



Effectiveness of the urban services electronic payment systems on the example of silesian card of public services

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ABSTRACT

Electronic payment systems used for urban services are implemented and funded by the public sector. Those are rather big investments, characterized by high costs, but they also allow for gaining profits – mainly connected with the transport offer optimization and with more effective price management. When preparing the documents, among other papers concerning functionality or technical and technological solutions, it is necessary to prepare a feasibility study, in which the assessment of the effectiveness of such investments is an important part. To do so, one ought to identify and assess the costs and the profits connected with the realization of such projects. Such assessment ought to be performed within the frame of financial analyses (from the perspective of the unit implementing and using the solutions) and of economic analyses within which the external costs and profits should also be considered.

KEYWORDS: economic effectiveness, electronic payment systems, urban services, external costs and profits, urban transport

1. Introduction

In cities, both in Poland and abroad, the electronic card based payment systems are being implemented in urban collective transport services. There is a tendency to find the solutions in which it will be possible to pay not only for urban transport services, but also for other urban services (parking, fees paid in urban institutions), taxes, and to pay for the goods not provided by the public sector in the places where one may pay by a credit card [1].

However, despite widening the function and the service range, for which one may pay thus, among public services the biggest financial flow is connected with payments for urban collective transport services [2].

Electronic payment systems used for urban services are implemented by the public sector. Those are investments characterized by relatively high implementation costs, as well as

great operational costs (for example Warsaw, where an electronic card payment system was implemented in 2001, the worth of contract was PLN 91 million net). When making a decision concerning the implementation of an electronic payment system for transport services, or, more widely, for the services provided by the public sector, it is necessary to assess the effectiveness of such investment, especially the ratio of investment compared to potential profits [3]. One ought to take into consideration the fact that part of the profits, connected with the implementation, come from the transport system environment, both on a local and on a national scale. It is important to predict the investment costs precisely, as very often in the case of IT projects the costs and time of realization are underestimated [4]. Often, when preparing the feasibility study, not all the costs are identified, focusing mostly on purchasing the equipment and the software or on expenses of investing costs. On the example of the project being prepared in the central part of Śląskie Voivodeship, the

implementation of Silesian Card of Public Services (ŠKUP), the costs and the advantages connected with the implementation of electronic card payment system for the urban services will be presented.

2. The rules of assessing the effectiveness of investment projects

IT projects do not generally differ from typical investments, therefore they are subjected to standard procedures of financial and economic assessment. To assess the investment project one may use simple methods of financial assessment of developing projects and more precise methods – discount economic outcome account, taking into consideration the time factor using a discount technique, meaning the method based on calculating the net present value (NPV) and the method within which the internal rate of return (IRR) is calculated and used. Simplified methods, despite many faults and imperfections, have one important advantage, allowing to decide in a quick and rather unambiguous way whether given investment should be realized. Financial assessment is performed from the perspective of the unit realizing given investment project.

The net present value (NPV) presents the current (present) value of profits and costs connected with the realized project and appearing at various times. It is calculated as the sum of separately discounted – for each year – net financial flows. Those consist of the difference among the stream of costs and profits in the whole period covered by the calculation. In the case of private units and projects performed without public part, two situations are possible due to financial assessment:

- $NPV > 0$, one of the variants of $NPV > 0$ is chosen to be realized, of course it is also assessed from the perspective of its influence on the environment, and when realizing the investment the norms and legal regulations are followed, obviously including those concerning the influence on the environment,
- $NPV < 0$ given variant of investment realization is not characterized by financial flows, in the case of private units or in the case of a project performed without public part the investment will not be realized, as it is not profitable.

In the case of private units, or in the case of projects in which there will be a public intervention, other rules are followed:

- $NPV > 0$ - one of the variants with positive NPV is to be realized, such situation, however, does not happen often in the case of investment realized with public money as the goods, the delivery of which is the effect of the investment, are usually the subject of the market turnover and are provided by the private sector (production and delivery of those goods is profitable, it allows for gaining financial surpluses and therefore private sector is interested in them).
- $NPV < 0$ - in this case one needs to widen the calculations with external costs and profits, therefore to run the calculations not only from the perspective of the unit (own costs and profits), but also from the perspective of the society, meaning to take into consideration social costs and profits, widening financial analyses, calculating ENPV (economic net present value).

