

## 5 Cost-Benefit Analysis

### 5.1 Fundamentals of cost-benefit analysis

Cost-benefit concepts were developed as a systematic tool to enable structured comparison of alternatives to action and facilitate the selection of the optimal alternative. Because benefit cannot be assessed exclusively monetarily, the method is designed to be able to include non-monetary evaluation criteria in the comparison.

#### 5.1.1 Procedure

For the cost-benefit analysis (CBA), the following basic steps should be followed.

##### **a Specification of target criteria**

The criteria of core importance in achieving the objectives are set (e.g. necessary characteristics, functions, effects). Each alternative is evaluated in the CBA according to the target criteria.

##### **b Weighting of criteria**

Because not all criteria necessarily have the same importance for achieving the objectives, each criterion can be assigned a percentage that reflects its influence on the overall objective.

##### **c Definition of the degree of criteria fulfillment**

In order to be able to compare the evaluation of different criteria, the degree of fulfilling each criterion is represented by a measure on a scale (e.g. from 1 to 5). The validity of the CBA can be significantly improved through the scaling of monetary and non-monetary criteria.

##### **d Specification of alternatives to be analyzed**

It is highly recommended that the alternatives to be analyzed not be conclusively specified until this step; otherwise wishful thinking and prejudice may influence steps **a-c**.

##### **e Determination of benefit for each criterion**

For each alternative and target criterion, the benefit is now determined. For monetary criteria, particularly in the case of large investment volumes, a dynamic investment calculation is to be used (e.g. net present value method, annuity method, internal rate of return method)

### **f Total benefit for each alternative, and comparison of alternatives**

The values for the evaluation of the criteria are now summed for each alternative, taking into consideration the weighting of the criteria. The totals form the basis for ranking the alternatives.

### **g Critical appraisal of the CBA results**

The CBA is concluded with a critical appraisal of the results, since subjective influences cannot be excluded in Steps **b**, **c**, and **e**.

#### **5.1.2 Applying the CBA to public transportation**

In applying the CBA to decisions in the domain of electronic fares/electronic fare management, often only the monetary criteria are used to make the decision. In this case, Steps **b** and **c** can be skipped, as can be seen in the following sections.

#### **5.2 Economic aspects of system alternatives in public transportation**

In making a selection among system alternatives in public transportation, a range of questions and a number of individual criteria are of core importance. The following questions and criteria represent a catalog to be selectively applied in each concrete case.

##### **5.2.1 Economic questions**

To assess the profitability of introducing a system, the following questions are of relevance:

- How large are the increases in revenues that can be achieved through the introduction?
- How large are the resulting increases in productivity for the business processes?
- What increases in productivity result with respect to capital deployment?
- What costs can be avoided through the new system?
- What costs are decreased through the new system?
- What costs result for creating the new system?
- What recurring costs result?
- What losses can be reduced through the new system?

##### **5.2.2 Catalog of target criteria**

The following target criteria are arranged according to functions of a company:

###### **Fare management**

- Costs of acquisition
- Installation costs
- Transportation security costs
- Retainage / interest profit
- Disposal costs
- Clearing expenses
- Costs of controlling clearing
- Losses due to incorrect booking
- Losses due to counterfeit money
- Billing costs
- Crediting costs

- Costs of complaints
- Refund expenses
- Losses due to theft
- Liquidity

#### **Process management**

- Ticket issuing time
- Money changing time
- Ticket canceling time
- CiCo time
- Route acceleration effects

#### **Ticket management**

- Acquisition costs
- Printing costs
- Distribution costs
- Installation costs
- Disposal costs
- Inspection costs
- Losses due to fare dodging
- Losses due to forgery
- Security costs
- Costs of printing receipts
- Costs due to proving fare dodging

#### **Product management**

- Product differentiation
- Best-price calculation
- Surcharge control
- Bonus control
- Transitional fares
- Costs due to changing fares
- Costs due to expanding product range

#### **Operating funds management**

(POS ticket machine/terminal, ticket canceling machines, inspection devices, CiCo/info-terminal, card)

- Investment costs
- Costs of operating the devices
- Maintenance/repair costs
- Depreciation
- Losses due to vandalism
- Costs of the background system
- Communication costs

#### **Corporate controlling**

- Increase in efficiency
- Increase in attractiveness
- Cost/revenue transparency
- Strategic alliances
- Data logging costs
- Costs of generating statistics
- Losses due to intersystem fare determination
- Proportional revenues allocation

- Standardization synergies
- Degree of self-service

#### **Operational management**

- Route performance report
- Route profit and loss account
- Vehicle scheduling
- Capacity utilization
- Capacity planning
- Start/transfer/destination relation
- Idle capacity costs/used-capacity costs
- Resource optimization

#### **Marketing controlling**

- Demand transparency
- Product statistics
- Customer performance report
- Database marketing
- Fare model optimization
- Sales & distribution costs
- Marketing costs
- Customer acquisition
- Customer retention

### **5.3 Useful tips and systematic approaches**

#### **5.3.1 Procedure**

In planning an electronic fare management system, it is recommended to proceed in three steps:

- Feasibility study
- Definition study
- Realization planning

The purpose of this division is the gradual refinement and detailed description of requirements, data, and assumptions, in order to improve the validity of a CBA step-by-step. The three steps differ from one another only in how detailed they are.

The reasons for this procedure are

- cost minimization considerations
- comprehensive consideration of the material
- rapid calculation of several implementation scenarios

Depending on the required decision, the number of analysis steps can be reduced.

For each of the steps (feasibility study, definition study, realization planning), the following outline is recommended:

1. Summary and analysis of existing fare, distribution, and marketing structures
2. Concept of the new electronic fare management system, including statements about customer media / chip cards, fare, sales & distribution, and marketing (description of the investment plan).

In this context: ascertainment of alternatives and pre-selection; see also Fig. 5.3.2, “Fundamental decision”

3. Business processes and distribution, as well as device options and background system.

4. Summary and evaluation of the benefits of the two systems (monetary)
5. Summary and evaluation of the costs of the two systems (monetary)
6. Decision

**5.3.2 Alternatives for pre-selection**

The following table, “Fundamental decisions,” cites (in no particular order) important system components that can be employed alternatively or additionally. A pre-selection must be made here, in conjunction with the previously addressed concept (description of the investment plan).

<b>Fundamental decision</b>	
<b>FIG. 5.3.2</b>	
<b>Fare system and payment procedure</b>	Introduction of an electronic fare and its monetary evaluation Pre-paid (payment procedure) Conventional trip-paid (payment procedure) Post-paid (payment procedure) Combinations of payment procedures (This allows the advantages of the system to be combined. Especially misgivings about data privacy can be dispelled in this manner)
<b>Processes and distribution organization</b>	Monetary evaluation of optimized/automated and accelerated processes Reorganization and re-appraisal of sales & distribution
<b>Marketing</b>	Costs for introducing the marketing program Monetary evaluation of more exact familiarity with the customer New customer retention programs Improvement of image
<b>System detection</b>	Contactless Proximity (CI / CICO / gating, ET) Wide range (WIWO, BIBO, ET) Combinations (CIBO, CIBI) Contact-type detection (CI, CICO, gating, ET) for a transition period
<b>Customer media</b>	Closed system (proprietary chip ticket) Open system (usage of German “Geldkarte” cash card, PayCard, PayBack card, other third-party chip cards also possible) Mix of media in open system (recommended, for reasons of costs and flexibility)
<b>Interoperability</b>	At the level of the transportation company (ticket can be used for travel with different transportation companies e.g. from the same integrated transportation network) At the level of the integrated transportation network (ticket can be used for travel between bordering transportation networks) At the state level, at the national level (ticket can be used for travel within a German state, or throughout Germany) Provision costs (black list management, certification, clearing) Economies of scale through larger number of chip tickets “Outsiders” do not have to be provided with new tickets
<b>Intermodality</b>	Monetary effect of sharing the media costs Provision costs (black list management, certification, clearing) What additional applications should be realized? (Park & Ride, customer cards, bonus system, CarSharing, taxi, etc.)

### 5.3.3 Business management aspects

The evaluation of an electronic fare management system with automatic fare determination must be based on the operational representations (data basis) from

- the actual state of fare, sales, and marketing domains, as a basis for comparison
- the new electronic fare management system

The ascertained data are to be compared to each other in the form of a cost-benefit analysis, considering the cases of if the system is introduced and if it is not introduced, in the context of a certain period of time, e.g. 8 years. In the end, an evaluation should result through the dynamic investment appraisal (e.g. the net present value method, internal rate of return method). The previously mentioned “standardized evaluation of investments in public transportation” also makes use of these methods.

#### 5.3.3.1 Determination of the basis of comparison

First, costs and benefits of the existing system, i.e. of the fare, of sales & distribution, and of marketing will be ascertained.

