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COST-EFFECTIVENESS EVALUATION OF SMART CARDS INTRODUCTION IN FINANCIAL INSTITUTIONS

The paper explores the perspectives of smart cards introduction in Russian financial institutions. Key methods of evaluating the effectiveness of financial investments in information projects are analyzed. Costs of bank plastic cards with magnetic stripe and bank smart cards are estimated by the method total cost of ownership. The comparative analysis of expenses for each type of cards is carried out subject to possible funds embezzlement from bank cards.
Keywords: bank plastic cards; total cost of ownership; funds embezzlement.

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ОЦІНЮВАННЯ ЕКОНОМІЧНОЇ ЕФЕКТИВНОСТІ ВПРОВАДЖЕННЯ СМАРТ-КАРТ У ФІНАНСОВИХ УСТАНОВАХ

У статті розглянуто перспективи впровадження смарт-карт в російських фінансових установах. Проаналізовано основні методи оцінювання ефективності фінансових вкладень в інформаційні проекти. Розраховано витрати на впровадження банківських пластикових карт із магнітною смугою і банківських смарт-карт за методом сукупної вартості володіння. Проведено порівняльний аналіз за витратами на кожен вид картки, з урахуванням можливих обсягів розкрадань коштів з банківських карт.
Ключові слова: банківські пластикові картки; сукупна вартість володіння; розкрадання коштів.
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ОЦЕНКА ЭКОНОМИЧЕСКОЙ ЭФФЕКТИВНОСТИ ВНЕДРЕНИЯ СМАРТ-КАРТ В ФИНАНСОВЫХ ИНСТИТУТАХ

В статье рассмотрены перспективы внедрения смарт-карт в российских финансовых институтах. Проанализированы основные методы оценки эффективности финансовых вложений в информационные проекты. Рассчитаны затраты на внедрение банковских пластиковых карт с магнитной полосой и банковских смарт-карт по методу совокупной стоимости владения. Проведен сравнительный анализ по затратам на каждый вид карты с учетом возможных объемов хищений средств с банковских карт.
Ключевые слова: банковские пластиковые карты; совокупная стоимость владения; хищение средств.

Problem setting. These days we witness quite rapid development of bank cards market in Russia, the reason is in the growth of cashless payments. The common universal estimated network is created by means of cash cards. This system allows providing the service of mass daily payments of the country's population and leads to the considerable reduction in the proportion of cash transactions and a qualitative change in the structure of financial flows in Russia.

Bank cards use considerably influences the increase of cashless money turnover; reduces the distribution of cash. Besides, bank cards have a significant impact on the turnover and profit growth, competitiveness increase and prestige of banks, enterprises of retail trade and other organizations which accept plastic cards for payment.

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Now financial institutions more often transfer from cards with magnetic stripe to smart cards, which provide greater reliability in carrying out banking operations.

Resent research and publications analysis. Tendencies and prospects for the application of smart cards are widely covered in the papers by Catherine and William (1996), Dreifus and Monk (2008), Goldman (2014), Rosen (1975), Saki (2010), Slawsky and Zafar (2005), Svigals (1987), Tavasiev et al. (2005), Turban et al. (2013) and many others. However, the usage of smart cards in banking is not sufficiently disclosed thus determining the relevance and need for further study.

The research objective is the cost-effectiveness evaluation of the smart cards usage in financial institutions in terms of their security in comparison with magnetic cards.

Key research findings. When using plastic cards the main problem is the security of funds on the owner card.

According to the FICO company data, which technologies protected 65% of cards in the world, the damage from cybercrimes in Russia grew approximately by 35% in 2013. In terms of embezzlement Russia takes the fifth place in Europe (Figure 1).
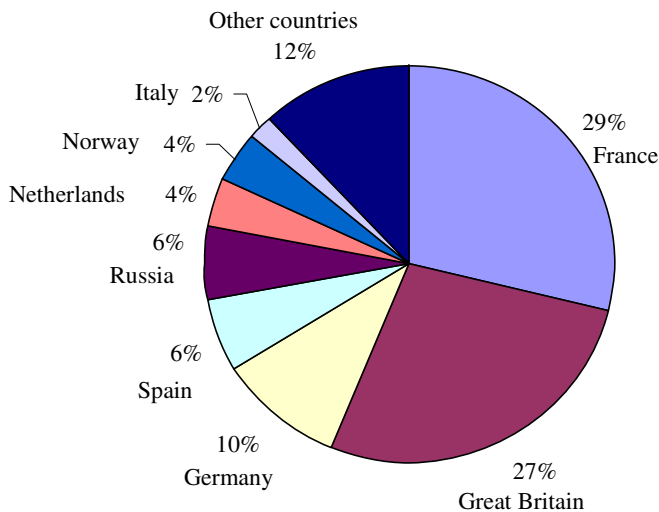

