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Graduate School of Management

Master in Management

KEY DECISION-MAKING FACTORS FOR ADOPTION OF SAAS IN SMES IN RUSSIA

Master's Thesis by the 2nd year student

Concentration — Master in Management

Nikita Bannikov

Research advisor:

Associate Professor, Sergey A. Yablonsky

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ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

Я, Банников Никита Игоревич, студент второго курса магистратуры направления «Менеджмент», заявляю, что в моей магистерской диссертации на тему «Ключевые факторы принятия решений о внедрении SaaS в российских компаниях малого и среднего бизнеса», представленной в службу обеспечения программ магистратуры для последующей передачи в государственную аттестационную комиссию для публичной защиты, не содержится элементов плагиата.

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Мне известно содержание п. 9.7.1 Правил обучения по основным образовательным программам высшего и среднего профессионального образования в СПбГУ о том, что «ВКР выполняется индивидуально каждым студентом под руководством назначенного ему научного руководителя», и п. 51 Устава федерального государственного бюджетного образовательного учреждения высшего профессионального образования «Санкт-Петербургский государственный университет» о том, что «студент подлежит отчислению из Санкт-Петербургского университета за представление курсовой или выпускной квалификационной работы, выполненной другим лицом (лицами)».

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25.05.2017 _____ (Дата)

STATEMENT ABOUT THE INDEPENDENT CHARACTER

OF THE MASTER THESIS

I, Nikita Bannikov, second year master student, program «Management», state that my master thesis on the topic «Key Decision-Making Factors For Adoption Of SaaS In SMEs In Russia», which is presented to the Master Office to be submitted to the Official Defense Committee for the public defense, does not contain any elements of plagiarism.

All direct borrowings from printed and electronic sources, as well as from master theses, PhD and doctorate theses which were defended earlier, have appropriate references.

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/ Bannikov Nikita (Student's signature)

25.05.2017 (Date)

АННОТАЦИЯ

Автор	Банников Никита Игоревич
Название магистерской диссертации	«Ключевые факторы принятия решений о внедрении SaaS в российских компаниях малого и среднего бизнеса»
Факультет	Высшая школа менеджмента
Направление подготовки	080200 “Менеджмент” (Профиль: CEMS MIM)
Год	2017
Научный руководитель	Сергей Александрович Яблонский, к.т.н., доцент
Описание цели, задач и основных результатов	Цель исследования состоит в анализе зависимостей между факторами, связанными с принятием решений о внедрении облачного сервиса SaaS в российских компаниях малого и среднего бизнеса. Для выполнения цели были сформулированы исследовательские гипотезы и концепция, основанная на моделировании структурных уравнений. На основании результатов опроса представителей различных российских компаний малого и среднего бизнеса, гипотезы о влиянии различных факторов на необходимость внедрения для бизнеса были протестированы. Продемонстрирована значимость ряда факторов (предыдущий опыт использования, надежность, и издержки, связанные со стоимостью владения облачными решениями).
Ключевые слова	Облачные вычисления, SaaS, принятие решений, моделирование структурных уравнений, средний и малый бизнес

ABSTRACT

Master Student's Name	Nikita Bannikov
Master Thesis Title	“Key decision-making factors for adoption of SaaS in SMEs in Russia”
Faculty	Graduate school of management
Main field of study	080200 “Management” (specialization: CEMS MIM)
Year	2017
Academic Advisor’s Name	Sergey A. Yablonsky, PhD in Technical sciences, Associate Professor
Description of the goal, task and main results	The goal of the research is to analyze relations in factors, associated to making decisions about adoption SaaS cloud service in Russian small and medium businesses. For this purpose, research hypotheses and research framework in form of structural equation model was developed. Basing on results of survey of various Russian SMEs’ representatives, hypothesis about affecting business need in adoption by different factors were tested, showing importance of particular factors (previous usage, reliability, and costs of ownership of cloud solutions).
Keywords	Cloud services, SaaS, decision-making, structural equation modelling, small and medium business

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INTRODUCTION

Introduction of the topic

Nowadays, cloud computing solutions are still globally regarded as prospective, as the market is growing rapidly. According to Gartner, the global market of public cloud services was on its way to grow by 17,2% in 2016, from $178 billion to $208,6 billion (Stamford, 2016).

As a model, cloud services have a lot of clear advantages for adopting companies. For instance, they require minimum specific knowledge from users (Safari, Safari, and Hasanzadeh, 2014; Wu, Wan, and Lee, 2011), allow for an access from multiple devices via the web (Bayrak, 2013; Johansson, Ruivo, 2013; Sebesta, 2013) and might offer latest versions of IT-infrastructure components and functionality (Sebesta, 2013; Wu, Wan, and Lee, 2011). What is more, they are often associated with various cost savings (Safari, Safari, and Hasanzadeh, 2014; Sultan, 2011)

The cloud services market in Russia is considered overall as developed. Major segments of the market are SaaS (software as a service – provision enterprise applications via Internet), data storage (provision of cloud storage accessible via Internet) and IaaS (infrastructure as a service – provision of computational resources via Internet) (CNews Analytics, 2016).

Another commonly mentioned segment – PaaS (platform-as-a-service – provision of platforms to deploy own applications on top of them via Internet) (Safari, Safari, and Hasanzadeh, 2014) is also present in the portfolios of services of largest Russian market players as an independent service (IT-GRAD, Softline), but more often considered as a part of IaaS (ActiveCloud, Cloud4Y, DataLine, I-Teco, KROK) (CNews Analytics, 2016). Peculiarities of services within particular segments would be described further in the introductory chapter.

In SaaS, which will be further the focus segment of the study, largest market players by annual revenue in 2016 are concentrated in two locations – Moscow and Saint-Petersburg, two large players also located in Ekaterinburg and Kazan (CNews Analytics, 2016).

Despite the maturity of the cloud services market, service proposition tools are limited to web-pages, where customers can specify particular service used and its parameters, such as a number of licenses or a payment scheme, and then contact sales representatives of a vendor (CNews Analytics, 2016).

The issue of the absence of decision-making support tools outlined above is particularly relevant for small and medium businesses (SMEs) as they are considered to be the major client

segment for cloud solution providers due to a lack of resources to create own IT-infrastructure, a necessity to frequently and drastically change its scale, and a low level of expertise of decision makers.

At the same time, SMEs need to make decisions and often conduct their own analysis. Odin in their SMB Cloud Insights Russia 2015 research (Odin, 2016) interviewed more than 400 IT decision makers in order to find out the latest trends in the perception of SaaS, as well as currently most common pluses and minuses. The research indicates, that on average, about half of SMEs prefer to hold own study (58% of microenterprises, 41% of small enterprises, 35% of medium enterprises) or rely upon a trusted advisor (26% of microenterprises, 41% of small enterprises, 35% of medium enterprises) in order to choose business application solutions (Odin, 2016).

In summary, these arguments stipulate for a need of universal, simpler to understand and implement mechanisms and instruments of decision-making.

Key details of research

The object of the research is decision-making process, related to the adoption of information technologies. The research subject is decision-making specifics of the adoption of SaaS by Russian SMEs.

Therefore, the research question can be formulated as follows: which factors are the most relevant and important when it comes to the choice and the adoption of cloud software as a service for SMEs in Russia, are there any dependencies and correlations between factors. The question is to be analyzed at the firm level from the perspective of SMEs.

We can define the objective of the study as providing a SaaS adoption framework and a multi-criteria decision making technique for both vendors and potential commercial users, taking into account the specifics of the Russian SaaS market (the regional concentration and industries that SMEs considering SaaS adoption belong to).

The objective therefore can be obtained through a following set of research tasks:

- Conduct analysis of extant theoretical studies (research questions and topics, subjects, design, frameworks, variables, hypotheses, methodologies of data collection and analysis, conclusions and findings, contributions, and limitations) in order to define the research gap and potential dimensions of own research;

- Outline the scope of own research in terms of parameters of studies mentioned above (more specifically, outline, which cloud services, deployment models, particular software types and regions of location of SMEs to consider);
- Formulate the research methodology based on extant theoretical studies and the analysis of industry research by practitioners: the research framework, decision-making factors, specific research hypotheses, methodologies of the data collection and the analysis;
- Retrieve primary data from potential and existing SaaS users among Russian SMEs using outlined data collection tools and techniques;
- Apply proposed methodology for the analysis of data and the hypothesis testing;
- Retrieve results of the application of the methodology, interpret them, and develop recommendations upon the SaaS adoption for researchers and practitioners.

The paper includes three chapters. In the first chapter, we outline relevant extant studies and analyze them in terms of key research components (research questions, scope, methodology etc.). As a following step, we identify the research gap for own study, based on limitations of existing papers.

The scientific research of academics in similar areas is based mostly on quantitative methods. Among them, we can name the formulation of the integral assessment based on factors and weights (Sun, Ni, and Lam, 2015), the usage of maps and relation matrices (Wu, Lan, and Lee, 2011) and other multi-criteria decision making techniques (Kilic, Zaim, and Delen, 2014), which will be further analyzed in following chapter. The hypothesis testing is also used as a way to formulate and explore research problems (Budniks and Didenko, 2014; Deshmukh, Kalamkar, and Thampi, 2015; Grama and Pavaloaia, 2014; Gupta, Seetharaman, and Raj, 2013; Lee, Park, and Lim, 2013).

Considering this, in the second chapter of the paper we define the scope of the research, formulate research hypotheses, establish the research framework, and describe the methodology of the research.

Variables operated in hypotheses are taken from those applied in “benchmark” extant studies (Gupta, Seethraman, and Raj, 2013; Wu, Wan, and Lee, 2011) and industry reports about the SaaS-market in Russia in recent years (CNews Analytics, 2015; CNews Analytics, 2016; Odin, 2016; TAdviser, 2016). In the research, we formulate and test four hypotheses, that are related to the dependence of business need in the adoption of SaaS by Russian SMEs on the positive previous experience of usage, features and capabilities, the reliability, and costs of cloud solutions.

The third chapter of the paper is focused on the description of the empirical study. We start with the description of the data collection procedure. We gather the information about factors and factor groups that in general or in certain case would affect the decision of the SaaS adoption of SME in the form of opinion of decision-makers in SMEs about relative importance and interdependencies between factors, representing SaaS solutions currently present on Russian market. Then we proceed with the description of the sample of respondents in terms of various characteristics.

Further analysis of the data is based on the application of factor analysis for justification of validity of the questionnaire and Structural Equation Modelling (set of mathematical models, statistical methods and computer algorithms used to work with statistical data, test hypotheses and so on (Gupta, Seethraman, and Raj, 2013)). Then we discuss the results of testing of hypotheses and interrelations of components of research variables.

Further parts of the third chapter are devoted to the discussion of implications of the paper for researchers and practitioners, as well as research limitations and suggestions for further studies. Apart from the insight about the importance of the decision-making factors we outline the combination of questionnaire, the factor analysis and the structural equation modelling as a research framework and a decision-making support tool, which can be applied by researchers in similar studies and by practitioners (SMEs and cloud software providers) in their activities.

Key definitions

In order to clarify the specifics of research observed in literature review in this paragraph we outline major definitions used by scholars, whose articles are reviewed, and by organizations that prepare reviews of the Russian cloud computing market. First of all, according to the Russian legislation (Federal Law #209 "About development of small and medium enterprises in Russian Federation" and related laws) small and medium enterprises (SMEs) are officially registered commercial entities, individuals, and consumer cooperatives, limited by share of participation of other business entities, by number of employees (1-100 for small business, 101-250 for medium business) and by amount of revenue (up to 800 million rubles for small business, up to 2 billion rubles for medium business) (Consultant Plus, 2017).

SMEs, just as large companies need to manage business processes (defined sets of business activities that represent the steps required to achieve a business objective and include the flow and use of information and resources) (BPMN, 2017) and rely on an IT-infrastructure (combined set of hardware, software, networks, facilities including all of the information technology that allow

to develop, test, deliver, monitor, control or support IT services) (Van der Veen and van Bon, 2007).

But, unlike large companies, SMEs often tend to prefer ready IT-infrastructure solutions (infrastructural components, which are meant to serve particular IT service or facilitate particular business process and provided by external entity) including an enterprise software (a computer software, used to satisfy needs of corporate entities, that, unlike software for individuals, implies stricter requirements to security, reliability, functions under higher workload and is complemented by a technical support and maintenance agreement), such as entire enterprise resource planning (ERP), collaboration, customer relationship management (CRM), project management, supply chain management (SCM), document automation systems, and other types of software (Gartner IT Glossary, 2017).

A common way of obtaining IT-infrastructure solutions for SMEs is the IT outsourcing (contracting one or IT-functions to a third party, while remaining business processes within responsibility of client organization (Sebesta, 2013)), mainly because it is often cheaper, faster to obtain and easier to manage.

What is more, IT-infrastructure related decision-makers in SMEs are usually either managerial position holders, such as CEO or CIO or specialists in charge of all IT-organization, often performing other duties at the same time (CNews Analytics, 2016). They might be aware of IT-needs of organization and extant solutions, but not always have time to perform a proper analysis and would prefer ready solutions. For them it is very convenient to work according to an SLA (a service level agreement – an official commitment that prevails between a service provider and a customer, where particular aspects of the service – quality, availability, responsibilities – are agreed between a service provider and a service user) (Kearney and Torelli, 2011).

A particularly popular way of the IT-infrastructure outsourcing nowadays is usage of the cloud computing – a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (NIST, 2017), based on the technology of the virtualization – "abstraction of IT resources that masks the physical nature and boundaries of those resources from resource users" (Gartner IT Glossary, 2017).

The service, related to providing enterprise software via cloud computing is called SaaS – software-as-a-service. Apart from particular software and SLA conditions SaaS-providers offer different software-licensing models (a structure of agreement between a holder of rights for

software and a subject it provides licenses to – intermediaries or end users; a model specifies amount and type of payments for license, number of licensees, their rights and responsibilities, as well as rights and responsibilities of licenser) and payment schemes (a way that payments for usage of cloud service are done, based either on fixed or variable payments) (NetLicensing, 2017).

As an example of a payment scheme, which was introduced specifically for cloud services, we can mention the "pay-as-you-use" model, that implies periodical payments for specific amount of resources used and potentially can allow for substantial cost-savings compared to fixed payments for dedicated amount of resources (Marian and Hamburg, 2012; Safari, Safari, and Hasanzadeh, 2014).

At the same time, there are decision-making techniques (schemes or processes, that allow to make particular decision, based on measurable objective or subjective criteria), such as Balanced Scorecard ("strategic planning and management system … that is used to align business activities to the vision and strategy of the organization … and monitor organization performance against strategic goals" (Balanced Scorecard Institute, 2017), that large companies use to manage IT-outsourcing.

Most of such techniques are based on the evaluation of decision-making criteria (characteristics of solutions, related to client organization, that are considered in decision-making process), such as Total Cost of Ownership ("comprehensive assessment of information technology (IT) or other costs across enterprise boundaries over time", including "hardware and software acquisition, management and support, communications, end-user expenses and the opportunity cost of downtime, training and other productivity losses" (Gartner IT Glossary, 2017).

Overall, an immersion into the topic requires knowledge of basic concepts and popular models of IT-services, common management tools and frameworks for decision-making.

1. THEORETICAL BACKGROUND

For each chapter of the thesis we will provide information its structure in form of scheme and short description. A scheme for the first chapter is represented on Figure 1.1:

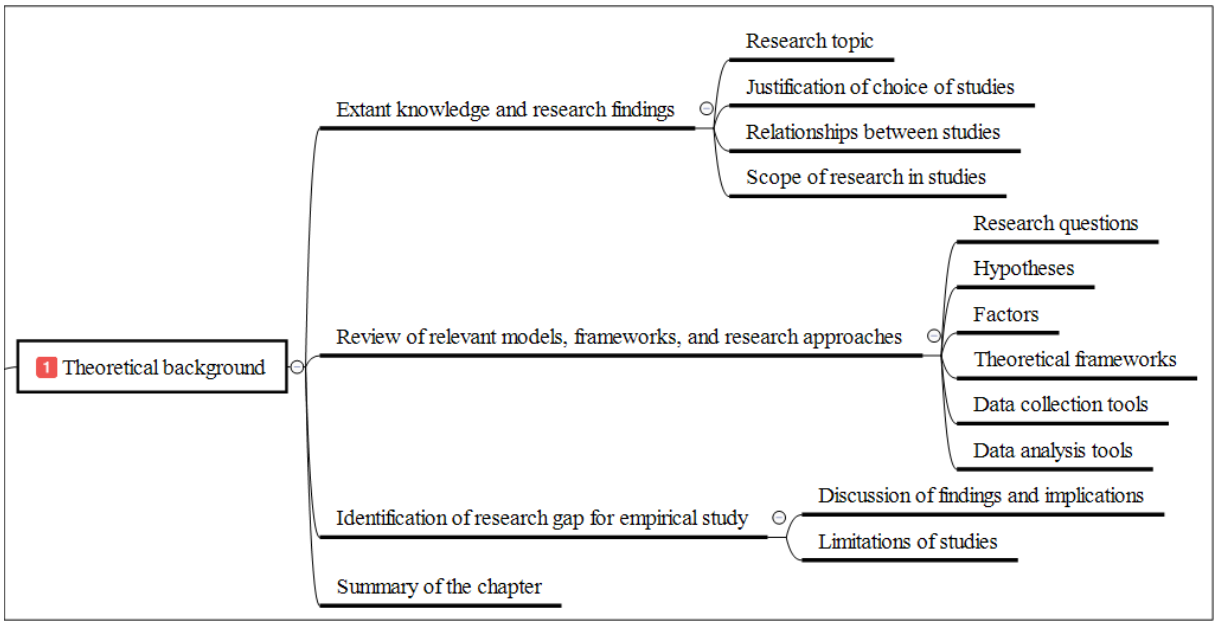

Figure 1.1 – Structure of the Chapter 1

The first paragraph is related to an overview of extant knowledge and research findings. It begins with a description of research topic and provides information, which studies were chosen for the analysis of theoretical background and why, how are they related to each other and what is the scope of research outlined in them.

