

China, PR: Metro in Guangzhou

Ex-post evaluation

OECD sector	Railway sector / 21030	
BMZ project ID	1993 65 883	
Project-executing agency	Guangzhou Metro Corporation (GMC)	
Consultant	Hamburg Consult (HC) und Siemens	
Year of ex-post evaluation	2004	
	Project appraisal (planned)	Ex-post evaluation (actual)
Start of implementation	Q 4 1993	Q 4 1994
Period of implementation	5 years	5 years
Investment costs	EUR 1.4 billion	EUR 1.2 billion
Counterpart contribution	EUR 1.2 billion	EUR 1.0 billion
Financing, of which Financial Cooperation (FC) funds	EUR 213.1 million of which FC: EUR 174.8 million	EUR 213.1 million of which FC: EUR 174.8 million
Performance rating	2	
• Significance / relevance	2	
• Effectiveness	3	
• Efficiency	3	

Brief Description, Overall Objective and Project Objectives with Indicators

The project comprised the construction of an approx. 18.5-km-long metro line running east-west in Guangzhou.

The overall objectives of the project were to contribute to improving the efficiency of the economy and to growth and, in this way, to creating new jobs in Guangzhou. No indicators were defined to measure achievement of the overall objectives.

The project objective was to transport passengers within the city area both quickly and cost-efficiently. An indicator of achievement of the project objective was a passenger transport volume during the first year of operation of 450,000 passengers per day and 60,000 passengers at the peak hour. Actual passenger figures show, however, that the project objective has not yet been achieved. In the first year of full operation (2000) the daily average number of passengers was 176,000, and around 25,000 people were transported at the peak hour. The project objective was still not attained in the year 2003. The average daily passenger transport volume of 218,100 people fulfils the target to 48%. Based on conservative growth estimates of the daily average transport volume of 5% p.a., the target initially set in the project appraisal will be attained in the year 2018 at the earliest. Nonetheless, the evaluation of the currently low passenger figures must take into account that key investments including the construction of the

tunnel and the running track are not split up properly to enable them to adjust to a continually fluctuating volume of passengers. Since the investments for railroad systems can have a long useful life (tunnels up to 100 years if properly maintained) and the technical design must take peak loads into consideration, occasional underutilization during the starting phase of the construction of a metro network must be accepted.

Project Design / Major Deviations from the original Project Planning and their main Causes

The project marked the introduction of a modern and promising system of mass transport that is currently being expanded rapidly.

According to the project design, the city center of Guangzhou was to be better connected with the city's outer districts on an east-west axis. The aim was to create a longer-term alternative and supplement to road traffic which, due to the rapid increase in motorized traffic and limited possibilities to expand the road infrastructure, is increasingly approaching its limits and hampering the further development of Guangzhou into a regional growth center.

At the time of the project appraisal in the year 1993 more than 300,000 motor vehicles (busses, taxis, minibusses, trucks, transporters and motorcycles) and some 2 million bicycles were registered. Since then the volume of traffic has continued to increase sharply. Overall the volume of civilian motor vehicles jumped from 1.7 million in 2000 to 2.3 million in 2002. Including vehicles registered in other regions, the daily volume of traffic in Guangzhou is currently estimated to be 3 million motor vehicles (cars and trucks), 1.1 million motorcycles and approx. 3.1 million bicycles. Public passenger transport makes use of around 7,500 busses, 16,900 taxis, 47 ferries and now also 31 metro trains. The average speed on the approx. 550-km-long road network and the 294 bridges, but especially in the old center of Guangzhou, is estimated to be less than 13 km/h.

The FC project comprised the construction of the first metro line in Guangzhou (Line 1). The investments included a section with 16 stations, a depot with a workshop, electromechanical equipment and 21 trains à 6 wagons, consulting services, system coordination services and a training component for the operating and maintenance personnel. For the most part, they were implemented as planned and on time. The Financial Cooperation (FC) funds were primarily used to finance the rolling stock, accompanying consulting services and training for the operating and maintenance personnel.

