

Karlsruhe 1975-1995

A case study of LRT development

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Paper

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ABSTRACT

The public transport system of Karlsruhe, in particular its innovative services on jointly used heavy rail lines, has received substantial attention throughout the last two decades. The discussion of the system and of its development was rather limited in the past, mostly highlighting technical aspects.

This paper provides an overview of the development including the urban development of the region and of the funding system. The ridership and financial development of the operator is documented in detail. Case studies focus on the integration of the system development in the general political process of the region and demonstrate the limitations of the operator under its current ownership structures.

KEYWORDS

Light rail development - LRT/Heavy rail joint usage - Public transport - Karlsruhe - Germany

1 INTRODUCTION AND BACKGROUND

Transport planners, in particular European transport planners, consider the city of Karlsruhe and its public transport system as an example of things done right, a nearly unqualified success story. Dieter Ludwig, the director of the public transport undertakings and a prime mover behind the developments, is a sought after speaker for international gatherings both in his own right, as well as in his role as the current vice-president of the UITP, the international trade association of the public transport firms. Unfortunately, the reporting of the city and its development tends to focus on the technical and public transport system elements of the story (among others e.g. Wyse, 1990, Griffin, 1992 or Drechsler, 1996). This partial reporting obscures the overall context of the city and of the financial and funding constraints under which the system develops. The purpose of this paper is to address this shortcoming by describing both the overall context of the developments in Karlsruhe, as well as the development of the public transport system, in particular, including its ridership and financial development. This case study approach highlights the contingent nature of the developments in Karlsruhe as well as their generalizable aspects.

The structure of the paper is as follows. The next section briefly describes the structure of the city and its socio-demographic development. It is followed by a description of the national/regional funding framework under which the system has developed. The main chapter summarizes the development path of the system including highlights of three particular projects. The final chapter looks forward and discusses in particular the challenges of the *Regionalisierung* of regional/suburban rail services.

2 THE CITY

Karlsruhe was founded in 1715 as the residence of a small local principality. The success of this foundation was assured, when the principality was enlarged seven fold during the reorganisation of the German states under Napoleon in 1803. While manufacturing contributed to the growth, the service sector has remained dominant with regional government, retail, finance, university and other educational and research establishments. Traditionally the catchment areas of the city and of its competitors have been relatively small for cities of their respective sizes due to the untypically high density of major urban centres in the Upper Rhine valley¹.

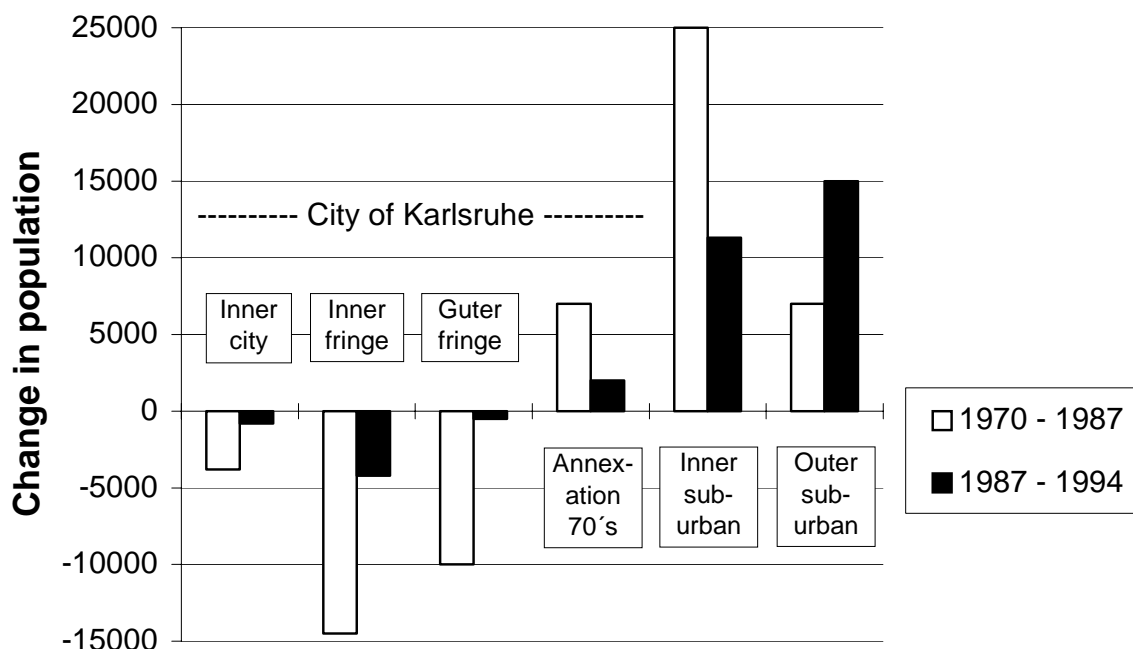
¹ see Christaller (1933) for a useful discussion of the problems arising from the late foundations Freiburg (around 1090), Mannheim (1606) and Karlsruhe (1715) within an urban system defined by Roman times.

The founder located the city on the main local east-west axis halfway between the older cities of Durlach at the margins of the Black Forest and Mühlburg on the high banks of the Rhine. Both are now incorporated into the city. This axis provides to this day the backbone of the settlement. The city's baroque plan imposed a ray patterns of streets, which had their centre at the palace of the founder, which was located slightly to the north of the axis. Only the southern quadrant (from SW to SE) was initially developed. More important for the future development was the location of the park and hunting grounds in the northern quadrant which is still in the main preserved today as a public park and forests. This wedge of attractive open space together with a counterpart to the South has led to a concentration of residential development on its margins: a Y-like pattern of growth, which is intersected by the development along the even stronger East-West axis.

The metropolitan area of Karlsruhe has today about 550,000 inhabitants², of which the core contributes 350,000 and city proper 275,000 inhabitants (Stadt Karlsruhe, 1995). This catchment area has not changed dramatically over the last 50 years. The distribution of population follows the expected patterns of postwar-development. The city was reconstructed after the war along the original pattern along the east-west axis, which was supplemented with new developments, both of public housing and single-family residential, in the Y mentioned above. At the beginning of the 70's suburban growth started in earnest with the attendant losses of residential population in the core areas (See 1). The growth continues in the suburban areas, while city has been able to balance most of the recent population losses through the massive immigration of the early 1990's (East Germans, Germans from the former Warsaw-Pact-countries, refugees from Yugoslavia etc.). 1 classifies the residential areas by type of population and residential accommodation at the municipal and city neighborhood level, which hides some of the internal variability of the areas. Still it clearly identifies the core of high-density housing, which is dominated by older and younger small households (Type 7) and the outer ring of suburban areas dominated by middle class single-family homes of differing level of quality (Types 2 and 4). Also visible are the problem areas of mostly public housing (Types 5 and 6) which are scattered throughout the city, while the cooperative-build housing of the interwar years has become middle-class (Type 3).

