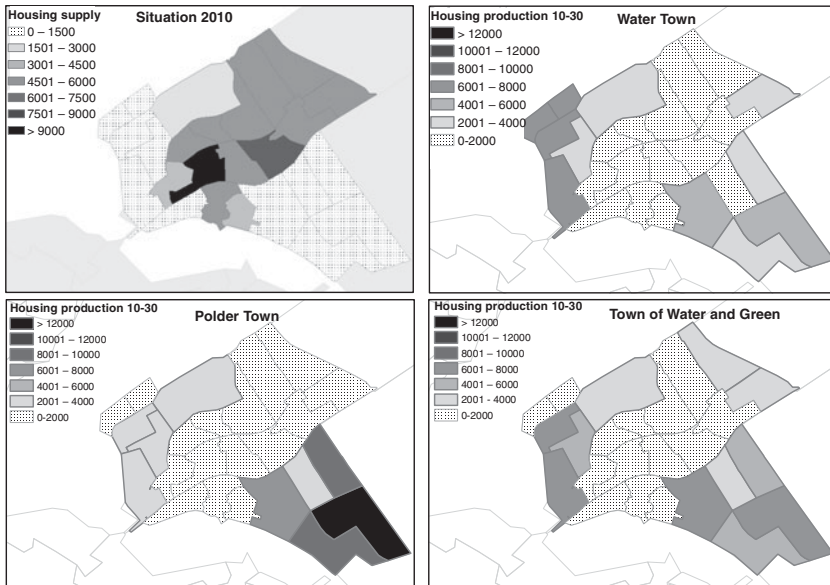


Figure 8.2 Clockwise from top left: housing supply in 2010, housing production between 2010 and 2030 in the scenarios Almere Water Town, Almere Town of Water and Green and Almere Polder Town

(11 000 dwellings and 30 000 jobs) and greenfield sites east of the town (14 000 dwellings and 11 000 jobs), as shown in Figure 8.2. The public transport programme includes the construction of a new IJmeer railway link, connecting Almere to Amsterdam and Amsterdam Airport Schiphol with a regional rail link through Lake IJmeer (see Figure 8.1). The new rail link has been examined with different train types (local train, metro and maglev). In this chapter, the focus is on the alternative with local train services (Regiorail).

To disentangle the effects of the land-use changes and public transport investments on accessibility, sensitivity runs using Tigris XL were conducted to estimate the land-use scenario Water Town with and without the new IJmeer rail link, as well as the reference scenario with and without the new IJmeer link.

Almere Polder Town scenario

In this scenario, urban growth is oriented towards greenfield development to the east of Almere (35 000 dwellings and 16 000 jobs). But urbanization

also takes place in the existing town (11 000 dwellings and 30 000 jobs), and in the western quarter (14 000 dwellings, without land reclamation). The public transport investments include an upgrade of the existing rail link across the Hollandse Brug (southwest) and the construction of a new rail link, the Stichtselijn, connecting Almere to Hilversum and Utrecht by regional rail, to the south. The western part of the town will not have a direct rail connection. The development to the east of the town requires an upgrade of the road network as well (an additional third lane on each direction on the A27 from Almere to the south).

Almere Town of Water and Green scenario

In this scenario the urban growth takes place more evenly across the town. To the west, Almere will grow by 20 000 dwellings, but without land reclamation, and 16 000 dwellings are built within the existing town of Almere. To the east, greenfield development will take place (24 000 dwellings) scattered around three smaller urban centres. The public transport investments include an upgrade of the existing rail link (across the Hollandsebrug).

8.4 POPULATION AND EMPLOYMENT CHANGES

Population and Employment Effects of Land-Use Plans

The effects of the land-use plans for Almere on population and employment were compared to the reference scenario. The housing production program of 60 000 new dwellings in Almere leads to a population growth of around 122 000 inhabitants between 2010 and 2030, more than doubling the growth in inhabitants as compared to the reference case (30 000 houses and 55 000 inhabitants). In the reference case, a substantial part of the housing programme facilitates additional housing demand that follows from the general trend of a decrease in household size in addition to offering new dwellings to households migrating to Almere from the surrounding region. In Almere, this average household size is expected to decrease from 2.5 persons per household in 2010 to 2.37 persons in 2030. This is above the national average, and follows from the high representation of young families in this relatively new town, facilitating part of the housing demand surplus for this group in the region (mainly from Amsterdam).