The economic analysis takes into consideration all costs and profits of socio-economic character. It allows to answer the question whether the investment is justified from the general social point of view. Therefore it seems necessary to calculate the economic effectiveness factors of the investment ENPV and ERR (economic rate of return) including external costs, which are the source of social costs, and profits due to the project realization. Two cases are possible:

- $ENPV > 0$ the project should be realized, it brings profits to the society, or to the chosen groups of people, units, municipalities, regions,
- $ENPV < 0$ project should not be realized as it is not profitable from the society perspective.

The method of internal rate of return is the second among the most popular discount methods. The internal rate means the discount rate with which the actual worth of financial expenditure flow equals the actual flow of financial profits. The IRR shows a precise profitability rate for which $NPV = 0$. A single investment project is profitable when its internal rate of return is higher than the cut-off rate, which is the lowest possible profitability rate acceptable for an investor. The cut-off rate may be related to interest rate free from risk (e.g. bank deposit interest rate), other alternative investments, maximum possible capital costs which may be accepted, costs available for the given unit.

Calculations performed based on these methods are not difficult. In practice, the most difficult part is to identify and to assess costs and profits connected with the realization of the investment in the set time limit.

3. Identification of the costs combined with implementing electronic card based payment system

Costs may be classified according to various criteria, therefore a costs prognosis may be identified and presented in many ways. To assess the costs level one may use costs accounting setting, meaning the identification of costs according to the places of their creation and, somewhat supporting, sharing the costs according to their type (independently from the places of their origin) [5]. The example of the setting and the level of the costs of the project connected with implementing the fee for public services was presented in Table 1. It presents the data from the project currently realized by the Municipal Transport Union of the Upper Silesian Industrial District (KZK GOP). The table presents both the expenditures of investment and operational character, so that the total expenditure on the project realization is visible. The project will be realized by the local government unit (inter-municipality union), therefore the depreciation cost of fixed assets was omitted. Moreover, it seems a good solutions, especially in the case of IT projects, to connect in one tender, and thus in one contract, the investment project and later, the system maintenance. It allows to avoid many situations that are unfavourable for the contracting entity [6].

Table 1. The assessment of the implementation costs of Silesian Card of Public Services system (net PLN) [7]

No	Costs item	Investment period						Total costs in investment period
		year 1	year 2	year 3	year 4	year 5	year 6	
1	2	3	4	5	6	7	8	9
1.	Costs of issuing and maintaining cards and the costs of equipping the municipalities with the devices to certify electronic signature	0	0	0	0	0	13 556 328	13 556 328
a	Including: investment costs	0	0	0	0	0	209 300	209 300
b	operational costs	0	0	0	0	0	13 347 028	13 347 028
2.	Card charging machines, parking counters, municipality devices, card charging centres	0	0	0	0	11 007 788	12 024 684	23 032 472
a	Including: investment costs	0	0	0	0	11 007 788	12 024 684	23 032 472
b	operational costs	0	0	0	0	0	0	0
3.	Devices in vehicles, in depots and to control passengers' tickets	0	0	0	0	27 649 397	4 256 406	31 905 803
a	Including: investment costs	0	0	0	0	27 649 397	4 256 406	31 905 803
b	operational costs	0	0	0	0	0	0	0
4.	Costs of the system software	0	0	0	5 688 828	17 582 000	4 540 164	27 810 992
a	Including: investment costs	0	0	0	5 688 828	17 582 000	4 540 164	27 810 992
b	operational costs	0	0	0	0	0	0	0
5.	Data transmission centre and purchasing ICT equipment	0	26	31 486	7 754 269	312 318	151 502	8 249 601
a	Including: investment costs	0	0	0	7 635 523	0	0	7 635 523
b	operational costs	0	26	31 486	118 746	312 318	151 502	614 079
6.	Remuneration of accounting agent	0	0	0	0	0	1 035 000	1 035 000
a	Including: investment costs	0	0	0	0	0	0	0
b	operational costs	0	0	0	0	0	1 035 000	1 035 000
7.	Project management costs	347 382	763 502	942 002	1 506 933	3 648 732	2 565 582	9 774 133
a	Including: investment costs	119 080	49 496	958	187 411	1 434 336	2 100 000	3 891 281
b	operational costs	228 302	714 006	941 044	1 319 522	2 214 397	465 582	5 882 853
8.	Other costs	3 207	17 040	11 543	91 535	5 360 885	4 665 045	10 149 254
a	Including: investment costs	0	0	0	0	0	0	0
b	operational costs	3 207	17 040	11 543	91 535	5 360 885	4 665 045	10 149 254
9.	Total costs (net)	350 589	780 568	985 030	15 041 565	65 561 120	42 794 712	125 513 584
a	Including: investment costs	119 080	49 496	958	13 511 762	57 673 520	23 130 554	94 485 370
b	operational costs	231 509	731 072	984 073	1 529 803	7 887 600	19 664 158	31 028 214

