FUZZY SWOT-ANALYSIS IN THE DEVELOPMENT OF THE IMPLEMENTATION STRATEGIES FOR CLOUD TECHNOLOGIES

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Abstract

The relevance of the research issues is due to the popularity of implementation of cloud technologies within enterprises. The decision on implementation becomes strategic, as it is often associated with major changes in the business processes and infrastructure of the company, the implementation of these decisions requires financial resources, and the consequences of wrong decisions can be critical to the survival of the company. The purpose of the article is to undertake a SWOT-analysis of strategic directions on the basis of fuzzy decision-making models for the formation of strategy and setting tasks in implementing the cloud technologies.

The leading approach to the study of this issue is fuzzy SWOT-analysis used to justify strategic decisions in implementing the cloud technologies. The results of practical application to develop an implementation strategy for the cloud technologies at PJSC “Rutelecom” are presented in the study. Fuzzy SWOT-analysis results enabled estimates of the importance related to some factors of the external and internal environment, as well as their combinations, to take them into account in the formation of the strategy of cloud technology implementation. The paper discusses the main strategic directions, based on the analysis, as well as the target-setting for the next stages of development of the strategy of PJSC “Rutelecom”.

The study presents the research results based on the possibility of using fuzzy SWOT-analysis to form a strategy and set tasks for the implementation of cloud technologies. The materials of the article can be useful for enterprises planning to implement cloud technologies in their activities to justify their application, reliability and value, as well as researchers in the field of strategic management, fuzzy systems and cloud technologies.

Keywords: Cloud technologies, strategy, fuzzy models, SWOT-analysis, decision-making, risks, information security, efficiency, methods, assessment, factors of external and internal environment of the enterprise.
I. Introduction

IT strategy development is the most important part of strategic business management. Development of information technologies resulted in a high dependence of organizations on them. The business environment changed, as well as the technology of work with customers and suppliers, processes and technologies of advertising and promotion of goods and services, additional analytical capabilities for decision-making and so on. In this regard, changing perception with respect to the role of IT strategy in the overall strategic management of the enterprise has changed over the past 30 years. Previously, the IT strategy was considered to be a functional-level strategy and the main task of the IT strategy development was its aligning with the chosen business strategy of the company [VI, XII, XXXVII]. At present, we consider a fusion between IT strategy and business strategy. This fusion is called a digital business strategy [IV]. These changes strengthen the importance of IT strategy development for the overall success of the enterprise. The fusion of business strategy and IT strategy requires a more detailed analysis of external and internal environment of the enterprise, with certain inclusion of information technologies in the considered environmental factors.

Searching for the approach to organization of the IT-infrastructure, more and more companies intend to turn to the cloud-based technologies that have great potential for the significant improvement in terms of efficiency without productivity loss. These issues are relevant both in the corporate and public management [I, XIV, XVIII, XX, XLII]

Cloud software provides benefits for the core business operations. The following strategic advantages of cloud technologies may be noted: the impact on organizational knowledge [XL, XXII, XXVIII], information delivery mechanisms [XXX], optimization of resources [IV, XVI], efficiency gains [XIII], faster connection of new users (scaling) and new functional [XV].

At the same time, the transition to the cloud technologies is associated with the serious risks. These are the security issues (integrity of the stored data, data protection during transmission, authentication, uninterrupted operation) [II, XVII, XXXV] as well as the risks related to compliance with legal and regulatory acts [XXXIX, XLIV, XLIII].

In this regard it is appropriate to use strategic planning tools. The paper presents the application of fuzzy SWOT-analysis for the development of the strategy for the implementation of cloud technologies for public company “Rutelecom”. The study is based on the research of A. Zakharova and A. Mitsel [XXIV, XLVI] and it takes into account the study of S. Ghazinoory and others [XLVII].

II. Material and Methods

Fuzzy methods for the SWOT-analysis are justified by the need to process the qualitative expert descriptions of the environmental factors and their linkages in order to obtain quantitative assessments to rank both individual environmental factors, and their combinations [X, XXVI], [XLIII, XLV]. In this paper, the
technology of fuzzy SWOT-analysis proposed in [XXVI, XLVI] is used. The application of this technology in the bankruptcy risk management of the enterprise is presented in [XLVII].

It is implemented through the following models and methods.