² Metropolitan area: at least fifty percent of commuters work in the core area. Core area: day time density of at least 500 persons/km² or more inbound commuters than outbound commuters.

Figure 1 Population development in the Karlsruhe metropolitan area, 1970-1994

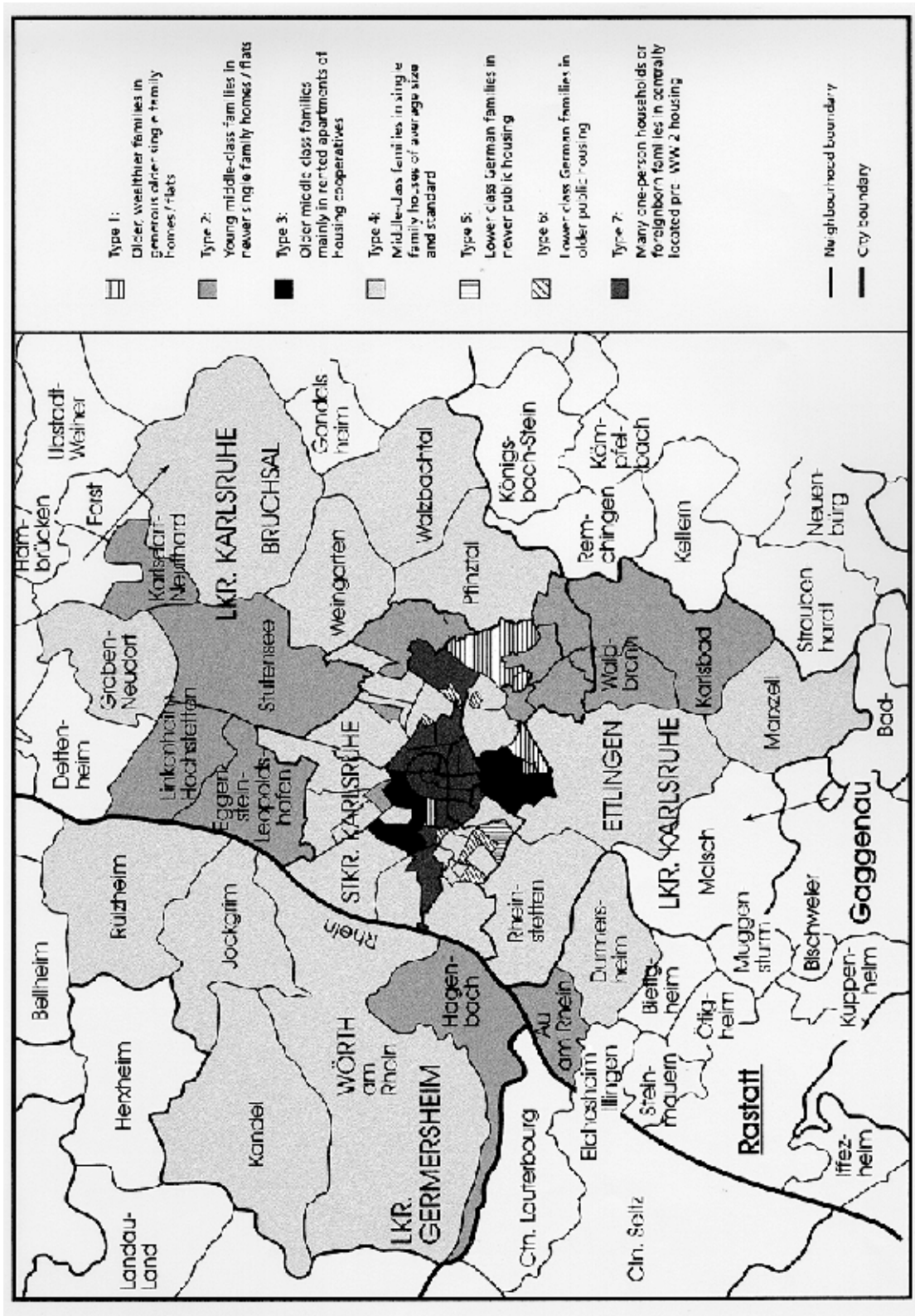


Source: Stadt Karlsruhe (1995), 27

The preferred areas (Type 1) are located to the west of the old centre (pre WW I), at the southern city limits (pre and post-WW II) and in the hills overlooking the city to the East (post 1960).

This overall distribution describes the typical situation of a core city, which needs to maintain its catchment area and to stifle or slow down the development of competing regional shopping/entertainment centres, which could draw on the dispersed population of the outer ring (see Garreau, 1991 for a discussion of the American situation), which is particularly urgent given the already small catchment area. The public transport policy is part of these attempts.

Figure 2 Joint socio-demographic and residential classification of the municipalities in the Karlsruhe region, 1993



Source: Stadt Karlsruhe (1995), 37

3 FUNDING RULES

Major transport infrastructures in German cities are funded on a matching grant basis involving the *Bund* (federal government), the federal *Land* and the municipality with funds mainly raised through a dedicated levy (0,054 DM/litre), which is part of the national fuel excise tax. The law regulating the fundable types of investment, the *Gemeindeverkehrsfinanzierungsgesetz* (GVFG), has been amended a number of times since it was first passed in 1971 (Muthesius, 1994). The municipalities can fund both public transport and road construction with these funds, which are channelled through the *Länder*, with each *Land* receiving a share of the total according to formula, while the federal government retains a share for large projects. Within each *Land* the projects are ranked according to cost-benefit criteria, which are calculated according to different guidelines for road and public-transport projects. The funds available can only be used, if the city can provide the matching funds. It is therefore crucial for a city always to have projects submitted in the hope, that higher ranked projects elsewhere cannot go ahead due to local funding problems there. The matching ratios have changed over time, but in general the proportions have varied around 50 : 35 : 15 for *Bund*, *Land* and city, which provides a very strong incentive for the cities to favour capital intensive projects. Rolling stock has become eligible only within the last decade: from the start, grade-separated rail public transport alignments, bus lanes, central bus stations, central maintenance and storage facilities, Park+Ride facilities, from 1988 purchase of standard- and articulated busses, 1991-1995 rehabilitation of public transport facilities in the former East Germany, 1992-1995 rehabilitation of rolling stock in the former East Germany, from 1992 public transport prioritisation, public transport stops and purchase of rail rolling stock (Muthesius, 1994)

The operating deficit has to be funded from local funds. In many cases the cities consolidate their public transport firm with their gas, water and electricity supplier within a joint-stock company framework to use the public transport losses to offset surpluses elsewhere. This form of cross-subsidy is coming under increasing pressure with the deregulation of the European energy markets and other EU initiatives and is unlikely to last very much longer (Aberle, 1997).