The contract for delivery, implementation and maintenance of the system of „Silesian Card of Public Services” was signed by the KZK GOP on the 9th January 2012. Trying to point cost positions so that it will be possible to identify the places of costs

origination as well as the places and activities generating the highest realization costs of this project, one may enumerate the following types of costs:

1. Costs connected with issuing and the maintenance of cards (purchase of the driver, personalizing, card issuing, documents archiving) and the costs of equipping the municipalities with the devices to certify the electric signature. During the project realization and the system operation it is estimated to issue around 700 thousand cards (385 thousand during the realization period and 325 thousand within 5 years after the project has been implemented, which is connected with the cards wearing off and the necessity to issue new ones).
2. Card charging machines, parking counters, municipality machines, card charging centres. It was estimated that within the project 800 centres will be equipped with the machines to charge the cards. Moreover, 109 free-standing machines were designed with the function to charge the cards, 223 parking counters enabling parking fees payment and 410 modules to accept payments for municipality services.
3. Devices in vehicles, in depots and to control passengers' tickets. In order to implement the electronic payment system based on electronic cards it will be necessary to equip 1,300 vehicles used to provide passenger transport services based on the contract with the KZK GOP. Within the project they will be equipped with modules to accept payments, board computers, devices for data transmission and other necessary elements. Moreover, 20 depots will be equipped with the proper infrastructure to collect data. What is more, 320 devices to control passenger rights to use urban collective transport services will be bought.
4. The system software and the cost of software installation and configuration.
5. Data transmission centres and purchasing ICT equipment – purchasing ICT equipment together with its installation and the expenditure connected with creating and equipping the main and the support data transmission centres.
6. Remuneration of the accounting agent. The implementation of a system for accepting payment based on electronic money requires payment accounting.
7. Project management costs – taking into account the costs of creating and operation of the managing and accounting unit, responsible for organizational, technical and formal issues of the project. Such costs include remuneration, information-promotion costs, costs of training the system users, of buying fixed assets and office equipment to manage the project, as well as the costs of consultations, opinions, analyses within the framework of tasks realized for the project use.
8. Other costs, including system maintenance costs, project audit costs, purchasing the fuel and fleet management, other administrative costs, insurance costs, system testing costs, supplement and additional orders costs.

It is visible on the example of the presented data that the realization of the project to implement an electronic card payment system requires expenses of around PLN 125.5 million net. During the first three years mainly personal costs, due to the project preparation, are incurred, meaning the ones connected with enabling the project to be realized.

Independently of the costs incurred during the project realization also the costs to be incurred after its implementation completion – during the system use – are assessed. It is to be discussed how long period should be taken to analyse a given investment; most often it is the time of use/depreciation of the fixed assets included in the given project. In the chosen example, IT tools dominate, and they have a relatively short depreciation time. The period of 65 months was assumed for the sake of calculation as the minimum length of the project which is to be guaranteed in order to obtain the resources from the European Regional Development Fund. However, big IT systems, comprising many subjects and requiring substantial expenditures, are not so quickly exchanged for new ones. That is why the system operation period will certainly be longer than that taken for assessment. Costs of the public services payment system operation are presented in Table 2. Within the period of 65 months after the investment process has finished and during its normal operation those costs will reach the level of PLN 11.9 million per year. The greatest costs are connected with issuing and maintaining the cards (around PLN 3.3 million per year), with the accounting agent remuneration (around PLN 2.7 million per year) and with the project management costs (around PLN 2.4 million per year).

