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ANALYSIS OF AGILE, LEAN AND CONTINUOUS PRACTICES IN RUSSIAN SOFTWARE DEVELOPMENT COMPANIES

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The goal of this research is to determine on what basis software development companies in Russia apply modern development approaches such as Agile, Lean development, and Continuous development. An analysis of 5 cases, based on 5 companies in St. Petersburg, was performed. Based on the analysis of the collected data, the main objectives, benefits, problems in the application of modern approaches were determined. In addition, the principles of choosing the approach were revealed and the differences between the use of such approaches in Russia and in the world were identified. Based on these data, recommendations for Russian companies, that are interested in expanding the use of modern approaches to software development in their work, were proposed. The results of this study may be potentially useful for such companies to understand the problem under discussion in a broader sense. In addition, this study may be interesting for the scientific community in Russia, as it draws attention to the problem of insufficient information about modern approaches to software development in Russia.
Acknowledgements

First of all, I want to thank Professor Kari Smolander for his time and valuable comments. His advice helped me to follow the correct direction in the work on this thesis. I also want to thank the representatives of the companies who have found it possible to spend their time on the interview, give detailed and honest answers and share information.
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LIST OF SYMBOLS AND ABBREVIATIONS

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ASD</td>
<td>Adaptive Software Development</td>
</tr>
<tr>
<td>ATDD</td>
<td>Acceptance Test Driven Development</td>
</tr>
<tr>
<td>BDD</td>
<td>Behavior Driven Development</td>
</tr>
<tr>
<td>CD</td>
<td>Continuous Development</td>
</tr>
<tr>
<td>CFD</td>
<td>Cumulative Flow Diagram</td>
</tr>
<tr>
<td>CI</td>
<td>Continuous Integration</td>
</tr>
<tr>
<td>CONWIP</td>
<td>CONstant work in process</td>
</tr>
<tr>
<td>CRC cards</td>
<td>Class-responsibility-collaboration cards</td>
</tr>
<tr>
<td>DSDM</td>
<td>Dynamic Systems Development Method</td>
</tr>
<tr>
<td>FDD</td>
<td>Feature-Driven Development</td>
</tr>
<tr>
<td>HR</td>
<td>Human Resources</td>
</tr>
<tr>
<td>INVEST</td>
<td>Independent, Negotiable, Valuable, Estimate-able, Small, Testable</td>
</tr>
<tr>
<td>LeSS</td>
<td>Large-Scale Scrum</td>
</tr>
<tr>
<td>MMF</td>
<td>Minimal Marketable Feature</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>SAFe®</td>
<td>The Scaled Agile Framework®</td>
</tr>
<tr>
<td>SoS</td>
<td>Scrum/Scrum-of-Scrums</td>
</tr>
<tr>
<td>TDD</td>
<td>Test Driven Development</td>
</tr>
<tr>
<td>WIP</td>
<td>Work in Progress</td>
</tr>
<tr>
<td>XP</td>
<td>eXtreme Programming</td>
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</table>
1 INTRODUCTION

Nowadays, rapid changes in the environment and the market are driving businesses to adopt approaches that allow them to respond quickly to changes. It is also very important for software development. The last decade has been characterized by an active transition from the use of traditional approaches, such as waterfall or iterative development, to various “flexible” or “agile” approaches. At the same time, there are still neither clear definitions of the approaches used nor universally accepted classification of approaches.

The theoretical justification for the agile approaches use in software development began with the formulation of Agile Manifesto in 2001. At present, it is advisable to distinguish Agile in its pure form with the principles formulated in the manifesto, and a family of agile principles created for the development of Agile. Agile Alliance has traditionally included methods such as eXtreme Programming (XP) (Beck 2000), Scrum (Schwaber and Beedle 2002), Dynamic Systems Development Method (DSDM) (Stapleton and DSDM Consortium 2003), Crystal Methods (Cockburn 2005), Feature-Driven Development (FDD) (Palmer and Felsing 2002), Adaptive Software Development (ASD) (Highsmith 2002). All of these methods have a lot in common, including short iterative life cycles, fast and frequent customer feedback and continuous learning (Wang, Conboy, and Cawley 2012).

The difficulty arises in the matter of distinguishing methodologies in order to ensure the approach itself, which professes its own principles. Different authors adhere to different approaches in the classification. Some authors tend to consider all the agile approaches used as a kind of one (Jalali and Wohlin 2010; Barton 2009). Other authors divide approaches, consider differences, and identify specific principles for approaches such as Lean Software Development, Continuous Development (CD) (Smits 2007), (Serignese 2010), (Hibbs, Jewett, and Sullivan 2009).