The buoyant finances of the city of Karlsruhe, especially in comparison with the other cities of same size within Baden-Württemberg, the *Land* concerned (Mannheim, Heidelberg, Freiburg, Ulm) have allowed a sustained investment programme in the past, as matching funds could nearly always be made available. The same applies to the funding of the operating deficits (see below).

4 NETWORK DEVELOPMENT SINCE 1975

4.1 Initial situation

At the beginning of WW II Karlsruhe had four public transport systems: the standard gauge local street car system with a bus system supporting it with feeder services; a metre gauge *Lokalbahn* (local train service) connecting Durmersheim in the South and Spöck in the North and the metre gauge *Albtalbahn* connecting Karlsruhe with Ettlingen, Bad Herrenalb and number of other villages to the South-East. The two train systems had peripheral alignments within the city: the *Lokalbahn* ran through the *Kriegsstrasse* just south of the centre and the *Albtalbahn* ended near the main station about a mile south of the centre.

Three of the four systems were reconstructed after the war: the street car system, the bus system and the *Albtalbahn*, while the *Lokalbahn* was closed down by 1953, partially to accommodate the increasing road traffic on the *Kriegsstraße*. Not only was the street car system rebuilt, but it was also expanded during a period when most European cities closed their street car systems down, although Karlsruhe was not exceptional in the sense that all neighbouring German cities did the same (Mannheim, Heidelberg, Stuttgart and Freiburg), but maybe not with the same vigour. The expansion brought the street car to the new residential areas built after the war to the Northwest and Northeast of the city centre. The bundling effect of the urban structure through the strong east-west axis, which also included the main shopping street, allowed the system to offer superior service at reasonable costs. This competitive advantage was enhanced further when the street car remained at-grade in the now pedestrianized (1972) central part of the east-west axis, the main shopping area of the region, served by all but one street car lines including the *Albtalbahn*.

In addition, the city acquired first the majority, then all shares of the *Albtalbahn* and maintained it as a separate legal entity, although led by the head of its own public transport operator. The *Albtalbahn* was integrated into the street car system by changing the gauge to standard gauge and by connecting the systems at the old terminus, the *Albtalbahnhof*. The trains on the *Albtalbahn* were run as street car within the city limits according to the *Strassenbahnbetriebsordnung* (BOStrab) (LRT/tram operations regulation, including design parameters) and as trains according to *Eisenbahnbetriebsordnung* (EBO) (heavy rail operations regulation, including design parameters) outside city limits. The rolling stock was adapted to conform to both set of regulations and the drivers were certified for both as well.

The recent history of system of expansion and of the consolidation of the *Albtalbahn*, the recent GVFG offering new funds and the acceleration of peripheral growth both within the city, but especially in the

suburban ring, facilitated and encouraged further growth of the system. In addition, the organisational structure involving at the time the *Verkehrsbetriebe*, the city owned operator as part of the city administration (VBK), and the *Albtalbahnverkehrsgesellschaft* (AVG) as a plc (ltd), but managed as one entity opened managerial opportunities not available elsewhere, in particular with regards to the development of investment projects. The recent history did not only encourage the operator, but also the city itself, which was willing to continue the funding of the expansion and further modernization of its successful operator.

4.2 Development 1975-1995

The internal dynamics of the expanding operator, the changes in the population distribution and an inherent local street car bias required the further expansion of the street car system. The bias expressed itself in a consistent preference of the travellers for street car service in comparison with prior bus services beyond the identifiable service qualities, as well as in the economic advantages of distributing the overheads of the system across a larger system and more services. The continuing growth of car ownership in the region and the larger share of peripheral customers forced the management to improve the service beyond the sheer expansion of the network. The quality and image had to be improved to maintain the momentum of the operator. The absence of serious plans for underground construction and services (but see below), which preoccupied and distracted many operators elsewhere and would have overwhelmed the small management team in Karlsruhe as well, allowed the Karlsruhe management team to concentrate their efforts on the conversion of a traditional street car operator into a modern light rail system, defining such a system in the process.

0 details the various network and service coverage extensions and, where known, changes in ridership associated with the opening of the LRT service in comparison to earlier bus or rail services (See also 2 and 4). The network growth follows the population to the Northwest (Haardtbahn to Hochstetten), the Southwest (Mörsch) and the East (Bretten). The new dual-system vehicles and interconnections between the heavy-rail and urban systems permit a range of new integrated services to further destinations: East (Pfinztal, Pforzheim), Southeast (Baden-Baden), Northeast (Menzingen, Eppingen). Other extensions are currently planned to the West (Wörth; opening September 1997), the South (Rastatt) and the Northeast (Blankenloch; opening September 1997) on both new and existing right-of-way.

While the expansion is generally welcome, it can become a political issue with local politics tying unrelated issues to the approval of a line. The line to Rheinstetten is the most prominent example, where

discussions about motorways, airport extensions and water rights delayed the line by about five years (Havranek, 1996).

