BARTLETT SCHOOL OF PLANNING

UCL

PROJECT PROFILE

Germany

New ICE Cologne–Rhine/Main line

Neubaustrecke (NBS) Köln-Rhein/Main

omega centre

Centre for Mega Projects in Transport and Development

A global Centre of Excellence in Future Urban Transport
sponsored by Volvo Research and Educational Foundations (VREF)

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A INTRODUCTION

Type of project

Project name

New Cologne–Rhine/Main line (*Neubaustrecke (NBS) Köln-Rhein/Main*)[1].

Description of mode type

The new Cologne–Rhine/Main line (177km) represents one of the most important projects for German and European high-speed rail traffic. It is the first rail track in Germany to be built for exclusive passenger high-speed transport. Thanks to the new high-speed route, it now takes only 76 minutes to cover the distance between Cologne and Frankfurt/Main instead of two hours 15 minutes. (Source: Deutsche Bahn AG 2009).

Technical specification

After the observation of spatial planning procedures (*Raumordnungsverfahren* or *ROV*), it was decided to let the new line run largely parallel to the A3 motorway thus reducing the route length from 222km to 177km. Together with the Wiesbaden branch lines and the Cologne/Bonn Airport loop, the high-speed route is 219km long altogether.

The engineers had to pass through the Siebengebirge, Westerwald and Taunus low mountain ranges. The ground largely consists of Devonian sedimentary rocks, which are covered by tertiary and quaternary layers. Serious weathering down to a depth of more than 40m is encountered in many parts of the route.

Gradients of 40% and minimum radii of 3,350m have been applied on the new route to construct it parallel to the motorway and reduce impacts on nature in contrast to existing high-speed lines that are designed with maximum gradients of 12.5%.

The new ICE 3 trains (in operation for the first time) can travel at a top speed of 300km/h.

Thirty tunnels were required in spite of these extreme design parameters, of which 22 were constructed by mining means. Given shallow overburden and the need to pass below motorways on no less than 15 occasions, the project called for practically all the special features involved in tunneling. The tunnels on the new line are 47km in length altogether, thus accounting for 21% of the entire route.

Further technical innovations were the construction of the ‘slab track’ (*Feste Fahrbahn*) along 155km of the NBS and the use of linear eddy current brakes (*Wirbelstrombremse*) as the trains’ brake mechanism.

Other important innovations were the construction contracts for the main parts of the new rail line, which are based on a description of performances with performance programme, usually known as ‘functional tendering’ (*Funktionale Leistungsbeschreibung*). (Source: Deutsche Bahn AG 2009).

[1] There are and were other NBS within the past 20 years in Germany. In the following report the term ‘NBS’ is used for this project.

Figure 1: ICE3 cross-over

(Source:www.bahn-report.de/docs/leseproben/http_download.inc.php?dat=brep0811.pdf)

Location/ principal transport nodes/ major associated developments

The new line links up important German conurbations (metropolitan regions Rhine/Ruhr and Rhine/Main combining 15 million inhabitants at present) as well as two large, international airports with the stations Cologne (Central), Cologne-Deutz, Siegburg/Bonn, Montabaur, Limburg South and Frankfurt (Central) as well as Cologne/Bonn Airport Station (via a parallel loop) and the Frankfurt Airport mainline station. In addition, the cities of Mainz and Wiesbaden are connected via a branch line at the Wiesbaden intersection.

Five completely new stations, intended to give a fresh impetus to the economic development of each city and its surroundings, have been constructed:

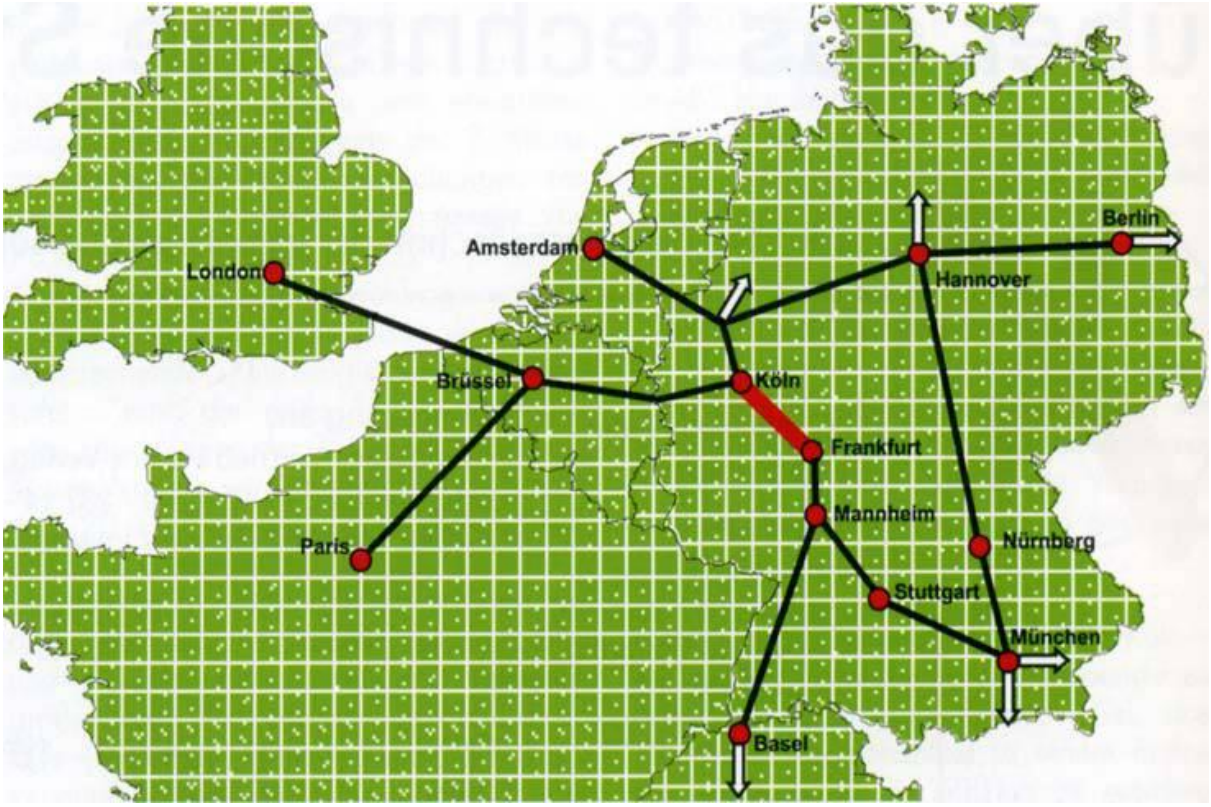
- Frankfurt Airport mainline Station;
- Cologne/Bonn Airport Station;
- ICE-Station Limburg South connecting the Lahn area of Western Hesse;
- ICE-Station Montabaur connecting Koblenz, the capital of Rhineland-Palatinate in the Rhine valley;
- Siegburg/Bonn Station connecting Greater Bonn.

(Source: Deutsche Bahn AG 2009).

Parent projects

Its central position in the heart of Europe makes it a key section on the north-south axis. As part of the high-speed corridor Paris - Brussels - Cologne/Frankfurt - Amsterdam - London (PBKAL) the linkage between Cologne and Frankfurt has been a crucial part of an integrative European high-speed network TEN since 1994. It is aimed at increasing the attractiveness of travelling by rail by offering substantial reductions in journey times and attracting passengers away from air and road travel. (Source: Sartori 2008).

Figure 2: The PBKAL Network



Source: Haase, D. (2002): Vom Kundenwunsch zum Trassenangebot. In: ICE Neubaustrecke Köln-Rhein/Main. Planen Bauen Betreiben. (= Bahnreport 2002/ Edition ETR = Sonderveröffentlichung der Eisenbahntechnischen Rundschau) S. 122-125.

Current status

The line was built from 1995 to 2002 (the Cologne/Bonn Airport loop was added in 2004) and is completed except remaining works at Cologne junction. The total cost so far is quoted as EUR 6bn by Deutsche Bahn AG. (Source: Deutscher Bundestag 2007).

B BACKGROUND TO PROJECT

Principal project objectives

Both the Ruhr basin and Frankfurt/Mainz/Wiesbaden regions play a crucial role in the German economy. Therefore, the new connection is a core element of the national German high-speed network. The new infrastructure has been designed for passenger trains only. Before the opening of the new tracks the overall capacity of 600 trains on the old tracks along the Rhine valley had been exploited with the highest possible train frequencies. Growing freight volumes are still forecasted for the future, and the shift in passenger capacities from the old to the new tracks can be used for growing freight volumes.

Previously, the journey from Cologne (Central) to Frankfurt (Central) took about 135 minutes. German Federal Railways (GFR) hoped for an increase in passenger numbers of 50% to 100% by means of the NBS as the shortest link, a travel time of about one hour at high speed and the use of the latest trains, thus relieving air and road traffic of about 15,000 to 30,000 passengers per day. The highest possible protection of the environment and avoiding the fragmentation of spacious landscapes by constructing the line parallel to existing railroad properties and the motorway A3, were also highly important.