1. Methods of determining the membership functions of linguistic variables. Certain strategic factors of the company development are presented as linguistic variables; this ensures a comparison of “qualitative” and “quantitative” expert assessments. Depending on the type of the factor, a variety of methods for determining the membership functions can be used. The method based on the standard functions [XLVIII] is used in this study. To define membership functions, an expert just needs to set the dominant values of the terms of the linguistic variable (i.e., the points at which the value of the membership function is equal to one), and the boundary values of neighbouring terms (points at which the membership functions of the neighbouring terms are of equal importance).

2. Systems of fuzzy rules (productions). Information, obtained in the course of the SWOT-analysis, is presented by the systems of reference fuzzy statements, establishing a connection between the input and output linguistic variables in the form of qualitative descriptions. Using a fuzzy rule system allows to present the expert’s knowledge about the impact of opportunities, threats, strengths and weaknesses, as well as their relationships in the form of a knowledge base.

For example, the following linguistic variables are entered for positioning the opportunities:

\( \beta_{Op} \) – probability of implementation (the probability that a company will be able to take the opportunity) with the domain of definition \( X = [0.1] \) and the set of basic values \( T_{Op} = \{ \text{low, moderate, high} = \{ a_{Op1}, a_{Op2}, a_{Op3} \} \} \).

\( \beta_{O} \) – the degree of impact of the opportunity on a company (possible consequences of the opportunity) with the domain of definition \( O \) and the set of basic values \( T_{O} = \{ \text{low impact, moderate impact, high impact} = \{ a_{O1}, a_{O2}, a_{O3} \} \} \). The domain of definition is different for every opportunity.

\( \beta_{Ov} \) – the value of the opportunity (the extent of its consideration in the strategy, the degree of the required reaction of the management entity to this opportunity) with the domain of definition \( O_v = [0.100] \) and the set basic values \( T_{Ov} = \{ \text{low, moderate, high} = \{ a_{Ov1}, a_{Ov2}, a_{Ov3} \} \} \). This index is provisional and may be estimated, for example, in points from 0 to 100. It serves for ranking the opportunities.

Input parameters of the prediction process are \( \beta_{Op} \) and \( \beta_{O} \), and the output one is \( \beta_{Ov} \). Dependence of the output parameter on the input ones is expertly expressed as follows:

IF the probability is low AND the impact is low
OR the probability is low AND the impact is moderate
OR the probability is moderate AND the impact is low

THEN, the value of opportunity is low.

IF the probability is moderate AND the impact is moderate
OR the probability is low AND the impact is high
OR the probability is high AND the impact is low

THEN, the value of the opportunity is moderate.

IF the probability is high AND the impact is high
OR the probability is moderate AND the impact is high
OR the probability is high AND the impact is moderate

THEN, the value of the opportunity is high.

Similarly, linguistic variables and the system of statements for the threats positioning have been developed. The difference is in the number of basic values of the linguistic variables, and accordingly, the number of fuzzy expert rules.

To calculate the importance of combinations of the environmental factors, the systems of fuzzy rules have been developed for each square of the SWOT matrix. For example, the following linguistic variables are used for the square “Strengths – Opportunities”:

1. \( \beta_{Ov} \) – value of the given opportunity. Input value of this variable, as well as the term-sets describing it are known, as this variable is output in assessing (positioning) the opportunities.

2. \( \beta_S \) – the intensity of strength with the domain of definition \( S \) and the set of basic values \( T_S = \{ \text{low, moderate, high} \} = \{ a_S, a_S, a_S, a_S \} \). The domain of the variable definition is different for various strengths.

3. \( \beta_C \) – the importance of considering this pair with the domain of definition \( C = [0.100] \) and the set of basic values \( T_C = \{ \text{low, moderate, high} \} = \{ a_C, a_C, a_C \} \).

The system of expert statements for the square “Strengths – Opportunities”:

IF the value of opportunity is low AND the strength intensity is moderate
OR the value of opportunity is low AND the strength intensity is low

THEN, the importance of the pair is low.

IF the value of opportunity is moderate AND the strength intensity is moderate
OR the value of opportunity is low AND the strength intensity is high
OR the value of opportunity is high AND the strength intensity is low
THEN, the importance of the pair is moderate.

IF the value of opportunity is high AND the strength intensity is high
OR the value of opportunity is high AND the strength intensity is moderate
OR the value of opportunity is moderate AND the strength intensity is high
THEN, the importance of the pair is high.