The second paragraph contains a review of major research components in extant studies – research questions and hypotheses, decision-making factors, theoretical frameworks, data analysis and data collection tools and methodologies.

The main purpose of the overview of theoretical background is to identify the gap for empirical study, based on findings, implications, and limitations of extant studies. It is described in the third paragraph.

1.1.Extant knowledge and research findings

Research papers in this review are concentrated across the following topic: criteria, which determine a decision of an IT manager or other decision maker of a SMEs or a large company in a particular region to adopt an outsourcing solution, namely a cloud computing one. Most of studies are dedicated to revealing these criteria (Budniks and Didenko, 2014; Grama and

Pavaloaia, 2014; Johansson and Ruivo, 2013) or studying interactions between them (Gupta, Seethraman, and Raj, 2013; Lee, Park, and Lim, 2013; Wu, Wan, and Lee, 2011).

Some of research papers aim to provide a methodology or a framework for an IT outsourcing solution and use the case method to demonstrate its application (Kilic, Zaim, and Delen, 2014; Sun, Ni, and Lam, 2015).

In accordance with requirements for the master thesis research, the document reviews existing research papers, published in peer-reviewed academic journals, such as International Journal of Information Management, Journal of Enterprise Information Management, Computers in Industry, and others.

Research papers were chosen, so that they represent studies held in different regions in different time. This allowed to observe different approaches and methods of research, for instance, Structural Equation Modelling (Gupta, Seethraman, and Raj, 2013), Analytic Network Process and Preference Ranking Organization Method for Enrichment Valuation (Kilic, Zaim, and Delen, 2014).

In addition to this, different hypotheses are observed, namely, interrelations between dimensions of Balanced Scorecard (Lee, Park, and Lim, 2013), influence of various factors on making a decision about an adoption of a cloud computing service (Gupta, Seethraman, and Raj, 2013), and relations of success factors to quality measures for a success of enterprise software implementation (Deshmukh, Kalamkar, and Thampi, 2015)).

Diverse representation also allows for multiple sets of conclusions and findings observed: some are related to the development of previous research on success factors for application service providers and their interrelations (Lee, Park, and Lim, 2013), others are more concentrated on outlining the significance of particular factors (Deshmukh, Kalamkar, and Thampi, 2015; Gupta, Seethraman, and Raj, 2013; Johansson and Ruivo, 2013) or the applicability of particular methodological tools (Kilic, Zaim, and Delen, 2014; Sun, Ni, and Lam, 2015; Wu, Wan, and Lee, 2011)).

With regards to the selection of studies for the description of the theoretical background, it could be stressed that the most relevant papers were examined in the first turn: they are devoted to the analysis of decisive factors of the SaaS adoption for SMEs in one particular region (Budniks and Didenko, 2014; Deshmukh, Kalamkar, and Thampi, 2015; Grama and Pavaloaia, 2014; Gupta, Seethraman, and Raj, 2013; Sebesta, 2013; Tutunea, 2014).

On top of that, we considered research papers, that slightly differ in research subjects (different IT-outsourcing services, perspective of large enterprises, global, rather than regional research and so on) and that cover broader research areas. This method of article selection allowed to focus on the most relevant knowledge, while adding up from neighboring areas.

Concerning relationships, established between studies, it would be necessary to mention, that in observed research area there is no single established approach or "benchmark", scholars are often familiar with a limited amount of limited research, often, they have only previous research of their known peers to rely upon. Thus, it is common for researchers to generalize or address neighboring areas of study.

For example, a study focused on usage of balanced scorecards as a decision-making technique for adoption of SaaS for SMEs (Lee, Park, and Lim, 2013) refers to factors, taken into account by SMEs in interaction with application service providers in general, usage of balanced scorecard by SMEs for making strategic decision and relevant cases of usage of partial least squares as data analysis methodology. Therefore, only few clearly outlined relationships between extant studies can be observed.

However, there are similarities in most research papers, which would be further discussed in this section. In terms of research subjects, most of papers chosen are addressing SMEs as adopters of cloud computing solutions (Bayrak, 2013; Budninks and Didenko, 2014; Gupta, Seethraman, and Raj, 2013; Oliveira, Rodrigues, and Ruivo, 2014; Sebesta, 2013; Tutnea, 2014) and providers of such solutions to SMEs (Johansson and Ruivo, 2013; Johansson, Rodrigues, and Ruivo, 2015).

There are three distinct groups of papers with different research scopes. First group has very specific focus with particular cloud software, ERP (Kilic, Zaim, and Delen, 2014) or business intelligence solutions (Rus and Tutunea, 2012), but different research methods.

Second group is observing decision-making processes and methodologies in particular SMEs for cloud computing services in general, conducting interviews and surveys (Gupta, Seethraman, and Raj, 2013; Lee, Park, and Lim, 2013; Wu, Wan, and Lee, 2011).

Third group relates to SMEs and vendors in general and relies upon previous research and expert opinion (Budniks and Didenko, 2014; Grama and Pavaloaia, 2014). To seek for variability, we reviewed studies focusing on all cloud solution adopters, including individuals and large companies (Sun, Ni, and Lam, 2015), software buyers and software vendors (Rohitratana and Altmann, 2012), other tertiary experts (Johansson and Ruivo, 2013).

The region of observation is a very important factor, due to differences in cloud computing market maturity, related infrastructure development, regulations, imposed by authorities, contribution of SMEs to economic activity of the country and so on. Most studies observed are focused on particular countries in Asia (Kilic, Zaim, and Delen, 2014; Lee, Park, and Lim, 2013; Sun, Ni, Lam, 2015; Wu, Wan, and Lee, 2011), Eastern Europe (Budniks and Didenko, 2014; Grama and Pavaloaia, 2014; Rus and Tutunea, 2012; Tutunea, 2014) and Western Europe (Brender and Markov, 2013; Gasterman, et al. 2015). There are as well some studies focused on several regions (Gupta, Seetharaman, and Raj, 2013; Martin, 2010), rest do not concentrate on a particular location.

To make a conclusion, research papers for literature review were chosen with regards to their relevance to the previously outlined research question, planned research constructs and empirical data to use. Although there are no "keystone" papers, outlined research is consistent and demonstrate great variety in components.

1.2. Review of relevant models, frameworks, and research approaches

The key research question outlined in studies reviewed is related to factors, that affect decision of SMEs to adopt cloud computing solutions. Factors observed are divided into three groups: factors that are perceived by SMEs as substantially important (Lee, Park, and Lim, 2013; Tutunea, 2014; Wu, Wan, and Lee, 2011); factors, that make cloud solutions objectively fit to needs of SMEs (Bayrak, 2013; Brender and Markov, 2014; Gupta, Seethraman, and Raj, 2013; Kilic, Zaim, and Delen, 2014; Oliveira, Rodrigues, and Ruivo, 2014); factors, outlined by expert opinion as essential (Budniks, Didenko, 2014; Sun, Ni, and Lam, 2015). Research papers analyze not only impact of factors on decision-making processes, but also causal interrelations between factors (Gupta, Seethraman, and Raj, 2013; Wu, Wan, and Lee, 2011).

In some papers, problems are outlined slightly differently, although still close to principal research questions. For instance, it is answered how SMEs can choose cloud services, which frameworks and tools could they use, such as Balanced Scorecard (Lee, Park, and Lim, 2013), SOURCER – framework for multi-criteria evaluation of IT sourcing solutions (Sebesta, 2013), and others.

Subsequently, there are studies focused on how usage of cloud services affect different aspects of performance of SMEs (Deshmukh, Kalamkar, and Thampi, 2015; Rus and Tutunea, 2012), which SMEs are most likely to adopt cloud services (Grama and Pavaloaia, 2014; Sebesta, 2013), what should cloud services providers do with their product and its proposition in order to attract SMEs (Sultan, 2011).

Although clear formulation of research hypotheses in extant studies is limited, it is possible to discuss and build upon this component. Namely, there are three papers taken into the consideration and serve as benchmark examples for the research hypothesis formulation in the master thesis (Deshmukh, Kalamkar, and Thampi, 2015; Gupta, Seethraman, and Raj, 2013; Lee, Park, and Lim, 2013).

To begin with, we analyze the usage of balanced scorecard for estimating the effect of the adoption of SaaS-solutions for SMEs (Lee, Park, and Lim, 2013), which demonstrate how hypotheses can be formulated with regards to design of the widely-known framework.

Traditionally, an impact of a new strategic initiative on an organization is assessed by changes in its financial performance metrics. Adoption of an application service is regarded in the research as a strategic initiative, but is believed to require a complex evaluation due to simultaneous effects of other factors, such as the competitive environment. Thus, it is recommended to use the balanced scorecard as relevant framework "which balances leading and lagging indicators, as well as … financial and non-financial measures."

Therefore, the research analyzes interrelations between standard dimensions of balanced scorecards: learning and growth, internal business processes, customer performance and financial performance.

Another approach to deriving research hypothesis is demonstrated in the study, analyzing the adoption of cloud services by SMEs in Asia-Pacific (Gupta, Seetharaman, and Raj, 2013). Authors reviewed scientific and newsletter articles, published in different time, which included opinion of SME managers, providers of cloud services and tertiary experts about cloud computing parameters, that are important for SMEs and expectations from future usage and adoption of the cloud computing. At the same time, they observed real cases of decision-making and tried to find out, which factors are taken into consideration by SMEs, that are different from large enterprises.

As a result, the paper presents five factors: cost reduction (data storage, subscription, upfront capital expenditures) and cost control (flexible changes in computational power consumption); ease of use and convenience in form of accessibility; reliability; sharing and collaboration; security and privacy.

The third case of implicit hypothesis formulation is observed in the study, devoted to the analysis of ERP implementation benefits for Indian SMEs (Deshmukh, Kalamkar, and Thampi, 2015). It also formulates hypotheses of factor interdependence based on an analysis of previous academic research and studies how following outlined critical success factors are related to quality

measures for the success of the CRM/ERP implementation: training, performance of hardware and software, top management support, skill of workforce and level of project management quality.

Studies mention and analyze a lot of positive and negative factors, that influence the adoption of cloud computing services by SMEs, some of them have already been mentioned above.

Among all, factors, related to costs are usually the most common. In other words, SMEs are believed to pay attention to cost-saving opportunities provided by cloud solutions as well as to additional costs, that usage of cloud services may cause.

To be more specific, extant studies mention an overall cost reduction (Gupta, Seetharaman, and Raj, 2013), savings for different types of costs, associated with an IT-infrastructure management, such as purchasing, support and maintenance, upscaling (Kilic, Zaim, and Delen, 2014), wages (Wu, Wan, and Lee, 2011), costs of decision making (Rus and Tutunea, 2012) and other fixed costs like power consumption (Martin, 2010). Also, different approaches to a cost estimation for cloud computing are considered, namely, TCO and ROI (Sebesta, 2013).

Another factor, that plays an important role is a reliability of a cloud computing solution (Gupta, Seetharaman, and Raj, 2013; Kilic, Zaim, and Delen, 2014; Martin, 2010; Sebesta, 2013). In includes taking into account such parameters as number of service outages, data loss incidents, quality of service provided compared to outlined in SLA.

Linked to previous one is an information security and privacy (Bayrak, 2013; Brender and Markov, 2013; Gupta, Seetharaman, and Raj, 2013; Johansson and Ruivo, 2013; Martin, 2010; Safari, Safari, and Hasanzadeh, 2014; Wu, Wan, and Lee, 2011). No only it includes a number of incidents (an unauthorized access, data leakage and other risks of losing confidentiality of information), but also security of procedures, related to a data transfer between a provider and a client, specifics of data storage on provider's site and provision of an access to information.

More controversial factor is a degree of standardization. On one hand, it allows for compatibility with most popular corporate software, on the other hand it constrains SME using cloud service and makes its IT-infrastructure less flexible (Brender and Markov, 2013; Kilic, Zaim, and Delen, 2014; Oliveira, Rodrigues, and Ruivo, 2014; Wu, Wan, and Lee, 2011).

Standardization is also tightly linked with degrees of a scalability (a possibility to change amount of computational resources quickly and easily, number of users, software licenses and other characteristics of cloud computing solution) and an integrability (an ability to combine solution with other enterprise software and hardware) (Sultan, 2011).

There are as well clear benefits of cloud computing solutions. To start with, cloud solutions are generally considered as easier to deploy by end users (Wu, Wan, and Lee, 2011) and to organize in general (Rohitratana and Altmann, 2012).

Another one is higher degree of accessibility: services are available via Internet (Bayrak, 2013; Sebesta, 2013), from different devices (Johansson, Ruivo, 2013) and from different locations (Martin, 2010).

Then goes an ability to easily share data and collaborate with partners using same cloud solution (Gupta, Seetharaman, and Raj, 2013; Wu, Wan, and Lee, 2011).

Most cloud service providers also offer beneficial payment schemes, such as "pay only for what you use" and others (Marian and Hamburg, 2012; Rohitratana and Altmann, 2012; Wu, Wan, and Lee, 2011).

Furthermore, cloud services include offering latest versions of IT-infrastructure components and available functionality (Rohitratana and Altmann, 2012; Sebesta, 2013; Wu, Wan, and Lee, 2011) as well as compatibility with current technologies and adaptability to current values, experiences, and potential needs of an organization (Safari, Safari, and Hasanzadeh, 2014).

Based on research papers, observed in the literature review we can formulate, analyze, and assess the fit of several theoretical constructs applicable for the research held in the master thesis. In order to justify applicability for the research, we consider studies that contain an overall description, a step-by-step implementation procedure and a rationale for use of frameworks.

Overall, adoption of cloud computing solution can be perceived by SMEs as an innovation that allows mainly to develop an IT component (Bayrak, 2013; Budnkis and Didenko, 2014; Grama and Pavaloaia, 2014; Gupta, Seethraman, and Raj, 2013), to improve planning and decision-making processes (Lee, Park, and Lim, 2013; Rus and Tutunea, 2012), to increase competitiveness (Alves et al., 2013; Kilic, Zaim, and Delen, 2014) and overall performance (Deshmukh, Kalamkar, and Thampi, 2015).

Thus, different theories, related to innovation management can be applied to the study. The key concept in this domain is DOI (Diffusion of Innovation) model – a theory, introduced by Rogers (1971), which is focused on studying factors of innovations that are interesting to population, underlines importance of communication among peers, and studies needs of five different segments of innovation adopters.

As a next framework to consider, we observe TOE (Technology, Organization, and Environment) – an innovation adoption framework at an organizational level, which elaborates on

three factors (mentioned in the name) as influential factors of an innovation adoption (Safari, Safari, and Hasanzadeh, 2014).

Safari, Safari, and Hasanzadeh (2014) base the application of TOE on different theories, related to the adoption of innovations in companies, such as DOI and other studies of SaaS adoption. This results into developing a research model, based on 10 criteria influencing SaaS adoption: relative advantage, compatibility, complexity, trialability, observability, security and privacy, IT resource, sharing and collaboration culture, competitive pressure and social influence. Each of factors are accounted for in 10 subsequent hypotheses (testing influence of factors for SaaS adoption).

As a particular methodology, Safari, Safari, and Hasanzadeh consider Fuzzy AHP – extension of Analytic Hierarchy Process onto the concept of fuzzy logic (concept, that contributes to making appropriate decisions under uncertain environment by involving ambiguity nature of problems in decision-making (Zadeh, 1965)). Main reason for a suitability of Fuzzy AHP in particular theoretic construct lies in an ability to operate linguistic variables (such as "poor", "medium", and "good").

TOE framework can also be observed in extant studies merged with TAM (Technology Acceptance Model) – a model that is used to explain the dependency between an acceptance level of particular technology and a willingness to adopt it (Autry et al., 2010). One of reasons for its application is that it is "successfully predicting and explaining users' intentions to adopt technologies" (Gangwar, Date, and Ramaswamy, 2015). It is also claimed to be "the most influential and commonly employed theory for describing an individual's acceptance of information systems" (Lee et al., 2003).

Gangwar, Date, and Ramaswamy (2015) identify three factors, that can be incorporated into TOE: reliability, availability, and security-related concerns. Their research suggests, that these factors can influence PEOU (Perceived Ease of Use – "users can use computing resources and IT solutions without going into detail or having deep knowledge to operate them") and PU (Perceived Usefulness – ability of cloud solution to "improve … business efficiency, performance, and productivity") of cloud computing solution.

Theoretical concepts in most studies are linked to particular research models, which also observed in this study. First model to analyze is Structural Equation Modelling - a statistical technique for simultaneously testing causal relationships among multiple independent and dependent constructs (Gupta, Seethraman, and Raj, 2013). It consists of a "set of equations with

accompanying assumptions of the analyzed system, in which the parameters are based on the statistical observation" (Tarka, 2017).

One of the reasons for application of Structural Equation Modelling is its applicability to measurement of latent constructs, such as ease of use and convenience, positive experience from usage or inclination towards usage of cloud computing solution (Gupta, Seethraman, and Raj, 2013). Measurement of such constructs is conducted "with the use of a set of observable variables and via observation of the causal effects in SEM between respective latent variables" (Tarka, 2017).