It is assumed that the project will last 65 months, but it is now difficult to precisely predict when the investment period is to close and the use period starts. That is because of the fact that part of the equipment will function before the investment period has finished.

4. Identification of profits connected with the electronic payment system implementation

identification of profits gained from development projects is performed from the perspective of profits gained by direct beneficiaries (financial analysis of the project) and from the perspective of its influence on its environment (economic analysis of the project) [8].

From the KZK GOP perspective, which is the project leader and at the same time, the urban collective transport organizer, the implementation of electronic payment system will allow to gain the following profits:

1. Limiting the expenses incurred due to performing operational work as a result of more effective transport offer management. Collecting fares with the use of an electronic payment system allows to collect data enabling a current analysis of the use of urban transport vehicles. This is especially important in the situations when the vehicles run almost empty and when they are overcrowded. Basing on the obtained data it is possible to dynamically manage the transport offer, especially within the area of changing the number of services a day or the size of vehicles set to service a given line. It is estimated that the expenses may be lowered by 1% to 2% of total operational expenses;

Table 2. The operational costs of public services payment systems (net PLN) [7]

No	Costs item	Working period						Total costs in working period
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	
1	2	3	4	5	6	7	8	9
1.	Costs of issuing and maintaining cards	7 448 684	1 600 000	1 600 000	1 600 000	5 360 361	172 308	17 781 352
a	<i>Including: investment costs</i>	0	0	0	0	0	0	0
b	operational costs	7 448 684	1 600 000	1 600 000	1 600 000	5 360 361	172 308	17 781 352
2.	Card charging machines service	661 538	793 846	793 846	793 846	793 846	463 077	4 300 000
a	<i>Including: investment costs</i>	0	0	0	0	0	0	0
b	operational costs	661 538	793 846	793 846	793 846	793 846	463 077	4 300 000
3.	Data trans-mission centre operation	267 000	440 000	440 000	440 000	440 000	356 333	2 383 333
a	<i>Including: investment costs</i>	0	0	0	0	0	0	0
b	operational costs	267 000	440 000	440 000	440 000	440 000	356 333	2 383 333
4.	Remuneration of accounting agent (data trans-mission included)	2 243 115	2 691 738	2 691 738	2 691 738	2 691 738	1 570 181	14 580 250
a	<i>Including: investment costs</i>	0	0	0	0	0	0	0
b	operational costs	2 243 115	2 691 738	2 691 738	2 691 738	2 691 738	1 570 181	14 580 250
5.	Project management costs	1 950 416	2 282 696	2 442 351	2 533 286	2 628 768	1 344 548	13 182 065
a	<i>Including: investment costs</i>	0	0	0	0	0	0	0
b	operational costs	1 950 416	2 282 696	2 442 351	2 533 286	2 628 768	1 344 548	13 182 065
6.	Other costs	1 290 656	1 642 028	1 742 028	2 142 028	1 942 028	3 508 696	12 267 466
a	<i>Including: investment costs</i>	151 466	335 000	435 000	835 000	635 000	403 000	2 794 466
b	operational costs	1 798 950	1 947 696	2 007 351	1 698 286	1 993 768	941 548	10 387 599
7.	Total costs (net)	13 861 410	9 450 309	9 709 964	10 200 899	13 856 741	7 415 143	64 494 466
a	<i>Including: investment costs</i>	151 466	335 000	435 000	835 000	635 000	403 000	2 794 466
b	operational costs	14 369 704	9 755 977	9 975 287	9 757 157	13 908 481	4 847 995	62 614 600

in the case of KZK GOP it is from PLN 4.6 million to PLN 9.2 million per year.

2. Limiting the expenses connected with printing the paper tickets – from about 25% to about 75% of current expenses, that is from PLN 162 thousand to PLN 487 thousand per year.
3. Acquiring data from electronic payment systems will allow to eliminate current expenses on measuring the number of passengers in vehicles, so far the annual expenses for this task has been around PLN 300 thousand.
4. The implementation of electronic card payment system will enable price differentiation to a greater degree than in the case of paper tickets. It is estimated that it is possible to gain additional profits because of that, amounting to 1.5 % of annual income from tickets, meaning up to PLN 3.5 million for the KZK GOP.