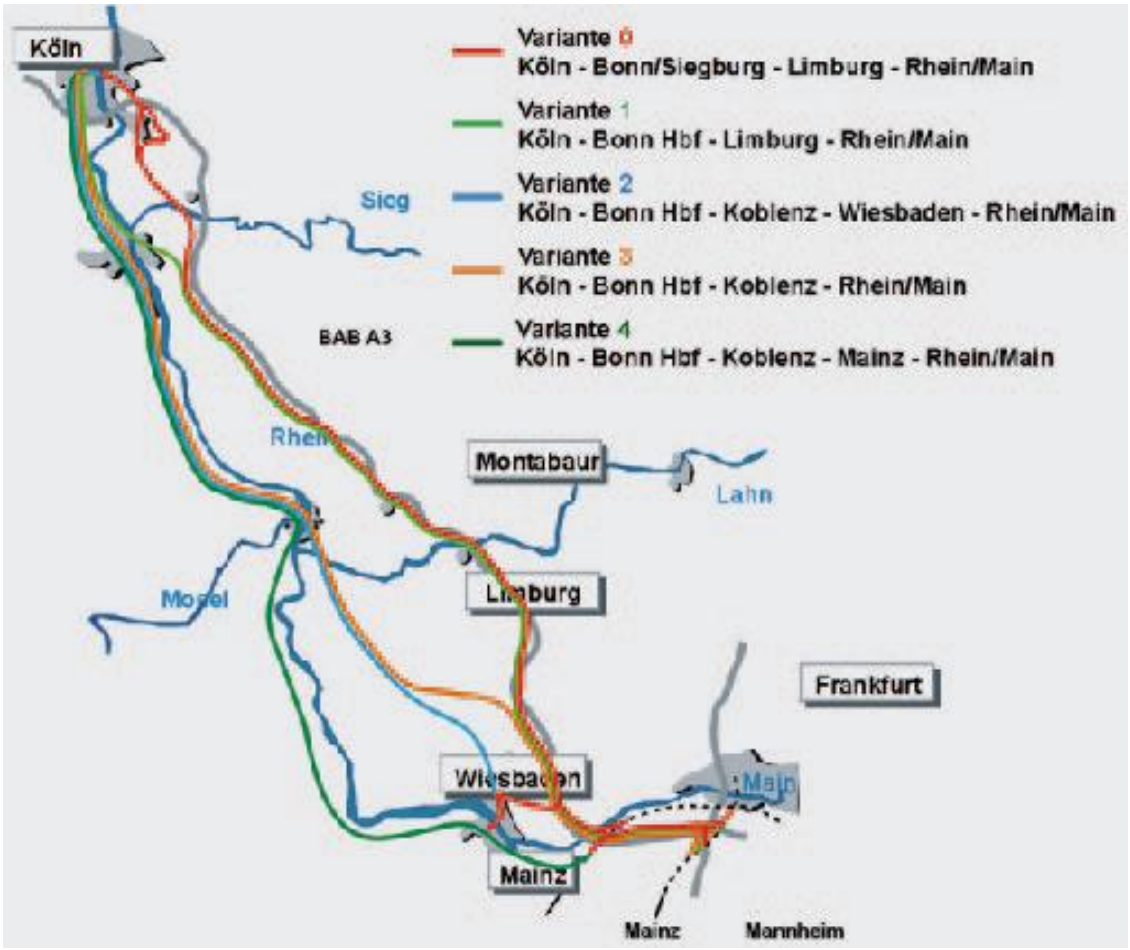
(Sources: Deutscher Bundestag 2007, Blind u.a. 1990)

Route options

The linear distance between Frankfurt and Cologne totals 160km, the motorway 189km. Due to the multitude of turns the Rhine valley line expands to a length of 222km. Between 1985 and 1987 an examination of five large-scale layout alternatives followed:

- Variant 0 (realised): 177km (initially with a different stop in Bonn/Vilich)
  5.0bn DM (about EUR 2.6bn)
- Variant 1: 186km (tunneling Bonn and Rhine before turning into variant 0)
  5.5bn DM (about EUR 2.8bn)
- Variant 2/3 (or S): 185km/187km (via Bonn and Koblenz before tunneling the Rhine)
  additional costs of 1.3/2.8bn DM (about EUR 0.7/1.4bn)
- Variant 4: 224km (continuous course on the left bank of the Rhine)
  6.5bn DM (about EUR 3.3bn).

Figure 3: NBS variants discussed in the 1980s



(Source: www.baumaschine.de/Portal/download.php?w=Tbg&p1=1997&p2=heft9&n=a528_531.pdf)

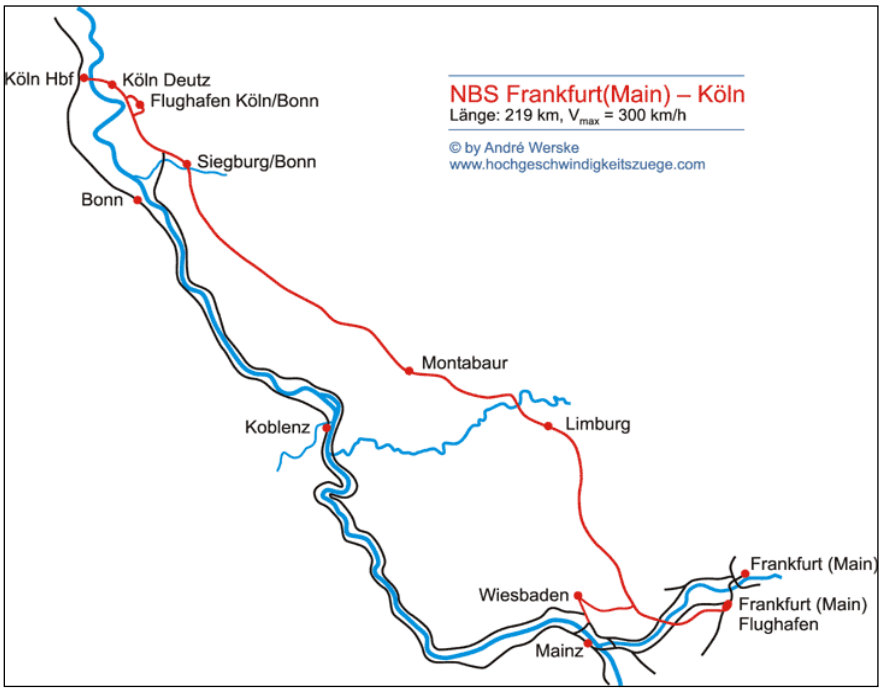
In January 1988 GFR expressed a preference for variant 0. The following aspects were found to be decisive:

- The lack of suitability of the Rhine valley for high-speed traffic north of, but above all south of Koblenz in the Rhenish Slate Mountains;
- Favourable grounds had been chosen before for the motorway on the right bank of the river;
- Avoidance of additional landscape fragmentation by route grouping;
- High additional costs with an inferior travel-time benefit (10-30 minutes more compared with variant 0);
- Expected travel-time benefit of just 14 minutes provided a mere expansion of the existing lines and the use of tilting train technology.

After the presentation of an expert report in 1991 even the nature conservation organisations favoured the routing east of the Rhine. Specific investigations followed, dealing with detailed routing and the possible location of new stations within the areas of Bonn/Siegburg, Montabaur/(Koblenz)/Limburg and Mainz/Wiesbaden. During spatial planning procedures various variants were examined in the three federal states of Northrhine-Westphalia, Rhineland-Palatinate and Hesse. The longest discussions on the exact routing dragged on in the Rhine Sieg district (NRW). Construction works did not start there until May 1997.

(Sources: Eschenburg 1995, Kandler 2002, Deutscher Bundestag 1997, Kaniut/Form 2002, Blind u.a. 1990).

Figure 4: Layout of the NBS and the Rhine Valley lines



Source: http://www.hochgeschwindigkeitszuege.com/germany/index_ice_strecken.htm

Technological options

- exclusive passenger transportation;
- route grouping with the motorway in the highlands;
- connection to Rhine/Main Airport and further direct links to Frankfurt and Wiesbaden;
- design speed at 250-300km/h;
- planned gradients of 40%;
- minimal radii of 3,250m;
- in the early 1980s the *Transrapid*, a magnetic monorail (or Maglev), was planned for the NBS. Assuming that the conventional wheel-rail system could not cope with the planned gradients the two technologies were compared by the German Federal Ministry of Research and Technology. Only then GFR spoke for the conventional technology in September 1987 and the Minister of Transport consequently settled the decision by the end of 1987.

(Source: Jänsch 2002).

Key enabling mechanism

Description of key enabling mechanism

NBS is a long-distance rail infrastructure project of the 1985 Federal Transport Infrastructure Plan (*Bundesverkehrswegeplan* or *BVWP*) and had been included in the 1992 FTIP as a priority requirement (category: backlog). Alongside the crucial 'German Unity infrastructure projects' (*Verkehrsprojekte Deutsche Einheit* or *VDE*) the NBS ranked among the most important German infrastructure projects in the 1990s and passed into the 'Law on the Expansion of Federal Railways' (*Bundesschienenwegeausbaugesetz* or *BSchwAG*) in 1993. The Cologne/Bonn Airport loop line had its origin in the 'Law on Berlin/Bonn' of 1994, intended to cover the move of the Federal Parliament and partly the Federal Government from Bonn to Berlin.

Key enabling mechanism timeline

Table 1: Overview of key enabling mechanisms timeline

Month	Year	Event
	1985	Resumption of planning: studies on different routing variants lead to the announcement of a new Cologne-Siegburg-Limburg-Frankfurt line by GFR for the 1985 FTIP. The cost-benefit ratio is 4.0. Line-routing remains open for the time being.
	1986	Due to high costs for a mixed-operations track GFR votes for a track exclusively for passenger transportation.
December	**1989**	Federal Government settles for a continuous routing east of the Rhine. At the same time a stop in Limburg and an extension to Cologne/Bonn Airport is suggested.
	1991	First spatial planning procedures start.
March	**1991**	GFR officially presents the routing east of the Rhine. For economic reasons a link to Cologne/Bonn Airport is to be cut out and subject to a future realization.
August	**1991**	Agreement on line-routing of the Wiesbaden branch.
	1992	NBS is updated to 'backlog' category in the first all-German FTIP without further reassessment.
	1993	First spatial planning decisions issued.
November	**1993**	NBS passes into law (*BSchWAG*).
	1994	First plan approval procedures start.
April	**1994**	Cologne/Bonn Airport loop line is laid down as the most significant compensation for Greater Bonn in the Law on Berlin/Bonn.
December	**1995**	Construction works start at Frankfurt interchange, a part of the southern section of NBS. Finance agreement clears funding of NBS.
October	**1998**	The last plan approval decision is issued in NRW.
September	**1999**	Contract to build the Airport loop line is signed.
February	**2001**	The last decision on the Airport loop line becomes effective.

(Sources: Blind u.a. 1990, Engels/Zießе 1991, Dickhut 2001, Block 1991, Siedenbiedel 2001, Kaniut/Form 2002, Deutscher Bundestag 2007)

Figure 5: The NBS project outlined in the 1985 FTIP

(Source: The Minister of Transport (1985): Bundeverkehrswegeplan 1985. Bonn, map 1.)

Main organisations involved

A complex mesh of considerations, planning, affections and decision-making paved the way for the NBS, consisting of:

- the political level of ruling and co-financing;
- the operational and entrepreneurial level of DB AG/FGR;
- the local level with a variety of actors;
- the numerous builders and contractors.

Therefore only a simplified overview can be met.

The main policy actors involved in the evolution cycle for the ICE rail track project Cologne-Frankfurt have been:

National government

The Federal Government, the German Bundestag and the Ministries of Transport and Finance respectively were decisive in paving the way for NBS with the adoption of the FTIPs mentioned, the binding character of the 'Law on the extension of federal railways' (*BSchwAG*) and the preparation of a financing agreement.

Federal states of North Rhine-Westphalia, Rhineland-Palatinate and Hesse

These Federal states were affected by the construction of NBS and thus were obliged to enforce spatial planning procedures including plan approval. The idea of involving Federal states in the evolution process for infrastructure investments ensures that regions also benefit from the new connections. The connection between Cologne and Frankfurt is expected to reduce resistance to shared labour and working markets in the area between the two cities. And the regions around the cities of Limburg, Montabaur and Siegburg/Bonn expected that with a direct connection to the Inter City Express network a higher demand in the residential market as well as for commercial properties will have occurred.