As applied by Gupta, Seethraman and Raj (2013), the implementation algorithm of Structural Equation Modelling and related procedures include following steps:

- Research framework and research variables are determined based on literature survey (dependency of cloud computing adoption on five factors, associated with cloud services), research methodology is established;
- Data collection from respondents (representatives of micro and small businesses, based in Asia Pacific region): based on feedback obtained from pilot survey (personal interviews with 30 respondents), final survey is developed and consists of questions that imply answers on questions, related to hypotheses testing on a scale from 1 to 5 (frequency - from "not at all" to "very often" and agreement - from "strongly disagree" to "strongly agree"); demographic details of respondents are also captured with help of the survey; sample size contains 211 valid answers (complete and usable);
- SEM is used as overall framework, while Partial least squares (PLS) regression techniques implemented via structural model based tool called Smart PLS are used to first run exploratory factor analysis on results of pilot survey and confirmatory factor analysis on results of final survey;
- Model fit is checked: reliability of research measurements is evaluated using Cronbach's Alpha (should be over 0,6) and composite reliability (should be over 0,7) scores; convergent validity is evaluated with using average variance extracted (should be over 0,5) and loading constructs (should be over 0,7); discriminant validity is evaluated using correlations between measures of potentially overlapping constructs (should be over 0,6);
- Hypotheses are tested by estimating path coefficients in structural model (indicate strength of relationships between independent and dependent variable) and R-square value (variance of dependent variable that is explained by independent variables), joined with

bootstrapping resampling (in order to make a larger sample, which models the unknown population).

This approach is useful, because it allows for simultaneous statistical testing of interrelations between multiple factors, also it implies rigorous testing of model via several parameters. What is more, there is a software available for this model (IBM SPSS AMOS). However, it might be relevant to implement factor analysis in case of large number of variables.

Another combination of techniques is Analytic Network Process (ANP) and Preference Ranking Organization Method for Enrichment Valuation (PROMETHEE), proposed by Kilic, Zaim and Delen (2014). ANP is a multi-criteria decision making technique (and generalization of analytic hierarchical process) used to obtain the ranked importance (weights) for criteria in particular set. Its benefit is in ability to account for complex network structure and it is widely used in neighboring fields of research. There are four distinct stages in ANP:

- Network model construction – outlining existing alternatives, criteria of comparison and their interrelations, ways, tools, and degrees of measurement; requires detailed understanding of a decision problem, its components, and outcomes; control criteria and sub-criteria are sometimes allocated to larger groups for better interpretation of the model (for instance, most commonly used ANP software incurs following groups: benefits, opportunities, costs, and risks);
- Pairwise comparisons and priority vector creation – alternatives are compared pairwise for each criterion (for example, solution A is more reliable than solution B, solution C is more reliable than solution B, solutions A and C are equally reliable, etc.);
- Supermatrix formation and transformation – during this step different algorithms may be performed, but they all serve to weight values for pairs "alternative-criterion" with relative "importance" of criteria;
- Determination of final rankings/priorities – key output of the model is set of values for all alternatives, which determines their preference ranking according to outlined criteria and their importance.

PROMETHEE, in turn, is another technique, that is used for ranking alternatives among conflicting criteria and consists of six steps:

- Model construction – similar to ANP: alternatives, criteria and other components of the model are outlined;

- Pair-wise comparisons of criteria performed and, based on them, deviations are obtained for all pairs of criteria (usually done during collective barnstorming session of a group of industry experts);
- Chosen preference functions are utilized to obtain a preference of one alternative with regards to another (preference function is chosen from several options based on opinion of ERP experts);
- Global (overall) preference indexes are computed in order to later rank preferences for alternatives;
- Positive and negative outranking flows are computed – technical transformation step, that allows to systematize difference between evaluation of alternatives by criteria;
- Net outranking flows are determined for each alternative – final step that allows to rank alternatives.

Key reason for choosing combination of ANP and PROMETHEE methods is based on decision modelling techniques' strengths and suitability to current decision situation, it is applicable to complex multi criteria decision making situation that requires involvement of a group of decision makers and evaluation of network structure among the decision-making system factors. ANP and PROMTHEE are both serve as independent statistical tools, but require some assumptions to be implemented.

Next approach overviewed is Decision-making Trial and Error Laboratory (DEMATEL). It originates from the Geneva Research Centre of Battelle Memorial Institute and serves to deal with different sorts of problems in various fields, such as service quality, portfolio selection, management system selection, technology selection, critical success factor selection and others (Falatoonitoosi, Ahmed, and Sorooshian, 2014).

The approach is based on matrices and graphs, which portray a contextual relation between the elements of the system, in which a numeral represents strength of influence. It is helpful as it converts the cause-effect relationship into an intelligible structural model. It also allows to separate involved factors into cause group and effect group.

Mathematically, approach consists of the following steps:

- Model construction – similar to other approaches;
- Creation of an initial direct-relation matrix by obtaining sets of pair-wise comparisons – each cell is the degree to which one criterion affects another, matrix is square, numbers of rows and columns are both equal to number of criteria;

- Normalization of direct-relation matrix into matrix, where each element is divided by number, equal to maximum possible sum of all elements in one row (so that maximum degree of affection of one factor by all other is equal to 100%) – technical step, that allows to obtain ranking of alternatives;
- Calculating total-relation matrix as a result of mathematical transformation of normalized direct-relation matrix, so that it becomes interpretable: sum of row and column numbers represent "prominence" – degree of importance each factor has, sum of row minus sum of column numbers is "relation" – indicator, that divides factors into cause and effect groups.

The approach allows to easily visualize a structure of complicated causal relationships, it is applied widely in similar cases, it is relatively simple in terms of collection and processing of data and interpreting results. Also, DEMATEL itself is an approach that allow to achieve meaningful statistical result and special software packages exist that serve to implement this method.

Dumpster-Shafter method is another approach that is used to determine relative importance (weights) for a set of criteria. It allows for combining several opinions on sets of decision alternatives and does not require consistency checks at the decision alternative level. It can be applied independently and consists of following steps:

- Scores are obtained to determine magnitude of critical success factors and key performance indicators influence on each stage of ERP implementation cycle (taking criteria from literature and then assessing by experts using Delphi method);
- Weights are normalized by dividing each score on sum of scores for one particular stage and expert;
- Weights for all CSFs and KPIs are obtained by combining opinions of all experts by applying combination rule.

Finally, there are some specific cases, which imply usage of particular methods. For instance, combination of agent-based modelling and analytic hierarchy process is used for analysis of interaction between software vendors and software buyers (Rohitratana and Altmann, 2012).

From the overview of techniques, applied in the existing research we can conclude that it is a commonly used practice to develop a model, which incorporates several alternatives, measured by a set of criteria, which are related to each other. It has been suggested for the master thesis to apply Structural Equation Modelling, due to its applicability to suggested research hypotheses and existence of relevant use cases (Gangwar, Date, and Ramaswamy, 2015; Gupta, Seethraman, and Raj, 2013) as well as comprehensiveness and interpretability.

IBM SPSS AMOS software was chosen for creation of the model as it is one of the most commonly used tool and it allows for developing a comprehensive graphical representation of structural equation model. As will be explained further, in order to test applicability of questions in survey for testing research hypotheses we have decided to conduct preliminary factor analysis, using IBM SPSS Statistics tool.

With regards to factors, that influence adoption of SaaS by SMEs we have decided to conduct additional analysis of analytical reviews of leading Russian IT-related information portals and reports of cloud software providers operating in Russia. In particular, we overviewed review of Parallels – one of the leading providers of IaaS and SaaS in Russia, CNews Analytics and TAdviser – two notable internet resources, conducting interviews and publishing articles about cloud services.

According to Parallels (Odin, 2016), most important factors for choosing business applications are (with shares of respondents marked factor as important):

- Features and capabilities of software (45%), which relate to functions that could be implemented within SaaS;
- Business need (25%) – actual need of business in usage of particular software application;
- Price (23%) – total price, that customer pays for leasing software licenses throughout the period of SaaS usage;
- Previous customer experience (6%), which usually available via trial or previous experience with SaaS.

Authors of Cloud Services 2016 review published in CNews Analytics (2016) have similar opinion and group factors into two parts: positively and negatively influencing. Within the first group they list:

- Awareness of service and its different aspects – technology, business model, pricing and functionality;
- Total cost of ownership in frame of potential to cut IT costs;
- Attribution to global trends in adoption of cloud services;
- Quality of services, demonstrated by SLA;
- Reliability backed by existence of successful adoption cases;
- Developing legal regulations, tend to clarify the situation with usage of cloud services;
- Synergies between cloud products, ability for them to create cloud ecosystem for client organization;

- Development of network infrastructure in Russia, allowing for better access to applications in the cloud from different devices.

Second group of factors, outlined by CNews Analytics (2016) partly overlaps with first, as same trends may have both enablers and barriers as implications. With regards to barriers we can name following:

- Inertial negative attitude because of disbelief in security of cloud applications;
- Strict information security regulations, which do not allow to store data and applications in third party's servers;
- Need to keep some amount of own costly hardware, related to necessity to maintain high capitalization;
- Lack of standardization in existing SaaS market offerings, demonstrated by different classification of services and discrepancies between declared and actually implemented SLA;
- Actively going modernization of information security legislation in Russia, which makes it hard for providers and SMEs to adopt quickly to changing regulations;
- Lack of competent IT-specialists, that are capable of outlining, evaluating and making adoption decisions regarding existing solutions for IT-infrastructure.

Additional analysis of sub-reports of CNews Cloud Services (2016) and semi-structured interviews with experts (TAdviser, 2016) have not revealed any significantly different factors of influence.

In the vast variety of factors observed we can clearly determine those, that are not related to objectively happening external trends, but to perception of SME decision-makers and characteristics of existing SaaS solutions. This second group of factors was used together with factors derived from literature review in formulation of research hypotheses. Following factors were taken into consideration with regards to analysis of extant studies: cost reduction, ease of use and convenience.

As outlined above, one group of studies is based on collection and analysis of primary data. Samples from SME representatives are selected either randomly (Lee, Park, and Lim, 2013) or from particular group such as middle-ranked managers and above (Budniks and Didenko, 2014). Some studies interview tertiary experts rather than SMEs (Johansson and Ruivo, 2013; Kilic, Zaim, and Delen, 2014). Sample sizes vary from 30 to 1266 observations with average number of about 100, depending on specifics of research.

Data collection methods include questionnaires with Likert-scale questions (Budniks and Didenko, 2014; Deshmukh, Kalamkar, and Thampi, 2015; Lee, Park, and Lim, 2013), closed questions in another form (Tutunea, 2014), open qualitative and quantitative questions (Gupta, Seetharaman, and Raj, 2013), semi-structured (Johansson and Ruivo, 2013; Kilic, Zaim, and Delen, 2014; Rohitratana and Altmann, 2012; Sun, Ni, and Lam, 2015; Wu, Wan, and Lee, 2011) and unstructured interviews (Martin, 2010).

Questionnaires are mostly developed by special software (Google Survey, Qualtrics Insight Platform etc.) distributed by e-mail or published online, interviews are held face-to-face or via videoconference tools (Skype, Google Hangouts etc.).

Another group of studies use secondary data, namely expert reports (Rus and Tutunea, 2012) and existing academic research (Alves et al., 2013; Bayrak, 2013; Gasterman et al., 2015).

In contrast to the data collection, there is a greater variety of methods of the data analysis. Data is mostly analyzed with conventional statistical methods as chi-square, regression analysis and factor analysis.

The partial least squares regression analysis is implemented for an estimation of a structural model and testing research hypothesis (Lee, Park, and Lim, 2013), the multiple regression method – for testing hypotheses in conceptualized model (Deshmukh, Kalamkar, and Thampi, 2015). There is also a case of usage of three-way ANOVA for hypothesis testing (Budniks and Didenko, 2014).

The factor analysis is applied for an assessment and measurement of survey data (Lee, Park, and Lim, 2013), together with principal components it is used for revelation and prioritization of factors of influence (Deshmukh, Kalamkar, and Thampi, 2015).

The combination of exploratory and confirmatory factor analysis is used for analyzing underlying structure of variables in testing questionnaire and in final questionnaire consequently (Gupta, Seetharaman, and Raj, 2013).

Rest of studies either merely describe results of data collection (Tutunea, 2014; Martin, 2010) or do not contain data analysis at all.

To sum up, research papers reviewed tend to vary a lot in terms of their components. Research questions include different variants of studying of key factors of adoption of IT-outsourcing by different companies (their interrelations and influence on performance indicators). Hypotheses exist only in several studies and they are related to testing interdependence of factors or their influence on making decision about adoption and on overall adoption success. Decision-

making factors observed are related to characteristics of service (cost, functions, reliability etc.) as well as to specifics of clients (degree of awareness, trust, infrastructure development etc.). Research models combine innovation management approaches (TOE, TAM etc.) and structural models, studying different dependencies (SEM, AHP etc.). Both primary data (collected questionnaires and interviews) and secondary data (academic research, expert opinion) used in research as well as different techniques of data analysis (factor analysis, regression, chi-square).

1.3. Identification of research gap for empirical study

Conclusions and findings in extant studies can be divided into three distinct groups. The first group, implications for researchers, includes an extension of research area and research methodologies as well as propositions for further research. The second group, implications for practitioners include recommendations for usage of particular tools and methodologies and taking into account particular factors during decision-making process. Finally, the third group is related to different types of limitations of existing studies.

Let us discuss outlined groups of conclusions in more detail. Implications for researchers include examples of development of previous research on success factors for application service providers and their interrelations (Lee, Park, and Lim, 2013), usage of new methodological tools for discussed research area, such as the balanced scorecard (Lee, Park, and Lim, 2013), the analytic hierarchy process (Kilic, Zaim, and Delen, 2014), the perceived risks – perceived benefits matrix (Wu, Wan, and Lee, 2011) or the dynamic lifecycle perspective (Sun, Ni, and Lam, 2015). Those studies suggest further usage of outlined methodologies thus enlarging the research area.

At the same time, some studies serve to prove that particular factors are significant in decision-making process regarding adoption of cloud services by SMEs and can be used by other researchers in the area (Gupta, Seetharaman, and Raj, 2013; Deshmukh, Kalamkar, and Thampi, 2015; Johansson and Ruivo, 2013).

Implications for practitioners are similar to recommendations for scholars, but address two categories of contractors – SMEs and cloud computing solution providers. For above mentioned balanced scorecard and analytical hierarchy process, studies provide detailed step-by-step implementation examples.

Papers also make conclusions, regarding to the importance of particular factors, such as ease of use and convenience together with security and privacy (Gupta, Seetharaman, and Raj, 2013), purchasing, implementation, service and support costs (Kilic, Zaim, and Delen, 2014),

necessity to develop quality service to ensure good customer experience (Johansson and Ruivo, 2013).

Lastly, studies discuss limitations and possible extensions of research. First of all, most publications claim regional limitations, that leave space for testing same methodologies, importance and interrelation of same factors in other regions (Gupta, Seetharaman, and Raj, 2013; Kilic, Zaim, and Delen, 2014; Wu, Wan, and Lee, 2011; Sun, Ni, and Lam, 2015).

What is more, such aspects as sample size (Lee, Park, and Lim, 2013), specifics of industry (Kilic, Zaim, and Delen, 2014) or particular organizations (Johansson and Ruivo, 2013) and chosen factors of importance (Gupta, Seetharaman, and Raj, 2013) are outlined as limitations and can help in formulating research gap for master thesis.

Taking into the consideration limitations and recommendations for further research in reviewed articles, it can be inferred, that there are several potential dimensions for development of own research.

First of all, it is regional dimension – it is suggested to focus on SMEs, located in Russia and served by largest SaaS-providers, which are, as previously outlined, mostly concentrated in Moscow and Saint-Petersburg (CNews Analytics, 2016).

Linked to region of study and existing reports are success factors, which should be taken not only from extant studies, but from industry research of Russian market as well in order to develop own research model.

Also, there is a room for testing both recommended and not mentioned methods of data collection (questionnaires with qualitative and quantitative questions, structured, semi-structured, and unstructured interviews) and data analysis (chi-square, regression, factor analysis, cluster analysis and more specific methods).

1.4. Summary of the chapter

Within the development of the theoretical background of the research, we started with outlining extant research papers for the analysis. They were chosen based on the relevance of research topics (studies of decision-making process, related to adoption of IT-infrastructure solutions by small and medium enterprises) and the presence of research methodologies and frameworks as well as different scopes of study.

As a next step, we outlined a group of research questions in extant studies and reviewed different characteristics of research – objectives, variables, hypotheses, frameworks, data

collection and data analysis methodologies. Research questions were based on study of factors, influencing decision-making process, degree and specific of their influence. Thus, studies mostly involved quantitative research methods, with some inclusion of mixed methods, such as semi-structured interview.

The major result of the theoretical background observation is identification of the research gap for the empirical study (in form of potential dimensions of development of own research), which was based on research conclusions and applications and limitations of extant studies.