The ambition of the development scenarios for Almere is to create 100 000 additional jobs in the period up to 2030, in addition to 60 000 houses. There is a long tradition of government planning of large

residential development in the Netherlands, and the realization of the 60 000 houses can be influenced by the government. However, the ambition to create 100 000 jobs is much more difficult to realize, since the influence of the government on the location choice of firms is very small in the Netherlands. Therefore, simulations were made with the Tigris XL model, assuming the 60 000 houses were constructed, to calculate the effects on population and employment. For all three scenarios, the calculated employment growth is much lower than 100 000 with an increase in number of jobs of only 46 000 forecasted between 2010 and 2030.

Compared to the reference case, there is an additional 23 000 jobs in the Almere development scenarios. At a more detailed level of economic sectors, the Tigris XL model simulates the development for seven economic sectors. The fastest-growing sectors in response to the housing plans are, as expected, population-related sectors such as the retail and government sectors. However, sectors such as logistics and business services (8500 additional jobs) also grow since these sectors are indirectly influenced by the population development.

The employment growth of 46 000 jobs compared to 2010 slightly influences the residential character of the town by increasing the ratio between employment and labour population from 0.66 to 0.73 jobs per worker. In theory, Almere will still have more commuters leaving the town than entering in the morning peak, and vice versa in the evening peak. This is in contrast with other large cities in the Netherlands, most of which have a net inward stream of commuters. Therefore, the town of Almere is likely to keep its function as a dormitory community to Amsterdam and, to a lesser extent, Utrecht.

Regional Population and Employment Effects

The development scenario for Almere effected the size of the population and number of jobs in municipalities surrounding Almere. The Tigris XL model is a distribution model which assumes that the number of people and jobs at the national level is an exogenous scenario input. Therefore, an increase in inhabitants and jobs in Almere results in a decline in other municipalities. The largest change in population and jobs is in the Amsterdam and Utrecht region. About 75 000 additional inhabitants in the development scenario for Almere predominantly originate from the Amsterdam or Utrecht region. The addition of 23 000 jobs in the Almere development scenario (compared to the reference scenario) is mainly at the cost of the job growth in municipalities within a radius of 50 kilometres of Almere. The directly neighbouring municipalities to the south benefit slightly from the additional urban developments in Almere. Business

sectors for these municipalities especially benefit, with an overall result that is positive. The largest changes in the number of jobs occur in the greater Amsterdam and Utrecht region. In the Amsterdam region, most losses are within the town itself, while in the Utrecht region losses are bigger in municipalities surrounding Utrecht town.

Transport investments can also have an impact on the spatial distribution of residents and jobs. The population effects of the public transport project examined are marginal (0.3 per cent change or less) compared to the total population growth between 2010 and 2030. This is due to the assumption that housing and real-estate supply are fixed, regardless of the public transport investments. Therefore, population effects only result from changes in the location preferences of the relocating households, and not from a change in housing supply.

The distribution of jobs is more responsive to changes in accessibility by public transport projects. Public transport improvements increase the logsum accessibility from the mode and destination model, with a significant location factor for economic sectors such as industry, consumer services and business services. The strongest employment growth for Almere is accomplished in the Polder Town scenario when the Hollandse Brug rail link is upgraded and the new Stichtselijn rail link is built. The public transport improvements lead to a redistributive effect of employment from the Amsterdam and Utrecht region to Almere, resulting in a jobs increase of about 1.5 per cent (1600 jobs) in Almere compared to the Polder Town reference scenario. The IJmeer rail link in the Water Town leads to an employment increase in Almere of about 0.9 per cent, jobs, and modest public transport investments programmes in the Town of Water and Green scenario result in an increase of about 0.4 per cent. These employment effects of the public transport investments are significant, but relatively small compared to the total employment growth between 2010 and 2030. In regions with well-developed infrastructure networks these effects can be expected to be small (Banister and Berechman, 2000; SACTRA, 1999).