3. The fuzzy inference model. To determine the value of the output variable based on the crisp values of the input variables, the deductive derivation scheme based on the fuzzy rule modus ponens is used. The use of this output allows calculating of the quantitative assessment of the importance of opportunities, threats, and their combinations.

The proposed algorithms of the fuzzy SWOT-analysis are implemented in the computer program FUZZY-SWOT-1.0. [VII].SWOT-analysis within the strategy to implement the cloud technologies for PJSC “Rutelecom” has been performed involving this software product in 2015.

III. Results

PJSC “Rutelecom” provides services to the public and enterprises of the city in the field of telecommunications (telephone services, data transmission, cable broadcasting). The growing demand for these services determines the need for expanding the range and quality of the rendered services, as well as for proliferation of clients. The problem of scalability is aggravating every year. At the same time, the IT budget of the company lags behind the required rate of growth, so it needs reliable and intellectual ways to meet the growing needs while controlling the costs. To comply with the time and to maintain the competitive advantages, a new approach to IT-infrastructure is required.

One of the possible solutions of the problem, considered by “Rutelecom” is the transition to the cloud technologies. In order to achieve this it is necessary to understand the benefits of the deployment of the cloud platforms, and how to ensure the effectiveness and safety of their implementation. And for ensuring a smooth transition and optimum results, the IT department of the enterprise should, first of all, develop a strategy for the implementation of cloud technologies aimed at solving the specific problems of a company. This paper presents the results of the SWOT-analysis, as the first phase of strategic planning.

Consider the main stages of the process of fuzzy SWOT-analysis in the development of the cloud technologies implementation strategy.
III.i. Generation of the List of Opportunities, Threats, Strengths and Weaknesses of a Company

The Expert Group generated the lists of internal and external factors affecting the implementation of cloud IT or exposed to the impact due to implementation of cloud IT. The results are presented in SWOT matrix (Table 1).

Table 1: SWOT analysis matrix when deciding on the transition to cloud IT

| Company's strengths | Opportunities in the implementation of cloud IT-applications |
|---------------------|-------------------------------------------------------------|
| 1) highly qualified employees; | 1) the growing rate of connection of new users and new functional; |
| 2) known market leader; | 2) increasing productivity (reduction of cost and timing for processing the incidents and changes); |
| 3) technical feasibility of IT implementation; | 3) optimization of resource utilization (reduction of downtime of computing systems); |
| 4) availability of innovative abilities of the staff and the possibility to apply them; | 4) cost cutting (reduction of capital and operating costs); |
| 5) a good reputation among the customers; | 5) ease of integration; |
| 6) a high degree of compliance with the contractual obligations, with regard to sub-contractors and end-users; | 6) the reduction of the need for strong competition in the short run. |
| 7) availability of the own platform and service centre; | |

| Company's weaknesses | Threats in the implementation of cloud IT-applications |
|----------------------|-------------------------------------------------------|
| 1) limited IT budget; | 1) failure to comply with SLA; |
| 2) deteriorating competitive position; | 2) inconsistency with regulations; |
| 3) the absence of clear strategic directions; | 3) loss of control; |
| 4) the need to enlarge the customer base; | 4) probability of incidents (loss of data, hacking, etc.); |
| 5) the lack of employees’ interest in the increase in sales; | 5) information security problems; |
| 6) a narrow range of services; | 6) economic crisis. |
| 7) a lack of mobility and business rate; | |
III.ii. The Formalization of Expert Knowledge on Strategic Factors on the Basis of the Linguistic Variables

Most of the strategic factors are qualitative. To formalize the expert perceptions of the level of the assessed factor, the method of constructing the term-sets of linguistic variables based on exponential functions, presented in [XLVIII] is used.

The columns 1 – 6 of the table 2 present the formed linguistic variables for the strengths and weaknesses of the company, the unit of measure and the domain of definition for the basic values of variables (low, moderate, high impact) are indicated.