Electronic payment systems create the possibility to gain the enumerated profits, but their scale will depend on how, from the moment of implementing new technologies, the work organization in the units will change, and how the conditions will allow to use modern technology. Urban collective transport is subject to regulations both in the case of price setting and in the case of conditions to perform transport services. Moreover, social policy, health protection and urban planning policy to a large extent are realized with the use of urban collective transport prices. That is why one may claim that reaching the profits greatly depends on the possibility to implement and to accept new solutions as far as prices are concerned, and that is quite beyond decision capability of organizers or providers of urban collective transport [9]. That is why the profits should be calculated in two variants: minimal and maximal.

It is visible, even without discounting, that the profits gained by the project leader are lower than the necessary means to implement and later to operate the system, therefore the NPV is negative. For example, the NPV calculated for the value of the interest rate of 6% is PLN (-) 94.3 million (in the variant of maximum benefit) and for the interest rate of 8% (in the variant of maximum benefit) NPV is PLN (-) 87.9 million. The NPV rate is also negative for higher interest rates. Therefore, in the absence of co-financing from the European Union, the internal rate of return (IRR) is at the level, which is not acceptable for the leader of the project.

The implementation of electronic payment systems to pay for urban services also allows to gain external profits:

1. The implementation of electronic payment system may be a tool to perform accounting among various units that provide transport services, especially in bigger cities. Electronic payment systems allow to perform such calculations based on the number of passengers carried by the given transport provider or based on the transport performance. Thanks to the facilities to use collective transport, one may expect them to be the factors limiting the decrease of collective transport share in servicing transport needs of cities.
2. Another type of external profits may be gained due to widening the range of cash-free financial flow. Cash calculations are connected with physical transporting of banknotes and coins and with paying with them, due to which they generate high costs for units, banks (accepting cash, authenticity veri-

fication, value verification, transport to a bank, accepting it by a bank, transport among banks etc.) as well as the effects on a macro-economic scale. Many of these activities are performed manually, the security is unavoidable and the risk is high. As a result, cash management costs may reach even 4.5% of its value, and the costs of cash financial flows in a country may reach even 1% GDP. Moreover, cash accounting may evoke cheating, certain abusing when calculating, thus making it difficult to tax the transaction and limiting the incomes for the country budget [10, 11]. That is why there is the tendency to popularize cash-free financial flows.

3. The popularization of IT technologies facilitates the use of many services, therefore it is then promoting the information society, new technologies, teleworking, the availability of many services with the use of computer network. Implementing new technologies when using public services means also improving the region cities as places owning developed technologies and implementing innovative solutions [12].

Taking into account external profits possible to be gained, IT systems, implemented within public services area may receive co-funding from regional or national programs. However, independently of the received funding, which generally concerns eligible investment costs, it is in the ordering party's interest to have such realization so that after the system implementation the costs of payment system operation are in majority, or at least significantly funded from the reached savings and the increased profits.

5. Conclusion

The implementation of cash-free payment forms for public services, realized through so called city cards, is connected with the need to create a wide ICT infrastructure as well as the infrastructure of service centres for issuing cards, their charging, selling seasonal tickets and accepting fares. Issuing electronic cards (purchasing the driver, personalization, card issuing, documents archiving), selling seasonal tickets and charging electronic wallet, buying, current maintenance and keeping the machines enabling card charging in order, purchasing the machines for service payment in municipalities, for parking and in collective transport vehicles, as well as creating data transmission centres generate high costs both during the investment period and after the solution implementation. Additionally, the project is complicated, and therefore it has its costs increased by the necessity to provide accounting among various units and parties. The implementation of the payment system generates profits, they may be perceived from the perspective of profits gained directly by the beneficiaries (KZK GOP and the cities) as well as from the perspective of external profits identified at the local and national level. Electronic payment systems may provide information concerning passengers' travels, therefore, within gains reached in urban transport one may enumerate the profits reached due to more effective transport offer management, lowering expenses connected with printing paper tickets and possible profit increase due to ticket sale as a result of better price management.

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