8.5 ACCESSIBILITY BENEFITS

Accessibility Benefits of the Public Transport Projects

Accessibility benefits are calculated as the difference between a run with the public transport investment projects and the reference scenario of each corresponding spatial growth scenario. In addition to the three standard investments programmes (one for each spatial scenario), the travel time

Table 8.1 Rule-of-half and logsum accessibility benefits for train users, 2030 (in million euro a year)

Scenario	Reference scenario	Rule-of-half Train	Logsum Train
New IJmeer rail link in Water Town	Water Town reference	55.9	72.9
New IJmeer rail link in Water Town without road pricing scheme	New IJmeer rail link in Water Town with road pricing scheme	53.4	69.0
Hollandsebrug Regiorail and Stichtse rail in Polder Town	Polder Town reference	55.8	67.6
Hollandsebrug Regiorail in Town of Water and Green	Town of Water and Green reference	32.2	33.1

benefits of the IJmeer regional rail link are calculated from two sets of sensitivity runs. Table 8.1 shows the accessibility benefits for train passengers using the rule-of-half and logsum measures of accessibility benefits.

The travel time benefits of the combined Stichtselijn construction and upgrade of the Hollandsebrug rail link are comparable to those of the IJmeer rail link. Travel time benefits were computed to be around €55 million yearly according to the rule-of-half, and around €70 million using the logsum methodology. The logsum benefits are slightly higher compared to the conventional rule-of-half (20 per cent to 30 per cent). As noted earlier, in theory, when land use is fixed, the rule-of-half and logsum benefit estimations will only differ slightly when computed at the same level of aggregation. The differences can be attributed to a more exact computation of the logsum measure; the logsum is computed at the same level of disaggregation as the mode-destination model, uses non-linear demand functions, and all changes in all mode and destination alternatives are weighed simultaneously.

Similar to the standard calculations applied with the regional transport (Zwaneveld et al., 2009), the assignment results were not accurate enough to predict the minimal travel time reductions on the car network due to a modal shift from public transport improvements. Therefore, these results were not included in the project evaluation.

Accessibility Benefits of the Land-Use Scenarios

Each spatial scenario can lead to accessibility benefits due to the more efficient distribution of population and employment in the urban

Table 8.2 Logsum accessibility benefits from each spatial scenario compared to the reference scenario without housing programme in Almere, 2030 (in million euro a year)

Logsum travel time benefits	Transport mode				
	Train	Car	BTM	Slow	Total
Almere Water Town	30.9	159.3	0.5	-76.6	113.9
Almere Polder Town	53.3	92.4	44.1	-58.8	131.9
Almere Town of Water and Green	36.1	92.3	6.8	-45.0	90.2

configuration. Table 8.2 presents differences in accessibility benefits calculated between the three Almere growth scenarios and the reference scenario without population and job growth and public transport projects.

The accessibility benefits for the different land-use scenarios are significantly larger than the accessibility benefits of the public transport investments. Almere Polder Town shows the largest accessibility benefits of €132 million per year; the Almere Water Town scenario yields a total of €113 million per year; and Almere Town of Water and Green about €90 million per year. The shift of urban development to the Almere region mainly leads to accessibility benefits for car (drivers and passengers) and train travellers. When planned motorway expansions are realized, Almere will be well accessible by car and train as compared to other neighbourhoods in the region that suffer more from congestion due to the existing high level of urbanization. The negative accessibility benefits for the slow modes (walking and cycling) mainly arise in relation to commuting. Almere is a residential town with a low employment to labour force ratio, even after the urban growth. The relative small number of jobs at close distance gives the commuting logsums a relatively lower value, translating into accessibility disbenefits for commuting by slow mode for residents who choose Almere as residential location instead of other cities (for instance, Amsterdam).

