# VERIFICATION OF USE THE COGNITIVE AGENTS FOR USERS' OPINIONS ANALYSIS RELATED TO E-BANKING

MARCIN HERNES, ANNA CHOJNACKA KOMOROWSKA, KAMAL MATOUK

*Department of Accounting, Controlling, Informatics and Quantitative Methods,*
*Wroclaw University of Economics*

Dynamic development of e-banking caused extremely difficult to make a choice, by individual user, which services to use. In cyberspace it is possible to find many opinions about these services, but their reading, objectively evaluating and comparing them with each other is very time consuming and subject to high possibility of error or not find major reviews in terms of decision making by user. It is therefore necessary to automated processing of unstructured knowledge (in particular customer opinions) associated with e-banking. The purpose of this paper is to analyze an unstructured knowledge processing capabilities in the area of e-banking using cognitive agents.

Keywords: E-banking, Cognitive Agents, Unstructured Knowledge Processing.

## 1. Introduction

The fast advancing global information infrastructure enables the development of electronic commerce at a global level. This fast emerging economy is bringing with rapidly changing technologies, increasing knowledge intensity in all areas of business and creating virtual supply chains and new forms of businesses and service delivery channels such as e-banking [1]. The banking industry is being re-shaped by globalization, competition and innovation and customer needs. However, it is extremely difficult for individual customer to make a choice of institutions, which should entrust their savings or use credit services. On Internet forums we

can find many opinions about these institutions, but their reading, an objective evaluating and comparing them with each other is a very time consuming. Also a high possibility of error appears which is related to the choice of service. Often customer cannot find the most important opinion in terms of the decision making. Therefore, it is necessary to an automatic process of unstructured knowledge (in particular, customer opinions) associated with e-banking.

The purpose of this paper is to examine possibilities for processing unstructured knowledge in the area of e-banking using cognitive agents. The first part of the article presents the essence of e-banking. Next, the unstructured knowledge processing has been characterized. The last part of the paper presents the research experiment performed in order to verify the possibility of using agents in the cognitive processing of unstructured knowledge in the considered area.

## 2. Development of e-banking

The banking sector, due to the intangible nature of the services it provides, is one of the more susceptible areas for the use of electronic communication channels. The development of e-banking depends largely on access to the high-speed Internet. As shown by studies on average roughly twelve months after obtaining access to the Internet network, users are beginning to realize their payments via the Internet [2].

The work [3] describes electronic banking as "an umbrella term for the process by which a customer may perform banking transactions electronically without visiting a brick-and-mortar institution". The paper [4] defines electronic banking as the delivery of banks information and services by banks to customers via different delivery platforms that can be used with different terminal devices such as a personal computer or a mobile phone with browser or desktop software, telephone or digital television. The most important is that the online operations allow for substantial expansions of service. Customers can connect with Internet banking systems anytime to check their email, conduct account inquiries, loan applications and file updates, all of which entail 24-hour real-time online communication. Although banking is a relatively new service markets, both polish and global, its dynamic development made the already isolated four main phases of its development. Most authors named them as follows [5], [6]:
   phase 1.    Internet as a tool for marketing,
   phase 2.    Implementation of customer interaction,
   phase 3.    Full range of transactions and banking services,
   phase 4.    Strategic use of the internet.

Table 1 presents the main tasks of each phase, its advantages, disadvantages and the main activities carried out in the phase.

**Table 1.** Phases of banking e-services development

| Phase | Tasks | Advantages | Disadvantages | Main activities |
|---|---|---|---|---|
| Phase 1 | Providing customers of the bank as much information by posting on the website of the main information on the bank for its services | The main advantage is the low cost of preparation and minimal risk. | In this phase there is no communication with the client, so the possibilities offered by the use of the Internet, are not used. | - Presentation of information about the bank,<br>- Presentation of offer,<br>- Current location of branches and ATMs,<br>- Customer contact via e-mail,<br>- The use of electronic brochures. |
| Phase 2 | The implementation of some elements of customer interaction at the client-bank and bank- client. | Build a relationship between the customer and the bank, reduce paperwork, and reduce transaction costs. | In this phase, an attempt to take cooperation with the client, but the settlement of any matter still requires a visit to the facility | - Calculators of loans or profits from deposits,<br>- Advice on financial planning,<br>- Interactive bank advisors,<br>- On-line applications by credit card, credit,<br>- Checking the status of bank account,<br>- Search information. |
| Phase 3 | Providing customers with a full range of banking services via the Internet. | The creation tools for customers to settle most cases the bank without having to visit a bank branch or institution. | Extremely expensive component is the preparation of an adequate and reliable system to guarantee the security of transactions. | - View account balances,<br>- View the history of the operations,<br>- Standing orders,<br>- Making transfers,<br>- Requests for cash loans and mortgage loans,<br>- The ability to create deposits. |
| Phase4 | Creating an offer tailored to each individual bank customers. | Benefits of this new opportunity for profit, the opportunity to increase market share, comprehensive system integration, greater opportunities to offer services. | The need to create offer support systems dedicated for specific customers. | - Analysis of customer profitability,<br>- Paying and preview on-line accounts,<br>- cross selling[1] services,<br>- Customizing the offer on the basis of customer information,<br>- New products or services (e.g. EBPP[2]). |