On the cost side, three different methods can be used for this purpose:

- Summary of the costs of the current system, differentiated according to operating costs and necessary re-investments
- Costs of a fictional new purchase of the old system
- Lump-sum base comparison values (in Germany, for instance, the distribution costs are generally 10-15% of the fare revenues)

The last two methods are inherently more of a rough estimate, and thus less accurate. In the case of the electronic fare management system, the individual components of the system are to be determined first and then documented in a concept (description of the investment plan). The costs and benefits of the investment plan are then calculated and documented. One-time and recurring costs must be clearly separated.

### 5.3.3.2 Components in the cost-benefit analysis

The following table shows a checklist of mandatory components that must be evaluated with respect to their costs and benefits.

<b>Components in the cost-benefit analysis</b>	
<b>FIG. 5.3.3.2</b>	
<b>Additional revenues</b>	<p><b>More profitable fares through</b></p> <ul style="list-style-type: none"> <li>• fare differentiation</li> <li>• fare flexibility</li> </ul> <p><b>Generation of additional travel through fewer obstacles</b></p> <ul style="list-style-type: none"> <li>• exact change always at hand</li> <li>• clear, simple fares</li> <li>• simple operation of ticket machines</li> <li>• no waiting to buy tickets</li> <li>• no waiting for ticket counter to open</li> <li>• intermodality and interoperability</li> </ul> <p><b>Revenue reliability through fewer</b></p> <ul style="list-style-type: none"> <li>• blatant fare dodgers</li> <li>• secondary fare evaders (e.g. passengers “forgetting” to purchase a ticket, carry their season pass, etc)</li> <li>• ticket machines being out of order</li> <li>• cases of fraud (e.g. ticket forgery)</li> </ul>
<b>General economic benefits</b>	<ul style="list-style-type: none"> <li>• improved use of publicly subsidized public transportation infrastructure</li> <li>• improved public services</li> <li>• decreased costs due to traffic jams</li> <li>• decreased costs due to accidents and their results</li> <li>• decreased costs due to environmental effects</li> <li>• improved internal profitability of local transit</li> <li>• technological advancement of society</li> </ul>
<b>Benefits that are difficult to estimate monetarily</b>	<p><b>Advantages for operative business and planning</b></p> <ul style="list-style-type: none"> <li>• more accurate and less expensive statistics</li> <li>• objective data basis for revenue allocation</li> <li>• exact data for calls for competitive bids</li> <li>• creation of route performance and profit and loss accounts</li> <li>• basis for marketing</li> </ul>
<b>Savings in sales &amp; distribution</b>	<ul style="list-style-type: none"> <li>• reduction in handling money</li> <li>• less vandalism of ticket machines</li> <li>• service and maintenance of old devices</li> <li>• automatic system operation (self-service, reduced assortment of tickets)</li> <li>• fewer inspection employees</li> <li>• lower ticket costs (printing and distributing)</li> <li>• ticket accounting</li> <li>• own points of sale (fewer distribution channels)</li> <li>• commissions (private POS, delivery)</li> <li>• flexible updating of software and fares</li> <li>• other recoverable sales &amp; distribution costs</li> <li>• new organization of the sales and distribution network (outsourcing, insourcing, participation of third parties)</li> </ul>
<b>Other savings effects</b>	<ul style="list-style-type: none"> <li>• optimization of deployment of operating funds</li> <li>• simplified, more exact collection of data for planning operating funds, revenue allocation, and statistics</li> <li>• interest in the case of pre-paid (e.g. re-loadable cards)</li> <li>• cost allocation in the case of intermodality and interoperability</li> </ul>

### Components in the cost-benefit analysis

FIG. 5.3.3.2

#### Costs of the new system

#### Investments:

- terminals and other system hardware
- background system
- cards
- infrastructure (cables & wiring, transmission and reception stations, ...)
- potential building remodeling
- software
- planning and realization

#### One-time costs:

- conceptual design (consulting, reviews, ...)
- training staff
- migration (transition from old system to new)
- advertising and public relations related to the launch
- development of a new fare model
- other project costs

#### Operational maintenance:

- communication costs
- energy costs
- EDP maintenance costs (updating and servicing the new infrastructure)
- interest expenses in post-paid procedures
- financing
- clearing
- trip accounting
- other operational costs

### 5.3.3.3 Other remarks on cost-benefit analysis

Like all management and operational perspectives, the validity of a cost-benefit analysis depends on how carefully the basis data has been collected and how realistic the assumptions were. For this reason, it is important to clearly document the basis data and assumptions.

One should also be aware that planning projects is an iterative process. The reliability of planning increases if the three steps described in section 5.3.1 are followed.

In general at the beginning of an analysis, not all basis data and assumptions can be determined with sufficient certainty. For example, if the price of a component lies between € 100K and € 200K, it makes sense to employ the upper limit in the data basis. Business management does provide other solutions for such cases through the sensitivity method.

Decades of experience indicate that new technologies in public transportation often have a general overall economic benefit. Compared to other items in a cost-benefit analysis, the general economic benefit is difficult to determine; it thus necessitates an especially careful analysis of the parameters. One helpful method here is the “standardized evaluation of investments in public transportation,” especially the section on general economic CBA.

Electronic fare management systems do not represent isolated local or regional solutions. The VDV core application demands both intermodality and interoperability in future solutions. It must be guaranteed that all solution alternatives can be extended step-by-step to the point of comprehensive mobility services.

If such extensions are to be not only prepared and ready at the time of launching the new electronic fare management system, but instead realized at

the same time, their costs and benefits must be separately ascertained and specifically identified.

#### **5.3.3.4 Net present value method**

Of the numerous investment appraisal methods, the net present value method is especially suited to the business management evaluation of an electronic fare management system. In this method, the current cash value of the future expenditures and income is compared to the initial investment. The current and planned solutions are compared with one another. The payments occurring in the future are discounted with the same interest rate so that they can be compared.

Based on a uniform interest rate, the result may be:

- a positive net present value (present cash value of the income > present cash value of the expenditures)
- net present value = 0 (present cash value of the income = present cash value of the expenditures)
- negative net present value (present cash value of the income < present cash value of the expenditures)

The decision-making rule for the net present value is that an investment is profitable if the net present value is positive or at least equal to zero. In the case of several investment alternatives, the one with the highest positive net present value is the most favorable economically.

Of interest may be the profitability analysis, based on the net present value method, of the use of different chip card systems carried out by the German Federal Ministry of Transportation, Building, and Housing (BMVB) (“ChipTarif” report\*).

The following structural outline and the sample CBA calculation for a medium-sized municipal transportation company (described in Chapter 5.4.3 and the Appendix) are based on the previously outlined remarks, including the net present value method.

\* Urban transportation research program of the German Federal Ministry of Transportation, Building and Housing, “Kundenfreundliche tarifarische Möglichkeiten durch Einsatz der automatisierten Fahrpreisfindung zur Steigerung der Attraktivität und Leistungsfähigkeit des ÖPNV (ChipTarif),” final report, Berlin, November 2000.

### **5.3.4 Outline of cost-benefit analysis**

#### **5.3.4.1 Notes on the calculation approach**

The following tables show the CBA’s calculation approach.

The calculation approach is divided into the following parts:

- Part 1: determination of the basis data
- Part 2: dynamic indexing of the basis data over 8 years
- Part 3: evaluation of the results with the net present value method.

For the CBA, a range of data is collected and entered into the presented tables. All fields in which items must be entered have been marked. All other fields result are automatically calculated.

The tables contain fields in which the collected data is entered. In the following, the tables are first described briefly in an overview.

For certain tables that require additional information to understand them, the specified table fields are additionally explained.

### 5.3.4.2 Part 1: determination of the basis data

The following tables are included in Part 1:

#### Part 1: Determination of the basis data

FIG. 5.3.4.2

Name of the tab page	Description
<b>Overview: Summary of costs and benefits</b>	This table gives an overview of the costs and benefits ascertained in the following tables. As a basis value for the following percentage-based calculations, the net fare revenues of the existing system are to be entered.
<b>Fare system modification</b>	Due to new methodological approaches and especially a more flexible manipulation of the fare elements area, time, and usage, the introduction of an electronic fare automatically yields greater fare profitability.
<b>Additional traffic</b>	This requires estimating the effects of a new system on changes in public transportation usage (experience from similar projects may be useful here)
<b>Revenue reliability</b>	The current situation is to be represented here and the effects of a new system on revenue reliability estimated.
<b>Traffic logging and statistics</b>	Changes in expenses for traffic logging and statistics as well as a potential change in revenue allocation are to be entered here.
<b>Optimization of deployment of operating funds</b>	Through more exact data from traffic logging, the operating funds can be deployed more efficiently. The operational costs for the fleet of vehicles can be reduced.
<b>External transportation costs</b>	This table illustrates the general economic benefit through reduction in private motorized traffic.
<b>One-time benefits</b>	Selling the current system generates revenues. Revenues and one-time subsidies are entered as one-time benefits.
<b>Personnel costs</b>	Differences between the current and new systems with respect to the personnel structure are made transparent here.
<b>Commission expenses</b>	The current situation and the expected changes with a new system are illustrated here.
<b>Handling money</b>	The current situation and the expected changes with a new system are illustrated here.
<b>Operational maintenance</b>	The current situation and the expected changes with a new system are illustrated here.
<b>Investment costs as write-offs</b>	The necessary re-investments in the existing system and the investments necessary in the new system are represented here.
<b>One-time costs of introduction</b>	The necessary introductory measures and their costs.

