The analysis of changes in the payroll of information system support specialists during the Devops methodology implementing

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Abstract. For a wide range of tasks, especially in the field of software development, the use of modern platforms for virtualization and containerization of applications can significantly increase the density of computing nodes (virtual machines and containers) on the equipment. In addition, the use of CI and CD practices can save the working time of employees responsible for supporting such IT infrastructure. At the same time, specialists supporting such IT infrastructure should have a number of additional competencies. The purpose of this article is to analyze the cost of specialists supporting information systems built using virtualization technologies, cloud computing in the context of CI and CD practices. This article presents an analysis of all available relevant vacancies in Saint Petersburg and Moscow from the HeadHunter site. Also, the difference between the required competencies and the level of salaries of specialists supporting classical and virtualized, automated IT infrastructure is shown.

1. Introduction

Informatization and digitalization of all the economic sectors leads to the fact that the amount of information that organizations have to work with is constantly growing [8]. For mid-level organizations that have their own developers, such trends create the prerequisites for a transition to a DevOps culture in managing IT infrastructure [3].

The main hypothesis of this article is that during the transition to the DevOps culture, besides the required capital investments for the IT infrastructure development and the purchase of the required software, staff costs may increase significantly, especially due to the growth of the salary fund for IT infrastructure support unit employees [11].

In accordance with this hypothesis, the purpose of this article is to analyze the labor market in terms of relevant vacancies.

2. DevOps Methodology

For mid-level organizations of which activities include software development (for example, for the internal consumer), the issues of the test environments deployment and the new versions of software deployment automatization may be quite acute [2].
Indeed, it is quite obvious that the use of Devops practices, in particular CI / CD-pipelines, may save a huge number of IT infrastructure technical support man-hours via the automatization of IT infrastructure routine processes [4].

In addition, our studies have shown that the accompanying approaches and platforms, used in the DevOps practices implementation, helps to increase the density of IT services on equipment: it is especially noticeable in moving to application containerization and in using platforms such as Kubernetes [6].

However, in the transition to the Devops methodology regarding the IT infrastructure organization, some significant additional costs may arise [9]. For example, if on average 3 IT support specialists (system administrators) are required for the classical mid-level organization IT infrastructure (up to 10 onsite servers and a computing cloud, for example, AWS), then at least 2 employees will be required to implement Devops practices qualified as Devops Engineer (Devops) or Site Reliability Engineer (SRE) [5]. The difficulty of finding such specialists may also be related to the fact that specialists of that level are not taught at universities and a lot of practical experience is required for a specialist to be able to achieve the Devops engineer qualification, for example, having received an education as an Information Systems Specialist, programmer or business analyst [7].

3. The results of the analysis of St. Petersburg and Moscow labor market
In the framework of this study, a huge number of data was collected from hh.ru, since it is the largest open register of information on existing vacancies in the Russian Federation. In our opinion, the information that employers place on this resource characterizes the level of demand for certain specialists and their requirements.

The vacancies of two categories were analyzed: “system administrator” and “Devops engineer”. Similar vacancies were included in each category. For example, for the category “system administrator”: system administrator, system engineer, technical support specialist, system administrator, engineer on duty, etc. For the category “Devops engineer”: Devops engineer, Devops, SRE, DevOps specialist, QA, developer (Devops) [10].

Data was automatically collected in March 2020, using a script developed by the authors for this study in the Python programming language. Data were collected for the two largest cities in the Russian Federation: St. Petersburg and Moscow. In total there are 2495 vacancies were collected and analyzed. In total, the “System Administrator” category data were collected for 263 vacancies in St. Petersburg and about 746 vacancies in Moscow.

In the category “Devops Engineer”, data were collected for 384 vacancies in St. Petersburg and about 1102 vacancies in Moscow.