Figure 1. **Ratio of embezzlement funds from bank cards in Europe** (Kiselev, 2013)

The question of saving money on bank cards for financial institutions in Russia became particularly relevant since January 1, 2014. On this day the article 9 of the Law "On National Payment System" came into force, according to which banks are obliged to return money to clients if those prove that transaction was made by the third person without the knowledge of the card holder (Gorovtsova, 2013).

Introduction of information technology can be considered as an investment project, but the financial result is less obvious, and risks are higher. Information projects are much more scale, as they should be evaluated not only as initial investment of resources, but also after the introduction stages: service, maintenance, improvement, training etc. All this needs additional resources and efforts. Essential requirement before the introduction of information technology should be its economic

assessment, finding an effect that can be obtained by investing in this information project.

Currently to evaluate the effectiveness of information projects, there exist several methods that can be divided into 3 basis groups: financial (quantitative), qualitative, probabilistic (www.clblog.ru).

The most effective method under the initial stage of introduction is the TCO (total cost of ownership) method. The TCO method is the most effective mechanism for instant assessment of total costs of the enterprise on IT infrastructure. It was developed by the Gartner Group in the 1980s (Ellram, 1995; Hirschhein and Klein, 1991; Kuznetsova and Shimansky, 2012; META Group, 1997; Rainer et al., 2013; Walker, 2009).

TCO of the information system (IS) is the expenses associated with acquisition, implementation and use of IS. The TCO methodology provides for the evaluation of expenses on IT-infrastructure and its separate components.

For an approximate estimate of the effectiveness of smart cards introduction we build a model on the basis of TCO, which allows analyzing the system introduction costs.

Analyzing the total cost of ownership method for an information system implementation, which includes both the initial investment I and the costs of the current work E_{month} during the evaluation period T_{plan}, is calculated by the following formula (Ellram, 1995; Kuznetsova and Shimansky, 2012; Walker, 2009):

$$TCO = I + E_{month} \times T_{plan}. \tag{1}$$

We will compare the introduction of bank smart cards and cards with magnetic stripe. We represent formula (1) not in monthly, but in annual calculations, and then it will be as follows:

$$TCO = I + E_{year} \times T_{plan}, \tag{2}$$

where E_{year} — annual operation costs of bank cards; T_{plan} — planning period in years.

Then we should select the option to reissue further cards with magnetic stripe or to implement smart cards. Respectively, to improve the security of the magnetic card it is necessary to convert ATMs anti-skimming devices, and to work with smart cards is necessary to change the appropriate program support and the hardware component.

The initial investment for magnetic cards will be:

$$I = I_{mscard} + I_{persmscard} + I_{PINenv} + I_{antiskdev}, \tag{3}$$

where I_{mscard} — introduced cards with magnetic stripe value; $I_{persmscard}$ — value of the magnetic card personalization; I_{PINenv} — value of PIN envelope in which the card is issued to the client; $I_{antiskdev}$ — cost of installation of the anti-skimming device on the ATM.

The initial investment for smart cards can be calculated by the following formula:

$$I = I_{smcard} + I_{perssmcard} + I_{PINenv} + I_{SW} + I_{cardreal}, \tag{4}$$

where I_{smcard} — introduced smart cards value; $I_{perssmcard}$ — value of smart cards personalization; I_{PINenv} — value of PIN envelope in which the card is issued to the client;

I_{sw} — cost of software installation for working with smart cards; $I_{cardread}$ — cost of installation of card readers for reading smart cards.

Annual operation costs of bank cards can be calculated by the general formula:

$$E_{year} = E_{replcard} + E_{maint} + E_{recov} + E_{rent} + E_{insur}, \qquad (5)$$

where Ereplcard — expenses for replacement of damaged cards; Emaint —maintenance costs of ATMs; Erecov — recovery expenses of ATMs; Erent — cost of renting places for ATMs; Einsur — cost of ATMs insurance.

We present the calculation for the introduction of 1 mln cards. 1 ths bank cards needs 1 ATM for optimal service according to expert estimates. Consequently, to serve 1 mln bank cards we would needs 1 ths ATMs (Perakh, 2010; Rainer et al., 2013).

The value of the active protection of devices of the last generation is pointed out for calculations on installation of anti-skimming system to improve the security of magnetic cards.