The following table summarizes the results of the basis data determination.

Overview: summary of costs and benefits	
<b>FIG. 5.3.4.3</b>	
Input	Comments
Net fare revenues up to now	This value serves as the basis for working out the percentage changes due to a new fare management system. For instance, if a "fare dodger" rate of 8-10% is specified, the company loses approx. 8% of its net fare revenues. If a new fare management system can cut fare dodging in half, the new system yields 4% of the net fare revenues up to now as additional income
Improved public services	If these types of general economic benefit are to be taken into consideration and if a value can be specified for them, this field should be filled.
Improved internal profitability	

**Part 1: Determination of basis data**

**Summary of benefits**

Business management benefits	Overall system benefits per year		Difference
	Existing system	New system	
<i>Basis, net fare revenues up to now</i>	0,00 €	0,00 €	0,00 €
Fare system modification	0,00 €	0,00 €	0,00 €
Additional traffic	0,00 €	0,00 €	0,00 €
Revenue reliability	0,00 €	0,00 €	0,00 €
Traffic logging and statistics	0,00 €	0,00 €	0,00 €
Optimization of deployment of operational funds	0,00 €	0,00 €	0,00 €
<b>General economic benefits</b>			
Decrease in external transportation costs	0,00 €	0,00 €	0,00 €
Improved public services	-	0,00 €	0,00 €
Improved profitability	-	0,00 €	0,00 €
<b>Total</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
One-time benefit	-	0,00 €	

**Summary of costs**

Operating costs	Operating system costs per year		Difference
	Existing system	New system	
Personnel costs	0,00 €	0,00 €	0,00 €
Commissions	0,00 €	0,00 €	0,00 €
Handling money	0,00 €	0,00 €	0,00 €
Operational maintenance	0,00 €	0,00 €	0,00 €
<b>Subtotal</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
Write-off of investments	0,00 €	0,00 €	0,00 €
Implicit interest	0,00 €	0,00 €	0,00 €
<b>Total</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
One-time introduction costs	-	0,00 €	

**Results - overview**

	Additional benefit	Additional costs	Difference
<b>In the launch year</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>

**Fare system modification**

Estimates are necessary here. The % values to be entered refer to net fare revenues.

Fare system modification	
Input field	Comments
Increased profitability	Due to new methodological approaches and especially a more flexible manipulation of the fare elements area, time, and usage, the introduction of an electronic fare automatically yields greater fare profitability. Detailed information is available in the kontiki report "Methodische Ansätze für Fahrpreisgestaltungen bei elektronischen Fahrgeldmanagement-Systemen mit automatisierter Fahrpreisberechnung (VDV-Stufe 3)."

(Amounts in €)

Description			
	Net fare revenues	0,00 €	
	Increased profitability	0,00%	0,00 €
	<i>TOTAL</i>		0,00 €

**Additional traffic**

The disappearance of barriers to access results in additional traffic. Estimates are necessary here. The % values to be entered refer to net fare revenues.

(Amounts in €)

Description			
	Net fare revenues	0,00 €	
	Additional traffic in % through use of "Geldkarte" cash card	0,00%	0,00 €
	Additional traffic in % through clear, simple fares	0,00%	0,00 €
	Additional traffic in % through simple ticket machine operation	0,00%	0,00 €
	Additional traffic in % through eliminating waiting in line to buy tickets	0,00%	0,00 €
	Additional traffic in % through independence of ticket counter opening hours	0,00%	0,00 €
	Additional traffic in % through interoperability	0,00%	0,00 €
	Additional traffic in % through intermodality	0,00%	0,00 €
	<i>Subtotal</i>	0,00%	0,00 €
	<i>TOTAL</i>		0,00 €

**Revenue reliability**

Typical sources of loss are cited here. Information should be entered as it is known from statistics on the current system, or it can be estimated.

Revenue reliability	
Input field	Notes
Primary fare dodger rate (those who actively avoid paying fares), in %	Known or estimated primary fare dodger rate in the existing system, as a % of the net fare revenues
Reduction in primary fare dodger rate, in percentage points	The primary fare dodger rate will be reduced by this amount through a new system.
Secondary fare dodger rate (those who passively evade fare payment, e.g. by "forgetting" to buy a ticket or postponing renewal of season tickets)	Known or estimated rate of secondary fare dodgers in the existing system, as a % of the net fare revenues
Reduction in secondary fare dodger rate, in percentage points	The secondary fare dodger rate will be reduced by this amount through a new system.
Losses up to now due to defective ticket machines	Known or estimated amount lost through defective ticket machines
Reduction of defective ticket machine loss, in percentage points	The loss will be reduced by this amount in the new system.
Fraud rate, in %	Known or estimated fraud rate in the existing system, as a % of the net fare revenues
Reduction of fraud rate, in percentage points	The fraud rate will be reduced by this amount in the new system

(Amounts in €)

Description		
Net fare revenues	0,00 €	
Primary fare dodger rate in %	0,00%	
Losses up to now due to primary fare dodging	0,00 €	
Reduction in primary fare dodger rate, in % points	0,00%	0,00 €
Secondary fare dodger rate in %	0,00%	
Losses up to now due to secondary fare dodging	0,00 €	
Reduction in secondary fare dodger rate, in % points	0,00%	0,00 €
Losses up to now due to defective ticket machines	0,00 €	
Reduction of defective ticket machine losses, in % points	0,00%	0,00 €
Fraud rate in %	0,00%	
Losses up to now due to fraud	0,00 €	
Reduction of fraud rate, in % points	0,00%	0,00 €
<b>TOTAL</b>		0,00 €

### Traffic logging and statistics

The costs for logging traffic in the existing system are compared with those in a new system. The costs in the existing system are known. Collecting data in a new system will be simpler, since the data basis already exists. Costs for creating and executing useful database queries are to be specified here.

Traffic statistics	
Input field	Comments
Costs of logging traffic	Logging traffic does not have to be carried out in a new system, since the data have already been recorded.
Change in the share of net fare revenues through more exact revenue allocation, in %	With the corresponding data basis in the new system, more exact and hence fairer revenue allocation can take place using a more demand-oriented method. Compared to the distribution method used up to now, this can have positive or negative effects for a transportation company. The required entry is a positive or negative % value of the net fare revenues; company-internal policy decisions regarding revenue allocation are not taken into consideration
Costs of statistics	The data from traffic logging or the that existing in the system must be processed in order to be useful. The costs for this preparation are entered here.

(Amounts in €)

Description	%	Old	New	Difference
Costs of logging traffic		0,00 €	0,00 €	0,00 €
Change in the share of net fare revenues through more exact revenue allocation, in %	0,00%	-	0,00 €	0,00 €
Costs of statistics		0,00 €	0,00 €	0,00 €
<b>TOTAL</b>				0,00 €

**External transportation costs**

In this section, a portion of the general economic benefit is determined. If the new system is successful in reducing the amount of private motorized traffic, this means costs are saved. In order to quantify this general economic cost savings, the additional traffic due to the system is equated with the reduction of private motorized traffic.

The average external costs per 1000 passenger kilometers amount to € 87 (according to IWW, University of Karlsruhe and INFRAS Consulting, Zurich, March 2000, data basis 1995). This includes costs for accidents, noise, air pollution, changes in climate, impact on nature and the landscape, urban effects, and the upstream process.

External transportation costs	
Input field	Comments
<b>Passenger kilometers per € of net fare revenues</b>	How many passenger kilometers of transport services does the transportation company provide per € of net fare revenue, in the existing system?

(Amounts in €)

Description		
Total of additional traffic in €		0,00 €
Passenger kilometers per € of net fare revenues (net fare revenues for the sample transportation company amount to 12 cents / passenger kilometer)		0,00
Total of additional traffic in public transportation in passenger kilometers = reduction in private motorized transportation Specified here in 1 000 passenger kilometers per year		
Average costs per 1000 passenger kilometers (according to IWW, Universität Karlsruhe and INFRAS Consulting/Zurich, March 2000, data basis 1995) <u>Includes costs for:</u> - accidents - noise - air pollution - climate changes - impact on nature and landscape - urban effects - upstream process		87,00 €
		0,00 €
<b>TOTAL</b>		0,00 €

**One-time revenues**

Through the replacement of the existing system, sales revenues from a range of components are realized. The expected revenues are summarized in this table.

Additionally, one-time public subsidies or those from other sources can be entered here.