8.6 SYNERGIES IN ACCESSIBILITY BENEFITS BETWEEN THE LAND-USE POLICY ALTERNATIVES AND RAIL INVESTMENTS

In this section we examine the effect of the urbanization variants on the accessibility benefits of the rail project alternatives. Two effects can be distinguished. Firstly, there is a volume effect resulting from the additional

Table 8.3 Rule-of-half and logsum accessibility benefits for train users, 2030 (in million euro per year)

Project alternative	Reference	Rule-of-half Regional transport model*	Rule-of-half Tigris XL	Logsum Tigris XL
New IJmeer rail link in Water Town	Water Town reference	55.4	55.9	72.9
New IJmeer rail link in Town of Water and Green	Town of Water and Green reference	44.4	n.a.	n.a.
New IJmeer rail link	Reference scenario	n.a.	27.7	48.8
Upgrade existing rail link in Water Town	Water Town reference	25.3	n.a.	n.a.
Upgrade existing rail link in Town of Water and Green	Town of Water and Green reference	23.3	n.a.	n.a.

Note: * figures derived from Zwaneveld et al. (2009).

population and job growth in Almere (growth of 30000 dwellings and 22000 jobs compared to the reference scenario). Tigris XL was used to estimate the Water Town land-use scenario with and without the new IJmeer rail link, and the reference scenario with and without the new IJmeer link. Both the rule-of-half and logsum accessibility measure were computed. The results are presented in Table 8.3.

Secondly, a location effect can be distinguished, referring to the difference in accessibility benefits resulting from the different allocations of the population and job growth between the three land-use policy scenarios for Almere (with fixed total population and job growth). This can be analysed comparing the accessibility benefits of a given public transport project for different spatial variants. This analysis was not conducted with Tigris XL, but in the CBA (Zwaneveld et al., 2009), the rule-of-half accessibility benefits for two public transport project alternatives (the IJmeer rail link and the upgrade of the existing rail link) were estimated for two spatial variants: Almere Water Town and Almere Water and Green (see Table 8.3).

Table 8.3 shows that for the new IJmeer rail link, the volume effect is stronger than the location effect. The magnitude of the effect is strongly related to the magnitude of the land-use change near the new railway stations of the new IJmeer railway link. The difference in urbanization

between Water Town and the reference scenario (volume effect) relates to adding 30 000 dwellings and 22 000 jobs to the new quarter in the western part of Almere, which is well connected to the new rail link. This increases the accessibility benefits of the new IJmeer rail link by about 50 to 65 per cent according to the rule-of-half and logsum measure, respectively. The location effect relates to the differences in locations of dwellings and jobs between Water Town and Town of Water and Green. The main difference between the policy scenarios is that in Water Town, 15 000 dwellings and 7000 jobs are added to the new western quarter of Almere, which is well connected with the new railway link, whereas in Town of Water and Green, they are located in the eastern part of Almere and are not connected to the new rail link. This increases accessibility benefits by about 25 per cent. The benefits are about €55 million in Almere Water Town in 2030, and €44 million in Almere Water and Green for the year 2030.

Table 8.3 also shows that the (rule-of-half) accessibility benefits for the upgrade of the existing rail link hardly differ between the Water Town and Town of Water and Green land-use policy scenarios. Both scenarios do not differ in population and job developments in the existing built-up area near the railway stations of the current railway link.

Finally, Table 8.3 shows that the rule-of-half accessibility benefits resulting from the new IJmeer rail link, as computed by Tigris XL, are very similar to those used in the cost-benefit analysis and computed by the regional version of the transport model. This is not surprising, since the regional transport model is a regional version of the national transport model included in Tigris XL.

It can thus be concluded that significant synergies can be found when land-use policies and public transport investments are integrated. However, the additional accessibility benefits are small compared to the investment costs and do not significantly affect the cost-benefit ratio of the public transport projects. The investment costs of all rail project alternatives are high, ranging from €2.9 to 6 billion. The project alternatives with new railway links are obviously the most expensive (€4 to 6 billion) as they involve construction of a new bridges and/or tunnels connecting Amsterdam to Almere. Upgrading the existing railway link (Hollandsebrug) is also quite expensive (€2 to 3 billion) due to the complexity of construction.