Key Results of the Impact Analysis and Performance Rating

On average, 24,789 passengers were counted at the peak hour (workdays from 5 – 6 p.m.) on Line 1, which was funded by FC, between January and July 2004. Thus, the normal capacity of Line 1 was utilized to approx. 57% and the maximum capacity was utilized to about 43%. The comparative figures for Line 2 (north-south corridor), which was not funded by FC, are approx. 41% and 31%, respectively. In comparison, the utilization of capacity of Line 1 on the peak day of 2004 (May 1st) and at the peak hour even attained 116%. The low average utilization of the created transport capacity is due primarily to insufficient interest in the metro network, which is

still being built up, to still inadequate coordination with surface bus traffic, and to the comparatively high tariffs for using the metro.

The expansion of the metro system is making rapid progress: in the year 2002 Line 2 started operating. The start of operation of Line 3, which is currently under construction, is scheduled for 2005. The section of Line 4 that is also still under construction is to take up operations in the same year. In 2007 the first section of the high-speed train from Guangzhou to Foshan will be opened. This expansion work will create an underground network that considerably improves public transport in Guangzhou and one that can be expected to transport a much higher volume of passengers.

To evaluate the project's microeconomic effects we created two scenarios on the basis of the financial data from a projected cash flow available to us: the normal scenario and the stress scenario.

Based on the cash flow statement, a rough real internal rate of return was calculated to assess the advantages of the investments in Line 1. The result was a barely positive internal rate of return of approx. 0.1% based on the figures for the normal scenario and a negative internal rate of return of around -4.6% for the stress scenario.

Due to the tremendous importance of the metro for the future development of local public transport and in view of a presumed declining need for subsidies coupled with a rising passenger volume, we consider the risk of insufficient subsidies to be minimal. The city of Guangzhou is one of China's most important industrial hubs. The assumption of the debt service and the provision of a subsidy for the urban metro operator (Guangzhou Metro Corporation – GMC) in the amount of some RMB 300 million in the year 2003 correspond to around 1.2% of public revenues.

Also compared to the situation of the local public mass transport systems in Germany, the result of the microeconomic analysis is positive. On the basis of the information available to us, we are forced to assume that none of Germany's local public mass transport systems can cover their operating costs with tariff revenues. In Germany as well the deficits are compensated by the regional authorities or through cross-subsidization among supply companies of the municipal utility.

Our overall assessment of the project's developmental effectiveness can be summarized as follows:

- The project objective was too optimistic. The daily target volume of passenger traffic will probably not be attained until the year 2018. Whereas the utilization of capacity at the peak hour is still not satisfactory, compared to European countries the average utilization of capacity is acceptable (partial evaluation of effectiveness: rating 3).
- In view of the high degree of complexity of evaluating the macroeconomic effects, we decided against making any economic calculations. However, we do assume positive effects overall (increase in economic efficiency, time savings, creation of jobs, economic learning cost savings via technology imports and adaptation) that justify public subsidies. Our assumption takes into account that the project-executing agency's technical,

economic and financial performance is good, and that public subsidies for the operation and debt service of the metro operator will be available for a long time to come (partial evaluation of efficiency: 3).

- The project laid the groundwork for the development of a modern mass transport system. In retrospect, the period of project implementation was well-chosen since the project made a useful contribution to the long-term resolution of problems with heavy traffic in the city of Guangzhou. The use of the FC funds paved the way for additional efforts to eliminate typical infrastructure bottlenecks in metropolitan areas. The further expansion of the metro network, the overall positive technology transfer and the efforts of GMC regarding other means of transport illustrate the project's substantial capacity-building impacts for the sector as a whole. Thus, we classify the project's developmental relevance and significance as satisfactory (partial evaluation of significance/relevance: rating 2).