Deutsche Bahn AG (former German Federal Railways)

DB AG's role as commissioner and client of NBS had been represented at first by DB Projekt Köln Rhein/Main Ltd. From April 1996 onwards the steering of the project had been the task of DBBau Projekt Köln Rhein/Main Ltd. Quality management and assessment rated highly within the scope of the project, because both the quality of planning and construction and the supervision of the performed work had been produced by external contractors. A thorough quality management system ensured the transparency of duties and responsibilities, optimisation of processes, knowledge-transfer in case of rotating personnel, the lowering of quality costs and thus increasing profitability.

Federal Railway Agency (EBA)

In January 1994 the Federal Railway Agency (*Eisenbahnbundesamt*) was established in connection with the reform of the Federal railway system. From then the EBA took over the supervisory and approval capacities from DB AG that were restricted to the role of project promoter. Parallel to the starting of plan approval procedures these new respective roles had to be learned. The EBA:

- in its function as granting authority guarantees that Federal funds are spent profitably and economically as well as appropriately;
- grants and withdraws operating licences;
- carries out plan approval procedures for Federal railway properties;
- grants licences for Federal railway vehicles, equipment and facilities;
- supervises rail operations and fact-finding in rail accidents;
- shuts down and declassifies rail infrastructure.

During the construction of NBS, manifold solutions had to be found with the responsible bodies for road construction, other authorities and territorial entities. Organisational changes within the DB AG, the shift of client responsibilities to the contractors and various conflicts of interest with public agencies and persons concerned, made the EBA a crucial mediator.

Cities, counties and municipalities, residents and civic action groups

Although these organisations all had their share in this multi-level project, a full description of all events is outside the scope of this project.

Contractors

An innovation was the building contract for the 135km central section between Siegburg and Main crossing near Frankfurt. It was awarded to a group of bidders in July 1996 in the form of a functional tendering by way of negotiations.

DE Consult designed the plan for the entire track and technical consultation was provided by Dorsch Consult Engineers Ltd.

NBS was subdivided into three sections (North, South and Central). All sections were subdivided into different lots.

The North section stretched from Cologne to Siegburg, followed by the longest section, Central (Lots A, B and C), which extended to the Main river.

Mittelstand Joint Venture (main contractor) in lot A consisted of eleven medium-sized companies and was awarded with an order of 1.07bn DM.

Table 2: Overview Contractors Lot A

Gebr. von der Wettern GmbH, Köln (Projektführung)
H. F. Wiebe, Achim
Max Bögl GmbH, Neumarkt
Leonhard Moll Hoch- und Tiefbau GmbH, München
J. Bunte Bauunternehmung GmbH, Papenburg
Josef Möbius Bau GmbH, Hamburg
Falkenhahn Baugesellschaft mbH, Kreuztal
Leonhard Weiss GmbH, Göppingen
Wittfeld GmbH, Wallenhorst
Heinz Schnorpfeil GmbH, Treis-Karden
Batigroup AG Tunnelbau, Bassersdorf (Schweiz)
Köhler + Seitz Beraten und Planen GmbH → Co-ordination of another 24 engineering offices

Figure 6: Contractors in Lot A (Mittelstand Joint Venture)

Source: ww.baumaschine.de/Portal/download.php?w=Tbg&p1=1997&p2=heft9&n=a528_531.pdf

Lot B was built by a consortium of major companies headed by Phillip Holzmann PLC, Frankfurt and Lot C was built by the Walter Group, Augsburg, headed by Dyckerhoff & Widmann PLC. A German-Austrian consortium headed by Alpine Bau, Munich, participated in tunnel construction throughout. Contracts for the central section amounted to 3.6bn DM.

The South section around Frankfurt and Wiesbaden had also been split up and tenders were called for throughout Europe.

Equipment technology works (380m DM), including catenaries, signalling equipment, telecommunications, switching stations, power supply and electric engineering, were carried out by a group headed by Siemens PLC (now Siemens Transportation Systems).

(Sources: Eschenburg 1997, Belter 2003, Deutscher Bundestag 2007, Engels/Zieße 1991, Kaniut/Form 2002, Blaasch 2000, Buchen/Neu 2002)

Planning and environmental regime

Outline of planning legislation

Public utility plans (*Bedarfspläne*) for the extension of federal railways merely identify the necessary projects to satisfy traffic demands. Detailed layout of the line remains part of spatial planning procedures on the level of the federal states. The Ministry of Transport subsequently approves the layout. Utility, nature protection, property and other issues have to be balanced.

The first national ideas for the sub-linkage between Cologne and Frankfurt came up in the early 1970s. Nevertheless, from the first idea until the opening year more than 30 years passed by. One reason for the long time period is the complex evolution process in Germany, especially for railway infrastructure projects. Therefore, it is important to understand the iterative process of evolution and its different steps when discussing deviations in construction costs, planning periods and design of the infrastructure projects. FTIP is not a law. Rather, it relies on a decision by the Federal government on the extent, structure and time of the intended transport infrastructure investment.

All actors mentioned above (National Government, Federal States, Deutsche Bahn AG, Federal Rail Agency) had a vote in the evolution process which finally defined the structure and design of the investment project. They were searching for an overall best solution with different sub-objectives depending on the scope of each actor. The cycle of process for German railway infrastructure projects is as follows:

1. Rough estimation of benefits, costs and revenues within the standard evaluation procedure of the Ministry of Transport;
2. Integration of the project in the German Federal Transport Infrastructure Plan (FTIP) for long distance infrastructure projects;
3. Start of detailed design of the project, check for spatial integration by the German federal states;
4. New requirements set by the Federal states as preconditions to implementation;
5. New cost estimation carried out by a planning agency, control activity by the Federal Railway Agency, revisions of forecasts, agreement between the German government and the Deutsche Bahn AG/GFR on cost sharing, establishment of financial plans and allocation of public payments to the future fiscal budgets;
6. Final design of the project, negotiations with communities, treatment of objections of citizens, expropriation process, new requirements set by the communities;

7. Construction of the project, reporting of actual cost development to a small group of officials from the involved agencies and the ministries of transport and finance as well as the Deutsche Bahn AG.

In each of the seven steps the project can be rejected or basic changes in design integrated. The original design (step two of the evolution process) for the ICE connection between Cologne and Frankfurt is based on the general objective of maximising speed and therefore reducing travel time between the main cities of Cologne and Frankfurt and their airports. This objective should be achieved by designing the project with only one stop between the two cities. The geographical location of the station should be discussed during the subsequent steps of the evolution process. After step five, where the cost sharing agreement is signed between the Federal government, the Federal states and the Deutsche Bahn AG, the Federal states had insisted on further stops in each of the affected states. One stop on the track had turned into five new stations. Stations in Bonn/Siegburg (NRW), Airport Cologne/Bonn (NRW), Montabaur (Rhineland-Palatinate), Limburg (Hesse) and Airport Frankfurt (Hesse) were included in the project. With the integration of further stations on the high-speed connection an increase in costs had to be granted indirectly. Furthermore, a shift in the original objective to reduce travel time between the cities of Cologne and Frankfurt had to be made because further stops go hand in hand with an increase in travel time.

(Source: Sartori 2008).

<u>Environmental statements/ ecological mitigation/ regeneration</u>

Ecological construction surveillance: Plan approval decisions defined a set of requirements, which are intended to guarantee sensitive handling of nature and landscape during the construction phase and to implement diverse measures to compensate for unavoidable impacts on the ecosystem. The main contractor was responsible for the surveillance of its respective lot.

Crucial for rail properties is the implementation of plan approval procedures. Since 1994 this task is incumbent on the Federal Railway Agency and grants the right to build in the section concerned. Since the NBS causes substantial and sustained intervention in nature and landscape, extensive studies must be carried out. Avoidable impacts should be omitted and unavoidable impacts eliminated or offset within a reasonable time. Compensation may be carried out elsewhere, or in the form of money if necessary. Initially, the flora and fauna stock is mapped. In a further step the stock situation is overlaid with route planning. The conflicts are depicted in conflict plans. The interventions need to be evaluated. As a result, necessary compensation and replacement measures have to be developed and presented in landscape conservation plans (*Landschaftspflegerische Begleitpläne*/*LBP*). The statements made here have to be balanced and legally protected. At changing of plans LBP need to be adapted. Maintenance is carried out after the implementation of the measures. A monitoring system controls the measures over the next five to ten years.

A total of 708ha of land were demanded for the NBS including the airport loop, and 2,000ha of ecological compensation area are plan-approved. Most of the compensation measures (such as slope protection and forest clearing) did not take place nearby, but in areas more distant from the NBS (such as extensification of agricultural land, creation of hedges and orchards, renaturation of watercourses, creation of wetlands and extensive afforestation). 1,700ha are already implemented or contractually governed.

Examples

Afforrestation of some 50ha for a planned recreation area near Frankfurt.

Several million cubic metres of muck were disposed alongside the motorway A3, shaped as a noise protection wall and subsequently recultivated.

On a length of about 30km a special method (*Besonders überwachtes Gleis*) is applied to the rails. It concerns rails, whose surface is kept in optimal repair by continuous grinding. This measure follows the effective sound insulation regulations.

While constructing the Siegaue tunnel the River Sieg has been displaced temporarily. The provisional riverbed has been incorporated in subsequent renaturation measures. That tunnel had not been provided in the original plans and can be traced back to local demands. Initially only a bridge should have been built. At that time the implementation of the EU Flora-Fauna-Habitat Directive into German law set the focus on the nature reserve Siebengebirge. The discussions that followed delayed planning procedures by one and a half years. As a result, the 19km so called 'Agreement-Route' provided the construction of another tunnel, the extension of two others as well as the construction of a capped hutch instead of a bridge. Additional muck has been planned for noise protection measures and landscaping.

By the year 2003 walls preventing noise and wind proved to be unstable and have since been restored in several sections. Complete replacement will be done in 2010, with the additional costs amounting to about EUR 105m, financed in part by the Federal Government.

(Sources: Kaniut/Form 2002, Neu/Bechtle 2002, Kandler 2002, Belter 2003, Dickhut 2001, Hessischer Landtag 2002)

Overview of public consultation/ complaints procedures

The high number of civil engineering structures along the line is due to the grouping of traffic infrastructure, but also to ecological protection and emission control measures as well as trade-offs with residents and local authorities. Within the scope of the plan approval procedures 169 trials were held. The last approval decision only became final in September 1998. Approximately 100 legal disputes have been sued, but remained largely unsuccessful. As a priority project in accordance with the 'Law on the expansion of the railways' (1993), lawsuits against the new line had no suspensive effect.