The data set collected by the authors contained the following information: the name of the vacancy, a link to the vacancy, the name of the employer, the location of the employer (metro, district), a full description of the vacancy, and the amount of salary. An analysis of the collected data was started by calculating the arithmetic average and average median salary for each category of vacancies. If the vacancy was indicated in the form of a range, then the arithmetic average between the beginning and the end of the specified range was used for calculations. For salaries indicated in foreign currency, the conversion was done at the Central Bank rate on 04/04/2020. The results of the analysis are presented in table 1.

| Table 1. Analysis of average wages for analyzed job categories (in Russian rubles). |
|---------------------------------------------------------------|
| System Administrator | Devops engineer |
|----------------------|-----------------|
| Average salary in Saint Petersburg | 60435 | 168253 |
| Average median salary in Saint Petersburg | 52500 | 150000 |
| Average salary in Moscow | 79216 | 180591 |
| Average median salary in Moscow | 70000 | 180000 |
The data presented in table 1, confirm the hypothesis formulated at the beginning of the article. For a mid-level organization (3 IT infrastructure support specialists and 2 Devops engineers), the salary fund will increase almost 3 times.

The authors also conducted an analysis of the requirements contained in the description of the selected vacancies [12]. To process the resulting data, several procedures for preparing the text for analysis were performed. The first step was tokenization. Tokenization is the process of breaking down text and sentences into separate words. In the process of tokenization, special symbols, punctuation marks and stop words, such as prepositions and conjunctions that do not carry a semantic load, were removed from the job descriptions.

After that, the authors lemmatized the obtained data. Lemmatization is the process of bringing words to their initial form. For this, we used the Yandex MyStem console application.

The next step in the data analysis is thematic modeling, which was carried out by applying the Latent Dirichlet allocation (LDA) method. This method allows you to explain the results of observations, forming implicit groups (topics). This analysis was performed using a script prepared by the authors in the Python programming language, using the Gensim library and the NLTK library package.

After processing the data, coherence was calculated for each topic. As a result, 20 sets of 20 “terms” were obtained in descending order of “terms” consistency. Below are the most relevant and representative results in the histograms form.

Thus, the analysis of the requirements for the “System Administrator” category in St. Petersburg has shown that the most relevant characteristics for such specialists, according to employers, are: “support”, “server”, “equipment”, “administration”, “system”, “technical”, “windows” - figure 1.

![Figure 1](image1.jpg)

**Figure 1.** Results for the “System Administrator” category, St. Petersburg.

The set of the most relevant characteristics, in general, objectively reflects the essence of the average specialist work in the “System Administrator” category.

Now we will consider the most relevant characteristics we received for Devops engineers, St. Petersburg: “experience”, “system”, “development”, “testing”, “devops”, “ci”, “code” - figure 2.

![Figure 2](image2.jpg)
The results show, what, on average, organizations are expecting from Devops engineer specialists (in addition to the skills required for IT infrastructure support specialists): experience in this position, software development skills, and skills software testing, the availability of automatization skills for deploying server infrastructure.

Similar requirements are imposed on specialists in the System Administrator category in Moscow, figure 3.

Similar requirements apply to Devops engineers — figure 4.

In addition, during the analysis of requirements for specialists in these categories, the authors noted interesting patterns. For example, for specialists in the “System Administrator” category, approximately half of the vacancies required knowledge of the Microsoft technological stack, and in the other half, knowledge of Linux and Unix-like systems. While Devops engineers in the vast majority of jobs require knowledge and experience with Linux and Unix-like systems. Another feature
of job descriptions for the Devops Engineer category is that many jobs require a knowledge of a programming language (most often Python and Java).

![Figure 4](image_url) Results for the “Devops Engineer” category, Moscow.

While comparing the requirements for specialists in these categories, it becomes obvious that the retraining (or advanced training) of IT support specialists in Devops engineers in many cases may not be possible, at least in the short period of time [1].

4. Results and conclusions
The results of the study allowed to confirm the hypothesis formulated by the authors at the beginning of the article. If the organization needs to use the Devops methodology in its IT infrastructure, it is important to consider the fact that the salary fund for specialists supporting such IT infrastructure can significantly (almost 3 times) increase.

Retraining or training of already existing in the organization IT infrastructure support specialists prior to the Devops engineer qualification may not be possible in the short period of time, since Devops engineers must have a number of additional competencies, including those in the field of software development and testing.

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