Table 2: Linguistic variables and expert evaluation of the factors of the internal environment in the implementation of cloud IT

| Name of the linguistic variable | Unit of measurement | Domain of definition | The dominant values of the terms of basic variables | Expert evaluation of the factor manifestation in the company |
|-------------------------------|---------------------|----------------------|-----------------------------------------------|----------------------------------------------------------|
|                               |                     |                      | Low impact       | Moderate impact | High impact     | Low impact       | Moderate impact | High impact | Low impact | Moderate impact | High impact |
| S1. Highly qualified employees | number              | [0 – 50]             | 0                | 25             | 50              | 30                |
| S2. Known market leader       | item                | [1 – 20]             | 20               | 10             | 1               | 10                |
| S3. Technical feasibility of the IT implementation | points | [0 – 100] | 0 | 50 | 100 | 95 |
| S4. Availability of innovative abilities of the staff and the possibility to apply them | points | [0 – 100] | 0 | 50 | 100 | 80 |
| S5. Number of customers       | thousand customers  | [0 – 250]            | 0                | 100            | 250             | 120               |
| S6. High degree of compliance with contractual obligations | points | [0 – 100] | 0 | 50 | 100 | 100 |
| S7. Availability of the own platform and | Boolean | [0, 1] | 0 | 0 | 1 | 1 |
It should be noted that name of the linguistic variable for such weaknesses as W3, W4, W5, W6, W7 has been formulated with a negative sense by the experts, which reflects the meaning of the very name of the environmental factor “Weakness”, for example, “Low customer base enlargement rate.” The basic values of the variable reflect low, moderate or high impact of this factor, or in other words, the intensity of manifestation of a weakness in the company. At the same time, the company’s activity indices of reverse direction have been chosen as the domain of definition for these linguistic variables, for example, the index “The customer base rate” is measured in % and shows the increase in the number of customers per year. Accordingly, if the value of this variable is closer to 0, the customer’s growth is low; hence the manifestation of the company’s weakness is greater. Conversely, if the variable value is closer to 10 (based on the domain of definition), the weakness will be manifested less in the company.

The columns 1 – 6 of the table 3 present the formed linguistic variables for the formalization of opportunities in the implementation of cloud IT-applications in the enterprise; the units and the domain of definition, and values of the basic variables (low impact, moderate impact, high impact) are indicated.
Table 3: Linguistic variables and expert estimates of the opportunities of the external environment in the implementation of cloud IT

| Name of the linguistic variable | Unit of measurement | Domain of definition | The dominant values of the terms of basic variables | Expert estimates: |
|---------------------------------|---------------------|---------------------|-----------------------------------------------------|-------------------|
|                                 |                     |                     | Low impact | Moderate impact | High impact | Probability of the opportunity | The degree of impact on the company |
| 1 O1. Connection of the new users and new functional | number | [0 – 40] | 0 | 20 | 40 | 0.9 | 20 |
| 2 O2. Reduction of the cost and timing for processing the incidents and changes | % | [0 – 100] | 0 | 50 | 100 | 1 | 80 |
| 3 O3. Reduction of the downtime of the computing systems* | thousand roubles | [0 – 10] | 0 | 5 | 10 | 0.8 | 4 |
| 4 O4. Reduction of the capital and operating costs | thousand roubles | [0 – 1000] | 0 | 500 | 1000 | 0.8 | 200 |
| 5 O5. Ease of integration | points | [0 – 100] | 0 | 50 | 100 | 1 | 95 |
| 6 O6. Reduction of competition* | points | [0 – 100] | 0 | 50 | 100 | 0.6 | 70 |
*Index “Reduction of the downtime of the computing systems” for the corresponding linguistic variable characterizes the opportunity “Optimization of resource utilization in the implementation of cloud IT services.” It is calculated by the formula:

\[ Uh \times (1 - Ch_t) \geq Uh_{DPC} \times \left( I - \frac{Ch_{DPC}}{Al} \right) \]

where \( Uh_t \) are the used cloud hours;

\( I \) - income;

\( Ch_t \) - cost of one hour of work in the cloud;

\( Uh_{DPC} \) - used hours of DPC (Data Processing Centre);

\( Ch_{DPC} \) - cost of one hour of work of DPC;

\( Al \) - average load.

The value of this index shows how much cash can be saved by reducing the downtime of the computing systems.

**Linguistic variable “Reduces competition” characterizes improvement of scalability and simplification of management while reducing costs, which in turn provides distinct advantages over their competitors.

The columns 1 – 7 of the table 4 present the formed linguistic variables to formalize threats when implementing the cloud IT-applications in the enterprise, the units and the domain of definition, and the basic values of variables (destruction, critical state, serious condition, “minor injuries”) are indicated.

