



Marcin Szmydt

Predicting customers' future online banking
activity to support electronic banking
promotional campaigns

Summary of dissertation

Thesis Supervisor: Prof. dr hab. Witold Abramowicz, prof. zw. UEP

Auxiliary supervisor: Dr Milena Stróżyna

Faculty: Informatics and Electronic Economy

Department: Information Systems

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The research objective of the dissertation was to propose a novel approach which, by application of the predictive modelling technique, will be able to support organizations from the banking sector in activities aimed at increasing usage of the electronic banking among customers and was not covered by the existing approaches. Within the proposed approach, there has been developed a predictive model and a method for identification of the prospective customers for actions aimed at increasing the electronic banking usage. During the research, a large collections of real-world customer data was utilized, provided by one of the largest international banks operating on the Polish market.

Nowadays, a financial sphere is one of the most significant industries influencing the developed economies (Iwańczuk-Kaliska, 2017). Thus, banks as payment intermediaries, have become an important component of the global market. However, the ongoing digital transformation of the banking sector forced leading banks to change their traditional approach in providing services (Cuesta et al., 2015). The demand for Internet services has initiated a mass implementation of a wide range of solutions enabling customers to use banking and complementary services via electronic channels. Moreover, these digital services, commonly known as the electronic banking or e-banking, have become a source of competitive advantage which, nowadays, defines market leaders in the banking sector.

Application of the electronic channels brings many benefits for the banking sector, customers, and the entire economy (Lassar, Manolis and Lassar, 2005). From the perspective of banks, the most significant advantage is that these services are much cheaper in maintenance than physical bank branches (Deloitte, 2016). The electronic banking also covers many advantages from the customer point of view. The most significant are reduced fees, easy banking products monitoring, fast money transfers and availability of supplementary digital services via a mobile phone or a personal computer (Wojciechowska-Filipek, 2010; Shaikh and Karjaluo, 2014). All these services are available 24 hours a day, seven days a week. Moreover, the electronic banking as a major component of a digital finance is also linked with an economic development. According to McKinsey Global Institute, digital finance services can add up to 1.6 billion unbanked people to the global economy (Manyika *et al.*, 2016).

However, despite the depicted advantages offered by the electronic banking, there is still a large group of bank customers who do not use this channel at all or use it only sporadically (Yaghoubi and Bahmani, 2010). Therefore, after making heavy investments in electronic banking technologies, currently, the banking sector is trying to find efficient ways to encourage customers to use their new-and-improved digital channels (Peters, 2019). Banks, which fail to attract customers to move to the electronic banking, must be prepared to be left behind the competition. Moreover, those customers

may be quickly taken over by dynamically growing companies from the fin-tech industry, which currently pose a serious threat to the entire banking sector (Anand and Mantrala, 2019).

To increase the interest in the e-banking, currently, banks conduct various educational and promotional campaigns. However, they are usually directed to all bank customers, without prior segmentation or selection. As a consequence, the budget of such campaigns is wasted also on those customers who would use the e-banking services even without any additional stimulation, or on those who are so conservative about the electronic services that any campaign is able to persuade them to start using them.

Taking into account the above, it is justified to conduct a research on new methods of supporting organizations from the banking sector in activities which aim at increasing the usage of the electronic banking among the customers. The literature review confirms the need for further research in this field, as the previous approaches focused only on general recommendations regarding factors affecting the use of the electronic banking by the customer, without providing practical methods for application on the operational level. Moreover, the conducted literature review did not cover any publications analysing potential application of predictive modelling for further digitalization of the banking sector. In addition, only a small number of publications analysed the perspective of the entire banking sector. These gaps were the main motivation for the research presented in this dissertation.

The main objective of the dissertation was to propose a novel, effective, accurate and useful method, which by application of predictive modelling technique, will be able to support organizations from the banking sector in activities aimed at increasing the overall usage of the electronic banking among customers.