2. METHODOLOGY AND DATA DESCRIPTION

Structure of the following chapter is represented on Figure 2.1 below:

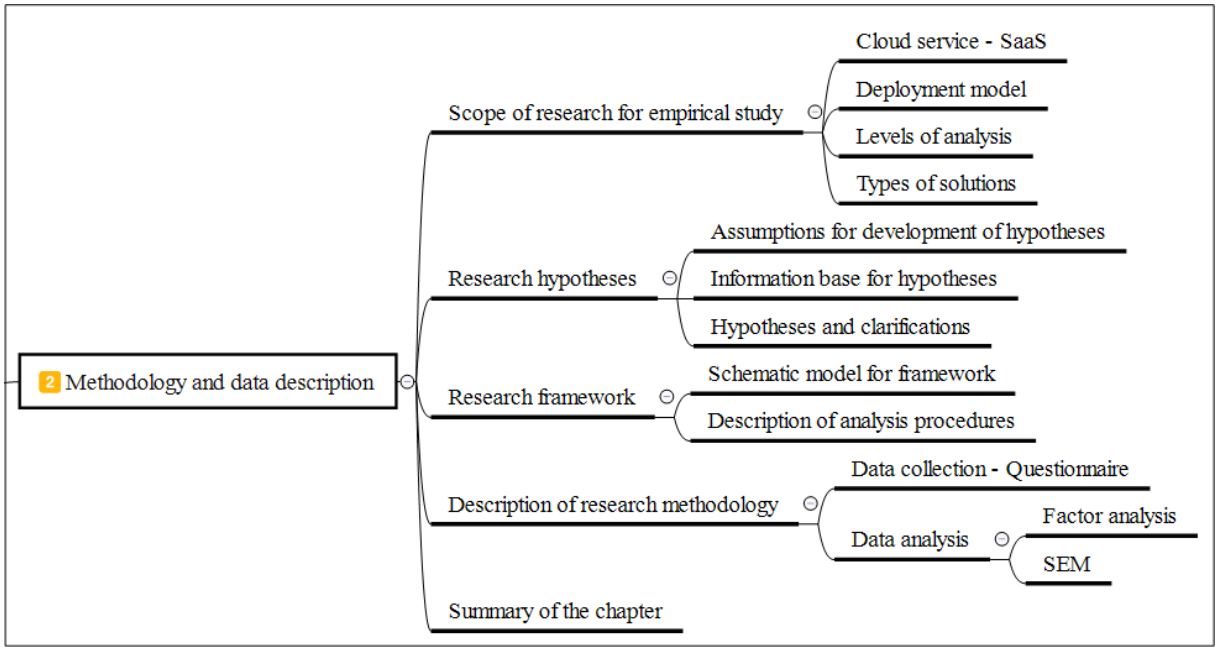

Figure 2.1 – Structure of the Chapter 2

The chapter starts with the identification of the scope of the research, based on gaps outlined previously. The part includes the identification of cloud services, deployment model, levels of analysis and types of solutions to observe (other components are identified earlier in the chapter).

Then we proceed with the development of research hypotheses, which are based on assumptions and previously observed sources, that are both mentioned. For each of hypotheses we provide clarifying explanations on why are they stated.

Further in the chapter we provide a description of the research framework, including presentation of a schematic model and overall description of the procedures of the analysis.

Description of the research methodology includes two distinct parts. The first part is related to the data collection in form of a questionnaire and provides information about questions, what do they measure and how are they related to research hypotheses. The second part is devoted to the description of data analysis methodologies employed, including justification of their usage and validation checks to be performed.

2.1.Scope of research for empirical study

In the next part, we are going to describe the scope of the research, related to software models and regions of observation. As outlined before, within research we focus on SaaS solutions – ready-to-use standard or customized business software, which is managed remotely by provider and most frequently delivered via Web or cloud portal for a subscription fee or on a pay-for-use basis (Gartner IT Glossary, 2017).

There are several reasons, related to choice of SaaS over other segments of market of cloud solutions in Russia, which are IaaS (basic level of cloud services which delivers infrastructure services to customers in form of storage and network, while letting users to have control over operating systems and deployed applications (Mell and Grance, 2011)), PaaS ("level of cloud computing which offers online access to all resources that are required to build an application" (Gangwar, Date, and Ramaswamy, 2015)), and web-presence (hosting and domain registration, unified communications – e-mail hosting and mobile conferencing (Odin, 2016)). The reasons are mostly related to the current market environment and growth projections.

First of all, SaaS is estimated as the largest segment of cloud services market in Russia – 1137 million dollars in 2015 (IaaS is the second largest with 605 million dollars) according to Odin (2016). On top of that, there is a tendency for Russian SMEs to prefer SaaS over IaaS and PaaS. Such preference is mainly believed to be due to a lower purchasing capacity (smaller budget for IT of SMEs (CNews Analytics, 2015)) and weak presence of large international players, such as Amazon Web Services (Nosov, 2015).

What is more, the SaaS is currently world's largest segment of cloud services with growth of 20,3% in 2016 and projected CAGR of 21,1% from 2016 to 2021 (Gartner, 2016). The SaaS segment grows with high pace in Russia as well – projected CAGR from 2015 to 2018 is 12,8% (Odin, 2016).

Another important parameter to determine within the scope of the research is the deployment model – specific type of environment, characterized by different forms of ownership and access to software as well as amount of computational resources allocated. Namely, we can define four deployment models (Gupta, Seethraman, and Raj, 2013)

- Public cloud – multiple clients have access to shared computational resources of a vendor, located in one server; within it, each client can have its own entity in software (for instance, folder or database in Database Management System);

- Private cloud – a single client has full access to computational resources (e.g., in form of dedicated server);
- Community cloud – more restricted and secure version of public cloud, when access and resources are distributed among a group of related client entities;
- Hybrid cloud – any form of combination of the above described models.

For the research, we are considering mostly solutions, provided via the public cloud as a model that intended to be used mostly by SMEs in Russia due to its relatively low costs and sufficient level of reliability and security (CNews Analytics, 2016).

In terms of the level of the analysis, we observe two separate levels – industry and management level. In the research, we observe Russian SMEs, mostly doing retail and wholesale trade (different groups of products and services), as currently most common clients of SaaS providers (Odin, 2015). Also, we include production companies, service providers, and firms operating in financial sector as they are considered prospective majority for the SaaS in Russia (Odin, 2015).

It is important to mention, that we include in observation companies, that have successfully adopted SaaS-solutions of one of the Russian top-10 SaaS providers (by sales in 2015-2016), as they have already gone through the decision-making process. The provider addressed have agreed to cooperate in organization the data collection part of the research as a part of its internal performance measurement processes.

An additional element that should be taken into consideration is a particular SaaS software or a type of software, due to the fact that factors are expected to interrelate in different manner depending on it. In the research, we decided to study following types of software delivered within SaaS model: Enterprise Resource Planning, Customer Relationship Management, Accounting Management, Supply Chain Management, Content Management. These types of software products are selected as they are provided by the top-10 SaaS market players in Russia in 2016 (CNews Analytics, 2016) and are present as well in the portfolio of the provider, whose clients were surveyed.

We also suggest not to focus on specific software solution as 70% of major SaaS players develop and sell primarily their own solutions (CNews Analytics, 2016) and there is sometimes a lot of applications within one particular software type. Therefore, a focus on particular software applications would make a research sample not diverse enough.

2.2.Research hypotheses

To proceed with the development of research hypotheses, we take an assumption, that final decision about adoption is dependent on several factors, but above all, business need, which results directly in adoption decision.

We determine business need as a clear understanding of an adopting company, that it has a necessity to adopt a particular SaaS solution and will include it into its plans of IT-infrastructure development in the nearest future. It is related to the concept of Perceived Usefulness, proposed by Davis (1986) - "if the technology is applicable for a company, it would rather be accepted" and used in “benchmark” studies for this research.

Research hypotheses are based on extant studies, that address similar research questions with quantitative research methods (Gangwar, Date, and Ramaswamy, 2015; Gupta, Seethraman, and Raj, 2013; Hanafizadeh and Ravasan, 2017; Lee, Park, and Lim, 2013; Tan and Kim, 2015; Tutunea, 2014). What is more, results of the survey, performed by Parallels (Odin, 2015), combined with semi-structured interviews of industry experts (CNews Analytics, 2015) are also taken into account.

According to the experience of software providers, it is important for SMEs to have free trial for software (86% of purchases are done with previous free trial) thus creating positive customer experience before deciding to adopt cloud solutions (Odin, 2015). With such evidence, it is logical to assume that a prior experience is relevant for determining a business need for a solution. Therefore, the first hypothesis as formulated as follows:

- **Hypothesis 1:** business need in adoption of cloud solution by SME is positively affected by positive previous experience;

One of the reasons claimed why most SMEs prefer using software they are already accustomed is that they consider it reliable and is capable of supporting necessary functions for organizations (CNews Analytics, 2016; Odin, 2015). Thus, we can formulate the second and the third hypotheses in the following manner:

- **Hypothesis 2:** business need in adoption of cloud solution by SME is positively affected by its actual features and capabilities;
- **Hypothesis 3:** business need in adoption of cloud solution by SME is positively affected by its reliability;

It is also necessary to consider the role of the cost factor in adoption of cloud solutions. While it is named the most important factor for IaaS, the situation is not so clear with SaaS – Russian

SMEs are claimed to have insufficient IT budgets and very price-sensitive, but also tend to recognize cost-cutting opportunities in SaaS adoption (CNews Analytics, 2015). Following this discussion, we formulate the fourth hypothesis in the following way:

- **Hypothesis 4:** business need in adoption of cloud solution by SME is negatively affected by its total cost of ownership.

2.3. Research framework

To test hypotheses, we begin with creating a schematic model for Structural Equation Modelling that incudes observed variables (business need for adoption, positive experience of usage, actual features and capabilities, reliability, total cost of ownership) and their suggested relations.

With regards to exploited variables outlined hypotheses we created a research framework, which is demonstrated on Figure 2.2 – latent variable business need is dependent for 4 independent latent variables (latent variables are presented with ovals, hypotheses by rectangles and relationships with arrows), all latent variables are measured by 3 to 4 observables via questionnaire (observable variables are presented with rectangles, measurement of latent variables by observables is presented with lines):

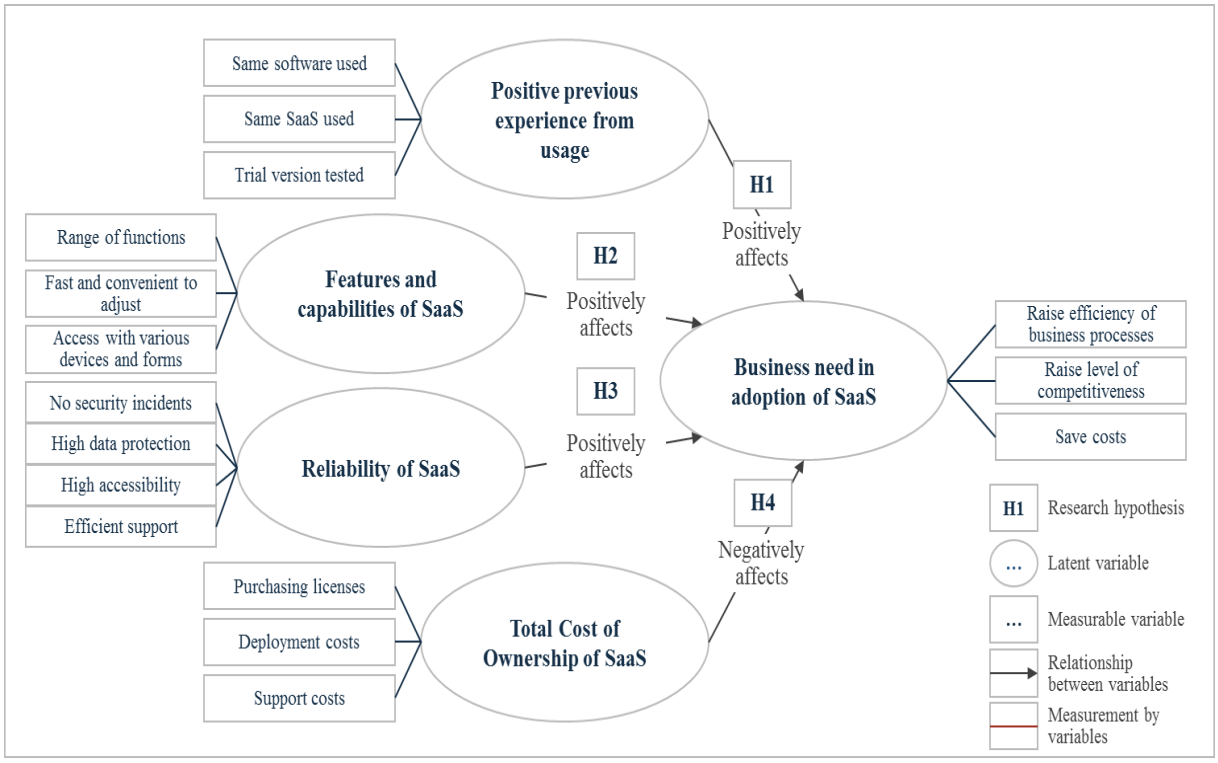

Figure 2.2 – Research framework (source: developed by author)

It can be inferred from the framework, that each of four latent variables are measured by several underlying components):

- The business need in a SaaS solution that a company has decided to adopt is measured via a recognition of a raise in efficiency of business processes, an increase in level of competitiveness or an emergence of opportunities to save costs;
- The positive previous experience can originate from usage of the same software, the same SaaS solution, or a trial version of it;
- Features and capabilities of SaaS solutions are functions that are relevant for an adopter, an adjustability of a solution in a fast and convenient manner, an access via various devices (workstation, laptop, tablet, smartphone) and a presence in different formats of applications (desktop, web, mobile);
- Reliability of SaaS solutions is measured by a number of data security incidents, a level of data protection, a level of accessibility (percentage of time when it is fully accessible, except planned maintenance), and speed of response to service requests and of resolution of incidents;
- Total Cost of Ownership is selected as a cost measure due to its frequent usage by practitioners, the applicability for cloud software adoption cases and the inclusion of relevant cost component; namely, in the research TCO is represented by costs of purchasing licenses, deployment and support of a SaaS solution.

This structuring is based on the recommendations of the provider who took part in the research and also reflects factors, that were previously outlined in research papers and industry reviews.

After the development of the model, we have designed the questionnaire to collect data about the relative influence of factors from representatives of SMEs. We justify the validity of the questionnaire with the factor analysis and input the data into the model and perform a step-by-step implementation of Structural Equation Modelling, which determines the result of the hypothesis testing. As an additional layer of the analysis used for the interpretation of results, we have retrieved predictive strengths of independent measurable variables to dependent. These stages will be described in further parts of the thesis.

2.4. Description of research methodology

The questionnaire begins with an explanation that the research is intended to study the influence of different factors on making a decision about adoption of SaaS solutions in Russian

SMEs and a recommendation to answer questions that best characterize actual decision-making in companies. Questions themselves are also introduced, supplemented by request of agreement for collecting and processing personal data and guarantee that data will be used only for purpose of academic research.

Content part of the questionnaire consists of two parts. First part includes questions that are relevant for hypothesis testing; for each latent variable measured, we have formulated three to four research questions that represent observable variables in order for following up factor analysis to be considered as reliable (Tabachnik and Fidell, 2007).

Questions are measured on a 5-point Likert scale using scales from "Strongly disagree" to "Strongly agree", basing on similar practices of extant studies (Gangwar, Date, and Ramaswamy, 2015; Gupta, Seethraman, and Raj, 2013; Hanafizadeh and Rawasan, 2017).

The second part of the questionnaire is intended to collect personal data of respondents: number of employees, region where business is registered, annual revenue, field of activity, and software products, that are currently used via SaaS model. This information is used to provide the description of the sample and to ensure its diversity. The questionnaire is designed in accordance with analogs in extant research (Gupta, Seethraman, and Raj, 2013; Hanafizadeh and Ravasan, 2017; Lee, Park, and Lim, 2013).

As outlined previously, the validity check for questionnaire is run with the factor analysis in IBM SPSS Statistics software. To justify that questions are applicable for measurement of latent constructs we perform the factor analysis, with several validation checks: normality tests, KMO and Bartlett's test, Cronbach's Alpha, correlation matrix, total variance explained table and rotated component matrix (principal components methods is used for factor extraction, varimax orthogonal method for rotation).

Structural Equation Modelling is employed to test research hypotheses, in IBM SPSS AMOS software. The validity of the structural equation model is checked with the Chi-Square test as a measurement of an overall fit of the model. Also, we use such indicators as a goodness of fit, a minimum discrepancy divided by its degrees of freedom, a comparative fit index, and a root mean square approximation. A detailed explanation of these indicators will be provided in the further chapter.

For a detailed interpretation of the results of hypotheses testing, we have also conducted a predictive analysis in IBM SPSS Watson. Namely, we aim at interpreting the influence of particular components, measuring positive previous experience from usage, features and

capabilities, reliability, and total cost of ownership of SaaS solutions on business need in their adoption by Russian SMEs (efficiency of business processes, level of competitiveness, cost saving).

2.5. Summary of the chapter

To conclude, in this chapter we outline the scope of the research, develop four research hypotheses that represent the influence of different factors (positive previous experience of usage, actual features and capabilities, reliability, total cost of ownership) on the business need in adoption of SaaS-solutions for Russian SMEs. Hypotheses are based on the previous similar research and the evidence from practice.

Research hypotheses result into the research framework, which represents the dependence of the business need as latent variable on four other variables, mentioned above, also as latent. All latent variables are measured by 3 to 4 observable variables by questionnaire.

The data analysis starts with factor analysis, which is used to validate measurement of latent constructs by observable variables. Structural Equation modelling is then used to test research hypotheses, followed by the predictive analysis, aimed at retrieving dependencies among component of research variables.