The CBA showed that the accessibility benefits do not even outweigh maintenance and operational costs. All rail projects examined in the CBA have strong negative welfare effects, mainly due to the high investment costs. Welfare losses for all public transport projects examined in the CBA range from €1.2 to 3 billion (net present value) (Zwaneveld et al., 2009). There are three main reasons for this result. Firstly, investment costs of the

projects are quite high because they involve large and complex constructions. Secondly, the rail service level is already strongly improved with planned investments (reference scenario), so additional investments show marginal returns. Thirdly, the new railway links reduce travel times to Amsterdam for residents in the new housing locations in Almere (up to 17 minutes), but not for existing residents in Almere (one minute or less). It is very difficult to achieve positive welfare gains for a new – and expensive – railway link when only a small part of the total population will profit, that is, the residents living near the new railway station planned in the new housing location Almere Pampus.

8.7 CONCLUSIONS AND DISCUSSION

Applying the land-use–transport interaction model, Tigris XL, enables the examination of the land-use, transport and accessibility impacts of integrated land-use and transport policy plans, in this case land-use policy variants for large-scale housing development in Almere with dedicated public transport investment programmes. Conclusions of the study can be drawn regarding the population and employment effects of the land-use and transport plans and regarding their accessibility benefits following the logsum method in comparison with the rule-of-half method.

Regarding the population and employment effects, two main conclusions can be drawn. Firstly, the Almere case of the construction of 60 000 houses results in an increase of 120 000 to 130 000 residents and just under 50 000 jobs. It is unlikely that the policy ambition of local governments to attract 100 000 jobs in Almere can be realized. Secondly, the major public transport projects examined result in minor increases in employment for the city of Almere. The impact on the number of residents is even smaller, but this is partly caused by the exogenous control of the number of houses in the development plans.

Regarding the accessibility benefits, three main conclusions can be drawn. Firstly, the different land-use policy alternatives for Almere result in significant logsum accessibility benefits, in the range of €90 to €130 million per year relative to the reference scenario. The logsum accessibility benefits from the land-use scenarios for Almere exceed those from the railway investments. This illustrates that land-use policies can effectively increase accessibility for travellers by increasing the number of activities which can be reached with constant (generalized) travel costs. These accessibility benefits are not measured by the traditional rule-of-half benefit measure of accessibility benefits. The rule-of-half measure also does not capture all benefits from the public transport investments.

Secondly, the logsum benefits of the public transport projects examined, given a land-use scenario, are slightly higher than the benefits measured with the conventional rule-of-half (20 to 30 per cent). This difference is plausible; the logsum is a more comprehensive measure in which the changes in all mode and destination alternatives are weighed simultaneously.

Thirdly, significant synergies can be found when land-use policies and public transport investments are better integrated. Adding dwellings and jobs to locations near railway stations can significantly increase accessibility benefits for public transport users. However, in our case study, this does not affect the outcome of the CBA since the synergy in accessibility benefits is small compared to the huge investment costs of the public transport projects examined. All rail projects examined in the CBA continue to have strong negative welfare effects.

The accessibility benefits estimated in this chapter provide a partial picture of the total economic effects of expansion of Almere and infrastructure investments. The wider economic benefits (such as agglomeration benefits and better-functioning labour markets) are not estimated, but can be very important. In the CBA of the public transport investments (Zwaneveld et al., 2009), the wider economic impact of the rail investments were included (assuming a fixed 30 per cent rise to the transport benefits), but the wider economic impacts of the land-use scenarios were not estimated. In theory, agglomeration and productivity gains increase with city size and density of employment (DfT, 2005). The wider economic impacts of further urbanization in Almere are not trivial and can be positive or negative, depending on the reference situation (for example, build dwellings in small towns or, in contrast, in Amsterdam with relatively high employment densities). Examining the size and the direction of these agglomeration effects is an important direction for further research.

NOTE

1. Translated from the original Dutch names: Waterstad, Polderstad and Stad van Water en Groen.

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