Table 4: Linguistic variables and expert estimates of the threats of the external environment in the implementation of cloud IT

| Name of the linguistic variable | Unit of measurement | Domain of definition | The dominant values of the terms for basic variables | Expert estimates: |
|---------------------------------|---------------------|---------------------|-----------------------------------------------|------------------|
|                                 |                     |                     | Destroyed | Critical state | Serious condition | “Minor injuries” | Threat probability | The degree of impact on the company |
| 1                               | 2                   | 3                   | 4         | 5              | 6               | 7              | 8              | 9                      |
| Th1. Failure to points          |                     |                     | 0 –       | 100            | 75              | 25             | 0              | 0.8                    | 80                     |
### III.iii. Expert Assessment of the Manifestation Level of Strategic Factors

Then the experts were encouraged to assess the impact of opportunities and threats on the business strategy of the company in the implementation of cloud technologies. Also, the experts were proposed to measure the probability of the specific opportunities and threats. The estimates of opportunities are presented in Table 3 (columns 7 and 8), and the estimates of threat are presented in Table 4 (columns 8 and 9).

Similarly, the experts were requested to evaluate the intensity of the strengths and weaknesses of the company at the time of analysis. The estimates are presented in Table 2, column 7.

### III.iv. Positioning of Opportunities and Threats

To rank the opportunities, the method of positioning every opportunity, revealed in the external environment, on the matrix of opportunities is applied.

Next, using the generated linguistic variables, systems of the fuzzy rules (productions), fuzzy inference on the basis of the modus ponens rule, as well as the expert estimates for the opportunities and threats (input values), the output values of linguistic variables “Opportunity value” and “Threat value” were calculated for the company. The calculation results (presented in Table 5) allow ranking the factors of external environmental by their significance for accounting in the cloud IT implementation strategy.
Table 5: The calculation results for the opportunities and threats in the implementation of cloud IT services

| Name of the linguistic variable                                      | The estimated value of an opportunity/threat |
|---------------------------------------------------------------------|---------------------------------------------|
| **Opportunities in the implementation of cloud IT-applications**    |                                             |
| Ease of integration                                                 | 97.13                                       |
| Reduction of the cost and timing for processing the incidents and changes | 88.5                                        |
| Connection of the new users and new functional                      | 88.27                                       |
| Reduction of the downtime of the computing systems                  | 80                                          |
| Reduction of competition                                            | 69.25                                       |
| Reduction of the capital and operating costs                        | 30.99                                       |
| **Threats in the implementation of cloud IT-applications**          |                                             |
| Information security problems                                       | 100                                         |
| Loss of control                                                     | 94                                          |
| Failure to comply with SLA                                          | 88                                          |
| Probability of incidents                                            | 78.75                                       |
| Economic crisis                                                     | 22.72                                       |
| Inconsistency with regulations                                      | 15                                          |

**III.v. Selection of Combinations of Factors of the External and Internal Environment and Calculation of their Importance for the Strategy**

Since the SWOT matrix is compiled, the researcher (expert) should identify the combinations of pairs (from among all possible) with meaningful links between them, and they should be considered in the strategy of the enterprise. As a result, several pairs of combinations of the factors of external and internal environment appear in each of the four fields of the matrix. These pairs should be also assessed in terms of their importance for the company.

The experts selected four combinations of factors in the square “Opportunities-Strengths,” 29 combinations in the square “Opportunities-Weaknesses,” 19 combinations in the square “Threats-Strengths,” and four
combinations in the square “Threats-Weaknesses” (Table 6). Calculation results of the importance of these combinations are presented in Table 7.

Table 6: Selection of factors in the SWOT matrix squares

| SW/OTh | Opportunities | Threats |
|--------|---------------|---------|
|        | O1 | O2 | O3 | O4 | O5 | O6 | Th1 | Th2 | Th3 | Th4 | Th5 | Th6 |
|        | S1 |    |    |    |    |    | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |
|        | S2 | ✓  |    |    |    |    | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |
|        | S3 |    | ✓  | ✓  | ✓  |    | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |
|        | S4 |    | ✓  | ✓  | ✓  | ✓  | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |
|        | S5 |    | ✓  | ✓  | ✓  | ✓  | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |
|        | S6 | ✓  |    | ✓  | ✓  | ✓  | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |
|        | S7 | ✓  | ✓  | ✓  | ✓  | ✓  | ✓   | ✓  | ✓  | ✓  | ✓  | ✓  |