Table 1 Network and service extensions 1975-1997

Opening	Type	Segment	Length Growth [km]	Ridership [%]
10/75	b	Langensteinbach-Ittersbach	9,0	(30)
11/75	a	Klinikum - Nordweststadt	2,3	(20)
10/79	b	Nordweststadt - Neureut	3,0	(80)
10/80	a	Eckener Straße - Rheinstrandsiedlung	2,1	(21)
9/86	a	Weinbrennerplatz - Oberreut	3,6	(48)
9/86	b	Neureut - Leopoldshafen	6,0	(73)
5/89	a	Rheinbrückenstraße - Lasallestraße		
6/89	a	Leopoldshafen - Hochstetten	4,3	(100)
9/89	a	Rheinstrandsiedlung - Mörsch	3,6	(215)
12/89	c	Leopoldshafen - Kernforschungszentrum	2,2	
11/91	a	Extension to Mörsch Merkurstraße	1,9	(80)
9/92	a, b, d	Durlach - Bretten/Gölshausen	23,8	(470)
4/94	a	Oberreut - Badeniaplatz	0,4	
5/94	b	Bruchsal - Bretten	21,0	(278)
9/96	b	Bruchsal - Menzingen	19,2	(120)
9/96	c, d	Karlsruhe Hbf - Baden-Baden	32,0	
6/97	b	Bretten/Gölshausen - Eppingen	20,5	(100)
6/97	b	Karlsruhe Europaplatz - Pforzheim	31,4	
9/97	a, c	Karlsruhe - Blankenloch Nord	10,7	
9/97	a, b, d	Karlsruhe Europaplatz - Wörth Bürgerpark	12,6	

Type: a New construction
 b New service including major improvements
 c New service on existing track
 d Interconnection between LRT & heavy rail

() immediately after opening, further growth has since occurred

The design aim of the lines has been to maximise the use of existing right-of-ways while maximising the access of the population to the new lines. In the case of the line to Bretten, for example, eight new stops were built along the existing right-of-way. In the case of the Haardtbahn the existing right-of-way was too far from the villages served and, e.g. a new alignment was built through Leopoldshafen to achieve the access necessary for the success of the line.

Figure 3 Network development - region - 1975-1997

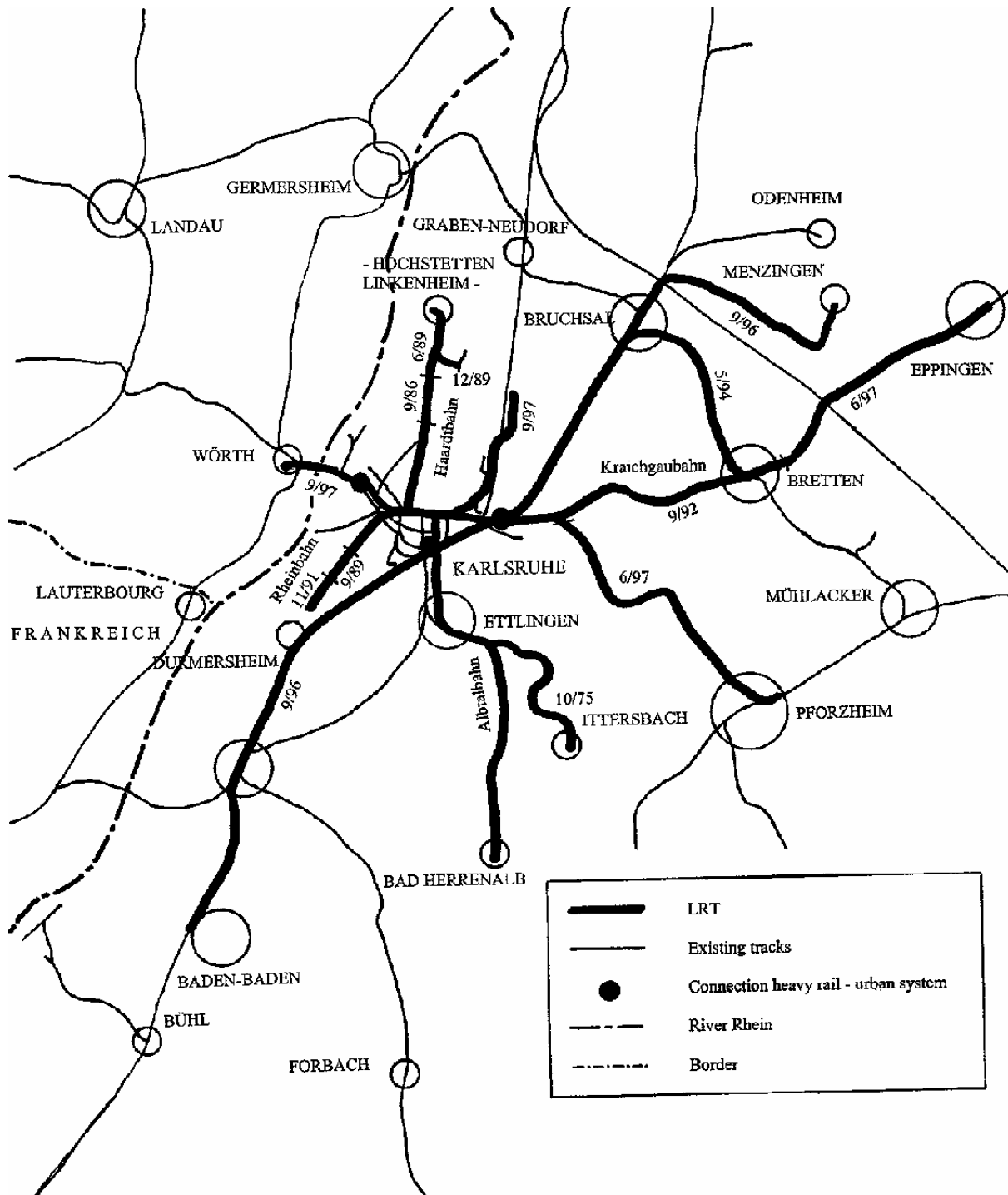
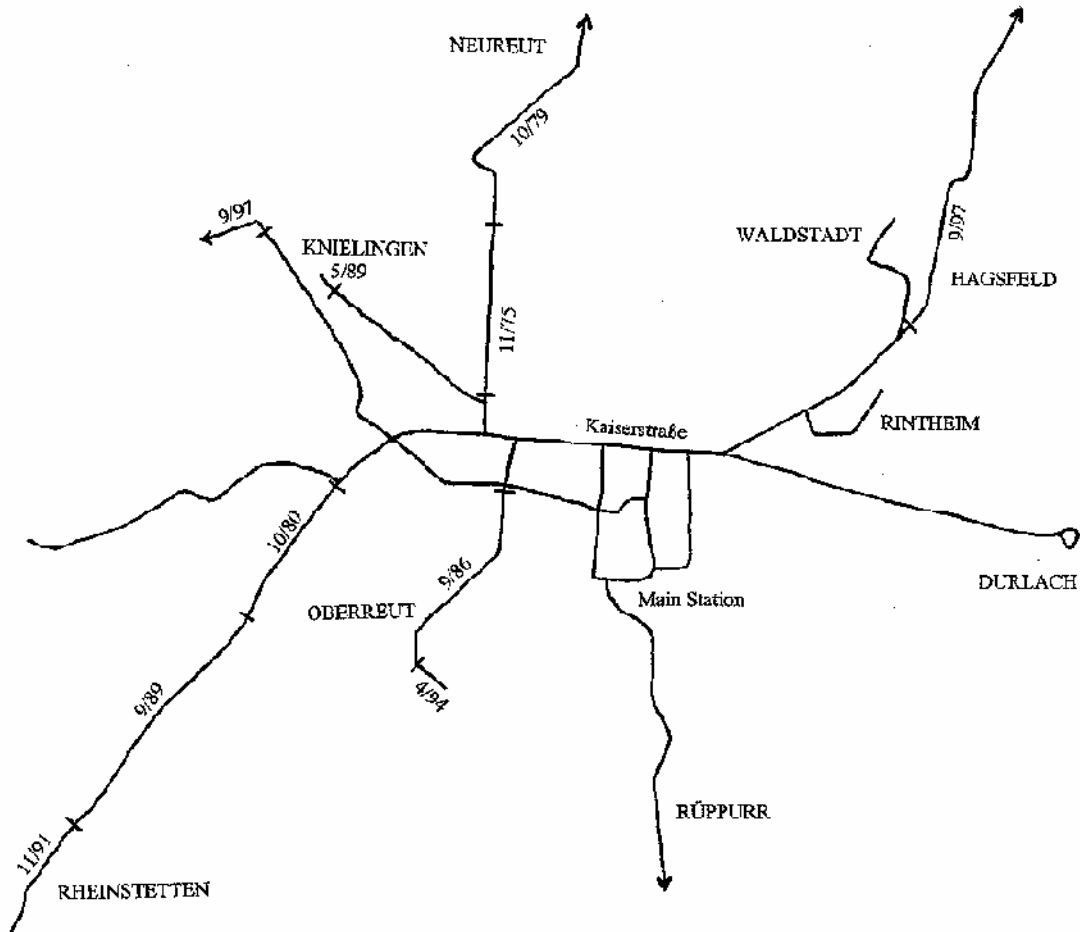