3. EMPIRICAL STUDY

Structure of the chapter is outlined on Figure 3.1:

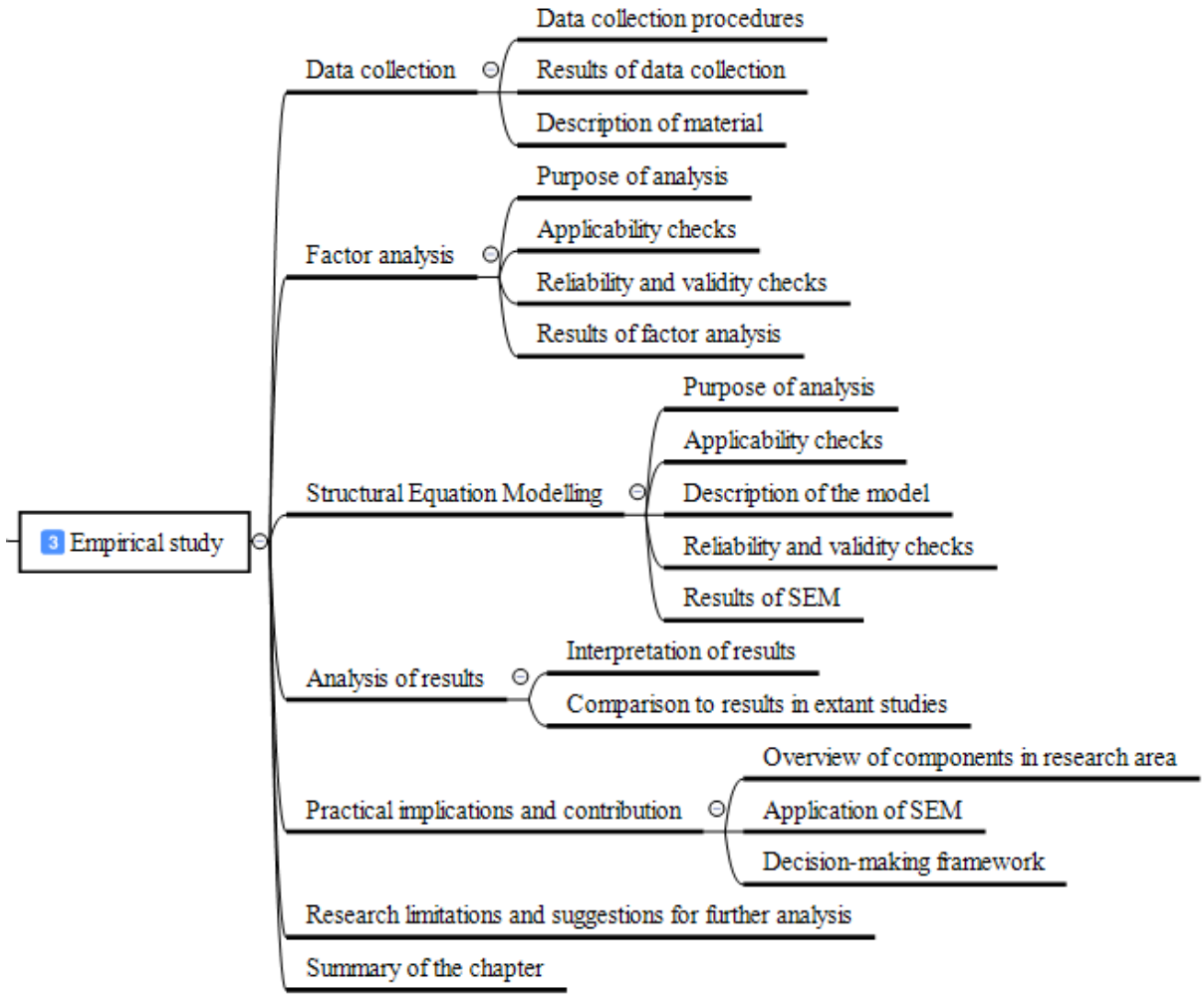

Figure 3.1 – Structure of the Chapter 3

The first paragraph contains information about how data has been collected and what were the results of the survey. For the respondents, we also provide information about how many employees do they have, what is their annual revenue, where are they located, what are their domains of activity and which types of software they use within SaaS-model.

The data analysis part includes factor analysis, which justifies usage of the questionnaire for the research model and Structural Equation Modelling for hypothesis-testing. In the second paragraph, we outline the purpose of the factor analysis, provide results applicability checks and tests, which justify reliability and validity the analysis. In the third paragraph, we proceed to Structural Equation Modelling, which contains similar parts in its description.

In the fourth paragraph, results of hypotheses testing are interpreted and compared to results of hypotheses testing from the "benchmark" extant studies.

Implications of study, discussed in the fifth paragraph, address researchers by providing the extension of the research area with the research framework developed and its application via Structural Equation Modelling. Practitioners can also benefit from the application of the framework.

Finally, the sixth paragraph is focused on limitations are related to regions, where SMEs and providers are located, their domains of activity and factors, related to making a decision about an adoption of a SaaS, that are accounted for in the research. Suggestions for further analysis include possibility of studying an effect of various characteristics of SMEs as mediating factors for dependencies between factors and further qualitative study for better understanding of the results of the hypothesis testing.

3.1.Data collection and description of material

In order to collect responses of companies, that have already successfully adopted SaaS solution we addressed one of the top-10 Russian SaaS players by revenue in 2015 listed in CNews Analytics Cloud Services 2016 review (CNews Analytics, 2016). Representatives of the provider were first contacted by mail and phone, in order to agree to provide information and contacts of its respective clients in January-February of 2017. As a result, representatives of the provider have allowed for collecting the data in one form or another, after making corrections to the survey.

During the next stage, the data was collected through the online survey distributed by mail, phone calls, and provided in personal interviews. Due to an assumed insufficient level of knowledge of English language among respondents and for the sake of an efficiency of the data collection survey was translated to Russian. Samples of the questionnaire are presented in the supplementary material (see Appendices 2 and 3).

The survey was delivered to a total of 818 companies in period of March-April 2017, resulting in 200 answers collected (response rate of 24,4%). After an additional research of answers (supported by information from SPARK Interfax database), it was found out that 43 companies either do not match criteria of SME outlined by Russian legislation (number of employees is equal or less than 250, annual revenue equal or less than 2 billion rubles) or have presented incomplete or invalid answers. Thus, a total number of 157 responses were selected for further study.

Further in this part we will describe the sample collected. From an overview of respondent companies' characteristics, it can be inferred that the majority of companies (62%) in the research sample can be characterized as micro-enterprises (5 employees or less), 88% of companies can be characterized as small (100 employees or less) and only 12% as medium.

The distribution is presented in Figure 3.2:

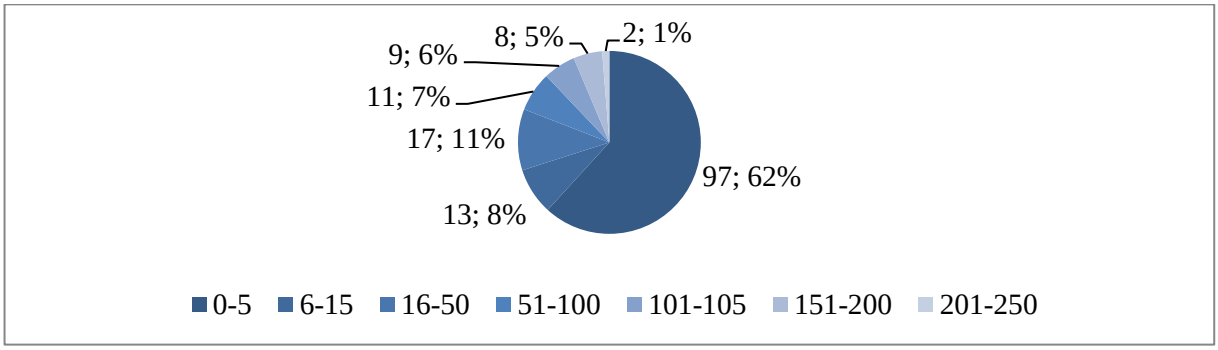

Figure 3.2 – Distribution of respondents by number of employees

Another factor, which allows to classify a company as SME is its annual revenue. This characteristic also demonstrates a skew towards lowest category (50 million rubles per year or less), which is shown on Figure 3.3 (there were as well 3 companies, that responded that they do not know their revenue, 27 companies have preferred not to disclose their revenue figures):

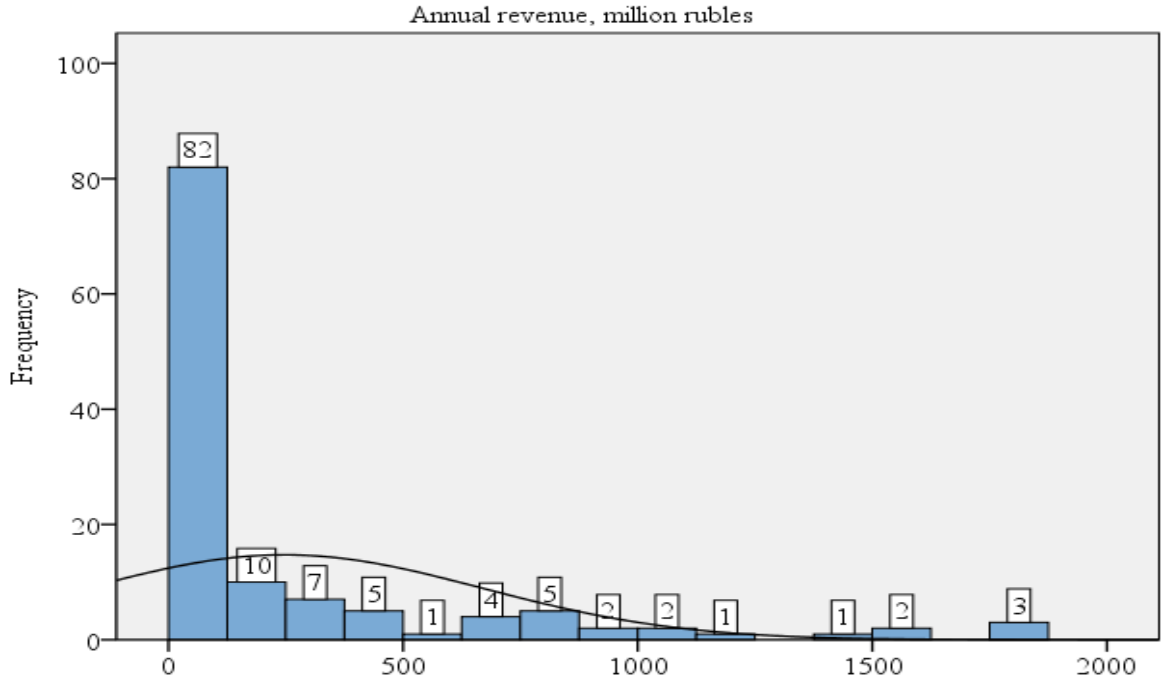

Figure 3.3 – Distribution of respondents by revenue

A combination of the above characteristics results into a classification into small and medium enterprises – 82% of respondent companies can be classified as small and 18% as medium (in case of lack of value of revenue only number of employees were used as a classifying criterion).

With regards to a distribution of respondents of region of location it can be noted that companies from Moscow (58% of respondents) and Saint-Petersburg (15% of respondents) were primarily targeted as the most mature in terms of usage and adoption of SaaS. However, during the data collection SaaS adopting SMEs from other regions were identified and included in the sample for further analysis. Namely, they represent, Kazan, Novosibirsk, Ekaterinburg, and other locations (27% of respondents).

Regional distribution of respondents in shown on Figure 3.4:

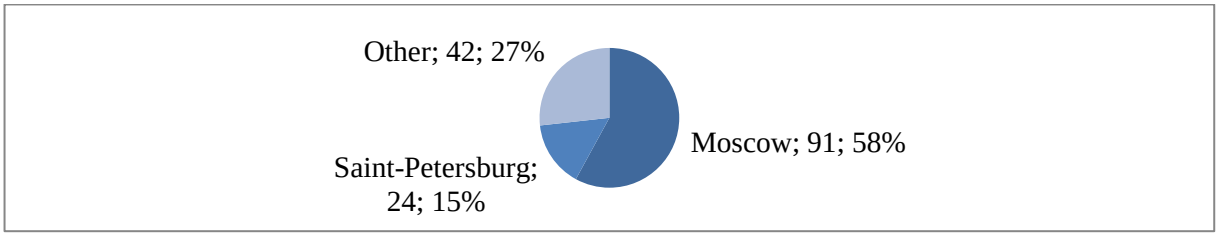

Figure 3.4 – Distribution of respondents by region of location

As outlined above, the survey was addressed to companies that represent industries that are either most frequently to adopt SaaS in Russia now or show potential to growth. Figure 3.5 demonstrates the distribution by domains of activity – service companies are most representative with 54%, trade companies represent 30% of respondents, residual 16% are distributed among manufacturing, construction, and other industries:

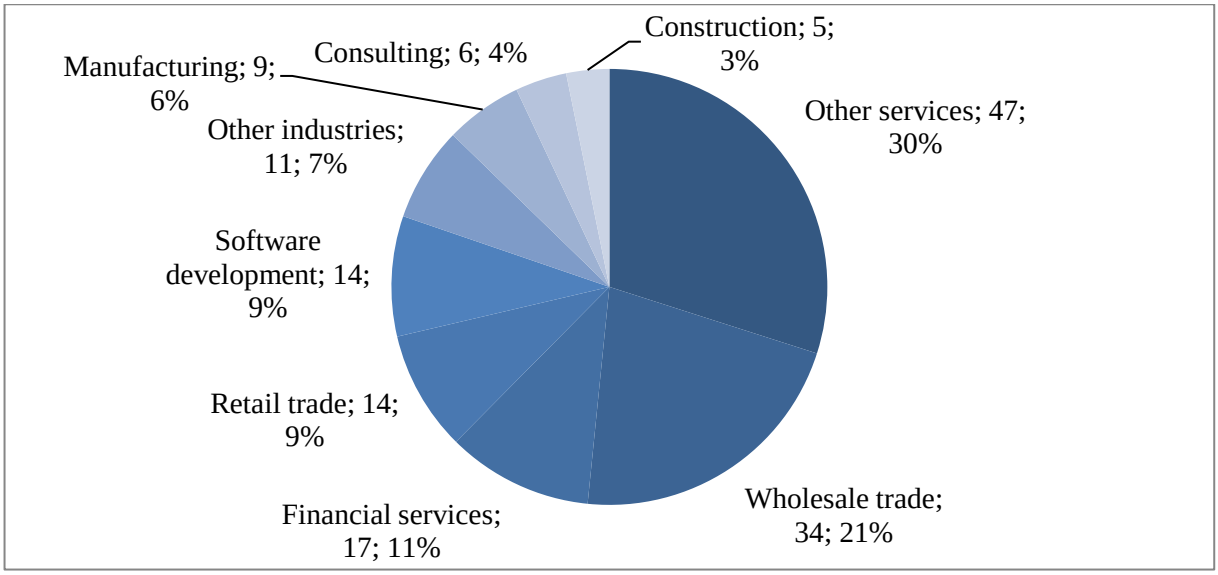

Figure 3.5 – Distribution of respondents by domains of activity

Finally, an information about types of software used within SaaS-model shows a prevalence of usage of customer relationship management systems, such as Microsoft Dynamics CRM and several solutions, developed by providers (89 cases of adoption). For other types of software, number of adoption cases is similar: 20 cases of adoption of both enterprise resource planning systems (Microsoft Dynamics NAV, Microsoft Dynamics AX, Oracle ERP, ERP Parus Enterprise, and several solutions, developed by providers) and content management system (developed by one of the providers), 18 – of accounting systems (different configurations of 1C: Enterprise), 15 – of supply chain management systems (Manhattan SCALE), and 30 – of other software types (Microsoft Exchange Server, 1C: Payroll and HR Management, Veeam Backup and Replication and others).

Two important remarks should be taken into the consideration with regards to the distribution of respondents by this parameter: first, some of SMEs in the sample have adopted more than one software product within SaaS-model and thus, a total number of cases of adopted software solutions represented on the diagram below (Figure 3.6) is more than the total number of respondents; second, it was not studied if any of respondents use multiple software solutions of several providers simultaneously, thus these SMEs might have some additional adoption experience (using SaaS of other providers) which was not accounted for in the research:

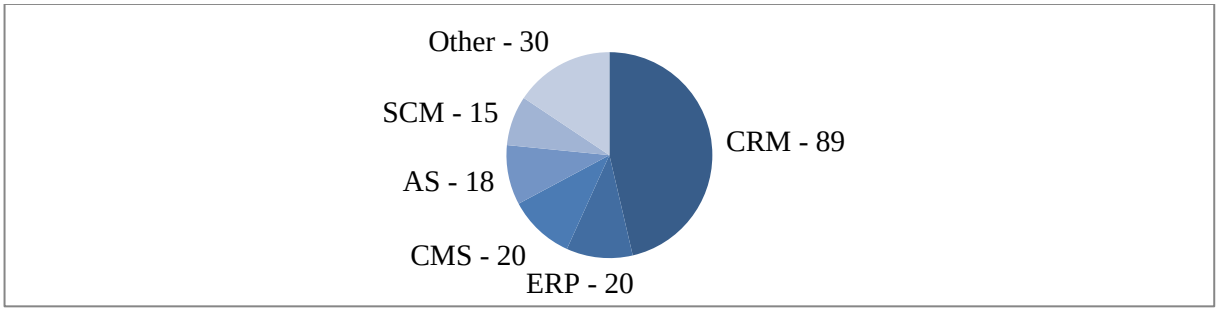

Figure 3.6 – Types of software used by respondents

3.2.Factor analysis

The factor analysis was implemented using IBM SPSS Statistics software for a justification of the validity of the questionnaire. In order to perform it, we ensured that prerequisites for this methodology of the analysis are met.