Yet, in addition to influences from trials and compositions, plan improvements also caused as many as 15 revision procedures per plan approval section – in the aftermath of the adoption of the approval decisions.

(Source:
http://de.wikipedia.org/w/index.php?title=Plan%C3%A4nderungsverfahren&action=edit&redlink=1)

These modifications were mainly related to:

- noise protection;
- installation of glare shields along the motorway;
- installations to prevent trains from collisions with vehicles or truckloads;
- awarding of contracts in functional tendering, but prior to approval decisions, thus needing to implement new ideas from contractors.

Appraisal methods

Cost-benefit evaluations are required for new and expanded infrastructure projects. A standardised evaluation is carried out for individual projects on the basis of the following criteria:

- cost-benefit ratio as a benchmark for the urgency of a project within the scope of a macroeconomic consideration (for example enhanced accessibility, transport safety vs. investment costs);
- nonmonetary ecological risk evaluation with subsequent obligations;
- additional criteria (e.g. project features which can be crucial for the evaluation (here, for example the intermodal connection of airports).

NBS had been evaluated with a cost-benefit ratio of 4.0 and thus categorised as an urgent priority (*Vordringlicher Bedarf*) in the 1985 FTIP. However, the FTIP had provided no definitive statements on funding or the timed realisation of the project. Execution of the task could only result from approval decisions and available funds.

(Sources (Consultation/appraisal): Siedenbiedel 2001, Kaniut/Form 2002, Deutscher Bundestag 2007, Sartori 2008)

Land acquisition

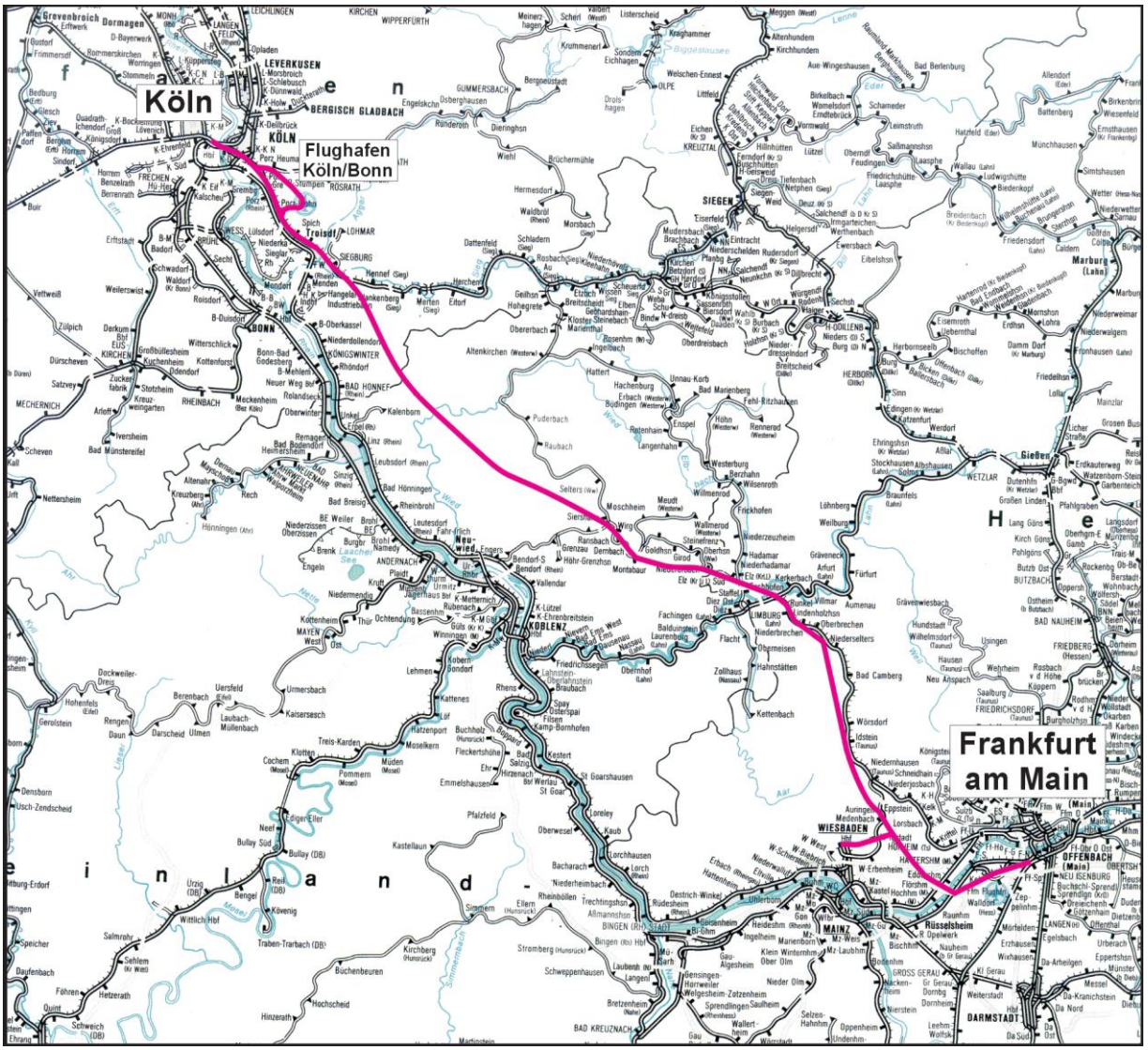
The 'Law on Federal Railways' §37 allowed GFR to claim external property.

(Source: Engels/Zieße 1991)

C PRINCIPAL PROJECT CHARACTERISTICS

Detailed description of route

Figure 7: NBS east of the Rhine



(Source: Deutscher Bundestag (2001): Drucksache 14/7945: Unterrichtung durch die Bundesregierung: Bericht zum Ausbau der Schienenwege 2001 [online] Available from: http://dip21.bundestag.de/dip21/btd/14/079/1407945.pdf)

Main route

The NBS starts in Cologne (Central) or Cologne/Deutz and runs along existing rail tracks as far as Siegburg. Subsequently it crosses Siebengebirge and Westerwald uplands mostly parallel to the motorway A3 and finally swings into Main valley before reaching Frankfurt Airport.

Pending the completion of the *Knoten Köln* (Cologne transport node) the trains currently operate from Cologne (Central) or Cologne-Messe/Deutz. Between Cologne-Porz and Siegburg the train can speed up to 200km/h. The completely redesigned Siegburg/Bonn station flags the beginning of the 143km new line to Frankfurt Airport. The enlarged station connects Bonn with the NBS in 25 minutes by public transport. Leaving Siegburg/Bonn the trains can accelerate to 300km/h and converge with the motorway. The line steepens

significantly and peaks the maximum gradient of 40% for the first time. Ascents, slopes, tunnels and bridges alternate further down the line. The trains climb 350m between the Rhine valley and the peak in the Westerwald region.

Montabaur station marks the midway of NBS. Trains can pass through at 300km/h. Further structures follow before trains arrive at Limburg (South) station. The line ascends into Taunus uplands and further tunnels and bridges.

(At Breckenheim junction the 13km Wiesbaden branch leaves. The trains have to decelerate here down to 160km/h and need to pass the stub terminal of Wiesbaden before departing to Mainz and Mannheim.)

Shortly after crossing the Main River the Left Rhine line connects and Frankfurt Airport main-line station is reached. The Frankfurt interchange tunnel marks the end of NBS. Trains follow the Ried line either north to Frankfurt (Central) or south to Mannheim.

Cologne/Bonn Airport loop

The 15km Airport loop is also used by local traffic. It is located entirely in the Cologne administrative area. It swings into the Airport tunnel (4.21km), passing the Röttgen castle tunnel, the protection area Wahn Heath and the Airport area. Further structures have to be passed before entering the NBS again in Cologne-Porz/Wahn.

Detailed description of main and intermediate travel nodes

Newly-built stations

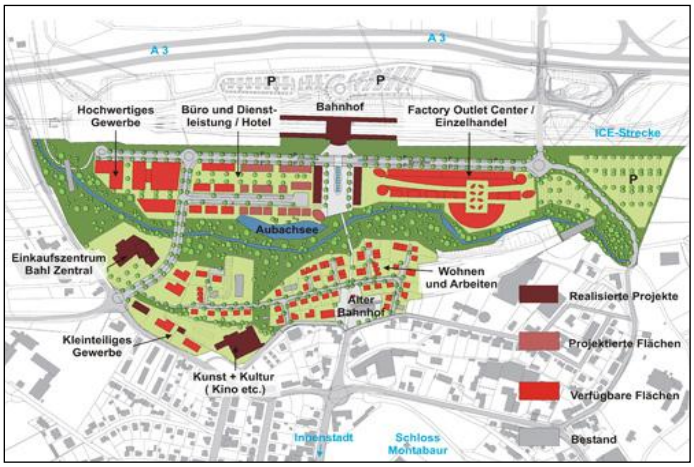
Montabaur and Limburg

Hesse held on to a station on state territory – just like Rhineland-Palatinate. In March 1991 GFR settled on the variant of constructing stations in Limburg and Montabaur. An extra stop in Montabaur was intended to compensate for the missing link to the Lahn valley line in Limburg. Koblenz ought to be connected via Montabaur station by car. Montabaur station offered a possible connection to the Westerwald line. This most cost-effective variant for station location in that area was estimated at 30m DM.

The selection of today's Limburg South location meant some minor expenditure at the expense of a link with local traffic and vicinity to the city centre. Thus, the station was built 2.5km southeast of the centre in the open countryside.

Montabaur station (designed by Jux&Partner, Darmstadt) is located on the outskirts of Montabaur (pop. 13,000). The federal state of Rhineland-Palatinate co-funded the new station and the highway connection. The municipality of Montabaur established a commercial area next to the station, which was seen as the nucleus of a new district filling the gap between the station and the city centre ('ICE-Park'). Fifty-two hectares were projected, creating space for 4,000 inhabitants and 2,000 workplaces. In 2009, 770 people work in 44 companies, EUR 48m has been invested and a (controversial) Factory Outlet Center is on its way – the future of Montabaur station is not too miserable.