One-time revenues	
Input field	Comments
Sales revenues from selling existing system	Absolute amount
Subsidies from the city	Public funding/subsidies for the new system in % of the investment total or as an absolute amount
Subsidies from the county	
Subsidies from the state	
Subsidies from the federal government	
Other subsidies	

Description		
Sales revenues from selling existing system		0,00 €
Investment costs	0,00 €	
or as an absolute amount		
Subsidies from the city	0,00%	0,00 €
Subsidies from the county	0,00%	0,00 €
Subsidies from the state	0,00%	0,00 €
Subsidies from the federal government	0,00%	0,00 €
Other subsidies	0,00%	0,00 €
<i>TOTAL</i>		0,00 €

**Personnel costs**

This table illustrates the existing and future situation in terms of personnel costs. The input fields exist for both the existing and the new system. The number of employees and their gross yearly salaries are to be inputted for each group of persons. Overhead can be specified as a % of personnel costs.

**Existing sales & distribution system**

(Amounts in €)

	Description	Number	Gross salary	Total
<b>Personnel costs per year</b>				
	Ticket inspectors		0,00 €	0,00 €
	Points of sale staff		0,00 €	0,00 €
	Sales logistics		0,00 €	0,00 €
	Service depot staff		0,00 €	0,00 €
	Sales department		0,00 €	0,00 €
	Ticket machine technology		0,00 €	0,00 €
	Data processing		0,00 €	0,00 €
	Cash office		0,00 €	0,00 €
	<b>Subtotal</b>	<b>0</b>		<b>0,00 €</b>
	Overhead (in % of personnel costs)	50,00%		0,00 €
	<i>TOTAL</i>			<b>0,00 €</b>

### New sales & distribution system

(Amounts in €)

	Description	Number	Gross salary	Total
<b>Personnel costs</b>				
<b>per year</b>	Ticket inspectors		0,00 €	0,00 €
	Points of sale staff		0,00 €	0,00 €
	Sales logistics		0,00 €	0,00 €
	Service depot staff		0,00 €	0,00 €
	Sales department		0,00 €	0,00 €
	Ticket machine technology		0,00 €	0,00 €
	Data processing		0,00 €	0,00 €
	Cash office		0,00 €	0,00 €
	<b>Subtotal</b>	<b>0</b>		<b>0,00 €</b>
	Overhead (in % of personnel costs)	50,00%		0,00 €
	<b>TOTAL</b>	<b>0</b>		<b>0,00 €</b>

### Commission costs

The commission costs of the two systems are compared with each other here.

Commission costs	
Input field	Comments
<b>Percentage of net fare revenues for which commission costs accrue</b>	Percentage of net fare revenues for which commissions must be paid. Alternatively, the absolute amount can be entered in the subtotal field.
<b>Commission share in %</b>	Percentage of the sales turnover that is paid to the sellers as a commission fee

### Existing system

	Description	(Amounts in €)	
<b>Commission costs</b>			
	Net fare revenues		0,00 €
	Percentage for which commission costs accrue		0,00%
	Subtotal		0,00 €
	Commission share in %		0,00%
			0,00 €
	<b>TOTAL</b>		<b>0,00 €</b>

### New system

	Description	(Amounts in €)	
<b>Commission costs</b>			
	Net fare revenues		0,00 €
	Percentage for which commission costs accrue		0,00%
	Subtotal		0,00 €
	Commission share in %		0,00%
			0,00 €
	<b>TOTAL</b>		<b>0,00 €</b>

### Handling money

The costs for handling money in the two systems are compared here.

Handling money	
Input field	Comments
Share of cash, in %	Percent of net fare revenues that accumulate as cash.
Cost fraction of the cash amount, in %	Costs of handling cash, in % of the cash amount.
Cost fraction of the non-cash amount, in %	Costs of handling non-cash money, in % of the non-cash amount

#### Existing system

Description		(Amounts in €)	
<b>Handling costs</b>		<b>%</b>	
	Net fare revenues		0,00 €
	Share of cash, in %	0,00%	0,00 €
	Cost fraction of the cash amount, in %	0,00%	0,00 €
	Cost fraction of the non-cash amount, in %	0,00%	0,00 €
	<b>Subtotal</b>		0,00 €
	<i>TOTAL</i>		<b>0,00 €</b>

#### New system

Description		(Amounts in €)	
<b>Handling costs</b>			
	Net fare revenues		0,00 €
	Share of cash, in %	0,00%	0,00 €
	Cost fraction of the cash amount, in %	0,00%	0,00 €
	Cost fraction of the non-cash amount, in %	0,00%	0,00 €
	<b>Subtotal</b>		0,00 €
	<i>TOTAL</i>		<b>0,00 €</b>

### Operational maintenance

The costs for maintaining operation of the two systems are compared here.

#### Existing system

(Amounts in €)

	Description	Number	Costs	Total
<b>Operational maintenance</b>				
	Communication costs	0,00	0,00 €	0,00 €
	Energy costs	0,00	0,00 €	0,00 €
	EDP maintenance costs (updating and servicing the infrastructure)	0,00	0,00 €	0,00 €
	Interest expenses, post-paid procedure	0,00	0,00 €	0,00 €
	Financing	0,00	0,00 €	0,00 €
	Clearing	0,00	0,00 €	0,00 €
	Trip accounting	0,00	0,00 €	0,00 €
	Other operational costs	0,00	0,00 €	0,00 €
	<i>TOTAL</i>			0,00 €

#### New system

(Amounts in €)

	Description	Number	Costs	Total
<b>Operational maintenance</b>				
	Communication costs	0,00	0,00 €	0,00 €
	Energy costs	0,00	0,00 €	0,00 €
	EDP maintenance costs (updating and servicing the infrastructure)	0,00	0,00 €	0,00 €
	Interest expenses, post-paid procedure	0,00	0,00 €	0,00 €
	Financing	0,00	0,00 €	0,00 €
	Clearing	0,00	0,00 €	0,00 €
	Trip accounting	0,00	0,00 €	0,00 €
	Other operational costs	0,00	0,00 €	0,00 €
	<i>TOTAL</i>			0,00 €

### Investments

The investment costs of the two systems are compared here. In the existing system, this largely involves re-investments.

The data for the new system must be ascertained. If determining this information is initially too time-consuming, it is possible to use 10 times the operational maintenance costs as a first approximation.

#### Existing system (re-investments)

	Description	Number	Price/unit	Total
<b>Investments</b>				
	<b>Terminals and other system hardware</b>			0,00 €
	Replacement of ticket machines	0,00	0,00 €	0,00 €
	Printers	0,00	0,00 €	0,00 €
	Ticket cancellers	0,00	0,00 €	0,00 €
	Control devices	0,00	0,00 €	0,00 €
	EDP systems (hardware & software)	0,00	0,00 €	0,00 €
	On-board computers	0,00	0,00 €	0,00 €
	Background systems	0,00	0,00 €	0,00 €
	Other	0,00	0,00 €	0,00 €
	<i>TOTAL</i>			0,00 €
	Yearly write-off over a depreciation period of	8,00	years	0,00 €

**New system**

	Description	Number	Price/unit	Total
<b>Terminals and other system hardware</b>				
	On-board computers, buses and trams	0,00	0,00 €	0,00 €
	Vehicle communication facilities	0,00	0,00 €	0,00 €
	Card issuing and loading terminal (KALT)	0,00	0,00 €	0,00 €
	Multi-terminals	0,00	0,00 €	0,00 €
	Ticket counter terminals	0,00	0,00 €	0,00 €
	Driver terminals	0,00	0,00 €	0,00 €
	Stationary CICO terminals	0,00	0,00 €	0,00 €
	Mobile CICO terminals	0,00	0,00 €	0,00 €
	Control terminals	0,00	0,00 €	0,00 €
<b>Planning and development</b> (factor of 10 times the operating costs) or:				0,00 €
	Functional design	0,00	0,00 €	0,00 €
	Technical design / realization	0,00	0,00 €	0,00 €
	Overhead (training, coordination, manuals)	0,00	0,00 €	0,00 €
	Risk surcharge production factor	0,00	0,00 €	0,00 €
	Project office	0,00	0,00 €	0,00 €
	General project costs	0,00	0,00 €	0,00 €
	Launch (internal communication, etc)	0,00	0,00 €	0,00 €
	Overall planning risk (10% of planning and development)	0,00	0,00 €	0,00 €
<b>Background systems</b>				
	Transp. co. computers	0,00	0,00 €	0,00 €
	Infrastructure (cable & wiring, transmission & reception stations, ..)	0,00	0,00 €	0,00 €
	Station computers	0,00	0,00 €	0,00 €
<b>Other</b>				
	Cards	1000000,00	2,50 €	0,00 €
	Remodeling	0,00	0,00 €	0,00 €
	Software	0,00	0,00 €	0,00 €
	<i>TOTAL</i>			0,00 €
Subsidies		0,00%		0,00 €
	Yearly write-off over a depreciation period of	8,00	years	0,00 €

**One-time introduction costs**

This table summarizes costs that arise once, but technically speaking cannot be considered investments.