*Source*: [5, 6, 7]

1. Cross selling is a strategy of offering customers new products and services on the basis of the history of their transactions and shopping. The advantage of this strategy is to brand loyalty and reduce the probability of transition to competition. Because customer retention is much cheaper than acquiring a new strategy it allows you to increase profits while incurring minimal costs.
2. EBPP i.e. *electronic bill presentment and payment* – service consisting in the transfer to the payer electronic form of the bill (invoice) and to enable him to make electronic payments.

An extensive and comprehensive service electronic banking aims to implement in particular the following tasks [8]:

- acquiring new customers for banks by promoting,
- maintaining their existing, mainly key customers,
- shaping the image of the bank's market,
- reducing significantly the costs, as a consequence of transactions for clients on the Internet without going through a bank staff,
- ability to introduce completely new services, impossible to offer in traditional conditions, e.g. virtual credit card.

Its further development may be related to the need to adapt the offer not only by banks, but also by telecommunications companies to the needs of not benefiting at present from such services. Despite a significant and dynamic development of Internet banking in Poland over the last several years, one can see also some barriers to development. These are primarily:

- the uncertainty associated with the provision of the bank's adequate level of security of transactions,
- high cost of Internet access (cost of the link and hardware), and therefore the impossibility of using electronic banking,
- high costs associated with the implementation of modern technology by banks,
- lack of public confidence in e-economy.

How calculates [8] professionally implemented electronic banking system can bring profit in the future, a significant reduction of costs, even to the level of 15-20%. Such a significant cost reduction is achieved by a lower cost of a single transaction performed by the bank's Internet service. In the traditional bank branch, it is about 1.07 (USD), while using the Internet only 0.01 (USD). Much higher are the costs of maintaining the customer's account in a branch of the traditional than the cost of maintaining the account in the offer virtual. At the same time with such a marked reduction of costs can be handled by online bank four times the number of customers compared with the same cost created a network of branches and affiliates.

## 3. Electronic banking services available for customers

The banking sector has to offer a very wide range of services to its retail customers  (Table 2). Choice of service refers often to services provided to third parties.

**Table 2**. Classification of online banking services

| SERVICES' CATEGORY | OFFERED SERVICES |
|---|---|
| Products enhancement of convenience | mobile banking , mobile payments , SMS notifications; |
| Services for third parties | Internet payments and paying bills , foreign transfers, standing orders direct debits , payments to the Tax Offices, payments to Social Security; |
| Different financial products | life insurance , motor insurance , property insurance; |
| Investments products | opening and management of the deposits in the account, purchase/sale of units in investment funds , purchase/sale of bonds and other investment instruments the possibility of using a brokerage account; |
| Financial products | application for a loan application for a credit card; |
| Simple banking products | account opening and management, applications of debit cards. |

*Source*: [7], [9].

Another interesting group of services offered by banks is the possibility of using investment products. At the moment, not all banks have such an offer, but this is starting to slowly come to the standards provided by the electronic banking services, especially in the case of banks aimed at affluent customers. In a situation where the bank offers such services, the customer without leaving home can buy units of investment funds, to insure a car or a house on the Internet, or buy shares on the Stock Exchange.

An important feature of banking is its interactivity, allowing for active communication with the customer's bank, without leaving home. There are so new developments such services as: *Call-Back-Button* (the manner of initiate telecommunications links through the website and pressing the appropriate key, which consists in turning), *Telewebsystems* (voice communication system that allows contact directly from the website) or videoconferences. They take into account more and more different and higher demands on the banks' customers and respond to the needs raised by him. Increasingly, it can also talk about *one-to-one banking* [10]*,* in which the most important is the individual approach to the client, through a comprehensive application of CRM (*Customer Relationship Management).*

## 4. Unstructured knowledge processing

In the processing of unstructured knowledge, following methods are used [11]:
- information retrieving,
- information extraction,
- text mining,
- natural language processing.