Figure 8: Montabaur station (left: ICE-Park scheme, right: the station - trains can pass it at 300km/h)



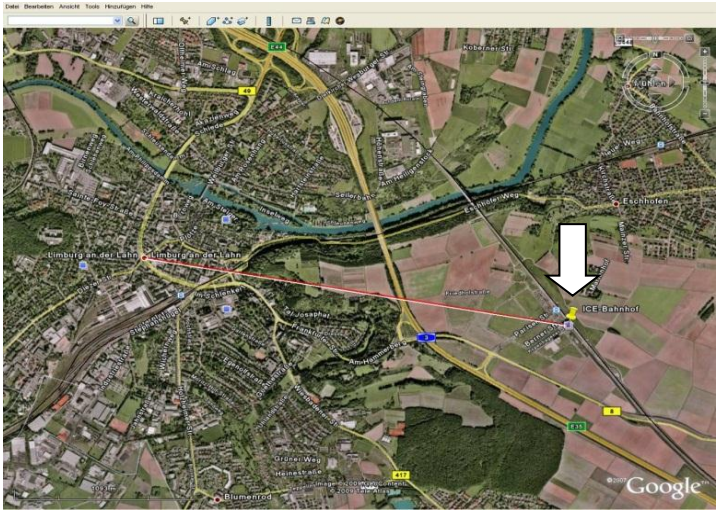
(Source: vrt.fd.cvut.cz/data/konference/24p.pdf)

The Limburg (South) ICE-station (designed by Schuster-Architects, Düsseldorf) is located 'in the open countryside' approximately 2.5km southeast of Limburg, a Central Hessian town (pop. 36,000). It is the only station in Germany where only ICE trains stop. The old station Limburg (Lahn) in Limburg downtown is accessible with local transport, but a link was too cost-intensive due to the 60m height difference. The selection of the current site for the station had represented a comparatively small effort at the expense of a link with local transport and a closer location.

Similar to Montabaur, Limburg (South) station also met with criticism from the start due to high construction costs and the extensive vacancies in the sales area of the station. Meanwhile, about 2,500 people per day make use of the station. Between 2003 and 2005, the number of passengers rose by 32%. The existence of the station as an ICE-stop seems secure now.

Limburg-Railport: Just as in the case of Montabaur the new station is seen as a chance for urban development. Covering an area of 35ha (200,000m^2 net) a mixed-use neighbourhood is to be established. The municipality sets special emphasis on companies that prefer to document its image through appealing architecture and successful urban integration. Above all this site is suitable for the relocation of back-offices from the Rhine-Main area.

Figure 9: Limburg 'South' station in the open countryside



(Source: author)

Siegburg/Bonn

Siegburg/Bonn station (designed by de Corné, Siegburg) connects Bonn, the former Federal capital, with the NBS by local transport. In 2000 the old station was demolished and replaced by a new building, which has been put into operation at the end of September 2004. It cost EUR 3.5m.

Airport stations

Cologne/Bonn Airport station (designed by Murphy Jahn, Chicago) is serviced by both local and long-distance transport. Opened in June 2004, it is part of the 15km Airport loop that connects with NBS. On opening it became the ninth Airport with rail access and the third (together with Frankfurt and Düsseldorf) with a gateway to ICE trains. The construction of the Airport loop had been justified by expected air traffic growth and a possible shift of capacities from Düsseldorf Airport which has limited capacity for expansion (whereas Cologne/Bonn had some spare capacity). Construction of the station should have strengthened intermodal transport and the operators of the Airport hoped for further gains, especially in passenger figures.

Figure 10: The Cologne/Bonn Airport loop

(Source: www.baumaschine.de/Portal/download.php?w=Tbg&p1=1997&p2=heft9&n=a528_531.pdf)

Frankfurt Airport mainline station (designed by Bothe Richter Teherani, Hamburg) became the most frequented German airport station (about 22,500 passengers per day). It came as an addition to an existing airport station which is now reserved for regional and local trains (Frankfurt Airport regional station). The station was built by order of DB AG and Frankfurt Airport AG (now Fraport AG) and is one of two purely mainline stations in Germany besides Limburg (South). Of the 210 trains that stop per day, 185 are ICE trains. From 2007 to 2010 the AirRail Center was built upon the station building, consisting of a nine-storey complex of buildings with eight hectares of office space. Costs are estimated at EUR 660m.

Figure 11: Frankfurt Airport main-line station

(Source: vrt.fd.cvut.cz/data/konference/24p.pdf)

The station's top was prepared for the installation of the future AirRail Center.

Other travel nodes

Cologne (Central) and Messe/Deutz

Cologne (Central) is one of the main hubs of European long-distance traffic. Together with the Cologne-Messe/Deutz station it forms a unit interlinked by the Hohenzollern Bridge.

Cologne-Messe/Deutz station forms an important node for short- and long-distance rail traffic. It had been rebuilt for the NBS project. So that ICE3 trains from the Ruhr area can avoid the congested Cologne (Central) station, rails heading north-south were submerged underneath the existing rails. In 1999 a public-private-partnership had been arranged by DB Station&Service, the city council and KoelnMesse Ltd. The station (former Köln-Deutz station) was renamed in December 2004 at the request of KoelnMesse, whose land adjoins the station. Since November 2006 the Trade Fair has been accessible directly from the station.

Wiesbaden

In 2003/2004 and 2006/2007 respectively the station and its forecourt have been renovated and modernised (at a cost of EUR 26.5m in total). This modernisation should have been completed by the time of the opening of the high speed line to Cologne, but due to the lack of available funds has been delayed several times.

Frankfurt (Central)

Frankfurt (Central) is one of the most frequented railway stations in Europe, with 350,000 passengers per day using 13 ICE lines, thus making it DB AG's main hub. Since 2002 the NBS has been in operation, shortening the travel time to Cologne to 75 minutes.

(Sources: Engels/Zieße 1991, Dickhut 2001, others (see Bibliography))

Project costs

Cost data about single sections is unascertainable so far. The Ministry of Transport could provide information about the funding stages, but amounts that differ from the financial agreement (1995) are aggregated and not specified in depth by DB AG for competition reasons. The project company DBBau relies on the possibility of not publishing annual financial reports.

(Sources: Deutscher Bundestag 1999, Deutscher Bundestag 2009)

Construction Costs/Timeline

NBS Cologne-Rhine/Main

- Predicted investment costs 1995: EUR 3.96bn (DEM 7.75bn)
- Total costs 2006: approx. EUR 6bn (DEM 11.8bn)

The sums indicated include the costs of the Cologne/Bonn Airport loop. The costs of remaining works on transport node Cologne are not included.

Station costs

- Cologne/Bonn Airport (opened 2004): EUR 60m
- Siegburg/Bonn (opened 2004): EUR 12m
- Montabaur (opened 2000/2002): EUR 13.8m
- Limburg South (opened: 2001/2002): EUR 15.3m
- Frankfurt Airport main-line (opened 1999): approximately EUR 225m

Construction costs timeline

Table 3: Construction costs timeline (overview)

	Planned costs	Background
1973	DEM 3bn (~EUR 1.5bn)	according to FTIP as Cologne-Groß Gerau (180km)
1985	DEM 4.5bn (~EUR 2.3bn)	according to FTIP
1987	DEM 3.3bn (~EUR 1.7bn)	according to a study comparing Maglev trains with wheel/rail technology; costs exclude electrification and line branches
1989	DEM 5bn (~EUR 2.6bn)	according to Federal Government
1992/93	DEM 5.725bn (~EUR 2.927bn)	according to FTIP and *BSchWAG*
1995	DEM 7.75bn (~EUR 3.96bn)	according to the financial agreement, Airport loop not included
2001	DEM 10bn (~EUR 5.11bn)	according to DB AG, including Airport loop (additional costs: ~EUR 8m)

(Sources: Engels/Zießе 1991, Siedenbiedel 2001, Deutscher Bundestag 2009, Deutscher Bundestag 2007, Heinisch 2002)

Project delivery

Table 4: Overview project delivery

		Forecast	Actual
(Completion according to earlier plans)	NBS	1985 – 1990	2002
Construction start (according to FTIP 1985 and other sources)	NBS	1993/1994	1995 (south section) 1998 (central section)
Completion of construction works (according to FTIP 1985 and other sources	NBS	2000/2001	1998 (south section) 2001 (central section)
Commissioning (according to FTIP 1985 and other sources)	NBS	1998/1999/2001	1999 (south section) 2002 (NBS) 2004 (airport loop)

After multiple delays discussions were held between client and contractors. In February 1999 the completion date for the north and central section was finally postponed until December 2001, commissioning of the entire line until May 2002. Geological issues while building the tunnels and delayed approvals (the duration ranging from 23 to 46 months) were held responsible. With the extension of construction time, increased costs were predictable.

Construction works near Frankfurt Airport started in December 1995, the foundation stone was laid in October 1997 and on 30 May 1999 the south section (7km) including Frankfurt Airport mainline station and the Frankfurt interchange tunnel were opened at the fixed time. Since then trains have run from Frankfurt via Mainz along the left bank of the Rhine to Cologne.

Figure 12: Frankfurt interchange construction works

(Source: vrt.fd.cvut.cz/data/konference/24p.pdf)

With the commissioning of the Airport loop in June 2004 the final section has been put into operation. However, the opening had been planned for 2002 initially. But as mentioned previously several plan modifications had to be carried out.

The expansion of the transport node Cologne is still under consideration. Within the 2003 FTIP it is categorised as 'other demand' (*weiterer Bedarf*). Financing and realisation are yet unclear. The connection of Cologne-Messe/Deutz to NBS is still single-tracked. In May 2008 DB AG called for tenders across Europe to install double tracks. This tendering process will continue until 2010. Long-distance traffic to Frankfurt could thus be focused in Messe/Deutz, relieving the Cologne (Central) hub.

(Sources: Deutscher Bundestag 1991, Siedenbiedel 2001).

Main engineering features

Details of engineering and construction

Highlights

- Grouping of traffic infrastructure minimised land consumption and additional noise;
- A planned 8% tunnel tracks stepped up to about 25%.

The exclusion of freight transportation allowed extreme parameters for the route. With gradients of 40% NBS is one of the steepest high-speed lines in the world. Here only the third generation of ICE trains is capable of starting, in case of problems with the traction system. The power unit is distributed over the train's entire length. A linear eddy current break helps with managing the rollercoaster-like ride by stressing the track system to a lesser extent.

Narrower radii and upgraded cants are thus determined.

A 155km slab track was embedded. It is characterized as a ballast-less track system made out of concrete in one piece.