Figure 4 Network development - urban network - 1975-1997



The reuse or joint use of existing right-of-way requires substantial negotiations and technological innovation. In the case of the Haardtahn the Bundesbahn handed the alignment over to the AVG, but retained the right to run a limited number of freight trains. In the case of the line to Bretten, the AVG had to develop a new type of vehicle conforming to both electrical and both security systems.

The line to Bretten

By the early 1980's the success of the AVG to the South and the successful extension to the Northwest (Haardtahn) partly on converted heavy rail right-of-ways and the internal growth dynamic of the firm justified the search for future expansion opportunities (Schafferer, 1996). The growth of the villages along the Pfinztal and in the direction of Bretten (Kraichgaubahn) (about 35 km to the Northeast) defined an attractive corridor for a suburban service. Unfortunately, the Bundesbahn was not willing or able to develop this corridor, as it was handicapped by old rolling stock and its network structure, in particular by the fact that its terminus at Karlsruhe main station is too peripheral within Karlsruhe to be attractive to many commuters or shoppers. The ridership

trend was downwards. In addition, the Bundesbahn did not want to relinquish the line to Bretten completely, as it had done with the Haardtbahn, as it was operating longer distance services on the line. It also did not want to lose the remaining operating revenue from the line. Still, it was clear that through-services to the centre of Karlsruhe were required to increase ridership, which implied vehicles operating both on heavy rail as well as on LRT tracks. While the AVG had long experience with operating both as a LRT as well as a railway, it was doing so on a line without other traffic (ignoring the diesel freight services on its lines), which allowed common safety and electrical systems. In the case of the Kraichgaubahn it was clear, that any operation would be under mixed traffic, i.e. both LRT-suburban services and heavy rail regional services. Mixed services were considered at the time to be technically impossible and undesirable with regards to safety (i.e. due to the weight differences between the lighter LRT-vehicles and the heavier heavy-rail sets). The precondition for the service was therefore both the development of a suitable technology and the political agreement of the communities along the line.

The technological development started in earnest in 1986 with funding from the German Ministry for Research and Technology. Initial tests included both a two-systems vehicle, able to run under both the urban and heavy rail electrical system, and a vehicle with an additional battery supply for the heavy rail portion of the line. After the initial tests only the two-systems vehicle was pursued and developed further. The further development included the installation of a heavy-rail compliant safety system (INDUSI ATP) and of a new type of wheel profile capable of running safely both on urban and heavy rail track and switches. The use of INDUSI overcame the safety concerns, as this system automatically assures safe distance between trains. Otherwise the vehicle employs only one type of system, e.g. the horn complies with railway regulation, while the brake complies with street car standards. Certain compromises were made with respect to the acceleration capabilities to keep the weight of the vehicle under control. The vehicle as such is a modern LRT-type vehicle with regards to seating, passenger comfort, passenger information, size of windows etc., but also weight. The vehicles were ready by 1991 and as mentioned above are not only being used on the line to Bretten by the AVG, but generally by the Bundesbahn for suburban services around Karlsruhe. They were in many ways the prototype for the new generation of light heavy rail vehicles, which have come on the market in the 1990's, which combine in essence lower weight, higher passenger comfort, better acceleration/deceleration with one man-operation for heavy rail lines.

The extension of the network was complemented by a comprehensive upgrade of the urban system through a conversion of most of the network from at-grade running to vertically separated right-of-ways, priority at signal controlled intersections, the widening of lateral distances between the track axes to accommodate modern and wider vehicles, the modernisation of the rolling stock, and in particular the acquisition of low-floor vehicles. New maintenance facilities and offices were built as well.

In addition, Karlsruhe introduced in 1983 a heavily-discounted transferable season ticket, which could be acquired as a monthly or as an annual season ticket. The structure of the timetables and of the lines was adjusted periodically throughout the period to match the new alignments and new patterns of demand.