First of all, the factor analysis is applicable for ordinal variables, such as answers for questionnaire in the research. Although recommendations for number of observations differ, there is an evidence that it is applicable, as subjects-to-variables ratio is 9,81, which is above 5 (Bryant and Yarnold, 1995). With 157 valid observations chosen for the analysis the usage of the factor

analysis is also justified by requirements for a total size of a sample (Hatcher, 1994; Hutcherson and Sofroniou, 1999). There were no cases with missing values that might have led to overestimation (Tabachnik and Fidell, 2007), as all questions were compulsory to answer.

Table 3.1 below represents descriptive statistics for variables (variables named HI_J represent a J-th response from the questionnaire, which is related to an I-th hypothesis; variables named BN_M represent M-th responses from questionnaire, related to determining of business need for adoption; for reference see Appendix 2):

Table 3.1 – Descriptive statistics for research variables

Descriptive Statistics			
Variable	Mean	Standard error of mean	Standard Deviation
H1_1	3,90	0,074	0,921
H1_2	3,74	0,055	0,69
H1_3	3,68	0,056	0,698
H2_1	3,03	0,073	0,909
H2_2	3,36	0,06	0,752
H2_3	3,31	0,06	0,748
H3_1	3,29	0,079	0,994
H3_2	3,52	0,057	0,712
H3_3	3,45	0,059	0,737
H3_4	3,46	0,062	0,78
H4_1	4,07	0,068	0,848
H4_2	3,74	0,056	0,699
H4_3	3,77	0,052	0,649
BN_1	3,36	0,056	0,699
BN_2	3,37	0,055	0,691
BN_3	3,73	0,052	0,654

Source: analysis of the author in IBM SPSS Statistics.

According to Child (2006), data collected should satisfy the assumption normality. Normality was checked with Kolmogorov-Smirnov and Shapiro-Wilk tests and presented in Table 3.2 (df – number of degrees of freedom, Sig. – statistical significance of the test):

Table 3.2 – Results of normality tests

Tests of Normality						
Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
H1_1	0,196	157	0	0,855	157	0
H1_2	0,310	157	0	0,820	157	0
H1_3	0,300	157	0	0,825	157	0
H2_1	0,234	157	0	0,894	157	0
H2_2	0,290	157	0	0,845	157	0
H2_3	0,251	157	0	0,848	157	0
H3_1	0,212	157	0	0,902	157	0
H3_2	0,271	157	0	0,833	157	0
H3_3	0,258	157	0	0,842	157	0
H3_4	0,240	157	0	0,857	157	0

Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
H4_1	0,231	157	0	0,834	157	0
H4_2	0,302	157	0	0,825	157	0
H4_3	0,313	157	0	0,800	157	0
BN_1	0,271	157	0	0,826	157	0
BN_2	0,289	157	0	0,823	157	0
BN_3	0,327	157	0	0,801	157	0

Source: analysis of the author in IBM SPSS Statistics.

There are no variables that may have been considered as outliers due to research design (Likert-scale).

It was also necessary to specify and justify the usage of specific parameters of the factor analysis. The principal components analysis was chosen as a factor extraction method as it has shown its applicability for "preliminary" EFA (Gangwar, Date, and Ramaswamy, 2015; Gupta, Seethraman, and Raj, 2013), so technically, on this stage we operate components, rather than factors, with the same meaning for the research framework (components represent factors, that affect business need in adoption of SaaS solution).

To test whether the sample and variables are suitable for factor analysis, we have used Bartlett's test (should be statistically significant) and Kaiser-Meyer-Olkin measure for sampling adequacy (should be above 0,5), the results are presented in Table 3.3 below (df – number of degrees of freedom, Sig. – statistical significance of the test):

Table 3.3 – Results of measurements of applicability of factor analysis:

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,79
Bartlett's Test of Sphericity	Approx. Chi-Square	2558,488
df		120
Sig.		0

Source: analysis of the author in IBM SPSS Statistics.

The reliability of variables is tested with Cronbach's alpha with a criterion of > 0,7 (Field, 2013). The result is presented in Table 3.4 below:

Table 3.4 – Results of testing reliability of variables

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0,92	0,926	16

Source: analysis of the author in IBM SPSS Statistics.

A requirement for at least three variables for each factor (Gorsuch, 1983) was met by questionnaire design, what is more, from the correlation matrix we can see that there most

variables, which are attributed to particular factors by research design are highly correlated (r > 0,7).

There are however, some cases of moderate correlation – between variables H4_1 and H4_2 and between variables H4_1 and H4_3. This can potentially lead us to preliminary conclusion that rejection to adopt SaaS solution because of high price of purchasing licenses might be only moderately correlated with rejection because other TCO components are considered as too high.

What is more, variable BN_3 is moderately correlated with variables BN_1 and BN_2 which suggests that the recognition of cost cutting opportunities of SaaS adoption might be only moderately related to raising efficiency of business processes and level of competitiveness. Correlation matrix is presented in the Appendix 4.

The principal components analysis in IBM SPSS Statistics includes producing a matrix, which includes a percentage of total variance explained (Table 3.5). With a taken cut-off for eigenvalue > 1 as according to Field (2013), it has shown, that four components (factors) satisfy and are sufficient to explain 83,36% of total variance. However, due to the initial research design, we acknowledge, that component, meant to represent business need might be correlated to other four, and thus, explain little additional variance. Therefore, we will keep five factors in the model.

Table 3.5 - Total variance explained

Total Variance Explained			
Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	7,738	48,363	48,363
2	2,112	13,198	61,562
3	1,93	12,063	73,625
4	1,557	9,733	83,358
5	0,408	2,552	85,911
6	0,387	2,42	88,331
7	0,312	1,953	90,284
8	0,298	1,863	92,146
9	0,263	1,642	93,788
10	0,242	1,515	95,304
11	0,221	1,379	96,683
12	0,187	1,17	97,853
13	0,146	0,915	98,768
14	0,102	0,638	99,406
15	0,078	0,486	99,891
16	0,017	0,109	100

Source: analysis of the author in IBM SPSS Statistics.

In addition to this, a scree plot was produced in IBM SPSS Statistics in order to provide additional demonstration. It is demonstrated on Figure 3.7:

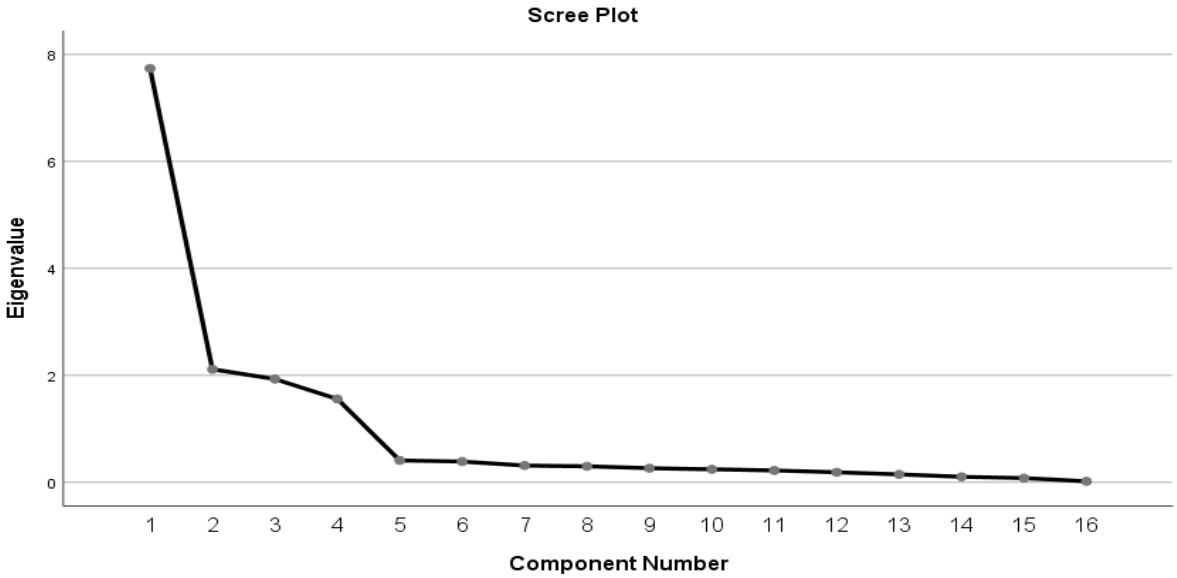

Figure 3.7 – Scree plot

In order to interpret the components (factors) we have used Varimax rotation, which is applicable as it is assumed that factors are uncorrelated (DeCoster, 1998; Rummel, 1970) and is also implemented in "benchmark" studies (Gangwar, Date, and Ramaswamy, 2015). From the results of the Varimax rotation it can be seen, that variables, that represent survey questions demonstrate an attribution to four components (factors).

The fifth component (business need in adoption), however, tends to be more attributed to the component 1 (for variables BN_1 and BN_2) and the component 3 (for variable BN_3) respectively. This can give us a valuable preliminary insight related to hypotheses H1 and H3.

The rotated component matrix is represented in Table 3.6:

Table 3.6 – Rotated component matrix

Rotated Component Matrix					
Variable	Component				
	1	2	3	4	5
H1_1	0,004	0,09	-0,024	0,948	0,161
H1_2	0,225	0,208	0,215	0,815	-0,13
H1_3	0,263	0,271	0,199	0,784	-0,056
H2_1	0,971	0,066	0,052	-0,007	0,03
H2_2	0,79	0,304	0,198	0,241	-0,062
H2_3	0,758	0,262	0,285	0,176	-0,277
H3_1	0,063	0,954	0,101	0,053	-0,037
H3_2	0,176	0,797	0,22	0,258	-0,176
H3_3	0,296	0,775	0,237	0,19	0,245
H3_4	0,212	0,862	0,166	0,192	0,048

Variable	Component				
	1	2	3	4	5
H4_1	0,036	0,088	0,957	0,028	-0,081
H4_2	0,201	0,278	0,783	0,176	-0,004
H4_3	0,212	0,285	0,767	0,184	0,308
BN_1	0,792	0,157	0,091	0,406	0,279
BN_2	0,838	0,148	0,363	0,058	0,052
BN_3	0,413	0,107	0,809	0,08	-0,104

Source: analysis of the author in IBM SPSS Statistics.

3.3. Structural Equation Modelling

In order to proceed with the analysis, we have developed the following structural equation model using SPSS AMOS (Figure 3.5). For usage of SEM, the satisfaction of requirements for sample size (>15 cases for predictor or >100 cases overall) and for normality of data was ensured.

Rectangles represent observable variables, which are corresponding to questions from survey. Circles are latent variables, which are measured by observables. There are four independent variables – TCO (total cost of ownership), PPE (positive previous experience), AFC (actual features and capabilities), R (reliability), and one dependent variable – BN (business need in adoption). Ovals represent so called “unique variables” or residuals for variables. Straight arrows represent so called “paths” – here they represent attribution of residuals to variables, observable variables to latent variables and dependence of one latent variable on another. Curved lines represent covariances – they are specified between all independent latent variables, as necessary for determining the model in IBM SPSS AMOS.

It might be noted that variables H1_1 and H3_1 are omitted and a covariance is drawn between some residuals (e4 and e5, e11 and e 12, e 14and e15) – this is a result of model adjustment, in order for it to fit assumptions of SEM.

This results into the model, which is demonstrated on Figure 3.8:

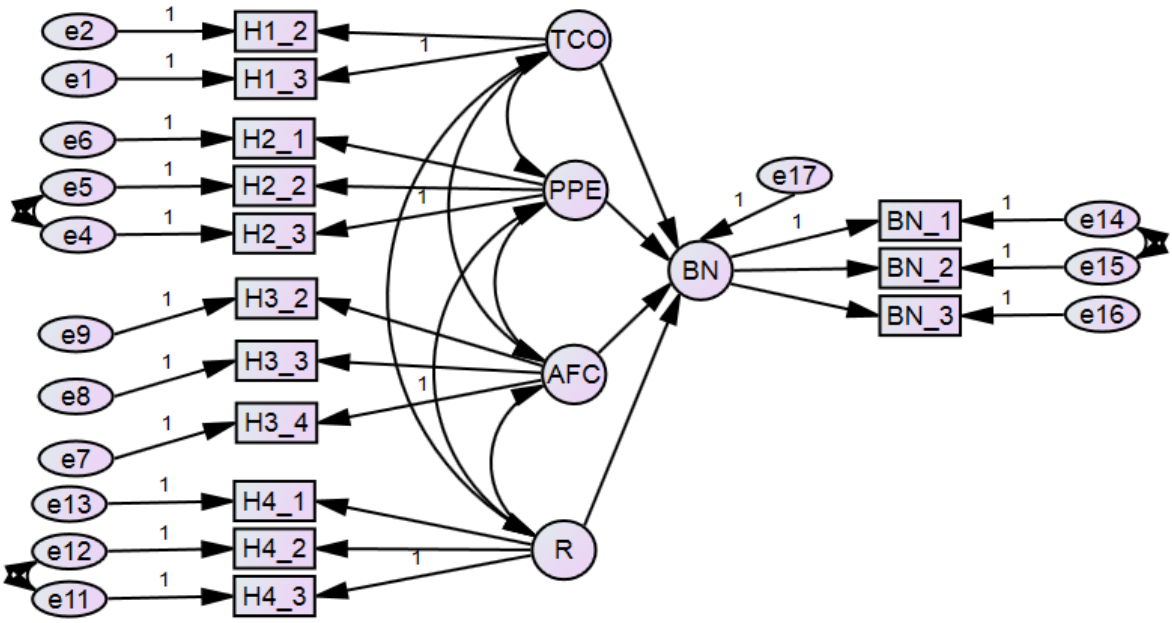

Figure 3.8 – Structural equation model drawn in SPSS AMOS

The omission of variables in the model is justified by a high correlation between remained variables (> 0,7) – in terms of framework it would signify that some part of redundancy in measured variables is eliminated, the positive previous experience is measured by two observable variables instead of three, and the reliability is measured by three observable variables instead of four. A covariance between residuals is also accounted for in the model.

The measurement of the overall fit of the model is performed in IBM SPSS AMOS by Chi-Square test. In the developed model the test was successfully past, model is statistically significant globally.

We have also used some additional indicators while adjusting the fit of the model, drawn from recommendations of statisticians (Browne and Cudeck, 1993) and extant studies (Gangwar, Data, and Ramaswamy, 2015; Gupta, Seethraman, and Raj, 2013). Namely, we have observed GFI (goodness of fit), recommended by Joreskog and Sorebom (1984). While GFI = 1 indicated a perfect fit of the model, in our research model is it equal to 0,803, which is on acceptable level compared to “benchmark research”.

Furthermore, we evaluated CMIN/DF (minimum discrepancy divided by its degrees of freedom), which is a ratio of overall fit of the model. A value observed is 4,129, which satisfies the recommendation of below absolute value of 5 (Marsh and Hocevar, 1985). Another parameter observed is CFI (comparative fit index), which shows that the sector in a model has enough high

stability. The value in the model is 0,910, which is acceptable, as CFI values close to 1 indicate a good fit (Bentler, 1990).

In addition, we also included RMSEA (root mean square error approximation), an indicator, which shows that data has enough low error value, that items explain respective values in the best manner. In our study, it is 0,081 which is considered acceptable (Browne and Cudeck, 1993).

After we have adjusted the fit of the model, we have performed the hypothesis testing, which lead to the following results, represented in Table 3.7 (Estimate – unstandardized regression coefficient, that represents the amount of change in the dependent variable for one unit of change in each of variables predicting it; S.E. – standard error of estimate; C.R. – critical ratio, estimate divided by standard error; P – probability value associated with the null hypothesis that the test is zero):

Table 3.7 – Results of hypothesis testing in SPSS AMOS

Dependent variable	Independent variable	Estimate	S.E.	C.R.	P
BN	TCO	,090	,024	3,786	***
BN	PPE	,637	,067	9,543	***
BN	AFC	,002	,019	,084	,933
BN	R	,617	,065	9,441	***

Source: analysis of the author in IBM SPSS AMOS.

As it can be derived from the table, hypotheses H1 (PPE on BN), H3 (R on BN), and H4 (TCO on BN) are supported and hypothesis H2 (AFC on BN) is not supported.

3.4. Analysis of results

To analyze the results of the hypothesis testing, we address the research framework and interpret meaning of each result with regards to it. We also provide results of testing similar hypotheses in extant studies for a comparison.

Finally, we provide the results of the predictive analysis in IBM SPSS Watson. The software was chosen, because of a possibility to represent of multiple predictive scenarios in visually comprehensive format and existence of successful use cases (Yablonsky and Faizullov, 2017).

Within the analysis, we presented each of the three variables measuring the business need in adoption of SaaS by Russian SMEs (efficiency of business processes, level of competitiveness, saving costs) as dependent variables from variables measuring the positive previous experience from usage, the reliability, and the total cost of ownership for SaaS. Dependency from variables

measuring features and capabilities of SaaS was not measured due to the fact that respective hypothesis was not confirmed.

For each of independent variables we retrieve predictive strength for a dependent variable – an indicator, that shows a confidence of a prediction model associated with a dependent variable. In other words, the higher the predictive strength of a field is, the stronger correlation it has with what is be predicted. According to the information, provided by IBM, the computation of correlation is run in accordance with Chi-square automatic interaction detection algorithm (IBM Analytics Communities, 2016). The predictive strength is measured on a scale from 0% to 100% and in the analysis, is used solely for a comparison of inputs of different variables (as according to the research framework observable variables are not intended to directly predict each other).