Table 7: The calculation results for the selected combinations of factors

| Combinations of the environmental factors | Estimated value of the importance of combinations of factors |
|------------------------------------------|----------------------------------------------------------|
| External factors                          | Internal factors                                         |
| Opportunities for the cloud IT implementation | Company’s strengths                                  |
| Reduction of cost and timing for processing the incidents and changes | Technical feasibility of the IT implementation | 94 |
| Ease of integration | Technical feasibility of the IT implementation | 97 |
|--------------------|---------------------------------------------|----|
| Reduction of the downtime of the computing systems | Availability of the own platform and service center | 80 |
| Reduction of competition | Availability of the own platform and service center | 69.25 |
| **Opportunities for the cloud IT implementation** | **Company’s weaknesses** | |
| Connection of new users and new functional | Limited IT-budget | 88.27 |
| | Customer base enlargement | 89.09 |
| | Poor management of the strategic action plan | 84.13 |
| | Disinterest of employees in the increase in sales | 88.27 |
| | Low mobility and business rate | 88.27 |
| Reduction of the cost and timing for processing the incidents and changes | Limited IT-budget | 88.5 |
| | Deteriorating competitive position | 88.5 |
| | Poor management of the strategic action plan | 84.25 |
| | Customer base enlargement | 89.35 |
| | Lack of interest of employees in the gain in sales | 88.5 |
| | Narrow range of services | 90.10 |
| | Low mobility and business rate | 88.5 |
| Reduction of the downtime of the computing systems | Limited IT-budget | 80 |
| | Deteriorating competitive position | 80 |
| | Poor management of the strategic action plan | 80 |
| | Lack of interest of employees increase in sales | 80 |
| Threats of the cloud IT implementation | Company’s strengths |
|--------------------------------------|---------------------|
| Failure to comply with SLA           | Highly qualified employees 88.23 |
|                                     | High degree of compliance with contractual obligations 94 |
| Inconsistency with regulations       | Highly qualified employees 15 |
|                                     | Availability of innovative abilities of the staff and the possibility to apply them 50 |
|                                     | Technical feasibility of the IT implementation 50 |
|                                     | High degree of compliance with contractual obligations 50 |
| Loss of control                      | Highly qualified employees 92.49 |
| Threats of the cloud IT implementation | Company’s weaknesses | Assessment |
|--------------------------------------|---------------------|------------|
| Economic crisis                      | Limited IT-budget   | 22.72      |
| Loss of control                      |                     | 93.55      |
| Probability of incidents             | Low mobility and business rate | 78.75 |
| Information security problems        |                     | 96.55      |

| Probability of incidents | Availability of innovative abilities of the staff and the possibility to apply them | 90.10 |
|--------------------------|--------------------------------------------------------------------------------|-------|
|                          | Availability of the own platform and service center | 94    |

| Information security problems | Highly qualified employees | 81    |
|-------------------------------|-----------------------------|-------|
|                               | Availability of innovative abilities of the staff and the possibility to apply them | 88.45 |
|                               | Availability of the own platform and service center | 78.75 |

| Economic crisis | Known market leader | 15.17 |
|-----------------|---------------------|-------|
|                 | Technical feasibility for the IT implementation | 58.17 |
|                 | Availability of innovative abilities of the staff and the possibility to apply them | 55.82 |
|                 | Availability of the own platform and service center | 22.72 |
V. Discussion

It should be noted that the issues of effectiveness and risks of the cloud IT are discussed in detail in the literature of the public sphere (e.g., in education and medicine [XI, XXI, XXXVI]), as well as in the business sector of enterprises [V, IX, XX, XXXI, XXXII, XXXIV]).

At the same time, not enough attention is paid to the issues of strategic analysis for the development of the information field of decision-making on the IT-environment migration into the cloud.

Thus, SWOT-analysis is expedient in the development of IT strategy for implementation of cloud technologies, as it focuses the decision-makers’ attention on the following issues:

- Probable additional opportunities in the external environment for the enterprise with the use of the cloud technologies;
- Any possible threats to the enterprise when using the cloud technologies;
- Strengths of the enterprise which may be used to adopt the cloud technologies and/or allow substantiating their introduction;
- Weaknesses of the enterprise which can be overcome through the introduction of cloud technologies and/or allow substantiating their introduction;
- Combination of internal and external factors which should be used to form the strategy for implementation of the cloud technologies.