The start of the *Karlsruher Verkehrsverbund* (KVV) in 1993 consolidated the achievements of the last two decades by extending the reach of the system even further. The KVV offers uniform through-

ticketing for all users, discounting of season tickets, in particular for suburban users, and coordinated time tables throughout the region. The dual-systems vehicles developed for the line to Bretten are used to offer an *S-Bahn*-like service to most centres in the region (Baden-Baden, Wörth, Bruchsal, Rastatt etc.) some running exclusively on Bundesbahn right-of-ways. In the case of the service to Baden-Baden and Pforzheim further interconnections between the urban and the heavy rail system built at the Albtalbahnhof, Grötzingen respectively, allows now through-services into the city centre of Karlsruhe.

The dramatic increase in services is finally threatening to choke the system with its own success, as the potential bottleneck of the Kaiserstraße could become a real one.

A tunnel below the Kaiserstraße ?

The further expansion of the system necessitated a further study after earlier ones in 1972 and 1989 in 1992/1993 (Stuefer, 1996). This time the solution tried to minimize construction costs and the size of the underground network in terms of length and number of stations. The study had been undertaken by a team formed from the staff of operator and of the city planning and civil engineering departments. The preferred option essentially proposed to move the suburban/regional traffic (initially 2 lines) into the tunnel, but to retain the remaining traffic above ground. The tunnel provided for the possible later extension to the South/main station. Its conclusions were accepted by the city council in 1994. While the city council majority for the first time with strong support of the VBK assumed that the solution would be built, local resistance built up. The resistance focused on the disruption to the pedestrian zone during construction, the perceived mismatch between the tunnel and the small amount of traffic using it (initially), the operating costs of the tunnel, a general fear of tunnels, the lack of a proper cost-benefit study, doubts about the cost figures provided, the perceived lack of a proper study of the major alternative corridor³ and a perception that Karlsruhe could not afford its share of the total budget given its other needs. The finalized design was approved by the council majority in May 1996, but was rejected in a referendum in October 1996 after a campaign, in which the proposers, in particular the mayor and the majority on the city council, did not fully engage relying on their prestige to carry the day. It is unclear to what extent the operator (VBK) was allowed to participate in the campaign.

The defeat of the proposal is an object lesson for the operator and the city. It shows that the citizens of Karlsruhe insist on a system serving them in the first instance with the suburban users welcome but not dominant. This is also reflected in the slow speed with which the system is expanding inside the city (Kopp, 1997) in spite of proposals ready for implementation. This conflict of interest between the city residents and the AVG/VBK, which can only substantially grow in suburbia, and the retailing interests, which need the suburban customers, but fear disruption, is set to fester, until an acceptable solution is found, which is neither too expensive nor too disruptive, but still offers the suburban travellers services to their destinations in the core of Karlsruhe.

³ An alignment along the Kriegsstrasse, a parallel major urban arterial about 400 m south of the Kaiserstrasse, which is scheduled for redesign, as its traffic function has changed due to the opening of urban motorways further to the South.

4.3 Ridership change and economic MOE's

The buzz, the innovation and service expansions and improvements have generated enough ridership and political support to sustain the developments described above. Unfortunately, the statistical analysis of the changes and the evaluation of the measures implemented is not of the same quality.

The aggregate figures given above for ridership change, for example, do not allow to separate the various effects operating when a new rail line replaces an existing bus service: the improvement in services (headways, service times, comfort of the vehicle), the changes in pricing due to the new operator⁴, changes in the patterns of the feeder services, discontinuation of direct services to the city centre, the image effect of rail services etc.. In addition very little is known, how the numbers were derived in detail, i.e. issues of comparability of before-and-after situations, duration of reference periods, timing of the reference periods etc. This cannot be blamed on the operator, for whom it is enough to know that prior ridership expectations were surpassed in all cases⁵ leading to quicker build-up of demand and services than anticipated. Consistent with the patterns of the AVG, where a substantial portion of that demand is leisure and weekend traffic, in particular on the line to Bretten: weekdays from 488,000 annual trips to 2,064,000 (increase 420%), Saturdays from 39,000 to 263,000 (increase 680%) and Sundays from 6,200 to 227,000 (increase 3670%); overall from 534,000 to 2,555,000 annual trips (480% increase) (AVG and ABB Henschel, 1993).

Even the most detailed study known to the authors (Socialdata, 1995), which was undertaken for the evaluation of the line to Bretten, leaves many questions unanswered. The main questions from a planning point of view are: the extent of any modal shifts or, in general, the generation of "new" public transport trips. The Bretten study gives some indications about the answers to these questions (see 2). The study involved repeated-one day cross section/panel travel surveys in two villages along the line (Grötzingen inside the city limits, which had previously been well served with busses to the old street car terminus in Durlach, and Jöhlingen, outside the city, which previously had been badly served by regional rail services and some busses).

⁴ In a number of cases the AVG/VBK replaced bus services of private operators or the Bundesbahn/Bundespost.

⁵ It is not known to the authors what forecasting procedure was adopted.

In the case of Grötzingen the "existing" users have increased their usage, while only a small share of new users was added⁶. The increase in public transport usage derives mostly from earlier walking and cycling trips, also associated with an increase of trips into the area served by the LRT-system. In Grötzingen new trips by existing public transport users should be the main source of ridership growth. In the case of Jöhlingen, both modal shift from car to public transport and a more intense use by the prior users, explains the ridership growth. The relative importance of the new public transport demand in comparison with modal shift effects will depend on the location of the new service and the prior conditions, but trip generation will always be present. The estimate for the line as a whole was, that 40% of users were prior car users, drivers or passengers. These new trips are consistent with the suburban settlement pattern, as they reflect the old ties of the new residents to their old social networks and as they reflect the current distribution of shopping and entertainment facilities in the region⁷. The LRT supports suburban growth, while maintaining the centrality of Karlsruhe, which is not choked by too much additional car traffic. The new lines help to realize the potential for public transport trips to the center of the metropolitan area.