**New system***(Amounts in €)*

	Description	Number	Costs	Total
	Conceptual design (consulting, reviews, ...)	0,00	0,00 €	0,00 €
	Training staff	0,00	0,00 €	0,00 €
	Migration costs	0,00	0,00 €	0,00 €
	Advertising and PR related to the launch	0,00	0,00 €	0,00 €
	Development of a new fare model	0,00	0,00 €	0,00 €
	Other project costs	0,00	0,00 €	0,00 €
	<i>TOTAL</i>			0,00 €

**5.3.4.3 Part 2: Dynamic indexing of the basis data over 8 years**

The following tables belong to Part 2:

Part 2: Dynamic indexing of the basis data over 8 years	
Table name	Description
Overall existing system	This table shows the results of the basis data determination for the existing system. By specifying the dynamic indexing according to which the displayed costs change over the course of 8 years, the future situation can be simulated. If an interest rate for the financing costs is specified, the corresponding costs through the years are also calculated.
Overall new system	This table shows the results of the basis data determination for the new system. By specifying the dynamic indexing according to which the displayed costs change over the course of 8 years, the future situation can be simulated. If an interest rate for the financing costs is specified, the corresponding costs through the years are also calculated.
Difference between new and existing	This table shows the difference in values between the new and old system. It serves as a basis for the net present value calculation.

Overview, existing system

(Amounts in €)

	Basis data	YEARS							
		1	2	3	4	5	6	7	8
<b>Benefits</b>									
Net fare revenues	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Fare system modification	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Additional traffic	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Revenue reliability	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Traffic logging and statistics	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Optimization of operating fund deployment	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Reduction in external transportation costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time revenues	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Total benefits</b>		0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Costs</b>									
Personnel costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Commission costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Money handling	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Operational maintenance	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Investments	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Financing costs		0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time introduction costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Total costs</b>		0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>RESULT</b>		0,00 EUR	0,00 EUR	0,00 EUR	0,00 EUR	0,00 EUR	0,00 EUR	0,00 EUR	0,00 EUR

Basic assumptions of dynamic indexing

Benefits

Net fare revenues	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Additional traffic	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Fare system modification	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Revenue reliability	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Traffic logging and statistics	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Optimization of operating fund deployment	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Reduction in external transportation costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
One-time revenues	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
<b>Costs</b>									
Personnel costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Commission costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Money handling	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Operational maintenance	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Investments	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Financing costs	6,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
One-time introduction costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
<b>Interest rate</b>	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%

Overview, new system

(Amounts in €)

	Basis data	YEARS								
		1	2	3	4	5	6	7	8	
<b>Benefits</b>										
Net fare revenues	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Fare system modification	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Additional traffic	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Revenue reliability	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Traffic logging and statistics	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Optimization of operating fund deployment	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Reduction in external transportation costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time revenues	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Total benefits</b>		<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
<b>Costs</b>										
Personnel costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Commission costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Money handling	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Operational maintenance	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Investments	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Financing costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time introduction costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Total costs</b>		<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
<b>RESULT</b>		<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>

Basic assumptions of dynamic indexing

Benefits

Net fare revenues	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Fare system modification	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Additional traffic	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Revenue reliability	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Traffic logging and statistics	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Optimization of operating fund deployment	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Reduction in external transportation costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
One-time revenues	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
<b>Costs</b>										
Personnel costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Commission costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Money handling	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Operational maintenance	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Investments	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
Financing costs	6,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
One-time introduction costs	100,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%

Interest rate

	0,0%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%	+ 0,00%
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Difference between new and old system

(Amounts in €)

	Basis data	YEARS								TOTAL
		1	2	3	4	5	6	7	8	
<b>Benefits</b>										
Net fare revenues	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Fare system modification	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Additional traffic	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Revenue reliability	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Traffic logging and statistics	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Optimization of operating fund deployment	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Reduction in external transportation costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time revenues	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Total benefits</b>		<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
<b>Costs</b>										
Personnel costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Commission costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Money handling	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Operational maintenance	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Investments	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Financing costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
One-time introduction costs	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
<b>Total costs</b>		<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>	<b>0,00 €</b>
<b>RESULT</b>		<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>	<b>0,00 EUR</b>

As a pure analysis, this table merely shows the differences between the individual cost and benefit categories over the observed time period of 8 years. This table serves as a basis for calculating net present value.

When transferring data into the table for calculating net present value, it is important to observe that the net present value calculation takes into consideration an interest rate; for this reason, there is no entry for financing costs. In the net present value method, costs are considered payments in, benefits are considered payouts. Payments in in Year 0: total investment costs + one-time costs. Payouts in Year 0: none.

**Part 3: Evaluation of the results with the net present value method**

In calculating the net present value, a distinction is made between a general economic perspective and a business management one. Calculating without the general economic benefit neglects the effects of external transportation costs, improved public services, and improved internal profitability.

The table can be calculated using different interest rates.

**Net present value calculation including general economic benefits**

Interest rate 0%

	Year									
	0	1	2	3	4	5	6	7	8	
Payments in (costs)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Payouts (benefits)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cash value	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Net present value	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

**Net present value calculation excluding general economic benefits**

Interest rate 0%

	Year									
	0	1	2	3	4	5	6	7	8	
Payments in (costs)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Payouts (benefits)	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Cash value	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
Net present value	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €

In the net present value method, it was assumed that in the year during which the new distribution system was created and introduced, all investment costs are incurred, but no additional benefit is yet achieved. For this reason, this investment year is positioned as year 0.

Year 1 is the first year in which a benefit has a financial effect:

- Year 0: all investment costs and one-time introduction costs are incurred, but only the benefit of the existing system is earned
- Year 1: The new system has been launched. The expected benefit of the new system arises for the first time.

## 5.4 Appendix

### 5.4.1 Sample calculation for a medium-sized municipal transportation company

#### Initial situation

Core operational data:

- 99 trams
- 254 route buses

Core sales & distribution data:

- 4 company-owned points of sale
- 130 private points of sale
- 1 center for season ticket subscribers
- 50 stationary ticket machines
- 353 mobile ticket machines
- 14 electronic ticket printers
- 1400 ticket canceling machines
- 35 ticket inspection devices

Assumptions:

- In conjunction with the introduction of the Euro, the sales and distribution system will be completely replaced within one year.
- An existing system is replaced by a new system within one year. Investments in the existing system or in a new system will be uniformly written off over 8 years.

Turnover:

- € 42 million in net fare revenues

Primary and secondary fare dodging:

- 6 % of net fare revenues

#### Conceptual design of electronic fare management

- Introduction of an electronic fare with greater profitability; automatic fare determination
- Pre-paid and post-paid payment methods
- Reorganization of sales & distribution (discontinuation of the subscriber center, reduction of private points of sale, streamlining the company-owned points of sale, expansion of non-cash transactions)
- Contactless proximity technology
- 403 sales terminals
- 1578 proximity card readers (check-in and check-out devices)
- 35 control terminals
- 1 million company chip tickets

### Basis data

With the CBA approach presented above, the changeover to a new sales and distribution system with an electronic fare management system and automated fare determination was calculated for the described transportation company:

#### Summary of benefits

Business management benefits	Overall system benefits per year		
	Existing system	New system	Difference
<i>Basis, net fare revenues up to now</i>	42.000.000,00 €	42.000.000,00 €	0,00 €
Fare system modification	0,00 €	630.000,00 €	630.000,00 €
Additional traffic	0,00 €	840.000,00 €	840.000,00 €
Revenue reliability	0,00 €	1.260.000,00 €	1.260.000,00 €
Traffic logging and statistics	0,00 €	100.000,00 €	100.000,00 €
Optimization of deployment of operational funds	0,00 €	800.000,00 €	800.000,00 €
<b>General economic benefits</b>			
Decrease in external transportation costs	0,00 €	609.000,00 €	609.000,00 €
Improved public services	-	0,00 €	0,00 €
Improved profitability	-	0,00 €	0,00 €
<b>Total</b>	<b>42.000.000,00 €</b>	<b>46.239.000,00 €</b>	<b>4.239.000,00 €</b>
One-time benefit	-	0,00 €	

#### Summary of costs

Operating costs	Operating system costs per year		
	Existing system	New system	Difference
Personnel costs	5.700.000,00 €	4.400.000,00 €	-1.300.000,00 €
Commissions	217.980,00 €	107.100,00 €	-110.880,00 €
Handling money	200.000,00 €	50.000,00 €	-150.000,00 €
Operational maintenance	0,00 €	250.000,00 €	250.000,00 €
<b>Subtotal</b>	<b>6.117.980,00 €</b>	<b>4.807.100,00 €</b>	<b>-1.310.880,00 €</b>
Write-off of investments	1.093.750,00 €	3.609.375,00 €	2.515.625,00 €
Implicit interest	525.000,00 €	1.732.500,00 €	1.207.500,00 €
<b>Total</b>	<b>7.736.730,00 €</b>	<b>10.148.975,00 €</b>	<b>2.412.245,00 €</b>
One-time introduction costs	-	1.000.000,00 €	

In this case, only the net fare revenues were entered. There was no data available on improved public services and improved internal profitability.

All other figures were automatically calculated and entered here in the course of the basis data determination.