The main purpose of *information retrieving* is to find the answer to the question of the collection's documents. *Extraction* is to identify an instance of a predefined event classes and their relationships, and instances in documents written in natural language [11]. The aim of *text mining* is to know the hidden text information using methods adapted to a large number of text data [12]. *The natural language processing* contains mechanisms that attempt to make "understand" the context of the text. These methods rely not on calculated value of the similarity of terms, but on the following categories of analysis of text [12]:

1) Shallow text analysis is defined as the analysis of the text, the effect is incomplete in relation to deep text analysis. Typically limitation is the recognition or non-recursive structures with a limited level of recursion which can be recognized with a high degree of certainty.

2) Deep text analysis is the process of computerized linguistic analysis of all possible interpretations and grammatical relationships found in natural text. Such a full analysis can be very complex.

In the process of analyzing text documents often semantic knowledge representation is used, including semantic networks [13]. Thanks to their application it can be widely understood knowledge representation. The important thing is to draw attention to the interdependence occurring between objects.

More and more often in order to process unstructured knowledge cognitive agent-based programs are used. They perform cognitive and decision-making skills, such that occur in the human brain, so that they can understand the real significance of the observed phenomena and business processes [14], among other things, on the banking market.

## 5. Research experiment

In order to perform unstructured knowledge analysis, the Learning Intelligent Distribution Agent (LIDA) [14] architecture has been used. The advantage of this architecture is its emergent-symbolic character, making it possible to process information both structured (numerical and symbolic) and unstructured (stored in natural language) knowledge. Methods of analysis of text documents using cogni-

tive agent has been characterized in the works [13, 15, 16] (due to reduced volume of text, they will not be the subject of analysis in this article). It will be presented the research experiment aimed to verify the ability to process opinions regarding e-banking. The experiment involves comparing the results of the automatic analysis of the results of the analysis carried out by a man (expert), i.e. manual analysis. The following assumptions have been made:

1. Opinions related to services of e-banking placed on the online shops web pages, portals enabling comparison of prices and online forums have been analyzed.
2. Opinions about six randomly selected banks were analyzed.
3. The shallow text processing has been performed.
4. The number of analyzed opinions: 300. This limitation is due to the fact that for each opinion has to be done a manually analysis, which is a time-consuming process.
5. For purposes of this experiment five features have been analyzed:
   - fees-fees charged for services rendered,
   - customer service-customer service quality,
   - services-quality of services, their diversity, competitiveness, but also an overall assessment of the bank where none of the criteria has not been indicated,
   - interface-easy to use website,
   - security-especially in the field of online transactions.
6. It is assumed that if the opinion contains no information about the sentiment of the feature, its connotation is identical with overtones reviews.
7. The method of learning with a teacher has been used. On the basis of the corpus (set) containing 75 opinions, a configuration of parameters of cognitive agent have been made.
8. In order to determine the accuracy of results of automatic analysis in relation to results of manual analysis, the following measurements were performed:
   - *effectiveness* – this measure defines the relationship of the number of opinions whose sentiment (or sentiment of features) has been determined automatically to the number of opinions whose sentiment (or sentiment of features) has been determined manually; this measure enables one to determine in how many cases the sentiment of opinions (or sentiment of features) has not been determined by an agent (an agent has not specified whether an opinion (feature) is positive or negative; the next used measures relate only to opinions (features) effectively recognized by an agent;

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- *precision* – which specifies the accuracy of classification within a recognized class of opinions and it is defined in the following way:

$$p = \frac{opp}{opp + onp} \qquad (1)$$

where:

$p$ – precision,
$opp$ – positive opinions recognized as positive ones,
$onp$ – negative opinions recognized as positive ones.

- *sensitivity* – the relationship of the number of opinions recognized by an agent as positive ones against all positive opinions is defined in the following way:

$$c = \frac{opp}{opp + opn} \qquad (2)$$

where:

$c$- sensitivity,
$opp$ – positive opinions recognized as positive ones,
$opn$ – positive opinions recognized as negative ones.

Research experiment was carried out in the following way:
1. Three hundred randomly selected opinions (opinions in Polish language translated into English in this paper) were recorded in a data base.
2. Manual analysis was performed (annotation on the opinions).
3. Then, a learning set was created which contained 75 randomly selected opinions on the basis of which parameterization of codelets was made (learning with a teacher). The opinions were also grouped according to the degree of difficulty (three groups – group 1 – polarity of opinions and features easy to determine, group 3 - polarity of opinions and features difficult to determine) of determining their polarity and the polarity of features of e-services characterized in the opinions (table 3). The previously characterized measures of accuracy were calculated taking into consideration particular groups of degree of difficulty. Considering the opinions of the first group it should be stated that they contain only the phrases regarding sentiment of opinion (they do not contain information on individual features). The recognizing of their sentiment is easy, and the sentiment of individual features is taken as a sentiment of opinion. In the second group there are the opinions containing information about particular features' sentiment. The difficulties may involve consideration of the given features. The third group is

the most difficult to analyze, because the opinions belonging to this group are related to different objects,  e.g. to several banks/services in one opinion. The difficulty is on the one hand determines which bank/services assign positive opinion, on the other hand determines which bank/services assign features characterized in the opinion.