Table 2 Effect of the line to Bretten

Variable	Grötzingen		Jöhlingen	
	Before	After	Before	After
Public transport trips/ person and day	0,3	0,4	0,2	0,3
Share of public transport users/day	15	16	12	17
Public transport trips/public transport user	2,0	2,2	1,8	1,9
Modal shares (all trips/area served by LRT)				
Walking and cycling	31 14	32 8	33 3	34 2
Motorcycle and car driver	42 49	40 50	46 64	42 54
Car passenger	16 17	14 17	13 14	11 11
Public transport	11 20	14 25	8 19	13 33

Source: Socialdata (1995), 6 and 7

The overall growth in ridership has been impressive (see 4), in particular after 1983, the year of the introduction of the transferable monthly/annual season ticket, which is replacing other ticket types rapidly (see 4) due to sustained marketing efforts and service improvements. This dominance together with the

⁶ This interpretation of "old" and "new" users is very tenuous for repeated cross-section surveys. A full panel analysis of the data would be required to identify users classes (stayers, adopter, leavers).

⁷ There is a fair number of shopping centres in the region, but none functions as a full-scale mall, i.e. includes extensive food and movie/entertainment facilities.

importance of the 24-hour ticket makes the interpretation of the figures difficult. It is notoriously difficult to estimate the number of trips undertaken with season tickets and no special studies are known to the authors for Karlsruhe. There is a rich stock of general knowledge about these numbers, but the development in Karlsruhe makes it likely that the figures as stated overestimate the true ridership to some, unknown, extent. The lower cost of the discounted and transferable season makes it attractive to users with fewer than the traditionally assumed numbers of trips, lowering the average number of trips/season. The same is true for the very rapid market penetration of the season, which reflects the purchase of the ticket by a fair number of users for which the ticket is not strictly economical, but convenient and consistent with the personal self-image.

Still, the ridership success is visible, in particular, in terms of average annual person trips on VBK services, which has continuously risen since the mid-1980's, to reach values around 220 trips/person and year in the service area. (This figure is an underestimate, as the trips made on AVG services within the VBK service area are not included). While the popular success continues, the VBK has come under financial pressure in recent years (See 7) with the operating deficit reaching a new higher plateau around 1993, while the cost recovery ratio regained its old level in recent years. Comparable figures are not available for the AVG. The productivity of staff has increased through the use of larger vehicles and the extensive use of trains with two or three vehicles, especially on the longer distance services (about 70000 trips/employee), but ridership per seat kilometre is stagnant or falling due to the generous service provided, especially during off-peak periods (now around 0,045 trips/seat kilometer). The financial pressure on the VBK will increase, as the finances of the city will deteriorate further due to the current long recession in Germany, the restructuring of public budgets in general and the losses due to the out-migration of middle-class residents. The AVG is in a better position, as it is dealing with suburban communities, which finances are in general better, and which are keen to obtain new LRT services and are therefore willing to pay for those services (Socialdata, 1993a). Equally, the regionalisation of rail services (see below) opens up new possibilities to lower overhead costs through expansion of services.

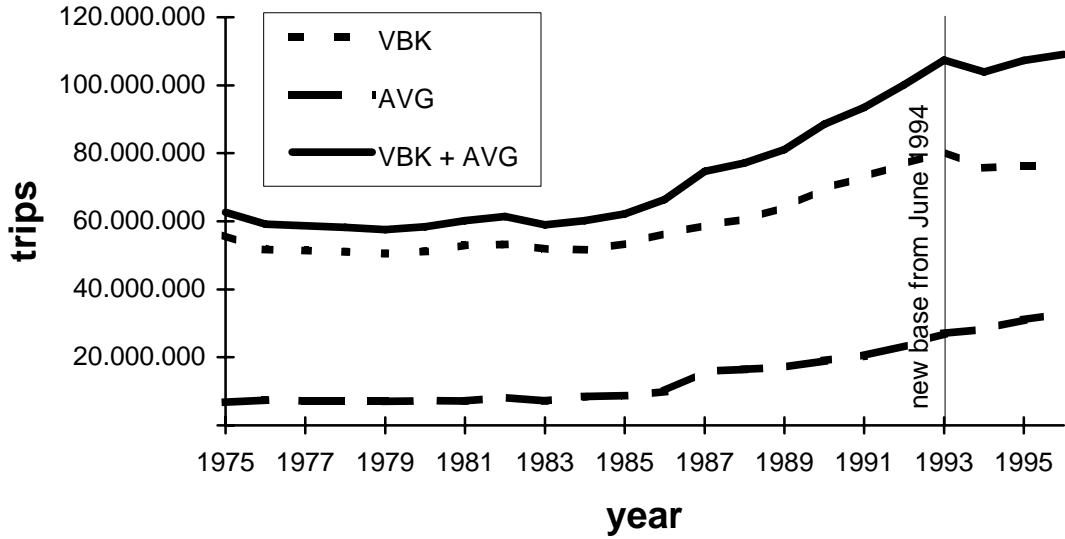
In spite of the dramatic ridership growth, the overall modal share in the Karlsruhe has not changed dramatically in recent years (Socialdata, 1993b). The share of public transport has increased from 13% (1982) to 16% (1992), while the share of the car has remained constant, with the gain for public transport stemming from car passengers (1%) and walking (2%). Cycling increased its share from 13% to 17% over the same period. The public transport system jointly with the expansion of cycling has been able to contain the growth of car use, but not massively reverse it. This is a special achievement as car ownership continued to grow steadily to about 500 per 1000 inhabitants (1994) over this period (Stadt Karlsruhe, 1997).

5 OUTLOOK AND CONCLUSION

The Karlsruhe public transport system, urban (VBK) and suburban (AVG), has had an extraordinarily successful twenty years characterized by nearly continuous growth and the conversion into a qualitatively new system (LRT and the *Karlsruher Model* of joint suburban services, see also Ludwig and Kühn (1995) for the strong national and international interest in this idea). The further expansion plans speak of the confidence the region has in the abilities of the operator to deliver superior services. It also puts the operator into an excellent position to benefit from the regionalisation of the heavy rail services, under which services are tendered by line or subnetwork. With its relatively low cost-base AVG/VBK should be able to expand into this business, especially given its control of access to the business and service core of the region. It has already started to do so, by taking over a rural/suburban train network North-East of Bruchsal.