The quantity of damaged magnetic cards which are subject to change in a year is 4% of the total number of cards and for smart cards it is 10 times less, according to experts (Perakh, 2010; www.credicards.ru).

The calculation will be carried out for the planning period of 5 years. All the calculations are summarized in Table 1. The results obtained by the TCO method are presented graphically (Figure 2).

Table 1. **Comparative analysis of introduction costs for smart cards and magnetic cards by the TCO method,** *author's development*

| Cost parameters	Cards with magnetic stripe		Smart cards	
Implementation of cards				
	Costs of one unit, USD	Costs of all quantity, ths USD	Costs of one unit, USD	Costs of all quantity, ths USD
Cards value	0.2	200	1.43	1430
Cards personalization	0.03	30	1.23	1230
Production of PIN envelopes	1	1000	1	1000
Installation of anti-skimming system	1800	1800	0	0
Installation software for smart cards	0	0	1800	1800
Installation of card reader	0	0	667	667
Total costs of implementation		3030		6127
Operation costs				
Damaged cards which are subject to change	1.23	49.2	3.66	14.64
Maintenance of ATMs	667	667	667	667
recovery expenses of ATMs	775	775	775	775
cost of renting places for ATMs	200	200	200	200
cost of insurance for ATMs	60	60	60	60
Total operation costs		1751.2		1716.64
TCO (1 year)	4781.2		7843.64	
TCO (3 years)	8283.6		11276.92	
TCO (5 years)	11786.0		14710.2	
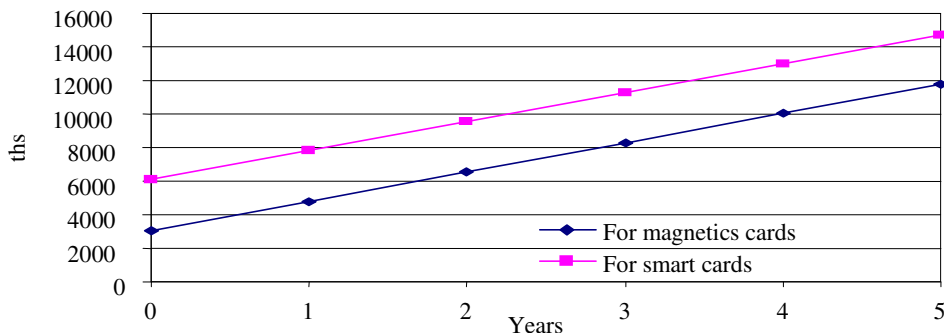
Figure 2. **The costs of introduction and operation of smart cards and magnetic stripe cards by the method of TCO,** *author's development*

The Table 1 shows the costs of smart cards introduction more than twice exceed the costs of the introduction of cards with magnetic stripe. On the other hand, servicing smart cards is cheaper than magnetic cards, but this difference is not considerable.

Introduction of smart cards should be evaluated as linked to the volume of embezzlement funds from bank cards, only in this case it is possible to assess the economic effect of the introduction. For this purpose we will transform formula (2) into the following form:

$$TCO = I + (E_{year} + Q_{emb}) \times T_{plan}, \tag{6}$$

where Q_{emb} — the volume of embezzlement funds from a bank card in a year.

We now estimate the amount of possible embezzlement from bank cards. In 2012 the volume of stolen funds from these cards in Russia was 128.8 mln USD (www.plus-word.ru; www.rbcdaily.ru). About 191 mln bank cards had been issued in Russia as fill January, 1, 2015 (The Central Bank of Russia, 2015). Respectively, approximately 0.68 mln USD of the stolen means accounted for 1 mln bank cards. If to consider that in 2014 more than 95% of bank cards were with magnetic stripes, we can assume that the entire volume of the stolen means fell on them.

By experts' estimates smart cards are 10 times safer than the magnetic ones, even taking installed anti-skimming systems into consideration (www.credicards.ru; www.rusarticles.com), then the volume of embezzlement from bank smart cards will make up about 0,068 mln USD a year.

We present calculations taking the stolen funds into account by the TCO method (Table 2, Figure 3).

The analysis shows when taking the stolen funds into account the expenses for the implementation and operation of smart cards will be lower than the expenses for magnetic cards for the fifth forecast year.

If to modify the formula (6) keeping in mind the dynamics of the stolen means volume, it will take the following form:

$$TCO = I + E_{year} \times T_{plan} + \sum_{i=0}^{n-1} (Q_{emb} \times K_{com}^{i}), \tag{7}$$

where K_{com}^{i} — the compensation factor, which determines the dynamics of volumes of embezzlement funds growth in the time range with bank card being 1.35 according

to expert data (www.banki.forblabla.com); $i = 0, n - 1$, where n − years of planning period.