Figure 13: The slab track

(Source: www.baumaschine.de/Portal/download.php?w=Tbg&p1=1997&p2=heft9&n=a528_531.pdf)

For construction purposes the NBS project was subdivided in four main sections:

Table 5: Overview of construction sections

Section	Location	Length	Structures
North	Cologne-St. Augustin/Königswinter	31km	tunnels: 2 bridges: 0
Central	Königswinter-Eddersheim/Nordenstadt	135km	
Lot A	Königswinter-Dierdorf/Sessenhausen	42km	tunnels: 6 bridges: 7
Lot B	Sessenhausen-Selters/Brechen	43km	tunnels: 11 bridges: 5
Lot C	Hünfelden-Eddersheim/Nordenstadt/Mainquerung Raunheim	50km	tunnels: 7 bridges: 4
South	Raunheim-Frankfurt interchange tunnel and Wiesbaden		tunnels: 2 bridges: 2
Airport loop	Cologne/Gremberghoven-Cologne/Porz-Wahn	15km	tunnels: 2 bridges: 0

Those six lots were subdivided into 48 plan approval sections (*Planfeststellungsabschnitte*):

NRW:	16 (airport loop: 4)
Rhineland-Palatinate:	19
Hesse:	13

Figure 14: Plan approval sections and lots

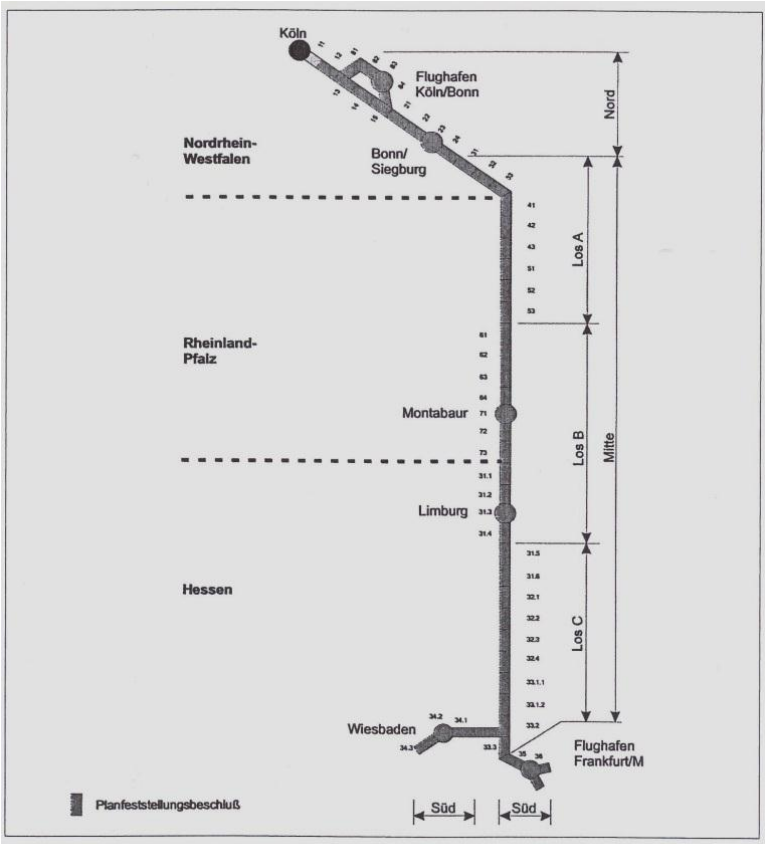


Bild 5: Planfeststellungsabschnitte und Bauloseinteilung der NBS Köln—Rhein/Main
(Quelle: DBBauProjekt GmbH)

Source: Kaniut/Form 2002 (see Bibliography)

Two more construction lots included the equipment technology for the entire track.

(Sources: Sternath 2002, Heinisch 2002, Blaasch 2000)

Details of main contracts

Motivation

Exploding costs and substantial delays while constructing major public projects.

Obectives

Achieving cost-certainty and adherence to schedules.

Implementation

Awarding of the entire NBS or sections of it to a main contractor (*Generalunternehmer*) at a fixed price. The new Cologne–Rhine/Main route was contractually split up into three sections with the central section subdivided into lots A, B and C. The construction contracts for the new rail line are based on a description of performances with performance programme, which is usually known in brief as 'functional tendering' (*Funktionale Leistungsbeschreibung).* In this case, the client merely obtains approval under public law in the form of compulsory acquisition applications whereas the contractors prepare the design and execution planning. The construction drawings and statics were carried out on this basis, checked by the *Eisenbahn-Bundesamt* and the client and approved for execution. The contractor was obliged to establish his own quality assurance system in order to ensure that the required structural quality was attained. This quality assurance system and execution were monitored on the spot by the site supervision.

Basic principles

- the results from the approval procedures;
- state-of-the-art technology;
- a fixed price;
- a deadline
- awarding of 40% of the order value to medium-sized companies.

Order value

- DEM 3.6bn (~EUR 1.84bn) for the central section;
- DEM 380m (~EUR 194m) for the equipment technology.

North, south and airport sections were awarded as performance programmes (*Lesitungsprogramm*) with work descriptions (*Leistungsverzeichnis*). This is the common way of tendering.

(Sources: Kaniut/Form 2002, Blaasch 2000, Belter 2003, Belter u.a. 2002)

Main engineering key facts and figures

Overall facts and figures

- Commissioning: 01 August 2002 (fully integrated: 15 December 2002)
- Construction period: six years (December 1995 to December 2001)

- Length: 219km (including branches, junctions and Airport loop);
- Travel time: 76min from Cologne (Central) to Frankfurt (Central);
- Travel time before: 134min;
- High speed: 300km/h;
- Maximum gradient: 40%;
- Course of the line:
  - 42.1km at ground level;
  - 72.8km in cuttings;
  - 51.4km on embankments;
  - 46.7km in 30 tunnels (21.3%);
  - 6.0km on 18 viaducts (2.7%);
- Space needed: 708 hectares (30% roadbed, 70% ditches, slopes and other);
- Minimum curve radius: 3,250m;
- Maximum camber: 180mm;
- Track spacing: 4.7m (common: 4.5m);
- Rails: 620,000m;
- Turnouts: 36;
- Sleepers: 420,887;
- Catenary masts: 4,000;
- Truss posts: 1,600 in tunnels;

- Slab track: 155km;
  - 245,000m³ hydraulic-bound base course;
  - 305,000m³ concrete;
  - ~EUR 770,000 per km;

- Structures: 7,000;
- Cubic capacity: 30 million m³;
- Construction roads: 214km;
- Steel needed: 300,000 tons;
- Cables/Wires/Ropes: 3,300km;
- Bolts/Dowels: 400,000;

- Electricity pylons: 414 (110km power supply line);
- Aluminium cables: 436km;
- Fibre-optic cables: 150km;
- New substations: six (over a distance of 20km)
- Interblock space: three to five km;

- Construction workers: 15,000;
- Miners: 1,400;
- Casualties: 13.

Airport loop facts and figures

- Length: 15.19km;
  - 2.50km at ground level;
  - 1.01km on embankments;
  - 5.26km in tunnels;
  - 1.41km on viaducts and ramps;
- Cross-overs: 13;
- Spoil: 2.26 million m^3;
- Speed: 130km/h, 80km/h in the airport tunnel due to sharp curves;
- Superstructure: conventional ballast, short section of slab track.

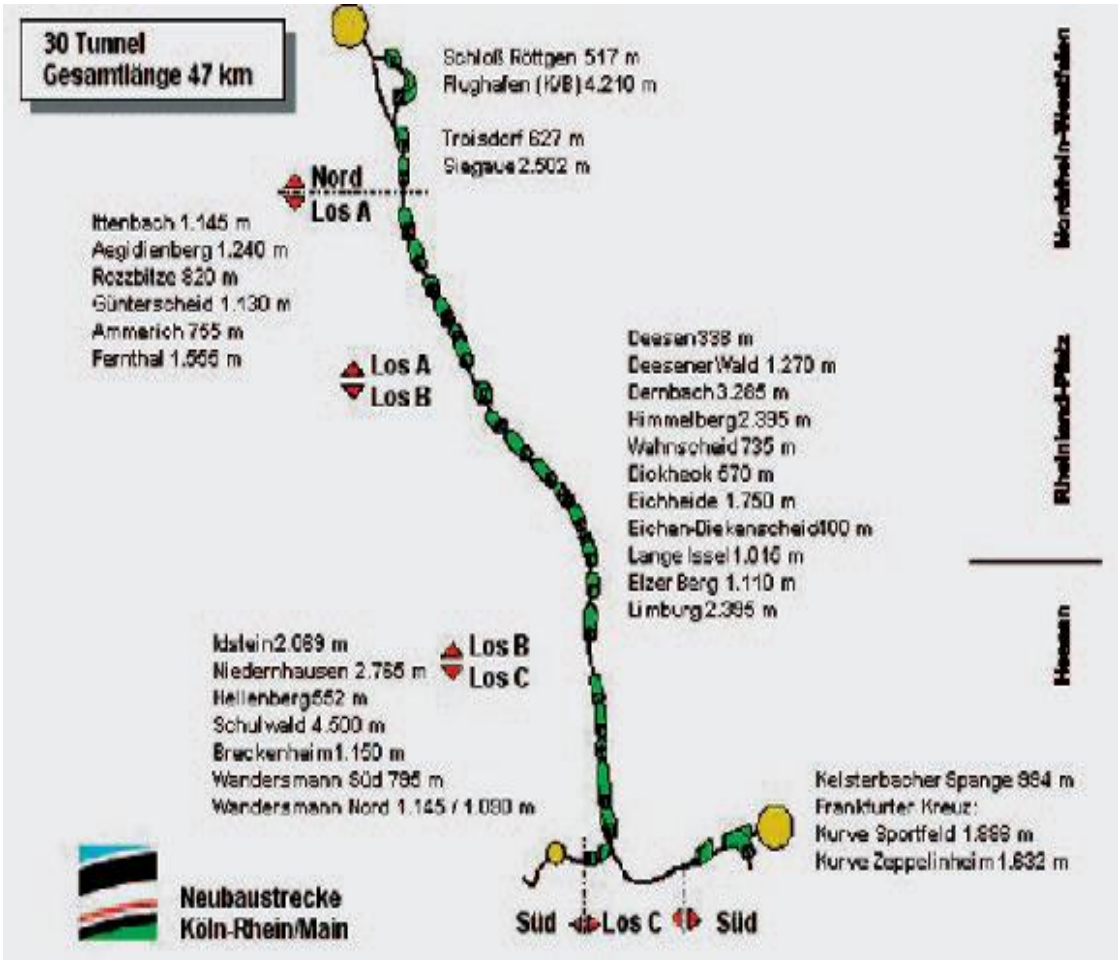
Tunnels and bridges

Tunnels

In the Alps, there are hundreds of meters of bedrock superstructure, in contrast to that NBS miners had to drift ten to 20 metres below the surface. They were confronted with deeply weathered soft rock and pending ground water. Twenty-four of the 30 tunnels were built by bored tunnel construction methods, six by cut-and-cover methods. The tunnels were usually drifted in *Ulmenstollen*-drift, mostly without controlled demolition. The drills proceeded at a rate of three metres per day. All tubes except Wandersmann North are two-tracked and built with the shotcrete lining method.

- Tunnels: 30 (46.7km, of which the longest is Schulwald-Tunnel at 4.5km);
- Tray-structure and cross-overs: six (up to 525m);
- Tunnel cross section: 92m^2 (common: 82m^2);
- Muck cross section: 150m^2;
- Muck masses: 10.8 million m^3;
- Tunnel lights: 6,000.