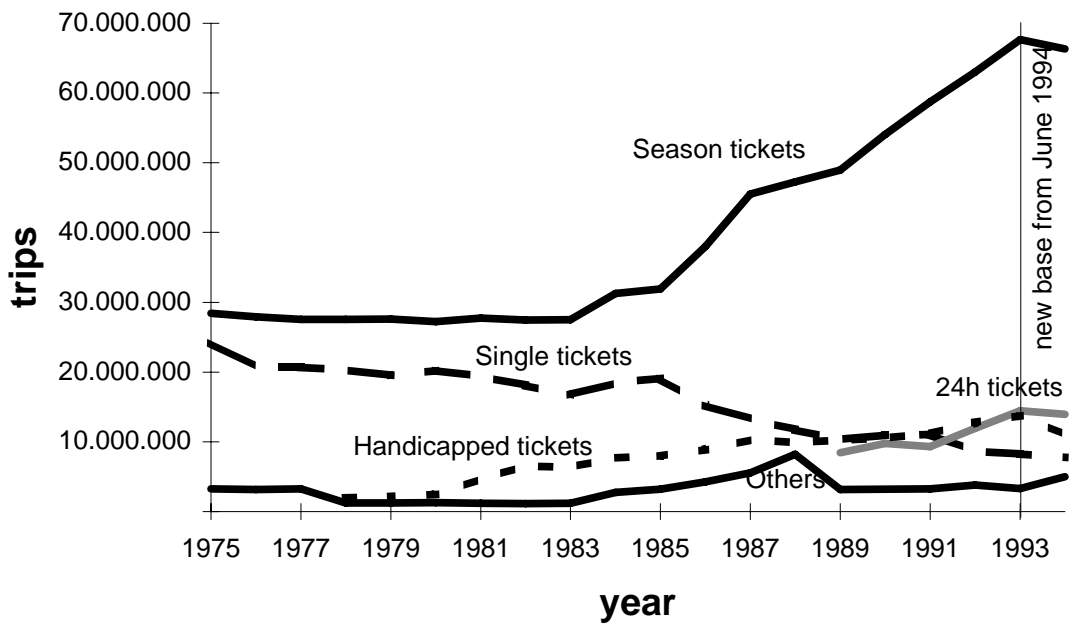
The success of the last twenty years could on the other hand become a problem for the future, as it has been achieved with a very small management team under charismatic leadership, though always with the financial backing and general confidence of the city and its leadership, but note the slowdown of expansion inside the city in recent years. Such structures are prone to mistakes such as the ill-conceived referendum campaign and are difficult to maintain, when the firm reaches a certain size and levels of complexity or when central figures retire or leave. The VBK/AVG and City of Karlsruhe combination might be at this point of transition and it is unclear, whether it can achieve an internal restructuring equally successful as its restructuring of its network and services.

Figure 5 Development of ridership VBK and AVG (1975-1996)



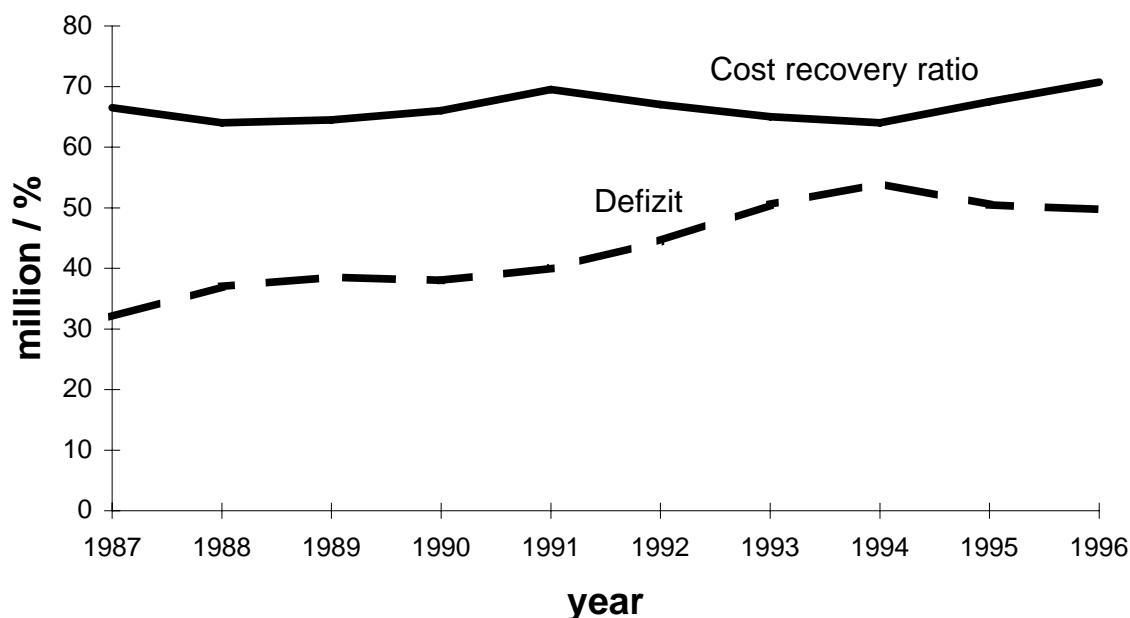
Source: Brandl (1996), 42

Figure 6 Ridership VBK by ticket type (1975-1994)



Source: Brandl (1996), 44

Figure 7 Annual deficit and cost recovery ratio VBK (1987-1996)



Source: Brandl (1995), 46

It is also unclear, whether the city wants to support the development of a commercial suburban railway service provider, which has to operate in price competition with the Bundesbahn and other providers participating in the tendering market. The commercial risks involved might be judged too high for the city as the sole owner of the AVG, the instrument of such a bid. This would be especially true, as the expansion into tendered suburban and regional services would weaken the perceived unity of interest between VBK/AVG and the commercial and policy interests of the city, as the attention of the management team would be diluted and diverted away from serving the city, even if the AVG can continue to cover its operating costs fully from the fare box and subsidies from the municipalities served. Finally, the mixture of city's role as regulator of the tendering process as as owner of a service provider is unstable in the long term.

This case study has summarized the development of the public transport system in the Karlsruhe region. The management team would be diluted and diverted away from serving the city. In addition, the current level within its regional and financial context. It has highlighted that the success of the system has not been smooth, but that the system is part of the overall political process of the region and is subject to

deficit of the VBK might not be sustainable for the city, even if the AVG can continue to fully its limitations. The operator (VBK/AVG) and its owner have now to decide, how to react to the development of a commercial market for rail services under regionalisation/deregulation. They have also to find a new balance between the interest of the urban and suburban users, in particular a mixture of the city's role as regulator of the tendering process and as owner of the service provider suburbanisation proceeds and the dominance of the city as a destination is diluted in the future. This is unstable in the long term.

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Any errors are our own.

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