After weighing the partial results and taking the continuing risk of insufficient integration of the various means of transport and the highly positive structural effects into consideration, due to its long-term impacts we assign the project satisfactory development effectiveness overall (rating 2).

General Conclusions

- The present project shows that introducing a new inner-city, rail-based means of mass transport (metro or light rail system) will not necessarily reduce road traffic to any significant degree. In this case the massive parallel expansion of the road network even led to a temporary increase in the average velocity on the roads, which quickly fell back to its former level due to induced traffic (yet at a higher traffic flow rate). The added value of rail-based transport stems primarily from the fact that it enables the transport capacities to be expanded quickly, safely and on a broad scale without further increasing air pollution in the cities, which is usually very high already. In the case at hand, this capacity was utilized to only a small extent by people who abandoned the roads for the tracks (surely due in part to the tariff policy, especially the price difference compared to other alternatives such as busses or taxis); instead, the metro mainly catered to the increase in traffic that the roads were no longer able to handle (induced traffic). A direct consequence of this experience is that the use of the capacities frequently does not fluctuate much. Rather, the demand is slowly rising up to match the capacities. Therefore, for a certain period (in view of the mostly invariable design of central system components) underutilization of capacity will have to be accepted. Accordingly, such solutions – as in this case – are only recommended for cities in which demand for transport will increase in the long term as a result of the dynamics of urban development (possibly supported by restrictions on individual traffic).
- Another experience to be applied in other, similar projects is that for inner-city, track-based means of mass transport the full costs and frequently also the operating costs cannot be covered out of tariff revenues – even in cities where the conditions are as favorable as in many large Chinese cities. Even if the economic impacts (time savings for users, road safety, lower land requirements, environmental impacts) are clearly positive and justify the investments, a solution like this one is only recommended if the project-executing agency - as was the case here – has sufficient, reliable sources of revenue and if there is broad political consensus to subsidize these systems for a long time.

- Inner-city local passenger transport measures should already be looked at during the project appraisal within the context of an entire system comprising various means of transport. In the project planning the coordination of various means of transport ought to be taken into greater consideration in terms of optimal use of the available resources, handling the volume of passengers and adequate tariff policy. What is more, specific measures ought to be defined to encourage better coordination.

Legend

Developmentally successful: Ratings 1 to 3	
Rating 1	Very high or high degree of developmental effectiveness
Rating 2	Satisfactory degree of developmental effectiveness:
Rating 3	Overall sufficient degree of developmental effectiveness
Developmental failures: Ratings 4 to 6	
Rating 4	Overall slightly insufficient degree of developmental effectiveness
Rating 5	Clearly insufficient degree of developmental effectiveness
Rating 6	The project is a total failure

Criteria for the Evaluation of Project Success

The evaluation of the "developmental effectiveness" of a project and its classification during the ex-post evaluation into one of the various levels of success described in more detail below concentrate on the following fundamental questions:

- Are the **project objectives** reached to a sufficient degree (aspect of project **effectiveness**)?
- Does the project generate sufficient significant **developmental effects** (project **relevance** and **significance** measured by the achievement of the overall development-policy objective defined beforehand and its effects in political, institutional, socio-economic and socio-cultural as well as ecological terms)?
- Are the **funds/expenses** that were and are being employed/incurred to reach the objectives **appropriate** and how can the project's microeconomic and macroeconomic impact be measured (aspect of **efficiency** of the project concept)?
- To the extent that undesired (**side**) **effects** occur, are these tolerable?

We do not treat **sustainability**, a key aspect to consider for project evaluation, as a separate category of evaluation but instead as a cross-cutting element of all four fundamental questions on project success. A project is sustainable if the project-executing agency and/or the target group are able to continue to use the project facilities that have been built for a period of time that is, overall, adequate in economic terms, or to carry on with the project activities on their own and generate positive results after the financial, organizational and/or technical support has come to an end.