Table 2. **Expenses for introduction and operation of smart cards and magnetic stripe cards by the TCO method taking stolen funds at a constant volume of embezzlement into consideration,** *ths USD, author's development*

| Years	0	1	2	3	4	5
Bank cards with magnetic stripe	3030	5461.2	7892.4	10323.6	12754.8	15186
Bank smart cards	6127	7911.64	9696.28	11480.9	13265.6	15050.2
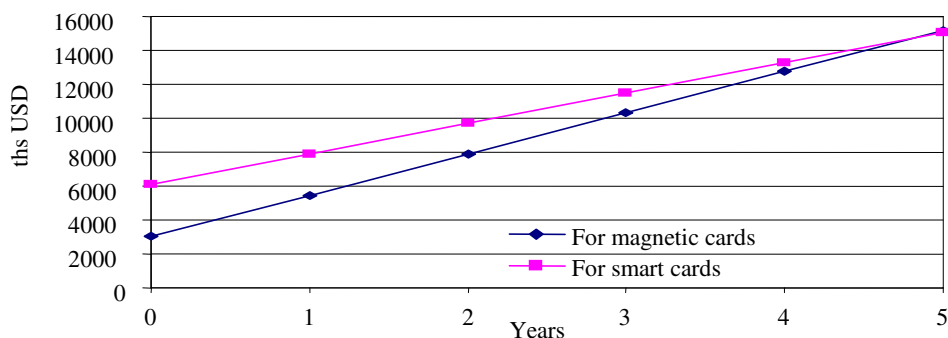
Figure 3. **Expenses for introduction and operation of smart cards and magnetic stripe cards by the TCO method taking stolen funds at a constant volume of embezzlement into consideration,** *author's development*

Calculations by the formula (7) are given in Table 3, Figure 4.

Table 3. **The calculation of costs taking into account the dynamics of change in the volume of the stolen funds from bank cards by the TCO method,** *ths USD, author's development*

Years	0	1	2	3	4	5
Bank cards with magnetic stripe	3030	5461.2	8130.40	11120.90	14545.16	18554.98
Bank smart cards	6127	7911.64	9720.08	11560.63	13444.64	15387.10
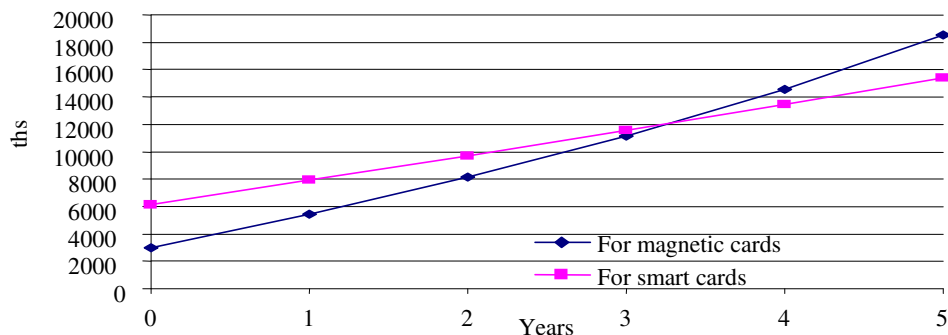
Figure 4. **Expenses for introduction and operation of smart cards and magnetic stripe cards by the TCO method keeping in mind the dynamics of change in the volume of stolen funds,** *author's development*

As a result of the study we can draw the following **conclusions:**
- the initial cost of the smart cards introduction is more than twice higher than the cost of a magnetic card implementation; expenses for operation of smart cards are

lower than for magnetic cards by more than 2% in 5 years of use due to the high security level and durability of smart cards; as a whole, the costs of smart cards implementation will be higher for 25% in 5 years of use as compared with magnetic cards;

- if to consider the implementation and operation of smart cards and magnetic cards in total with possible plunders of money from bank cards in case of constant volume of embezzlement every year, then costs of smart cards usage in 5 years will be 1% lower. This defines the economic efficiency of their implementation even under such conditions;

- if to examine the use of smart cards and cards with magnetic stripes in correlation with dynamics of change in the volumes of embezzlement from cash cards in a time range, costs of smart cards in 5 years of operation will be 21% lower in comparison with magnetic cards. And this obviously proves the cost-effectiveness of their introduction.

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