This aim was achieved by following the methodology devised by the design science (Hevner et al., 2004) which assumes that a researcher answers relevant research questions by creating innovative artifacts. The term artifact is used to describe something that is artificial, or constructed by a human, as opposed to something that occurs naturally (Hevner and Chatterjee, 2010). The artifact must provide a first solution to an important problem or improve upon existing solutions to a problem. In the dissertation two artifacts were proposed and developed: (Artifact 1) Customer Electronic Banking Usage Prediction model (CEBUP); (Artifact 2) Electronic Banking Prospective Customers Identification method (EBPCI).

In the conducted research, the author assumed a potential relationship between the probability of using the electronic banking and the vulnerability to activities encouraging to use of the e-banking services.

In the proposed approach, the predictive model (CEBUP) based on Neural Network was developed. The model aim at predicting customer activity in the electronic banking services. Different time horizons can be used as a model's parameter. CEBUP model was trained using a real-life dataset consisting of 33,726,832 records related to bank's customers in the time period of two years (from 1st January 2017 to 31st December 2018). Variables for the model were selected based on the conducted literature review and the interviews with the experts from banking sector. As an output, the model generates a set of probabilities indicating which customers are likely to use the electronic banking services in a specified time horizon.

Then, based on the probabilities provided by the CEBUP model, there was proposed the method (EBPCI) for identification of the most prospective customers for campaigns that promote the electronic banking. In this method, the prospective customer refers to a customer who is susceptible to actions aimed at encouraging him/her to use the electronic banking. The method assumes that the probability scores, saying whether a given customer will use the electronic banking, can be used to identify a group of customers which is more susceptible to the e-banking promoting campaigns than other groups.

The proposed artifacts were evaluated using the Framework for Evaluation in Design Science (FEDS) (Venable, Pries-Heje and Baskerville, 2016). The evaluation consisted of few steps, in which real-life banking data were used. The goal was to demonstrate the quality, efficacy, and utility of the artifacts. This was conducted in two phases in which CEBUP model and EBPCI method were evaluated separately. Evaluation of the CEBUP model was based on the test data (20% of the entire dataset), whereas, EBPCI method evaluation was based on the SMS campaign which encouraged customers to log into the electronic banking services. The SMS campaign was sent on 25th of April 2019 and in the evaluation 1,559,255 customers were analysed.

The design and evaluation of both artifacts required engineering, processing and analysing a huge amount of real banking data. To deal with the challenge, a corporate architecture of banking servers adjusted to Big Data processing was used.

Based on the conducted experiments, the author has confirmed that the proposed predictive model (CEBUP) is able to provide more accurate estimations than the expert method. Therefore, it may be concluded that the method might be useful for potential users from the banking sector. Moreover, the proposed EBPCI method is able to identify the group of customers who are more susceptible to actions encouraging them to use the electronic banking then other groups of customers. Effectiveness of the EBPCI method makes it a useful tool for potential users from the banking sector.

Summarizing, the conducted research confirmed that the method based on predictive modelling allows organizations from the banking sector to forecast customer behavior in the electronic channels with higher accuracy than the expert methods and enables to identify the best customers for activities aimed at increasing the overall usage of the electronic banking. The best customers in this context refer to customers who are the most susceptible to actions aimed at encouraging them to use the electronic banking services. These are the customers who are more likely to respond to electronic banking promoting actions than the others.

The dissertation consists of two parts. Chapters 2-3 present the state of the art in the area of the electronic banking and the predictive modelling in banking. This part describes previous studies, approaches and methods. Chapters 4-5 presents the proposed solution based on the developed artifacts and provide the overall evaluation of the solution. This part aims at providing the novel contribution to the existing body of knowledge. The dissertation concludes with the summary and suggestions for future work.

The conducted research was interdisciplinary, since it focused on different sub-disciplines of economics as classified by Journal of Economic Literature (JEL): *Banks; Other Depository Institutions* (JEL G21) and *Data Collection and Data Estimation Methodology* (JEL C8). The dissertation was conducted as a part of the industry PhD-track Program (“Doktorat wdrożeniowy”) by the Polish Ministry of Science and Higher Education.

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