Thus, the terms Agile, Lean Software Development, Continuous Development are broad and often poorly defined. They can mean different things in different reports and their interpretation in reports of application experience is often ambiguous (Swaminathan and Jain 2012; Conboy 2009).
For instance, initially Lean software development was considered as another agile method (Highsmith 2002; Dyba and Dingsøyr 2009), but now Lean is more often considered as a separate category of methods (Hibbs, Jewett, and Sullivan 2009; Hiranabe 2008; Smits 2007). The theoretical basis for the lean software development application was laid by Poppendieck and Poppendieck (2003, 2006). It is assumed that Lean helps to increase flexibility from a project or team level to an organization level (Smits 2007).

Continuous Development (CD) further increases flexibility and extends it beyond the organization. CD not only strives to keep the software in a constantly released state (Dingsøyr and Lassenius 2016) as continuous delivery, but also automates the final step of software delivery to production as soon as the code is checked-in and all automated tests have been successfully passed (Humble and Farley 2010). CD allows managing the entire value stream from strategic planning to delivery to customers.

In this case, the idea that a combination of different approaches gives a good effect is widely recognized. This concept can provide the most effective software development. Researchers even introduce different terms to combine approaches, for example, “Scrumban” for a software development model based on Scrum and Kanban (Ladas 2008), “leagility” (Naylor, Naim, and Berry 1999), “leagile” (Wang, Conboy, and Cawley 2012) for software development models with a combination of Agile and Lean.

Several studies on the application of software development approaches have been conducted in different countries. These studies, among other things, are aimed at drawing conclusions about which approach is preferential for a particular task or team. For developers, it is important to be able to compare various potential agile processes with their context, goals, constraints, and to implement the chosen combination of processes.

The purpose of this work is to analyze the application of software development approaches such as Agile, Lean, and Continuous Development in Russian companies. This study is designed to understand the extent to which Russian software development companies are aware of the existence of modern approaches to software development, the specifics of approaches, their advantages and disadvantages. The task is also to understand how
companies choose an approach for use in their work. In addition, the study intends to understand whether the features of the application of modern approaches to software development in Russian companies are revealed and how these features influence the choice of approach. Accordingly, on the basis of these goals, it is possible to formulate the following research questions:

RQ1. How do companies choose the approach to the software development process in Russia?
RQ2. What approaches are considered for selection?
RQ3. What is the choice based on?
RQ4. Are there differences in the application of approaches between Russia and other countries and what are they?

The answer to these research questions can help in determining recommendations for choosing an approach to software development in Russian companies.

This thesis is organized as follows: Section 2 gives a brief background of Agile, Lean development and Continuous development and reveals existing research on their application in different countries. Section 3 describes the structure of the study. Section 4 presents a description of the cases selected for the study and gives the analysis results of the case study. In section 5, based on the results of the analysis, possible hypotheses on the research issues are proposed and recommendations on the use of modern approaches to software development in Russian companies are formulated. Also, the obtained results are compared with the results of the corresponding published Russian studies. In addition, this section describes the limitations of the study and areas of future research. Section 6 concludes the study.
2 MODERN APPROACHES TO SOFTWARE DEVELOPMENT

In 2001, Agile Manifesto was formulated as a response to the inefficiency of the software development approaches used at that time. Flexibility is designed to provide the greatest opportunities in a volatile market. Agile Manifesto has prioritized customer satisfaction and increased competitive advantage through timely and uninterrupted software delivery. Customer requirements are accepted throughout the project. On this basis, appropriate changes are made. For this purpose, special means of communication and motivation in teams are developed. The team must be self-organizing, efficient, maneuverable. The team work on the project is characterized by constant attention to technical excellence, good design, simplicity, and high-quality working software (agilemanifesto.org 2001).

Agile software development brings together a group of frameworks. The most famous frameworks of Agile are:

- eXtreme Programming (XP);
- Scrum;
- Dynamic Systems Development Method (DSDM);
- Crystal Methods;
- Feature-Driven Development (FDD);
- Adaptive Software Development (ASD).

Certain practices correspond to the frameworks used in Agile, and there are practices specific to a particular framework. Table 1 lists the most commonly used frameworks and their corresponding practices according to the Agile Alliance methodology (Agile Alliance n.d.).