Let us discuss the results in more details. The hypothesis H1 claimed positive effect of the positive previous experience of using the solution on the business need in its adoption. What is more, the corresponding path coefficient is the highest for all factors, which can be interpreted as following: changes in degree of having positive previous experience can lead to highest changes in business need in adoption, than changes in any other single factor.

The finding is in line with the evidence of industry reports, which claim that most adopters make a decision after having positive experience with trial versions of solutions (Odin, 2015). Although not directly measured in the same way in the extant studies, it is in line with findings of Gangwar, Date, and Ramaswamy (2015), whose hypothesis about the positive effect of an organization readiness ("perception and evaluation by managers the degree to which they believe organization has the awareness, resources, governance, and commitment to adopt") on a perceived usefulness of a cloud solution.

Results of the predictive analysis for corresponding observable variables are demonstrated in Table 3.8 (BN1 – efficiency of business processes, BN2 – level of competitiveness, BN3 – saving costs, PPE1 – previous experience of usage of the same software, PPE2 – positive previous experience of usage of the same SaaS, PPE3 – positive previous experience of usage of trial version the same SaaS). It can be inferred from results that raise in the efficiency of business processes is moderately correlated with the previous positive experience, especially from the same SaaS (and not just the same software) usage.

Other aspects of business need are only slightly correlated with observable variables of the group. In some cases, a variable, related to usage of the same software is not even considered by IBM Watson Analytics as having any predictive power (which is consistent with the results of

SEM in IBM SPSS AMOS – as variable, that corresponds to PPE1, was omitted from the model, due to lack of fit).

Table 3.8 – Predictive analysis for group of variables "Previous positive experience"

Dependent variable	Independent variable	Predictive strength
BN1	PPE1	20%
	PPE2	28%
	PPE3	30%
BN2	PPE1	-
	PPE2	12%
	PPE3	14%
BN3	PPE1	-
	PPE2	12%
	PPE3	12%

Source: analysis of the author in IBM Watson Analytics.

The hypothesis H2, related to the positive effect of actual features and capabilities the solution on business need in its adoption is not supported by testing within the research model. This result can lead to the following interpretation: SMEs as adopters are by some reason tend not to pay much attention to features and capabilities of software (mainly, its functions, adjustment and access possibilities) when determining the business need in adoption (at least, compared to other studied factors in the research). It is clear, though, that the result implies a potential further research of underlying reasons, which will be discussed more in a corresponding chapter of the master thesis.

Results for the hypothesis H3 (business need in adoption of cloud solution by SME is positively affected by its reliability) are similar to those of H1 – hypothesis is statistically significant and path coefficient is sufficiently high. This means that SMEs in Russia tend to pay significant attention to reliability of SaaS solutions, namely to absence of security incidents, high level of data security and high level of support in SLA.

Similar hypotheses were studied by several researchers from extant studies. In the research of Gupta, Seethraman, and Raj (2013) the hypothesis about the positive relation of the reliability of cloud providers to the usage and adoption is not supported and it is claimed that "SMEs do not consider cloud as reliable". Such result is explained by a lack of trust of decision makers in SMEs located in Asia-Pacific region to store data on site of provider, a low bandwidth resulting in a low availability of the solution and lots of downtimes. The finding does not contradict the result of our study, as we also assumed that reliability of the cloud is a concern for SMEs, but rather demonstrated by analysis that SMEs who recognize a business need in an adoption of a cloud solution also tend to ensure that it has a high level of reliability.

Study of Hanafizadeh and Ravasan (2017), which has more industry specific sample (representatives of banks in India) has confirmed a hypothesis that "perceived low information security and privacy is negatively related to the ITO adoption level", which is claimed to be the most essential factor influencing decision-making of respondents. In our research sample, we have also included some cases of financial institutions that have adopted SaaS solutions with specific requirements for information security, but their number is rather limited, therefore, we cannot state that hypothesis H3 is confirmed mostly due to high security requirements of institutions dealing with financial data.

Let us proceed with the predictive analysis for the group of variables, measuring the reliability of a SaaS solution, which results are presented in Table 3.9 (R1 – sufficiently low number of data security incidents, R2 – high level of data protection, R3 – high level of accessibility, R4 – fast response to service requests and resolution of incidents). Results demonstrate modest predictive strengths of variables R2-R4, while R1 is considered as not having predictive strength (and was also omitted from the model in the SEM part).

We can also see that a high level of accessibility has relatively higher strength for all components of business need, especially for the efficiency of business processes and the level of competitiveness. The possible explanation would be that a higher level of an accessibility (no downtimes, required level of latency) correspond positively to a higher efficiency and a competitiveness of an enterprise.

Table 3.9 – Predictive analysis for group of variables "Reliability"

Dependent variable	Independent variable	Predictive strength
BN1	R1	-
	R2	13%
	R3	19%
	R4	17%
BN2	R1	-
	R2	15%
	R3	21%
	R4	15%
BN3	R1	-
	R2	15%
	R3	16%
	R4	12%

Source: analysis of the author in IBM Watson Analytics.

Lastly, the hypothesis H4, which is related to the negative influence of the TCO on the business need for an adoption of a software, is also confirmed to be statistically significant. It needs to be stressed though, that the assumption was made that a refusal of SMEs to adopt SaaS

solutions due to perceived high components of TCO represents the statement of hypothesis. With the assumption, the finding could be interpreted in following way: SMEs in Russia tend to see lower business need in SaaS solution if TCO of it is perceived as too high. However, we should also note that estimate for path coefficient is 0,9, which is rather low compared to other statistically significant factors of influence – positive previous experience and reliability.

As outlined previously, costs are frequently mentioned as major influencing factor for an adoption, both in academic research (Gupta, Seethraman, and Raj, 2013; Kilic, Zaim, and Delen, 2014; Sebesta, 2013) and industry reports (CNews Analytics, 2015, 2016; Odin, 2016). Namely, Gupta, Seethraman, and Raj (2013) test the following hypothesis: "cost reduction or cost saving achieved using cloud has a positive effect on the SMEs usage and adoption of cloud computing", which is supported in the study and demonstrated of examples of an elimination of IT-infrastructure costs (hardware, data storage and backup, salaries of IT specialists etc.).

Our research is rather focused on studying the relation of the adoption intention to comparative TCOs of SaaS solutions, but can be logically linked to results of the above mentioned research in the following way: one of directly measured variables is related to a recognition of cost saving potential as result of a SaaS solution adoption, that is according to the model influenced by an intention of SMEs to choose solutions with acceptable TCO.

Let us finish with the results of the predictive analysis, related to the total cost of ownership components, which are presented in Table 3.10 (TCO1 – cost of purchasing licenses, TCO2 – cost of deployment, TCO3 – cost of support of SaaS solution). With regards to values of the strength it can be inferred that the component of the business need, that is related to cost-saving is correlated with variables, measuring the TCO, which makes sense, as SMEs are expected to not recognize any cost-saving if they perceive TCO of SaaS as very high. Other components of the business need are moderately correlated with TCO components.

Table 3.10 – Predictive analysis for group of variables "Total Cost of Ownership"

Dependent variable	Independent variable	Predictive strength
BN1	TCO1	-
	TCO2	13%
	TCO3	15%
BN2	TCO1	22%
	TCO2	22%
	TCO3	24%
BN3	TCO1	59%
	TCO2	45%
	TCO3	49%

Source: analysis of the author in IBM Watson Analytics.

3.5. Practical implications and contribution

There are several groups that can benefit from the results of this research. First of all, the study provides several contributions to the research area of the decision-making for an adoption of IT-infrastructure solutions. The theoretical part contains the overview of key research components, including research frameworks, decision-making criteria, data collection and data analysis methodologies with detailed examples of usage in research. This information might be relevant for researchers operating in the same or neighboring research areas.

They include the application of Structural Equation Modelling for studying of business need of SMEs to adopt SaaS solutions. The justification of structural model with factor analysis and measures for evaluation of model fit are provided. These applications and results of their implementation (hypothesis testing and interpretation of its results) also might be relevant for similar research. Several suggestions for further research are as well discussed in this chapter.

Implications for practitioners address both Russian SMEs considering adoption of SaaS solution and SaaS providers that operate in Russian market with SMEs.

Two components of research might be interesting for both groups. First one is an array of factors that should be taken into consideration when making a decision and particular characteristics of a software which are related to them, which are depicted in the research model and the questionnaire. These are applicable for SMEs as they can determine factors that are particularly important for them and design their own decision-making tool that might help them to choose the most suitable cloud solution.

Providers, in turn, may analyze factors of importance for their current and prospective clients, and receive knowledge of how their products, services, contracts, and marketing elements can be adjusted in order to raise recognition of business need and subsequently develop their business performance.

Developed research framework also represents a useful tool for practitioners, as it might be applied in the same manner. However, it needs to be mentioned, that applicability of the framework should be ensured.

3.6. Research limitations and suggestions for further analysis

Another important component of research covers imposed limitations. As outlined above, the study intends to focus on Russian SMEs and incorporate the experience of relevant research of SMEs in Europe in Asia, thus it has a regional limitation. In particular, due to significant difference in IT-maturity of SMEs in different regions of Russia, we decided to focus mostly on Moscow and

Saint-Petersburg as locations for the most advanced SMEs. It is reasonable then to suppose that sample of SMEs, that mostly represent other regions of Russia may demonstrate other results within the model, as they might consider different factors or same factors but differently while evaluating business need in an adoption of SaaS solutions.

Following recommendations of practitioners (Odin, 2015), we focused mostly on commercial SMEs operating in industries that either represent major client segments for SaaS market in Russia or are projected to represent them in future. Therefore, results of the research of representatives of different industries might vary.

What is more, the sample included only existing clients of the major Russian SaaS provider, thus, it does not observe companies, which use SaaS solutions of other providers (both Russian and international), and companies that by some reason decided not to adopt SaaS or adopted and then switched to other solutions.

In addition to this, our study focuses on five factors: the business need in an adoption, the positive previous experience, features and capabilities, the reliability, and the total cost of ownership, mentioned most frequently in scientific and industry studies. As stated previously, there is a lot of factors, influencing an adoption decision, identified in extant studies, such as the degree of standardization (Brender and Markov, 2013; Kilic, Zaim, and Delen, 2014; Oliveira, Rodrigues, and Ruivo, 2014), the integrability (Sultan, 2011), data sharing and collaboration functions (Gupta, Seethraman, and Raj, 2013; Wu, Wan, and Lee, 2011), beneficial payment schemes (Marian and Hamburg, 2012; Rohitratana and Altmann, 2012) and others. Mentioned factors might also potentially be relevant for Russian SMEs.

As outlined before, the methodology, presented in the study, can be extended to companies, representing different regions and industries and other factors of influence. In addition to this, there are suggestions that result from the research sample and results of hypothesis testing.

Following the research framework, proposed by Tan and Kim (2015), characteristics of the companies could be studied as mediating factors. More specifically, indicators, related to size of companies (number of employees), degree (annual revenue), domain of activities (industry), and region of activities can be studied with results on how representatives of different groups show different results of a hypothesis testing.

Regarding the results of testing of the hypothesis H2 (“business need in adoption of cloud solution by SME is positively affected by its features and capabilities”), it can be inferred, that there is a possibility for a further research of underlying reasons for an insignificance of features

and capabilities of a software for recognizing the business need in adoption. Namely, a qualitative study implying structured interviews with sample representatives could be a dimension of further research. This suggestion applies as well to the results of testing of other hypotheses.

3.7.Summary of the chapter

This chapter begins with the description of the data collection process, during which the questionnaire was distributed to SMEs, currently using solutions of the largest SaaS providers in Russia. As a result, the sample of 157 valid answers was collected. The data description is followed by the provision of sample characteristics – company size, annual revenue and distribution by industry.

For the justification of the measurement of latent variables in the model by observable variables represented by survey questions we have conducted the factor analysis in IBM SPSS Statistics. The results of the factor analysis have shown that observable variables are justified to latent independent variables.

The structural equation model was developed and adjusted for a better fit in IBM SPSS AMOS. As a result of the model implementation, hypotheses H1 (business need in adoption of cloud solution by SME is positively affected by positive previous experience), H3 (business need in adoption of cloud solution by SME is positively affected by its reliability), and H4 (business need in adoption of cloud solution by SME is negatively affected by its total cost of ownership) are supported and the hypothesis H2 (business need in adoption of cloud solution by SME is positively affected by its actual features and capabilities) is not supported.

Then we proceed with outlining of implications of study and recommendations for researchers and practitioners' recommendations (Russian SMEs and software providers working with them) considering usage of factors and framework for decision-making.

Furthermore, research limitations are discussed. They are mainly related to region of location and industry that respondents are operating in, as well as related to factors of importance. Suggestions for further research are provided subsequently.

CONCLUSION

The current study is devoted to the research and the analysis of factors, that are related to making decisions about adoption of SaaS solutions in Russian SMEs. Cloud solutions in general are perceived as a useful tool, which may lead to raise of performance of their adopters. They have a lot of advantages for adopting companies, such as ease of use and deployment, sharing and collaboration of data and beneficial payment schemes.

There are as well some controversial factors, that may in different situations result in adoption of cloud computing solutions or make a company to refuse of such an idea. Namely, these are costs associated with solutions, (which in practice of Russian IT companies often aggregated in total cost of ownership), reliability (linked with level of information security and technical support according to service level agreements), and degree of standardization.

The Russian cloud services market exists for more than ten years, but is still considered as developing, showing higher pace of growth than average worldwide. The SaaS is currently a second and most promising segment of the market, with few major players located in Moscow and Saint-Petersburg. Among clients SMEs represent majority by revenue of SaaS vendors, but on average, single SME tends to use only limited amount of basic services. Industry experts explain such a situation with an insufficient IT budget and a lack of the expertise for making rational decisions about the adoption of the SaaS based on actual business needs.

Therefore, this study intends to outline factors, which are important for determining the business need in the adoption of the SaaS. Factors are taken from extant theoretical studies of the decision-making processes of the adoption of IT solutions among various types of companies worldwide, as well as from recent analytical reports and interviews with industry experts in Russia. In addition to this, a broader theoretical background was observed, including key research questions and topics in the area, research subjects, different possible scopes, research models and frameworks, data collection and data analysis methodologies.

In the research area, most of studies are intended to outline factors, attributed to IT-solution, or related to it, which are taken into account by companies, when they make the decision about the adoption of solutions. These factors in general attribute to one or several of the following characteristics: perceived by SMEs as substantially important, making IT-solution objectively fit to needs of SMEs or outlined by expert opinion as essential.

Alongside with the influence of factors on the adoption decision, it was discovered that extant studies focus on their interrelation, which, supported by evidence from industry reviews,

resulted into a development of present research question, that is related to the influence of business need (as one factor resulting into adoption) by other factors – previous experience, features and capabilities, reliability, and costs. These factors are claimed as important for Russian SMEs when it comes to the adoption of SaaS solutions.

Several related research questions that contributed to the development of the research were also identified: which frameworks can SMEs employ when they choose cloud services to adopt, how usage of cloud services affect different aspects of performance of SMEs, which SMEs are most likely to adopt cloud services, what should cloud service providers do with their product and proposition in order to attract SMEs.

Therefore, the study analyzes interdependencies between factors and aims at providing both vendors and decision makers in Russian SMEs with a framework of their evaluations and related recommendations. The research framework is based on most relevant studies, which were taken as "benchmarks". It is focused on determining the strength and the direction of the influence of positive the previous experience from usage SaaS, its features and capabilities, its level of reliability and the cost of ownership on the recognition of the business need in the adoption by Russian SMEs, who are currently using solutions of major Russian SaaS providers.

Factors within the research framework are represented as latent constructs and measured by observable variables in forms of 5-point Likert-scale questions in the survey. In order to obtain results for the survey major Russian cloud services providers were contacted, who then provided opportunity to distribute the questionnaire among their respective clients either by e-mail, by phone or in personal interviews.

In order to justify the measurement of latent constructs with observable variables, factor analysis was performed in IBM SPSS Statistics, with an estimation of validating indicators. As a result, observable variables were valid to represent independent variables of the research model. Variables that are related to the dependent variable (business need) have demonstrated a higher attribution to the positive previous experience and the reliability respectively, which was explained by the implied influence of independent variables on dependent and it was decided to proceed with the structural equation model.

SEM was developed in IBM SPSS AMOS, the model was also adjusted for better overall fit, validity, and reliability of measurements. Changes in the model are justified by relationships between model variables.

Hypothesis testing was performed after adjusting the model.

As a result:

- hypothesis H1 (business need in adoption of cloud solution by SME is positively affected by positive previous experience) is confirmed;
- hypothesis H2 (business need in adoption of cloud solution by SME is positively affected by its actual features and capabilities) is not confirmed;
- hypothesis H3 (business need in adoption of cloud solution by SME is positively affected by its reliability) is confirmed;
- hypothesis H4 (business need in adoption of cloud solution by SME is negatively affected by its total cost of ownership) is confirmed.

While similar findings exist in extant studies for confirmed hypotheses, it cannot be said that for the non-confirmed hypothesis, there are relevant results in other research. Thus, it is suggested as a proposition of further research to conduct a study on how features and capabilities of SaaS are related to recognition of business need in its adoption by Russian SMEs.

In addition to the results of hypothesis testing, the analysis of predictive strengths in IBM Watson Analytics has demonstrated a set of results. Namely, the efficiency of business processes is moderately correlated with the positive previous experience, especially from the same SaaS usage; other components of the business need are slightly correlated with observables.