Figure 15: NBS tunnels



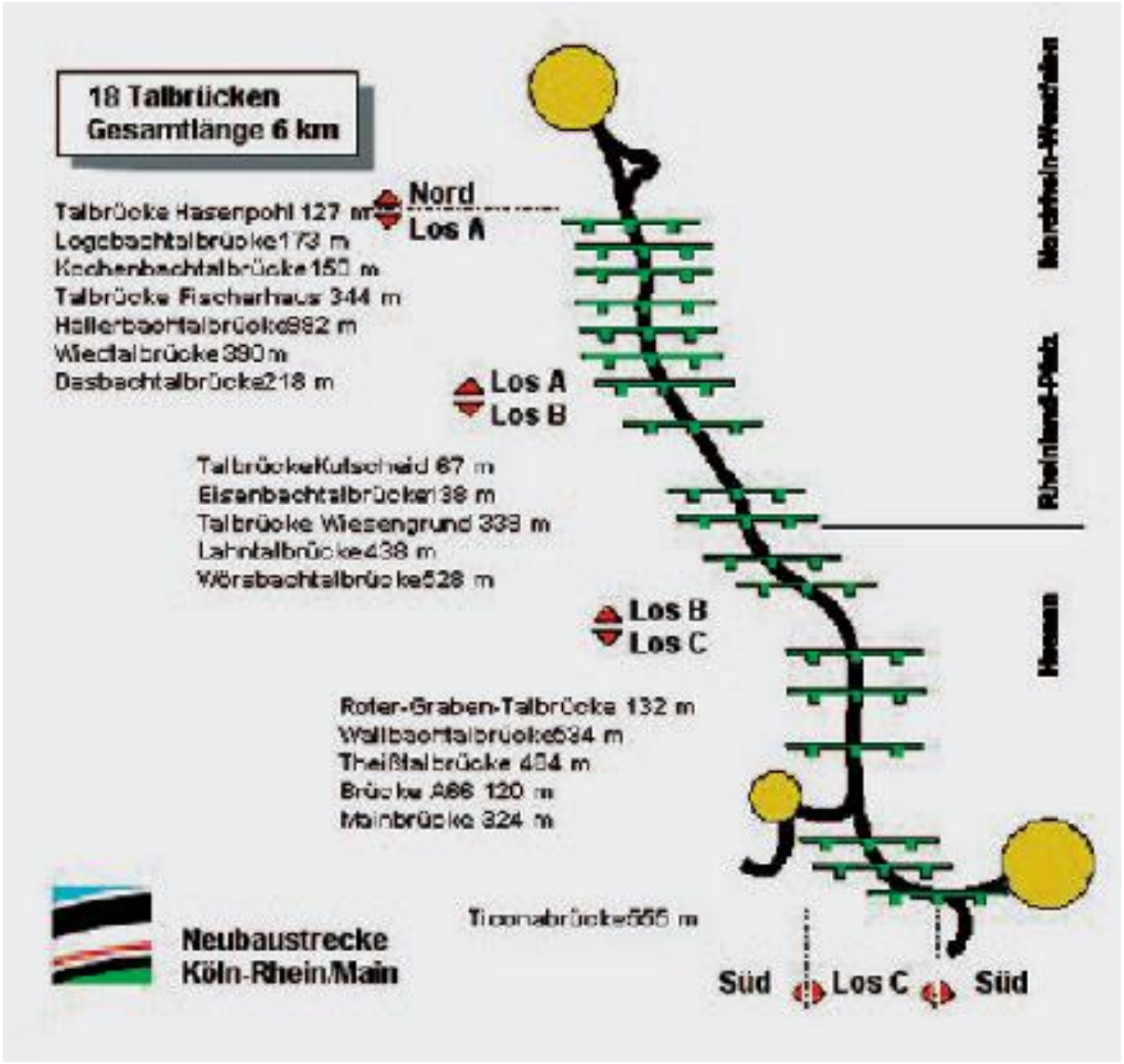
Source: Blaasch, G. (2000): Die Neubaustrecke zwischen Köln und Frankfurt. In: Tiefbau. 7/00, S. 396-406.

Bridges

The main way of constructing the NBS viaducts was fitting the span and the headroom to local conditions. Thirteen of the 18 viaducts were carried out as prestressed concrete constructions with spans between 30m and 65m. Varying from that method, the Lahn viaduct was carried out as an arched bridge, the Main viaduct needed a wider single span of 130m to give space for shipping, and four others were slimmed because of the visual bulkiness of the prestressed concrete box beam (*Spannbetonhohlkasten*).

- Viaducts: 18 (6km, of which the longest is Hallerbach viaduct, at 992m).

Figure 16: NBS viaducts



(Source: Blaasch, G (2000): Die Neubaustrecke zwischen Köln und Frankfurt. In Tiefbau. 7/00, S. 396-406.)

Performance

The Frankfurt Airport-Siegburg/Bonn rail link is the fastest rail service between two cities in Germany at an average cruising speed of 232km/h (143.3km within 37 minutes).

(Sources: Siedenbiedel 2001, Belter u.a. 2002, Belter/Ditzen 2000, Dickhut 2001, Deutscher Bundestag 1997)

Figure 17: Structures. Top left: Eichenheide tunnel, top right: Lahntal viaduct, bottom: Schulwald tunnel

(Source: Belter, B. (2003): Erfahrungen beim Bau der Neubaustrecke Köln-Rhein/Main – Erkenntnisse für zukünftige Projekte. Vortrag zum Eisenbahntechnischen Kolloquium 2003 der TU Darmstadt, Fachgebiet Bahnsysteme und Bahntechnik. [online] Available from http://www1.tu-darmstadt.de/verkehr/bs/etk/e03/kf/03_%20Belter.pdf)

D PROJECT TIMELINE

Project timeline

Table 6: Overview project timeline

Year	Month	Type of Decision/Event	Key Decision/ Event
1965	-	Project initiation	Early studies by GFR of a possible new line between Cologne and Rhine/Main region
1970	Sept	Project initiation	An appropriate line is demanded within the 'Expansion of the German railway network programme'
1971	-	Project initiation	Early detailed route examinations are carried out
1973	Oct	Project initiation/ Financing	A new line named *Cologne-Groß Gerau* is accepted as one of four planned new lines in the first FTIP. Implementation is scheduled for 1985
1974	Dec	Problems project initiation	Due to permanent debates about the layout the Federal Minister of Transport prompts further studies
1976	-	Problems project initiation	*ROVs* are carried out, yet due to debates on a routing east or west of the Rhine, the planning of this line fell through
1979	Nov	Problems project initiation	A 'Cologne-Koblenz' segment is categorised as 'Other Needs' in the 1980 FTIP
1985	Sept	Project initiation/ Financing	A line routing east of the Rhine under the name of 'NBS Cologne-Rhine/Main' is part of the 1985 FTIP; further layout details to follow. Planned costs: about EUR 2.3bn.
1988	Jan	Project initiation	GFR favours 'variant 0' (mentioned above)
1989	Dec	Project initiation	Policy decision by the Federal Government in favour of a routing east of the Rhine
1990	-	Project initiation	Implementation of the first *ROV* in NRW
1990	Mar	Project initiation	The prime ministers of Hesse and Rhineland-Palatinate and the Federal Minister of Transport agree on the implementation of two new stations along the new line near Limburg and Montabaur
1990	Dec	Project initiation	Start of *ROV* in Hesse
1991	Mar	Project initiation	GFR presents the future layout of the line
1991	Mar	Project initiation	Start of *ROV* in Rhineland-Palatinate
1991	Aug	Project initiation	A ground-level solution for the Wiesbaden branch is planned
1993	Jun	Project initiation	Cologne regional government completes *ROV* in NRW
1993	Jul	Project initiation	First plan approval procedures in NRW
1993	Oct	Project initiation/ Financing	Enrolment of NBS project in the 'Law on the expansion of federal railways' (*BSchWAG*). Planned costs: EUR 2.927bn.
1994	Jan	Actors	Restructuring of GFR; amongst other things founding date of EBA and DB AG
1994	Mar	Project initiation	The Rhineland-palatian office of the prime minister in Mainz releases *ROV*
1994	Apr	Project initiation/ Financing	'Berlin/Bonn' law determines the construction of a Cologne/Bonn Airport link to the NBS as crucial compensatory measure (mentioned above)
1995	Apr	Project initiation	First plan approval decision grants right to build in the southern section
1995	June	Problem financing	For a short time the NBS project is up for discussion due to the financial difficulties of the German federation. Vehement protests by the Federal states put the NBS back on track.

Year	Month	Type of Decision/Event	Key Decision/ Event
1995	Dec	Financing	Financial agreement between DB AG and the Federal Government settles a maximum amount of federal funds: 7.5bn DM (~EUR 3.963bn)
1995	Dec	Implementation	Construction works start at Frankfurt interchange tunnel
1996	Jul	Actors	Awarding of construction contracts for the central section (135km) in 'functional tendering'. Delivery date is set to December 2000
1997	Feb	Implementation	Start of construction works in the central section
1997	May	Implementation	Start of construction works in NRW
1997	Jul	Project initiation	Final plan approval decision in Hesse
1998	May	Project initiation	Final plan approval decision in Rhineland-Palatinate
1998	Sept	Implementation	Start of tunneling in the central section
1998	Sept	Problems Implementation	Last remaining construction works in the central section start in Rhine Sieg district
1998	Oct	Problems project initiation	Final plan approval decision in NRW (Rhine Sieg district)
1998	Nov	Actors	Awarding of construction contracts for the Airport loop
1998	Nov	Implementation	Construction works are in progress at full length of NBS
1998	Dec	Implementation	Completion of the southern section near Frankfurt
1999	Feb	Problems Implementation	According to intense discussions between DB AG and contractors the delivery date is postponed to December 2001 due to tunneling troubles and delayed plan approvals
1999	May	Implementation	The southern section (Frankfurt interchange tunnel and Frankfurt Airport main-line station) is put into operation at the fixed date
1999	Sept	Project initiation/ Financing	The Airport loop is contracted
2000	Apr	Financing	Funds for the construction of the Airport loop are released: investment costs of EUR 1.04bn are borne by the Federal Government, the federal state of NRW and the Airport Cologne/Bonn Ltd.
2000	May	Implementation	Installation of the slab track in the central section starts
2000	July	Implementation	A first regional train arrives in Montabaur (there is no access for ICE trains until December 2002)
2000	Sept	Implementation	Tunneling works are completed
2000	Dec	Problems Implementation	Start of construction works in the Airport loop section behind schedule
2001	Feb	Problems Project initiation	Final plan approval decision for the Airport loop
2001	July	Implementation	Fusing of the last rails in the central section
2001	Aug	Problems financing	One year ahead of commissioning NBS, the DB AG communicates further cost increases: 10bn DM (EUR 5.11bn)
2001	Dec	Implementation	Final completion of construction works in the northern, central and Wiesbaden sections
2002	Jan	Implementation	Test train uses the track for the first time at full length
2002	Jul	Implementation	NBS inauguration themed: 'German Rail donates you one hour'
2002	Aug	Implementation	NBS opened to the public: travel time is reduced by about 60 minutes, fares rise by more than a third. Opening of Limburg South, Montabaur and Siegburg/Bonn stations