### Fare system modification

(Amounts in €)

Description		
Net fare revenues	42.000.000,00 €	
Increased profitability	1,50%	630.000,00 €
<b>TOTAL</b>		<b>630.000,00 €</b>

It was assumed that through new, more productive fare structuring, a 1.5% increase in profits can be achieved.

**Additional traffic***(Amounts in €)*

Description		
Net fare revenues	42.000.000,00 €	
Additional traffic in % through use of "Geldkarte" cash card	0,00%	0,00 €
Additional traffic in % through clear, simple fares	0,00%	0,00 €
Additional traffic in % through simple ticket machine operation	0,00%	0,00 €
Additional traffic in % through eliminating waiting in line to buy tickets	0,00%	0,00 €
Additional traffic in % through independence of ticket counter opening hours	0,00%	0,00 €
Additional traffic in % through interoperability	0,00%	0,00 €
Additional traffic in % through intermodality	0,00%	0,00 €
<i>Subtotal</i>	2,00%	840.000,00 €
<b>TOTAL</b>		840.000,00 €

Through the effects cited in the table, additional traffic of 2% is expected.  
This value was not specified in any more detail.

**Income reliability***(Amounts in €)*

Description		
Net fare revenues	42.000.000,00 €	
Primary fare dodger rate in %	6,00%	
Losses up to now due to primary fare dodging	2.520.000,00 €	
Reduction in primary fare dodger rate, in % points	50,00%	1.260.000,00 €
Secondary fare dodger rate in %	0,00%	
Losses up to now due to secondary fare dodging	0,00 €	
Reduction in secondary fare dodger rate, in % points	0,00%	0,00 €
Losses up to now due to defective ticket machines	0,00 €	
Reduction of defective ticket machine losses, in % points	0,00%	0,00 €
Fraud rate in %	0,00%	
Losses up to now due to fraud	0,00 €	
Reduction of fraud rate, in % points	0,00%	0,00 €
<b>TOTAL</b>		1.260.000,00 €

In the integrated transportation network, a fare dodging rate of 6-8% was ascertained. This will be reduced by at least 50% in the new system. There was no data available on the further effects of revenue reliability.

### Traffic logging and statistics

(Amounts in €)

Description	%	Old	New	Difference
Costs of logging traffic		0,00 €	0,00 €	100.000,00 €
Change in the share of net fare revenues through more exact revenue allocation, in %	0,00%	-	0,00 €	0,00 €
Costs of statistics		0,00 €	0,00 €	0,00 €
<b>TOTAL</b>				100.000,00 €

In calculating the transportation statistics, lump cost savings of € 100,000 are expected. The revenue allocation and the costs for statistics were not analyzed in more detail.

### Optimization of operating fund deployment

(Amounts in €)

Description	%	Old	New	Difference
Operating costs, fleet of vehicles	0,00%	0,00 €	0,00 €	800.000,00 €
<b>TOTAL</b>				800.000,00 €

Optimized deployment of operational funds leads to a lump savings of € 800,000.

### Reduction in external transportation costs

(Amounts in €)

Description		
Total of additional traffic in €		840.000,00 €
Passenger kilometers per € of net fare revenues (net fare revenues for the sample transportation company amount to 12 cents / passenger kilometer)		8,30
Total of additional traffic in public transportation in passenger kilometers = reduction in private motorized transportation Specified here in 1 000 passenger kilometers per year		7000,000
Average costs per 1000 passenger kilometers (according to IWW, Universität Karlsruhe and INFRAS Consulting/Zurich, March 2000, data basis 1995) <u>Includes costs for:</u> - accidents - noise - air pollution - climate changes - impact on nature and landscape - urban effects - upstream process		87,00 €
		609.000,00 €
<b>TOTAL</b>		609.000,00 €

In the transportation company under consideration, 8.3 passenger kilometers of transportation were provided for each Euro of net fare revenues.

### One-time revenues

Description		
Sales revenues from selling existing system		0,00 €
Investment costs or as an absolute amount	23.875.000,00 €	
Subsidies from the city	0,00%	0,00 €
Subsidies from the county	0,00%	0,00 €
Subsidies from the state	0,00%	0,00 €
Subsidies from the federal government	0,00%	0,00 €
Other subsidies	0,00%	0,00 €
<i>TOTAL</i>		0,00 €

In the transportation company under consideration, no sales revenues from the old system and no public funding were applied.

### Personnel costs

#### Existing sales & distribution system

(Amounts in €)

	Description	Number	Gross salary	Total
<b>Personnel costs</b>				
<b>per year</b>	Ticket inspectors	0	0,00 €	0,00 €
	Points of sale staff	0	0,00 €	0,00 €
	Sales logistics	0	0,00 €	0,00 €
	Service depot staff	0	0,00 €	0,00 €
	Sales department	0	0,00 €	0,00 €
	Ticket machine technology	0	0,00 €	0,00 €
	Data processing	0	0,00 €	0,00 €
	Cash office	0	0,00 €	0,00 €
	<b>Subtotal</b>	<b>0</b>		<b>0,00 €</b>
	Overhead (in % of personnel costs)	50,00%		0,00 €
	<b>TOTAL</b>			<b>5.700.000,00 €</b>

**New sales & distribution system***(Amounts in €)*

	Description	Number	Gross salary	Total
<b>Personnel costs</b>				
<b>per year</b>	Ticket inspectors	0	0,00 €	0,00 €
	Points of sale staff	0	0,00 €	0,00 €
	Sales logistics	0	0,00 €	0,00 €
	Service depot staff	0	0,00 €	0,00 €
	Sales department	0	0,00 €	0,00 €
	Ticket machine technology	0	0,00 €	0,00 €
	Data processing	0	0,00 €	0,00 €
	Cash office	0	0,00 €	0,00 €
	<b>Subtotal</b>	<b>0</b>		<b>0,00 €</b>
	Overhead (in % of personnel costs)	50,00%		0,00 €
	<b>TOTAL</b>			<b>4.400.000,00 €</b>

No itemized data were provided for the personnel costs. The current and future personnel costs were entered and used.

**Commission costs****Existing system**

	Description			
				<i>(Amounts in €)</i>
<b>Commission costs</b>				
	Net fare revenues		42.000.000,00 €	
	Percentage for which commission costs accrue		17,00%	
	Subtotal		7.266.000,00 €	
	Commission share in %		3,00%	
				217.980,00 €
	<b>TOTAL</b>			<b>217.980,00 €</b>

**New system**

	Description			
				<i>(Amounts in €)</i>
<b>Commission costs</b>				
	Net fare revenues		42.000.000,00 €	
	Percentage for which commission costs accrue		8,50%	
	Subtotal		3.570.000,00 €	
	Commission share in %		3,00%	
				107.100,00 €
	<b>TOTAL</b>			<b>107.100,00 €</b>

The analyzed company concludes 17% of its net fare sales through external points of sale. At least half of these points of sale can be eliminated in a new system.

## Costs for handling money

### Existing system

Description		(Amounts in €)	
		%	
<b>Handling costs</b>			
	Net fare revenues		42.000.000,00 €
	Share of cash, in %	0,00%	0,00 €
	Cost fraction of the cash amount, in %	0,00%	0,00 €
	Cost fraction of the non-cash amount, in %	0,00%	0,00 €
	<b>Subtotal</b>		0,00 €
	<b>TOTAL</b>		<b>200.000,00 €</b>

### New system

Description		(Amounts in €)	
		%	
<b>Handling costs</b>			
	Net fare revenues		42.000.000,00 €
	Share of cash, in %	0,00%	0,00 €
	Cost fraction of the cash amount, in %	0,00%	0,00 €
	Cost fraction of the non-cash amount, in %	0,00%	0,00 €
	<b>Subtotal</b>		0,00 €
	<b>TOTAL</b>		<b>50.000,00 €</b>

The costs for handling money currently amount to € 200,000. Through pre-paid and post-paid procedures, this amount can be reduced to € 50,000.

## Operational maintenance

### Existing system

Description		Number	Costs	Total
<b>Operational maintenance</b>				
	Communication costs	0,00	0,00 €	0,00 €
	Energy costs	0,00	0,00 €	0,00 €
	EDP maintenance costs (updating and servicing the infrastructure)	0,00	0,00 €	0,00 €
	Interest expenses, post-paid procedure	0,00	0,00 €	0,00 €
	Financing	0,00	0,00 €	0,00 €
	Clearing	0,00	0,00 €	0,00 €
	Trip accounting	0,00	0,00 €	0,00 €
	Other operational costs	0,00	0,00 €	0,00 €
	<b>TOTAL</b>			0,00 €

### New system

Description		Number	Costs	Total
<b>Operational maintenance</b>				
	Communication costs	0,00	0,00 €	0,00 €
	Energy costs	0,00	0,00 €	0,00 €
	EDP maintenance costs (updating and servicing the infrastructure)	0,00	0,00 €	0,00 €
	Interest expenses, post-paid procedure	0,00	0,00 €	0,00 €
	Financing	0,00	0,00 €	0,00 €
	Clearing	0,00	0,00 €	0,00 €
	Trip accounting	0,00	0,00 €	0,00 €
	Other operational costs	0,00	0,00 €	250.000,00 €
	<b>TOTAL</b>			<b>250.000,00 €</b>

Detailed information on the operating costs was not available. It is expected that the operating costs of a new system will be € 200,000 more than in the existing system.