**Table 3.** Types of opinion by degree of difficulty of analysis

| Group | Example of opinion's content |
|-------|------------------------------|
| 1 | The worst bank with which I worked I do not want to even write what irritates me |
| 2 | Although I am customer of Bank1 from several years and everything seemed to be very much in order - the ever increasing charges and problems with the repayment of the loan (despite the payment of installments of the money is pulled again) |
| 3 | Attention. I did the day before yesterday express transfer to the Bank1 for its second account in Bank3 significant amount for me - my last cash !!! The horror !!! The commission 5zl . WORST is that yesterday cash has not arrived at my profile at Bank1 info about the transfer that has not yet been realized or cannot go back and cash in space !!! |

4. The next step was to conduct the agent analysis of these opinions and saving the results in a database.
5. Measures of the results of the automatic analysis have been calculated in the last step.

The summary of the results is presented in the Table 4.

Generalizing the results of experiment, it can be concluded that the effectiveness of recognition opinions about individual features is lower than the efficiency of recognition sentiment of all opinions, i.e. not all words (phrases) indicating sentiment of features, annotated by hand, were found by an agent. This was mainly due to the fact that not all of these words (phrases) occurred in the opinions of the training set. It should also be noted that a low measurement precision and sensitivity with respect to the sentiment characteristics included in the no. 3 group means that the sentiment of features in many cases has not been recognized correctly, i.e. many features have a positive opinion has been recognized as having the characteristics of a negative opinion, or vice versa. In absolute values, numbers of particular opinions are as follows:

- group 1: 119 opinions (positive: 63, determined by agent as positive: 41).
- group 2: 80 opinions (positive: 43, determined by agent as positive: 25).
- group 3: 26 opinions (17 positive, 7 determined by agent as positive).

**Table 4.** Results of analysis of opinions about e-banking

| Group of opin-ions | Measure | Sentiment of opinion | Sentiment of features | | | | |
|---|---|---|---|---|---|---|---|
| | | | Fees | Customer's service | Services | Interface | Security |
| 1 | Effectiveness | 0,675 | 0,630 | 0,601 | 0,663 | 0,621 | 0,671 |
| | Precision | 0,651 | 0,635 | 0,593 | 0,612 | 0,638 | 0,596 |
| | Sensitivity | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| 2 | Effectiveness | 0,612 | 0,532 | 0,588 | 0,593 | 0,564 | 0,601 |
| | Precision | 0,582 | 0,563 | 0,542 | 0,556 | 0,512 | 0,568 |
| | Sensitivity | 0,523 | 0,545 | 0,511 | 0,520 | 0,501 | 0,521 |
| 3 | Effectiveness | 0,502 | 0,328 | 0,345 | 0,389 | 0,418 | 0,397 |
| | Precision | 0,411 | 0,335 | 0,331 | 0,328 | 0,412 | 0,419 |
| | Sensitivity | 0,423 | 0,345 | 0,325 | 0,387 | 0,368 | 0,401 |
| Average | **Effectiveness** | **0,596** | **0,497** | **0,511** | **0,548** | **0,534** | **0,556** |
| | **Precision** | **0,548** | **0,511** | **0,489** | **0,499** | **0,521** | **0,527** |
| | **Sensitivity** | **0,649** | **0,630** | **0,612** | **0,636** | **0,623** | **0,641** |

*Source*: own work.

The cognitive agent stated that the highest rated features include "service" and "interface", while the worst rated features are "fees" and "security". The bank2 was ranked as the best bank by agent (the number of negative opinions was lowest in case of this bank). With respect to these features, the banks should therefore take measures to improve the quality of services.

## 6. Summary

Processing of unstructured knowledge in e-banking is an important element in improving the quality of services in the area. The results of experimental research performed in this paper allow to conclude that the cognitive agent recognizes the sentiment of opinion property in most cases. Also in the case of opinions which sentiment is clearly defined, the sentiment of the features of services is also recognized property in most cases. However, in the case of an opinion characterized by ambiguity in the description of sentiment of individual features or characteristics containing several banks/services in one opinion, agent had difficulty in determining the sentiment of features of the service. For this reason it is necessary to conduct further research in order to increase the accuracy of recognition sentiment characteristics of the services by the agent in relation to all

the groups. This work may involve both changes in the algorithm of cognitive agents functioning, as well as their configuration. It is also necessary to develop procedures to automatically make decisions based on the results of analysis.

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