SWOT-analysis has proven itself as a tool for analysis of opportunities, threats, strengths and weaknesses of a company. With regard to the IT sector, SWOT-analysis also has a wide practical application. For example, in the development of implementation strategies for certain IT types in the enterprise [XXIII, XXIV, XXIX], in the public sector [XLI], industry [VIII], and educational organizations [XXXVIII, XXXIX]. [XLV, XXVII]

At the same time, the researchers have noted the following deficiencies of the basic methodology of the SWOT-analysis: the problem of ranking and quantitative assessment of individual environmental factors and sets of the generated strategies [XIX, XXV]; the problem of modelling the potential relationships between the SWOT factors [XXXVIII]. The methodology of the SWOT-analysis requires experts to generate strategies and to assess the environmental factors under uncertain external environment and incomplete information. Most often, qualitative factors are chosen for the analysis, but it is rather problematic to establish relationships between them in the form of a quantitative description.

It should be noted that SWOT-analysis has not yet been studied to develop a strategy for the implementation of cloud IT.
Thus, the Fuzzy SWOT-analysis performed for PJSC “Rutelecom” by a group of analysts, experts and decision-makers resulted in the following set of additional information:

- Estimated values of the opportunities and threats of the external environment in the implementation of the cloud technologies, as well as the lists of external factors sorted by this value;
- Estimated values of the importance of combinations of factors of the external and internal environment (for each SWOT matrix square);
- Interim information that may also reduce the uncertainty of the environment – linguistic variables and their parameters; expert assessment of the current level of impact of the environmental factors.

The next challenge is the interpretation of the obtained information for generation of the field of decision-making, strategic alternatives and recommendations on the strategy development.

IV.i. Generation of Strategic Alternatives

To generate the strategic alternatives, the most important combinations of factors in each square of SWOT matrix were considered (those with estimate 80 points or more).

Based on the obtained combination of environmental factors and their importance for “Rutelecom,” we can identify directions on which the strategy will be developed. Thus, a good technical base available at the enterprise for the IT implementation and the own platform with service center will make a smooth transition to the cloud technologies. With the introduction of cloud services, the company can achieve the mobility and the business rate; expand its customer base and range of services; improve its competitive position; increase the interest of employees by reducing the downtime of the computing systems; optimize the IT-budget due to the reduced capital and operating costs, timing for processing the incidents and changes, as well as the ease of integration.

The highly qualified employees, the existence of innovative abilities of the staff, the availability of the own platform and the service center will allow to partly avoid such threats as failure to comply with SLA, loss of control, the occurrence of incidents, and problems related to information security. However, these issues should be thoroughly analysed when choosing a service provider.

The work of the decision-maker and analytical group resulted in generation of the following strategic alternatives of the cloud technologies implementations.

**Square “Strengths - Opportunities”.

**Using Your Own Infrastructure to Deploy Cloud Computing will Enable Your Organization to Use A Private Cloud**
Strategy 1. The use of own facilities to deploy the cloud computing (creation of a private cloud for the company). This will greatly reduce the risks, as the company will be much less dependent on the provider. If the private cloud is owned by the company and physically exist within its jurisdiction, it will be possible to abstract from the cloud idea, and assume that the company does not use it. When using a private cloud, the company’s employees can be considered a client, and the company – the service provider. Moreover, with the own capacities, there is no need to consider the implementation of IaaS.

Square “Weaknesses - Opportunities.”

Strategy 2. Implementation of cloud technologies to optimize financial and technological structure of the IT scope. Inadequate use of infrastructure during the regular periods of activity decline throughout the year leads to hidden losses of resources, including the costs of equipment, electric power, management and cooling. By using a SaaS model, the cloud technologies will significantly reduce these costs in these areas.

Strategy 3. Improving the competitiveness of the services of PJSC “Rutelecom” due to the sufficient bandwidth. It will support the significant fluctuations in the volume of traffic on the network according to the high activity and decays in different periods of the day and year. That will improve the quality of telecommunication services and, accordingly, enlarge the customer base.

Square “Strengths - Threats.”

Strategy 4. Development of competences of staff to reduce the risks of using the third-party cloud services. The highly qualified employees with expertise in the cloud technologies can solve problems in the event of incidents more quickly and efficiently. Moreover, if utilization of the private cloud is proposed, the knowledge and skills of the employees should be upgraded. This will allow the company to use their own powers and to a lesser extent depend on the provider.

Strategy 5. Creation of the back-up data processing and storage centers based on the enterprise’s capacities. With this center, data loss in the event of an incident can be avoided due to the data back-up, and the performed operations can be performed at a faster rate.

Square “Weaknesses - Threats.”