## Investments

### Existing system (re-investments)

	Description	Number	Price/unit	Total
<b>Investments</b>				
<b>Terminals and other system hardware</b>				
	Replacement of ticket machines	0,00	0,00 €	6.750.000,00 €
	Printers	0,00	0,00 €	0,00 €
	Ticket cancellers	0,00	0,00 €	2.000.000,00 €
	Control devices	0,00	0,00 €	0,00 €
	EDP systems (hardware & software)	0,00	0,00 €	0,00 €
	On-board computers	0,00	0,00 €	0,00 €
	Background systems	0,00	0,00 €	0,00 €
	Other	0,00	0,00 €	0,00 €
	<b>TOTAL</b>			8.750.000,00 €
	Yearly write-off over a depreciation period of	8,00	years	1.093.750,00 €

### New system

	Description	Number	Price/unit	Total
<b>Terminals and other system hardware</b>				
	On-board computers, buses and trams	0,00	0,00 €	4.500.000,00 €
	Vehicle communication facilities	0,00	0,00 €	0,00 €
	Card issuing and loading terminal (KALT)	0,00	0,00 €	6.500.000,00 €
	Multi-terminals	0,00	0,00 €	0,00 €
	Ticket counter terminals	0,00	0,00 €	0,00 €
	Driver terminals	0,00	0,00 €	0,00 €
	Stationary CICO terminals	0,00	0,00 €	5.250.000,00 €
	Mobile CICO terminals	0,00	0,00 €	0,00 €
	Control terminals	0,00	0,00 €	125.000,00 €
<b>Planning and development (factor of 10 times the operating costs) or:</b>				
	Functional design	0,00	0,00 €	0,00 €
	Technical design / realization	0,00	0,00 €	0,00 €
	Overhead (training, coordination, manuals)	0,00	0,00 €	0,00 €
	Risk surcharge production factor	0,00	0,00 €	0,00 €
	Project office	0,00	0,00 €	0,00 €
	General project costs	0,00	0,00 €	0,00 €
	Launch (internal communication, etc)	0,00	0,00 €	0,00 €
	Overall planning risk (10% of planning and development)	0,00	0,00 €	0,00 €
<b>Background systems</b>				
	Transp. co. computers	0,00	0,00 €	0,00 €
	Infrastructure (cable & wiring, transmission & reception stations, ..)	0,00	0,00 €	0,00 €
	Station computers	0,00	0,00 €	0,00 €
<b>Other</b>				
	Cards	1000000,00	2,50 €	2.500.000,00 €
	Remodeling	0,00	0,00 €	0,00 €
	Software	0,00	0,00 €	0,00 €
	<b>TOTAL</b>			28.875.000,00 €
	Subsidies	0,00%		28.875.000,00 €
	Yearly write-off over a depreciation period of	8,00	years	3.609.375,00 €

For the investment costs, the necessary re-investments in the existing system are compared to the necessary investments in the new system. Because no costs for planning and development had been ascertained, these costs were estimated as a factor of the operating costs. Because no absolute amount was available for the operating costs, they were multiplied by a factor of 20 instead of 10.

## One-time introduction costs

## New system

(Amounts in €)

	Description	Number	Costs	Total
	Conceptual design (consulting, reviews, ...)	0,00	0,00 €	0,00 €
	Training staff	0,00	0,00 €	0,00 €
	Migration costs	0,00	0,00 €	0,00 €
	Advertising and PR related to the launch	0,00	0,00 €	0,00 €
	Development of a new fare model	0,00	0,00 €	0,00 €
	Other project costs	0,00	0,00 €	1.000.000,00 €
	<b>TOTAL</b>			<b>1.000.000,00 €</b>

One-time introduction costs were estimated at a flat € 1 million.

## Part 2: Dynamic indexing of the basis data over 8 years

## Overview, existing system

(Amounts in €)

	Basis data	YEARS								TOTAL
		1	2	3	4	5	6	7	8	
<b>Benefits</b>										
Net fare revenues	42.000.000	42.000.000	42.840.000	42.840.000	43.696.800	43.696.800	44.570.736	44.570.736	45.462.151	349.677.223
Fare system modification	0	0	0	0	0	0	0	0	0	0
Additional traffic	0	0	0	0	0	0	0	0	0	0
Revenue reliability	0	0	0	0	0	0	0	0	0	0
Traffic logging and statistics	0	0	0	0	0	0	0	0	0	0
Optimization of operating fund deployment	0	0	0	0	0	0	0	0	0	0
Reduction in external transportation costs	0	0	0	0	0	0	0	0	0	0
One-time revenues	0	0	0	0	0	0	0	0	0	0
<b>Total benefits</b>	<b>42.000.000 €</b>	<b>42.840.000 €</b>	<b>42.840.000 €</b>	<b>43.696.800 €</b>	<b>43.696.800 €</b>	<b>44.570.736 €</b>	<b>44.570.736 €</b>	<b>45.462.151 €</b>	<b>45.462.151 €</b>	<b>349.677.223 €</b>
<b>Costs</b>										
Personnel costs	5.700.000	5.814.000	5.930.280	6.048.886	6.169.863	6.293.261	6.419.126	6.547.508	6.678.458	49.901.382
Commission costs	217.980	217.980	217.980	217.980	217.980	217.980	217.980	217.980	217.980	1.743.840
Money handling	200.000	196.000	192.080	188.238	184.474	180.784	177.168	173.625	170.153	1.462.522
Operational maintenance	0	0	0	0	0	0	0	0	0	0
Investments	8.750.000	1.093.750	1.093.750	1.093.750	1.093.750	1.093.750	1.093.750	1.093.750	1.093.750	8.750.000
Financing costs	0	525.000	459.375	393.750	328.125	262.500	196.875	131.250	65.625	2.362.500
One-time introduction costs	0	0	0	0	0	0	0	0	0	0
<b>Total costs</b>	<b>7.846.730 €</b>	<b>7.893.465 €</b>	<b>7.942.604 €</b>	<b>7.994.192 €</b>	<b>8.048.275 €</b>	<b>8.104.899 €</b>	<b>8.164.113 €</b>	<b>8.225.966 €</b>	<b>8.225.966 €</b>	<b>64.220.244 €</b>
<b>RESULT</b>	<b>34.153.270 €</b>	<b>34.946.535 €</b>	<b>34.897.396 €</b>	<b>35.702.608 €</b>	<b>35.648.525 €</b>	<b>36.465.837 €</b>	<b>36.406.623 €</b>	<b>37.236.185 €</b>	<b>37.236.185 €</b>	<b>285.456.978 €</b>

## Basic assumptions of dynamic indexing

## Benefits

Net fare revenues	100,0%	+ 2,00%		+ 2,00%		+ 2,00%		+ 2,00%
Additional traffic	100,0%							
Fare system modification	100,0%							
Revenue reliability	100,0%							
Traffic logging and statistics	100,0%							
Optimization of operating fund deployment	100,0%							
Reduction in external transportation costs	100,0%							
One-time revenues	100,0%							

## Costs

Personnel costs	100,0%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%
Commission costs	100,0%							
Money handling	100,0%	- 2,00%	- 2,00%	- 2,00%	- 2,00%	- 2,00%	- 2,00%	- 2,00%
Operational maintenance	100,0%							
Investments	100,0%							
Financing costs	6,0%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%
One-time introduction costs	100,0%							

For the dynamic indexing, it was decided that the fare prices would be increased every other year and lead to a 2% increase in net fare revenues, that personnel costs would increase by 2% yearly, that the costs for handling money would decrease yearly by 2%, and that the financing costs would remain constant at 6%.