<table>
<thead>
<tr>
<th>eXtreme Programming (XP)</th>
<th>Sustainable Pace, Pair Programming, Sign up, Daily meeting, Iterations, Velocity, Frequent releases, User stories, Collective Code Ownership, Continuous Integration, Simple design, Refactoring, Test Driven Development (TDD)</th>
</tr>
</thead>
</table>

Table 1. Agile Practice Classification.
<table>
<thead>
<tr>
<th><strong>Scrum</strong></th>
<th>Iterative development, Timebox, Three Questions, Burndown Chart, Task Board, Definition of Done, Definition of Ready, Points (estimates in), Relative Estimation, Planning Poker, Product Backlog, Backlog Grooming, Iteration/sprint planning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product management</strong></td>
<td>Personas, Story Mapping, Story Splitting, The Three C’s, INVEST, Incremental Development, Prioritized work list, Release planning, Frequent and incremental delivery of working software, Automated Builds</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Ubiquitous Language, Rules of Simplicity, Quick Design Session, CRC Cards</td>
</tr>
<tr>
<td><strong>Teams</strong></td>
<td>Project charters, Scrum of Scrums, Niko-Niko Calendar, Team Room, Heartbeat Retrospective, Facilitation</td>
</tr>
</tbody>
</table>

Agile development methods improve the ability of software organizations to respond to dynamic market changes, shorten delivery times, and improve quality (Highsmith 2002; Kettunen 2009). Business flexibility is about changing business and business processes, as well as perceiving environmental changes and responding accordingly (Overby, Bharadwaj, and Sambamurthy 2005; van Oosterhout, Waarts, and van Hillegersberg 2005).

The basics of using Lean in software development are laid down by Poppendieck and Poppendieck (2003, 2006) and further deployed by other authors (Hibbs, Jewett, and
Directly, Lean methods have been used in manufacturing since the 1970s, starting their development back to the Toyota Production System (TPS) in the 1950s (Ōno 1988). Leanness means developing a value stream to eliminate all waste, including time, and to ensure a level schedule (Naylor, Naim, and Berry 1999). The task was to formulate the principles of Lean specifically for software development and introduce the principle of lean thinking into software development (Womack and Jones 2003). According to the Womack and Jones, Lean thinking is based on 5 guiding lean concepts:

- **Value**: It is defined by the customer and it is paramount to have a clear understanding of what that is.
- **Value stream**: A map that identifies every step in the process and categorizes each step in terms of the value it adds.
- **Flow**: It is important that the production process flows continuously.
- **Pull**: Customer orders pull the product, ensuring nothing is built before it is needed.
- **Perfection**: Striving for perfection in the process by continuously identifying and removing waste.

In modern sounding, the principles of Lean software development are as follows:

- **eliminate waste**: spend time on what adds real customer value only,
- **optimize the whole**: beware of the temptation to optimize parts at the expense of the whole,
- **build quality in**: don't try to tack on integrity after the fact – build it in,
- **learn constantly**: continuous learning process will minimize the effort spent developing features that customers don’t find valuable,
- **deliver fast**: deliver value to customers as soon as they ask for it,
- **engage everyone**: lean practices encourage teamwork among engaged people who are empowered to make decisions appropriate to their level,
- **keep getting better**: let the people who add value use their full potential (Poppendieck and Cusumano 2012).

In the context of software development, waste that needs to be reduced and limited is understood as WIP (Work in Progress). Also, important principles of practices such as
Kanban are: manage queues, visualize the workflow, manage flow, improve collaboratively and constantly, focus on creating customer value, continuous flow of small batches in the development process, make decisions as late as possible, transparency and collaborative development.

Lean software development has no formal practices. It has a toolkit of recommended practices to choose from. The most common Lean software development practices are Kanban, code reviews. Also, it is possible to highlight such practices as (Wang, Conboy, and Cawley 2012):

- Cumulative Flow Diagram (CFD)
- Hansei: relentless self-reflection, to acknowledge one’s own mistakes and to commit to making improvements (Liker and Hoseus 2008).
- Kaikaku: radical improvement within a limited time (Womack and Jones 2003).
- Kano analysis: link voice of the customer to requirements (Middleton, Flaxel, and Cookson 2005; Raffo et al. 2010).
- Pull systems: Kanban board, Limited WIP, CONWIP (Sugimori et al. 1977; Bradley 2007; Kniberg and Skarin 2010), Batch control processing (Bradley 2007), Minimal Marketable Feature (MMF).
- Value stream mapping (Poppendieck and Poppendieck 2003; Mujtaba, Feldt, and Petersen 2010).
- R&D team areas (Rodríguez et al. 2013).
- And others.

Lean development is aimed at achieving continuous and uninterrupted production in order to remove waste in the process and increase customer value (Petersen and Wohlin 2010). Lean development means creating an organization that is tolerant to changes and can survive and succeed in times of uncertainty, change, and complexity (Charette 2003).
Poppendieck considered Lean thinking a “platform to build agile software development practices upon” (Poppendieck and Poppendieck 2003). Coplien and Bjørnvig expressed an opinion that Agile and Lean complement each other by addressing different components of systems development (Coplien and Bjørnvig 2010).