Furthermore, the number of security incidents, related to a SaaS solution demonstrates no predictive strength for the business need; the level of data protection and the speed of response on service requests and incidents, has demonstrated a moderate predictive strength for the business need; the level of accessibility demonstrates highest strength for all components of the business need;

In addition, components of the business need, that are related to the level of efficiency of business processes and the level of competitiveness slightly correlated with the cost of purchasing licenses and moderately with the cost of the deployment of the SaaS solution; the cost-saving component of the business need is highly correlated with all TCO components.

Overall, this study contributes to the extension of the research area in terms of geography, and interrelations in hypothesis studied. It has also provided another example of applicability of SEM. Practitioners can benefit from the list of potential factors of influence and methodology of their evaluation. Propositions for further research include suggestions to study of between-group differences for SMEs and of mediating variables, such as size, region, and domain of business activities.

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SUPPLEMENTARY MATERIAL

Appendix 1: Overview of data collection methodologies in relevant studies

№	Hypotheses tested	Information about survey and questions, related to hypotheses testing	Relevant supplementary questions included in survey	NR[1]	RR[2]	AR[3]
1	Influence of characteristics of cloud computing solutions and related metrics (relative advantage, compatibility, complexity, organizational competency, top management support, training and education, competitive pressure, trading partner support) on determinants of TAM model (perceived usefulness, perceived ease of use) Influence of determinants of TAM model on each other and on cloud computing adoption	Responses collected from top and middle-level IT professionals in the companies (finance, IT, and manufacturing) who are in process of adoption of cloud computing solutions Respondent companies are taken from official national database of Bombay Chamber of Commerce and Industry, India Responses collected during personal visits to the respondents or collected through e-mail Questions, related to hypothesis testing are based on five-point Likert scale	Processing of respondents: Are you aware of cloud computing? Are you willing to adopt cloud computing or are you already in process of adoption? Categorization of respondents: What is the size of your company? What is your employee turnover per year (in number of employees)?	1000 (433)	43,3%	64,6%
2	Influence of different characteristics of cloud computing solutions (cost reduction, ease of use and convenience, reliability, sharing and collaboration, security, and privacy) on each other and on its usage and adoption by SMEs	Responses collected from representatives of SMEs that "are well aware of the cloud" Responses collected via e-mails, distribution of hardcopy forms and face-to-face interviews Questions, related to hypothesis testing	Categorization of respondents: How many employees do you have? How many IT staff do you have? Where is your company registered? What is your annual revenue (turnover)?	1100 (230)	20,9%	91,7%

[1] NR – total number of responses, that are used in research.

[2] RR – response rate – ratio of responded applicants to of surveyed applicants.

[3] AR – applicable responses – ratio of responses applicable to use to total number of responses.

		are based on five-point Likert scale For each variable, 3 to 5 questions are formulated	Do you have broadband (Internet) connection? Which payment mode would you prefer?			
3	Influence of characteristics of ITO and related metrics (technological, organizational, and environmental attributes) on ITO adoption level	Responses collected from managers or other decision-makers responsible for adoption of e-banking services Responses collected via phone calls and e-mail Respondent companies are taken from a list published by Central Bank of Iran Questions, related to hypothesis testing are based on five-point Likert scale	Categorization of respondents: What is the size of your company? What is your ITO adoption level?	300 (127)	42,3%	N/A
4	Interrelations of different dimensions of balanced scorecard (learning and growth, internal business processes, customer performance, financial performance) with regards to adoption of SaaS	Responses collected from IT personnel of SMEs using SaaS Respondent companies are taken from a list of registered in Small & Medium Business Administration in South Korea Questions, related to hypothesis testing are based on seven-point Likert scale	Categorization of respondents: Which industry does your company operate in? What is the size of your company? For how many years do you use SaaS? What is the percentage of SaaS use in total processes of your company? What is your monthly SaaS usage fee (in USD)? Which SaaS applications do you use?	500 (101)	20,2%	N/A
5	Relationships between different indicators, related to SaaS collaboration tools (confirmation with expectations, perceived usefulness, satisfaction, continuance intention)	Responses collected from MBA students that are making project via Google Docs (they represent general population of SaaS collaboration tool users)	Studying effect of mediating variables: What it the level of your IT-skills? Do you have any prior experience using Google Docs?	N/A (132)	N/A	98,5%

	Affection of relationships by mediating variables (prior experience with SaaS collaboration tools, level of IT skills)	Responses collected via face-to-face interviews or e-mail				
6	No formal hypotheses tested The study is intended to identify the level of knowledge and awareness of SMEs regarding cloud computing solutions available for them on the market Also, one of research tasks is to identify the perception of SMEs regarding the main categories of benefits and risks related to the adoption of cloud computing solutions	Responses collected from representatives of SMEs in Romania Responses collected phone calls, social network platforms or e-mail Closed questions that are aimed to identify benefits and risks of cloud computing solutions perceived by SMEs	Categorization of respondents: Where do you deploy your activity? Are you located in urban or rural area? What is your field of activity? How many employees do you have? What is your level of knowledge and awareness about cloud computing solutions? Which types of cloud computing solutions and online tools do you use?	1266 (595)	47%	78,5%

List of studies, used in overview:

1. Gangwar, Date, and Ramaswamy (2015)
2. Gupta, Seethraman, and Raj (2013)
3. Hanafizadeh and Ravasan (2017)
4. Lee, Park, and Lim (2013)
5. Tan and Kim (2015)
6. Tutunea (2014)

Appendix 2: Research questionnaire sample

English version

Description of the questionnaire
Please consider this information before answering questions: The questionnaire is intended to understand influence of different factors on making decision about adoption of SaaS solutions in Russian SMEs. First part of the questionnaire contains 16 questions, related to peculiarities of decision-making process. Please choose answers, that are closest to how adoption decision is made in your company. Second part of the questionnaire is related to information about Russian SMEs that use SaaS solutions.

Please note that this questionnaire collects personal data about your company without necessity to disclose company name or other details that would allow to identify it. By answering this questionnaire, you agree for usage and processing of your personal data according to Russian Legislation. It is guaranteed that data will be used only for purpose of academic research.			
Part 1: Questions, related to hypothesis testing:			
№	Question	Related hypothesis/factor	Options to answer
1	Our company has decided that we need to adopt a SaaS solution we are currently using because we have successfully used the same software solution previously	H1/Positive previous experience	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
2	Our company has decided that we need to adopt a SaaS solution we are currently using because we have successfully used the same SaaS solution previously	H1/Positive previous experience	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
3	Our company has decided that we need to adopt a SaaS solution we are currently using because we had an opportunity to test trial version of SaaS solution and were overall satisfied with it	H1/Positive previous experience	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
4	Our company has decided that we need to adopt a SaaS solution we are currently using because it has a wide range of relevant functions	H2/Features and capabilities	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
5	Our company has decided that we need to adopt a SaaS solution we are currently using because it can be adjusted (by scale, range of functions) in fast and convenient manner	H2/Features and capabilities	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
6	Our company has decided that we need to adopt a SaaS solution we are currently using because it can be accessed via various devices (workstation, laptop, tablet, smartphone) and is represented in different formats of applications (desktop, web, mobile)	H2/Features and capabilities	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree

7	Our company has decided that we need to adopt a SaaS solution we are currently using because it has sufficiently low number of data security incidents	H3/Reliability	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
8	Our company has decided that we need to adopt a SaaS solution we are currently using because it implies high level of data protection (authentication by password, data encryption etc.), claimed by provider for the service	H3/Reliability	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
9	Our company has decided that we need to adopt a SaaS solution we are currently using because it has sufficiently high level of accessibility (percentage of time when it is fully accessible, except planned maintenance), claimed by provider for the service	H3/Reliability	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
10	Our company has decided that we need to adopt a SaaS solution we are currently using because provider guarantees sufficiently fast response for service requests and resolution of incidents	H3/Reliability	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
11	Our company have refused to use SaaS solutions other than we are currently using because cost of purchasing licenses for them was perceived as too high	H4/TCO	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
12	Our company have refused to use SaaS solutions other than we are currently using because cost of deployment of them was perceived as too high	H4/TCO	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
13	Our company have refused to use SaaS solutions other than we are currently using because cost of support of them was perceived as too high	H4/TCO	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree

14	Our company has decided that we need to adopt a SaaS solution we are currently using because we recognized the potential to raise efficiency of its business processes	Business need	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
15	Our company has decided that we need to adopt a SaaS solution we are currently using because we recognized the potential to raise the level of our competitiveness	Business need	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
16	Our company has decided that we need to adopt a SaaS solution we are currently using because we recognized the potential to save costs with help of SaaS solution adopted	Business need	1 – Strongly disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly agree
Part 2: Questions, related to categorization of respondents			
№	Question	Type	Options to answer
17	How many employees do you have?	Closed	1-5 6-15 16-50 51-100 101-150 151-200 201-250
18	Which region is your business registered in?	Closed with possibility to specify other option	Choice from all federal subjects of Russia Other (specify)
19	What is your annual revenue (in millions of rubles)?	Closed with possibility to specify other option	0-50 50-100 100-400 400-800 800-2000 Confidential Do not know Other (specify)
20	What is the field of activity of your company?	Closed with possibility to	Choice from all sections of

		specify other option	Russian Classificatory of Types of Economic Activity Other (specify)
21	Which types of SaaS are you currently using?	Possibility to choose from multiple options or to specify other option	Enterprise Resource Planning System Customer relationship management system Accounting system Supply chain management system Content management system Other (specify)

Russian version

Описание опроса			
Пожалуйста, ознакомьтесь со следующей информацией перед началом прохождения опроса: Данный опрос предназначен для исследования влияния различных факторов на принятие решения о внедрении SaaS-решений в российских компаниях малого и среднего бизнеса. Первая часть опроса содержит 16 вопросов, которые связаны с исследованием особенностей принятия решений. Пожалуйста, выбирайте варианты ответов, которые наиболее близко соответствуют тому, как решения о внедрении SaaS-решений принимаются в вашей компании. Вторая часть опроса связана со сбором информации о компаниях малого и среднего бизнеса, использующих SaaS-решения. Пожалуйста, обратите внимание на то, что данный опрос предполагает сбор и обработку персональных данных, однако не имеет своей целью сбор данных, которые позволяют однозначно идентифицировать компании-респонденты. Отвечая на данные опрос, вы автоматически согласны со сбором и обработкой данных о вашей компании согласно законодательству РФ. Данные будут использоваться только в целях академического исследования.			
Часть 1: Исследование факторов, влияющих на принятие решения о внедрении SaaS			
№	Вопрос	Гипотеза/Фактор	Варианты ответа
1	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании предыдущего успешного опыта использования такого же программного обеспечения	H1/Положительный опыт предыдущего использования	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен

			5- Полностью согласен
2	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании предыдущего успешного опыта использования такого же SaaS решения	H1/Положительный опыт предыдущего использования	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
3	Решение о внедрении SaaS, которое сейчас используется в компании, было принято, так как была предоставлена возможность протестировать пробную версию и опыт тестирования был в целом оценен как удовлетворительный	H1/Положительный опыт предыдущего использования	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
4	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании того, что решение содержит в себе большое количество релевантных функций	H2/Функции и возможности	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
5	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании того, что параметры решения (масштаб, функционал) могут быть быстро и удобно перенастроены	H2/Функции и возможности	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
6	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании того, что сервис доступен с различных пользовательских устройств (рабочий компьютер, ноутбук, планшет, смартфон) и представлен в различных форматах (десктопное приложение, веб-приложение, приложение для мобильных устройств)	H2/Функции и возможности	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
7	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании отсутствия или допустимо низкого количества инцидентов, связанных с информационной безопасностью, заявленного провайдером для сервиса	H3/Надежность	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
8	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании высокого уровня защиты данных (аутентификация по паролю,	H3/Надежность	1 – Полностью не согласен 2 - Не согласен

	шифрование данных), заявленного провайдером для сервиса		3 – Не знаю 4 – Согласен 5- Полностью согласен
9	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании приемлемого уровня доступности (доля времени, в течение которого сервис полностью доступен, за исключением плановых работ), заявленного провайдером для сервиса	Н3/Надежность	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
10	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании приемлемого ответа на заявки и разрешения инцидентов, заявленного провайдером	Н3/Надежность	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
11	Решение об отказе от внедрения альтернативных SaaS решений было принято на основании того, что стоимость приобретения лицензий для них была посчитана слишком высокой	Н4/Стоимость владения	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
12	Решение об отказе от внедрения альтернативных SaaS решений было принято на основании того, что стоимость развертывания и настройки решений была посчитана слишком высокой	Н4/Стоимость владения	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
13	Решение об отказе от внедрения альтернативных SaaS решений было принято на основании того, что стоимость поддержки была посчитана слишком высокой	Н4/Стоимость владения	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
14	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании потенциала для повышения эффективности бизнес-процессов	Необходимость для бизнеса	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
15	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на	Необходимость для бизнеса	1 – Полностью не согласен 2 - Не согласен

	основании потенциала для повышения уровня конкурентоспособности		3 – Не знаю 4 – Согласен 5- Полностью согласен
17	Решение о внедрении SaaS, которое сейчас используется в компании, было принято на основании потенциала для сокращения издержек	Необходимость для бизнеса	1 – Полностью не согласен 2 - Не согласен 3 – Не знаю 4 – Согласен 5- Полностью согласен
Часть 2: Сбор данных о респондентах			
	Вопрос	Тип вопроса	Варианты ответов
18	Сколько сотрудников работает в вашей организации?	Закрытый	1-5 6-15 16-50 51-100 101-150 151-200 201-250
19	В каком субъекте РФ зарегистрирована ваша организация?	Закрытый с возможностью указать собственный вариант ответа	Субъекты РФ Другой вариант (необходимо указать)
20	Какова годовая выручка вашей компании (в миллионах рублей)?	Закрытый с возможностью указать собственный вариант ответа	0-50 50-100 100-400 400-800 800-2000 Конфиденциальная информация Неизвестно Другой вариант (необходимо указать)
21	Какова основная экономическая деятельность вашей компании?	Закрытый с возможностью указать собственный вариант ответа	Раздел ОКВЭД (Общероссийский Классификатор Видов Экономической Деятельности) Другой вариант (необходимо указать)
22	Какие программные продукты вы в настоящее время используете в рамках услуги SaaS?	Закрытый с возможностью указать несколько	Система планирования

		вариантов ответа или указать собственный вариант ответа	ресурсов предприятия Система управления взаимоотношениями с клиентами Система ведения бухгалтерского учета Система управления цепочками поставок Система управления контентом Другой вариант (необходимо указать)

Appendix 3: Correlation matrix for factor analysis

Correlation matrix																
	H1_1	H1_2	H1_3	H2_1	H2_2	H2_3	H3_1	H3_2	H3_3	H3_4	H4_1	H4_2	H4_3	BN_1	BN_2	BN_3
H1_1	1	0,714	0,717	0,004	0,248	0,185	0,123	0,297	0,284	0,262	-0,007	0,187	0,229	0,436	0,059	0,061
H1_2	0,714	1	0,691	0,238	0,492	0,441	0,297	0,462	0,407	0,414	0,25	0,389	0,424	0,516	0,351	0,355
H1_3	0,717	0,691	1	0,289	0,502	0,445	0,345	0,491	0,489	0,47	0,276	0,406	0,375	0,553	0,405	0,374
H2_1	0,004	0,238	0,289	1	0,761	0,74	0,132	0,251	0,361	0,25	0,055	0,255	0,284	0,778	0,818	0,489
H2_2	0,248	0,492	0,502	0,761	1	0,724	0,374	0,469	0,527	0,523	0,271	0,449	0,434	0,735	0,776	0,524
H2_3	0,185	0,441	0,445	0,74	0,724	1	0,347	0,456	0,495	0,45	0,34	0,472	0,449	0,656	0,734	0,587
H3_1	0,123	0,297	0,345	0,132	0,374	0,347	1	0,774	0,752	0,838	0,181	0,357	0,381	0,227	0,227	0,227
H3_2	0,297	0,462	0,491	0,251	0,469	0,456	0,774	1	0,689	0,731	0,3	0,443	0,469	0,376	0,361	0,384
H3_3	0,284	0,407	0,489	0,361	0,527	0,495	0,752	0,689	1	0,757	0,298	0,513	0,51	0,48	0,467	0,395
H3_4	0,262	0,414	0,47	0,25	0,523	0,45	0,838	0,731	0,757	1	0,261	0,444	0,449	0,421	0,385	0,33
H4_1	-0,007	0,25	0,276	0,055	0,271	0,34	0,181	0,3	0,298	0,261	1	0,744	0,716	0,13	0,437	0,773
H4_2	0,187	0,389	0,406	0,255	0,449	0,472	0,357	0,443	0,513	0,444	0,744	1	0,644	0,365	0,492	0,701
H4_3	0,229	0,424	0,375	0,284	0,434	0,449	0,381	0,469	0,51	0,449	0,716	0,644	1	0,41	0,504	0,715
BN_1	0,436	0,516	0,553	0,778	0,735	0,656	0,227	0,376	0,48	0,421	0,13	0,365	0,41	1	0,728	0,438
BN_2	0,059	0,351	0,405	0,818	0,776	0,734	0,227	0,361	0,467	0,385	0,437	0,492	0,504	0,728	1	0,574

BN_3	0,061	0,355	0,374	0,489	0,524	0,587	0,227	0,384	0,395	0,33	0,773	0,701	0,715	0,438	0,574	1