Year	Month	Type of Decision/Event	Key Decision/ Event
2002	Dec	Implementation	NBS in full operation and integrated into the European timetable. The new line is serviced by seven ICE lines (each at two-hourly intervals). The most substantial changes in the timetable since 1979 (implementation of the InterCity network) and 1991 (implementation of the early ICE1 network)
2004	Jun	Implementation	Opening of the Airport loop and Cologne/Bonn Airport station
2004	Sept	Implementation	New Siegburg/Bonn station building opened to the public
2004	Dec	Implementation	Cologne-Deutz station renamed Cologne-Messe/Deutz

(Sources: Kandler 2002, Engels/Zieße 1991, Kaniut/Form 2002, Block 1991, Jänsch 2002, Wille 2003, Börnecke 1995)

Project timeline/ key events

1965-1974: A key issue then and now has been the line-routing, especially discussions regarding on which side of the Rhine the trains should run. On the one hand a most direct routing between the important conurbations seems reasonable. On the other hand many wishes have to be answered in the wake of such a mega-project. And there are some substantial stakeholders such as the Federal states, which can be very influential, especially in the *ROV*. It is not easy to leave the capitals of Hesse and Rhineland-Palatinate, Wiesbaden and Mainz, and the then Federal capital of Bonn – all situated on the left bank of the Rhine – out of such a crucial infrastructure project. In the 1970s this led to the plans being temporarily abandoned until 1984.

1984-1989: From the next GFR approach (realising this project which was held to be highly significant for their network – and it was, considering the north-south orientation of the then West Germany situation) it took five years before the Federal Government settled the decision to let the NBS run east of the Rhine. In the meantime (until 1987) comparative studies were carried out that came to the conclusion to rely on the conventional wheel/rail technology instead of implementing an embryonic maglev-technology.

1990-1998: The technical and contractual innovations intended for this project in mind, one must not forget that it has been a long process before the tunnels and viaducts could make an impression on public opinion. Planning procedures lasted from 1990 until the autumn of 1998, indicating comprehensive negotiations between all actors involved.

1999-2002: DB AG (former GFR) was on the move since 1994 and had to adapt to a new role, making the transformation from a public authority to a profit organisation. Midway through, general traffic conditions worsened. In particular, long-distance rail traffic rates appeared marginal compared with rising figures for short-distance flights offered by innovative low-cost airlines. Finally, in 1999 DB AG had to delay the inauguration of its prime example of innovation and future-orientation. This was due to the technical complexity of the structures and pending approval decisions. Consequently, costs rose and DB AG had an even greater incentive to succeed ultimately by staging a complete restructuring of its fare system and orientating its long-distance traffic network towards the NBS line.

E PROJECT FUNDING

Introduction

The NBS project was intended to be mainly financed with public Federal funds. The Federal Government is obliged to provide German railway infrastructure under the 'Law on the expansion of federal railways' (*BSchWAG*). In the case of the Airport loop the investment was mainly distributed over Federal and state funds. A finance agreement (1995) has been introduced for the NBS. Costs above a maximum amount would have been taken over by DB AG. Due to mounting costs (1999-2001) the co-payment by DB AG was much higher than had been planned or expected.

Background to funding

Revenue

Prediction of funding costs

Finance agreement as of 21 December 1995

Table 7: Figures in the finance agreement

Fixed costs	**To be spent on**	
DEM 7.75bn	track construction	DEM 4.391bn
	contact wire	DEM 308m
	environmental protection (e.g. noise insulation)	DEM 439m
	Other (e.g. land acquisition, equipment, structures, planning costs)	DEM 2.612bn

DB AG's own share was fixed at DEM 409m

- The type of financing reads as follows:
  - DEM 1bn construction subventions (non-refundable);
  - DEN 6.62bn interest-free loan;
  - DEM 130m for the stations.

- Total costs (as of 2007): EUR 6bn (~ DEM 11.8bn);
- Federal share: EUR 4.007bn (~ DEM 7.837bn)[2].

- All subprojects except pending works in Cologne are included;
- DB AG had to bear all additional costs.

Contributions from the EU

As a part of the 'European infrastructure roadmap' (1992) the NBS project was also co-financed from European funds. The EU granted about EUR 150m in subsidies for this sub-project of the high-speed system Paris-Brussels-Cologne/Amsterdam-London (PBKAL) for:

- Studies;
- construction costs (Cologne-Messe/Deutz – Siegburg and a rail link near the Main viaduct);

[2] A trilateral agreement (March 2001) between DB AG, Federal Ministry of Transport and the Federal Ministry of Finance ensures inter alia that the German federation accepts additional costs to a limited extent.

- ERTMS/ETCS (telecommunications).

Further funding sources

The Airport stations and the Airport loop were realised with the help of Federal funds:

- Cologne/Bonn station and loop: EUR 255m (others: NRW EUR 222m, Cologne/Bonn Airport Ltd. EUR 53m)
- Frankfurt Airport main-line station: EUR 97.5m (FRAPORT Plc: EUR 140m).

(Sources: Heinisch 2002, Deutscher Bundestag 2000, Kaniut/Form 2002, Deutscher Bundestag 2007, Deutscher Bundestag 2004, Deutscher Bundestag 1999).

Funding key stages

Besides the finance agreement (for the first time and in contrast to other agreements stipulating a maximum funding amount):

- another extension plan granted middle-term funding for the years 1995 to 1997 *Dreijahresplan*), providing DEM 3.504bn for the NBS project;
- a five-year plan granted subsidies from 1998 to 2002 of DEM 4.79bn;
- an 'investment programme 1999-2002' secured continued funding for ongoing infrastructure tasks.

(Sources: Deutscher Bundestag 2005).

Traffic forecasts

According to DB AG, passenger figures in the Rhine area were forecast to rise from 11–12 million to 20–25 million, i.e. 70,000–80,000 in 79 trains per day in each direction. Other appropriate data is not available.

(Sources: see Secondary sources)

Funding sources

The Federal Government funds investment in new construction, expansion and substitution of Federal railways according to the *BSchWAG* Act, whereas maintenance and overhaul costs are borne by, for example, DB AG. Further financing is subject to agreements that settle the Federally funded costs and the refinancing. The NBS project and others have profited from additional and non-refundable construction costs.

The EU funds projects within the scope of the TransEuropeanNetworks (TEN), on the basis of official acts (as of 1995, 1996 and 2004). The NBS project profited from this (as seen above).

(Sources: Deutscher Bundestag 2005).

Commentary on financing/funding

Although the planned costs were overrun, the underlying estimations were settled before the initiation of plan approval procedures and geological examinations. These two elements

(having in mind a tripled tunnel-ratio) were held mainly responsible for the exploding costs. According to DB AG the costs also included investments from third parties.

Besides other massive technical modifications the DB AG self-critically admitted that the awarding of contracts ahead of the plan approval decisions attached, might not be a solution for the future. The same position is taken by the EBA, which went one step further by claiming that the functional tendering was a mistake. EBA stated it had warned and had related its concerns about implausible calculations, pending approval procedures and unrealistic expected profits.

(Sources: Heinisch 2002, Kaniut/Form 2002).

F OPERATIONS

By the time the NBS lines had been integrated into the European timetable of 2002/2003 and a new fare system had been introduced, DB AG's share in mainline traffic was forecast to improve. Some key figures are presented below:

Table 8: DB AG's traffic volumes 2000-2003

	2000	2001	2002	2003
Traffic volume (in million passengers)	144.8	136.3	128.4	117.3
Share in overall volume (in %)	8.46	8.01	7.75	6.98
Transport performance (in million passenger-km)	36.226	35.342	33.173	31.619
Share in overall performance (in %)	48.7	47.47	47.5	45.47

(Sources: DB AG 2003).

Reported traffic volume

Table 9: Predicted and reported traffic volume

	Predicted traffic volume (according to 1990s operational concept)	**Reported traffic volume** (2002/2003)
Line concept	five main lines ('Sprinter' trains without intermediate stops)	seven main lines ('Sprinter' trains not applied)
Traffic volume	80 trains per day and direction	70 trains per day and direction
Other traffic	Hotel trains and light goods traffic (at night)	not implemented
Capability	eight trains per hour and direction	five trains per hour and direction
Passenger volume	80,000 per day	21,600 per day 32,000 per day (+36% in 2007)
Other		Shutdown of flights connecting Cologne with Stuttgart and Frankfurt

Note: BERSCHIN states that the increased passenger figures in 2007 have to be weighed against the adverse figures of 2000/2003 (discussed above). A previously consistent performance came to a halt and figures took a hit (see figures of 2003). The so called 'gain' of passengers must be regarded rather as a 'regain'.

(Sources: Jänsch 2002, Berschin 2008, Görge 1997)

How traffic forecasts were formulated

FTIP's 1992 figures for the future degree of utilisation were based on a general forecast for the year 2010. Experts forecasted a shift of rail traffic from the Rhine valley line to the NBS in the order of 30,000 to 40,000 passengers per day and direction. Substitution effects from individual and air traffic were estimated at 5,600 or 10,100 passengers, thus producing figures of 26,000 to 32,000 passengers per day and direction for the entire Rhine corridor. Weighed against the forecasts of the 1985 FTIP, this suggests a rise of 50% to 80%. An empirical formula was considered: speeding up travel times by 30% would correlate with an increased demand of 30%.

(Sources: Franz 2002).

Figure 18: Spectacular view near Hallerbach Bridge

Source: vrt.fd.cvut.cz/data/konference/24p.pdf

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H GLOSSARY

Abbreviations used	German term	English term
BSchWAG	Bundesschienenwegeausbaugesetz	Act/Law on the expansion of federal railways
DB AG	Deutsche Bahn AG	Deutsch Bahn plc
DEM	Deutsche Mark	German Mark
EBA	Eisenbahn-Bundesamt	Federal Rail Agency
FTIP	Bundesverkehrswegeplan	Federal Transport Infrastructure Plan
GFR	Deutsche Bundesbahn	German Federal Railways
ICE	InterCityExpress	InterCityExpress
NBS	Neubaustrecke	Newly built line/track
ROV	Raumordnungsverfahren	Spatial planning procedure(s)