## Overview, new system

(Amounts in €)

	Basis data	YEARS								TOTAL
		1	2	3	4	5	6	7	8	
<b>Benefits</b>										
<b>Net fare revenues</b>	42.000.000	42.000.000	42.840.000	42.840.000	43.696.800	43.696.800	44.570.736	44.570.736	45.462.151	349.677.223
<b>Fare system modification</b>	630.000	630.000	639.450	649.042	658.777	668.659	678.689	688.869	699.202	5.312.689
<b>Additional traffic</b>	840.000	840.000	856.800	873.936	882.675	891.502	891.502	891.502	891.502	7.019.420
<b>Revenue reliability</b>	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	10.080.000
<b>Traffic logging and statistics</b>	100.000	100.000	102.000	102.000	102.000	102.000	102.000	102.000	102.000	814.000
<b>Optimization of operating fund deployment</b>	800.000	800.000	816.000	816.000	816.000	816.000	816.000	816.000	816.000	6.512.000
<b>Reduction in external transportation costs</b>	609.000	609.000	621.180	627.392	633.666	640.002	646.402	652.866	659.395	5.089.904
<b>One-time revenues</b>	0	0	0	0	0	0	0	0	0	0
<b>Total benefits</b>		46.239.000 €	47.135.430 €	47.168.370 €	48.049.918 €	48.074.964 €	48.965.329 €	48.981.974 €	49.890.250 €	384.505.235 €
<b>Costs</b>										
<b>Personnel costs</b>	4.400.000	4.400.000	4.488.000	4.577.760	4.669.315	4.762.702	4.857.956	4.955.115	5.054.217	37.765.064
<b>Commission costs</b>	107.100	107.100	107.100	107.100	107.100	107.100	107.100	107.100	107.100	856.800
<b>Money handling</b>	50.000	50.000	49.500	49.005	48.515	48.030	47.550	47.074	46.603	386.277
<b>Operational maintenance</b>	250.000	250.000	255.000	260.100	265.302	270.608	276.020	281.541	287.171	2.145.742
<b>Investments</b>	28.875.000	3.609.375	3.609.375	3.609.375	3.609.375	3.609.375	3.609.375	3.609.375	3.609.375	28.875.000
<b>Financing costs</b>		1.732.500	1.515.938	1.299.375	1.082.813	866.250	649.688	433.125	216.563	7.796.250
<b>One-time introduction costs</b>	1.000.000	1.000.000	0	0	0	0	0	0	0	1.000.000
<b>Total costs</b>		11.148.975 €	10.024.913 €	9.902.715 €	9.782.420 €	9.664.064 €	9.547.688 €	9.433.329 €	9.321.029 €	78.825.133 €
<b>RESULT</b>		35.090.025 €	37.110.518 €	37.265.655 €	38.267.498 €	38.410.899 €	39.417.642 €	39.548.645 €	40.569.221 €	305.680.102 €

## Basic assumptions of dynamic indexing

Benefits									
Net fare revenues	100,0%		+ 2,00%		+ 2,00%		+ 2,00%		+ 2,00%
Fare system modification	100,0%		+ 2,00%	+ 2,00%	+ 1,00%	+ 1,00%			
Additional traffic	100,0%		+ 1,50%	+ 1,50%	+ 1,50%	+ 1,50%	+ 1,50%	+ 1,50%	+ 1,50%
Revenue reliability	100,0%								
Traffic logging and statistics	100,0%		+ 2,00%						
Optimization of operating fund deployment	100,0%		+ 2,00%						
Reduction in external transportation costs	100,0%		+ 2,00%	+ 1,00%	+ 1,00%	+ 1,00%	+ 1,00%	+ 1,00%	+ 1,00%
One-time revenues	100,0%								
Costs									
Personnel costs	100,0%		+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%
Commission costs	100,0%								
Money handling	100,0%		- 1,00%	- 1,00%	- 1,00%	- 1,00%	- 1,00%	- 1,00%	- 1,00%
Operational maintenance	100,0%		+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%	+ 2,00%
Investments	100,0%		- 100,00%						
Financing costs	6,0%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%	+ 6,00%
One-time introduction costs	100,0%		- 100,00%						

Beyond the assumptions made in the existing system, more additional traffic is expected in the first four years. By flexibly adjusting fares, an additional 1.5% revenue growth can be attained each year.

Further optimization in traffic logging and deployment of operational funds are included once in the second year. An increase in operating costs of 2% per year is expected. The introduction costs and the investments are incurred only in the first year.

## Difference between new and old system

(Amounts in €)

	Basis data	YEARS								TOTAL
		1	2	3	4	5	6	7	8	
<b>Benefits</b>										
Net fare revenues	0	0	0	0	0	0	0	0	0	0
Fare system modification	630.000	630.000	639.450	649.042	658.777	668.659	678.689	688.869	699.202	5.312.688
Additional traffic	840.000	840.000	856.800	873.936	882.675	891.502	891.502	891.502	891.502	7.019.420
Revenue reliability	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	1.260.000	10.080.000
Traffic logging and statistics	100.000	100.000	102.000	102.000	102.000	102.000	102.000	102.000	102.000	814.000
Optimization of operating fund deployment	800.000	800.000	816.000	816.000	816.000	816.000	816.000	816.000	816.000	6.512.000
Reduction in external transportation costs	609.000	609.000	621.180	627.392	633.666	640.002	646.402	652.866	659.395	5.089.904
One-time revenues	0	0	0	0	0	0	0	0	0	0
<b>Total benefits</b>		4.239.000 €	4.295.430 €	4.328.370 €	4.353.118 €	4.378.163 €	4.394.593 €	4.411.238 €	4.428.099 €	34.828.012 €
<b>Costs</b>										
Personnel costs	-1.300.000	-1.414.000	-1.442.280	-1.471.126	-1.500.548	-1.530.559	-1.561.170	-1.592.394	-1.624.242	-12.136.318
Commission costs	-110.880	-110.880	-110.880	-110.880	-110.880	-110.880	-110.880	-110.880	-110.880	-887.040
Money handling	-150.000	-146.000	-142.580	-139.233	-135.959	-132.754	-129.619	-126.551	-123.549	-1.076.246
Operational maintenance	250.000	250.000	255.000	260.100	265.302	270.608	276.020	281.541	287.171	2.145.742
Investments	20.125.000	2.515.625	2.515.625	2.515.625	2.515.625	2.515.625	2.515.625	2.515.625	2.515.625	20.125.000
Financing costs	0	1.207.500	1.056.563	905.625	754.688	603.750	452.813	301.875	150.938	5.433.750
One-time introduction costs	1.000.000	1.000.000	0	0	0	0	0	0	0	1.000.000
<b>Total costs</b>		3.302.245 €	2.131.448 €	1.960.111 €	1.788.228 €	1.615.790 €	1.442.788 €	1.269.216 €	1.095.063 €	14.604.888 €
<b>RESULT</b>		936.755 €	2.163.983 €	2.368.259 €	2.564.891 €	2.762.374 €	2.951.805 €	3.142.022 €	3.333.036 €	20.233.124 €

As a pure analysis, this table merely shows the differences between the individual cost and benefit categories over the observed time period of 8 years. This table serves as a basis for calculating net present value.

When transferring data into the table for calculating net present value, it is important to observe that the net present value calculation takes into consideration an interest rate; for this reason, there is no entry for financing costs. In the net present value method, costs are considered payments in, benefits are considered payouts. Payments in Year 0: total investment costs + one-time costs.

Payouts in Year 0: none

### Part 3: Evaluation of the results

#### Net present value calculation including general economic benefits

Interest rate 6%

	Year								
	0	1	2	3	4	5	6	7	8
Payments in (costs)	21.125.000 €	-1.420.880 €	-1.440.740 €	-1.461.139 €	-1.482.085 €	-1.503.585 €	-1.525.649 €	-1.548.284 €	-1.571.499 €
Payouts (benefits)	0 €	4.239.000 €	4.295.430 €	4.328.370 €	4.353.118 €	4.378.164 €	4.394.593 €	4.411.238 €	4.428.099 €
Cash value	-21.125.000 €	5.339.509 €	5.105.171 €	4.860.983 €	4.622.028 €	4.395.185 €	4.173.537 €	3.963.422 €	3.764.223 €
Net present value	<b>-21.125.000 €</b>	<b>-15.785.491 €</b>	<b>-10.680.320 €</b>	<b>-5.819.337 €</b>	<b>-1.197.309 €</b>	<b>3.197.876 €</b>	<b>7.371.413 €</b>	<b>11.334.836 €</b>	<b>15.099.058 €</b>

#### Net present value calculation excluding general economic benefits

Interest rate 6%

	Year								
	0	1	2	3	4	5	6	7	8
Payments in (costs)	21.125.000 €	-1.420.880 €	-1.440.740 €	-1.461.139 €	-1.482.085 €	-1.503.585 €	-1.525.649 €	-1.548.284 €	-1.571.499 €
Payouts (benefits)	0 €	3.630.000 €	3.674.250 €	3.700.978 €	3.719.453 €	3.738.161 €	3.748.191 €	3.758.371 €	3.768.704 €
Cash value	-21.125.000 €	4.764.981 €	4.552.323 €	4.334.213 €	4.120.105 €	3.916.938 €	3.717.849 €	3.529.229 €	3.350.510 €
Net present value	<b>-21.125.000 €</b>	<b>-16.360.019 €</b>	<b>-11.807.696 €</b>	<b>-7.473.483 €</b>	<b>-3.353.378 €</b>	<b>563.560 €</b>	<b>4.281.409 €</b>	<b>7.810.638 €</b>	<b>11.161.148 €</b>

This table illustrates the development of the present value of the planned investment. The only configurable variable here is the interest rate, since all other parameters have been specified in previous tables. A distinction is made between general economic and business management perspectives.

The calculation is based on the results of the differential formation. This means that as a payment (investment), only the differential amount between what would have to be invested in the new system and that which would have to be reinvested in the old system is used. This approach also applies to the income.

The results show that in the general economic perspective, the present value will already be positive in the fifth year, and thus the investment is recommended. From the business management perspective, the present value of the investment is also already positive in the fifth year, but not so large. Hence the investment also makes sense from the business management perspective.