Strategy 6. Partial transition to the cloud of applications related to the support of non-key business processes of the enterprise. To avoid possible problems of implementation of cloud IT or to reduce the scale of their impact on the company, it is advisable to start implementing the cloud IT with the ones providing functional areas of the enterprise, for example, human resource management, payroll accounting, accounting of inventory. This will allow, on the one hand, to get experience in implementing the cloud IT, and reveal the “pitfalls,” and, on the other hand, avoid risks and losses for key business processes in the event of failed implementations.
The choice of strategic alternatives from the generated list is performed in the subsequent stages of the strategic planning.

IV.ii. Development of Directions to Support Decisions on the Implementation of Cloud Technologies

After analysing the set of combinations that received high importance points, the analysts highlighted the list of factors which were repeatedly considered in the SWOT matrix (repeated in the pairs of the selected combinations for three or more times):

1. Reduction of cost and timing for processing the incidents and changes.
2. Ease of integration.
3. Reduction of the downtime of the computing systems.
4. Connection of the new users and new functional.
5. Failure to comply with SLA.
6. Loss of control.
7. Information security problems.
8. Technical feasibility of the IT implementation.
9. Availability of the own platform and service center.
10. Low mobility and business rate.
11. Limited IT-budget.
12. Customer base enlargement.
13. Highly qualified employees.
14. Availability of the own platform and service center.
15. Availability of innovative abilities of the staff and the possibility to apply them.

This list of factors requires special attention in the further development of strategies for the cloud technologies implementation. A detailed analysis of these factors allows understanding which aspects of the cloud technologies implementation should be analysed more deeply, using special methods of assessment and decision-making.

Four additional directions to analyse were identified for the further development of a strategy for implementing cloud technologies of PJSC “Rutelecom”:

Direction 1. To analyse the cloud services providers, as the implementing of the cloud technologies focuses on the security issues and it depends on the provider. When studying the provider, it is important to analyse the following:
1) data security during the storage and transmission;

2) authentication issues (recognition of the client authentication by the provider);

3) connection to the provider (reaction to incidents).

Also, when analysing the provider, it is important to study documentation (contracts, agreements) for consistency with the standards:

4) analysis of the provider’s compliance with the SLA document;

5) study the service contract (rights and obligations);

6) guarantee of smooth operation and data recovery in the event of an incident (It is stipulated in the contract).

**Direction 2.** To analyse the IT-infrastructure of the company, namely to find out whether it is possible to implement cloud technologies in the enterprise and whether any additional hardware is required for that.

**Direction 3.** To analyse the existing applications in the company for their possible transition to the cloud environment, and to determine the cloud service model (SaaS, PaaS, IaaS) and the deployment model (public, private or hybrid cloud).

**Direction 4.** To determine the financial benefits of the cloud IT. Among the important factors are the “Reduction of cost and timing for processing the incidents and changes,” “Reduction of the downtime of the computing systems,” “Connection of the new users and new functional.” This means that the implementation of cloud services will increase users’ productivity, optimize the resource utilization and thus save money.

**V. Conclusions**

The study proved the possibility and necessity of the SWOT-analysis for the development of a strategy for implementing cloud technologies in a company. The results of practical application of this method are presented for the development of the strategy for PJSC “Rutelecom”. The application of the fuzzy SWOT-analysis allowed:

1) to provide quantitative estimates of the importance of the environmental factors for the cloud IT implementation strategy, although most of them are qualitative and have no universal measuring properties;

2) to provide quantitative estimates of the importance of combination of the environmental factors, although there are no exact dependencies between the factors.

The results of the fuzzy SWOT-analysis allow appreciating more information to make strategic decisions in the IT sector, as well as the adjustment of IT-strategy to the business goals of the enterprise. Based on the analysis of the estimates of factors and their combinations, the main strategic alternatives of the company development, related to the implementation of the cloud technologies have been developed.
In addition, the directions to support decisions regarding the key issues identified during the SWOT-analysis were identified. In particular, the task of assessing the options of the cloud solutions in terms of their compliance with the business strategy, effectiveness, efficiency and risks for the company needs to be addressed.

VI. Recommendations

The materials of the article are relevant to the companies intending to implement cloud technologies in their activities to justify their use, reliability and efficiency.

The practical value lies in the possibility to obtain recommendations on the optimal choice of IT-applications for the transition to the cloud technologies, which is an urgent task in the context of a limited IT-budget of the enterprise.

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