There is an opinion that Agile methods describe a set of practices, primarily intended for developers use (Dall’Agnol et al. 2003), in order to ease the tension between the developer and the customer due to conflicting goals. At the same time, Lean development is applied from the point of view of top management in order to optimize activity throughout the organization as a top-down approach. Lean helps to scale agile development methods to the level of programs, products and organizations without changes (Smits 2007; Ambler 2009). The focus of agility is on working closely with customers and quickly delivering working software as early as possible, while the Lean software development is focused on eliminating waste in the context of what the customer values are. In lean processes, WIP (work-in-process) limits are used and the work is “pulled” in when the team has the capacity, therefore the team is not overloaded (Middleton and Joyce 2012). In addition, in Agile more attention is paid to people, not work. In contrast, Lean development relies on data for continuous improvement; the team is more focused on the organization of work (for example, fixing time). It is easier to evaluate the effectiveness and results. Thus, differences in approaches in a software development context, such as focus on the customer, delivery speed, efficiency, focus on people, focus on work, measurement (Wang and Conboy 2011), work standardization and effort allocated to upfront analysis (Rodriguez et al. 2014), are revealed.

The literature discusses the following possible categories of lean application in agile software development:

- Lean approaches are applied to the business areas related to software development
  - Agile within, lean out-reach: using lean approaches to interact with neighboring business units while keeping agile development processes internally
- Lean approaches are applied to software development processes directly
  - Lean facilitating agile adoption: before or during the transition process
  - Lean within agile: using various lean elements to improve agile processes
  - From agile to lean: comprehensive application of lean approaches to transform agile processes
• Synchronizing agile and lean: agile team and lean team work in parallel in a synchronized manner (Wang, Conboy, and Cawley 2012).

The most common situation is using a combination of approaches to optimize existing agile software development processes to meet different needs at different stages of agile maturity. Kanban software development pursues the concept of continuous flow or Sustaining Kanban (Hiranabe 2008). The Kanban approach is particularly well suited for software maintenance or support operations, where uncertainty is higher than in conventional designs and changes occur more often than allowed by agile iterations. In addition, when an agile implementing organization is sufficiently mature, there is a tendency to transition from time-boxed agile processes to more flow-based lean processes (Wang, Conboy, and Cawley 2012).

The emergence of Continuous Development is associated with increased turbulence in the business environment, reduced planning cycles, the need for increased transparency and knowledge sharing in organizations (Suomalainen, Kuusela, and Tihinen 2015). Software functionality must constantly evolve, and customer feedback is the main driver of innovation (Holmstrom-Olsson, Bosch, and Alahyari 2013). Continuous Development seeks to bridge the gap between planning, developing and implementing software. It is intended to introduce continuity in planning, testing, integration and releases. In particular, continuous integration is a practice that emerged to bridge the gaps between development and deployment. Continuous deployment requires automating all processes that must be executed to deliver software to customers (Järvinen et al. 2014). Continuous planning process related to software releases perform before each iteration and during daily stand-up meetings (Shalloway, Beaver, and Trott 2010). Fitzgerald and Stol (2017) propose to ensure continuity for the business strategy as a whole, i.e. continuous (but not necessarily fast) software development pipeline.

The development of the approach began with the concepts ‘release early, release often’ (Feller 2005), Enterprise Agile (Overby, Bharadwaj, and Sambamurthy 2005), Beyond Budgeting (Bogsnes 2009), DevOps (Debois 2009), Lean Startup (Ries 2011). These concepts complement the flexibility of software development with a flexible approach in the respective organizational structure, including finance and HR (Leffingwell 2007). Continuous Development allows enterprises to reduce cycle times so that users can quickly
receive feedback. In addition, the risk and cost associated with the deployment of production are reduced (Humble and Molesky 2011; Lwakatare, Kuvaja, and Oivo 2016).

Currently, there is no strict definition of terms for Continuous Development. As mentioned above, various authors may include a different volume of business processes in a number of “continuous” actions. It seems that the approach should cover the entire software development life cycle, including business strategy and planning phase, development phase, operations phase and improvement and innovation phase. Each phase involves a specific set of actions. This position provides a close link between the company's business goals and the functioning of software development at all its stages. Continuity at all stages allows to correctly and actively respond to all changes that occur, give fast feedback, solve problems that arise. The structure of the approach is approximately as follows (Fitzgerald and Stol 2017):

1. Business strategy and planning
   - Continuous planning
   - Continuous budgeting

2. Development
   - Continuous integration
   - Continuous delivery
   - Continuous deployment
   - Continuous verification
   - Continuous testing
   - Continuous compliance
   - Continuous security
   - Continuous evolution

3. Operations
   - Continuous use
   - Continuous trust
   - Continuous run-time monitoring

4. Improvement and Innovation
   - Continuous improvement
   - Continuous innovation
   - Continuous experimentation.
The work, which is the essence of the above stages, is based on many well-known principles, practices and methodologies of Agile and Lean development (for example, lean decision-making and “eliminate waste” principles, which ultimately bring significant benefits and competitive advantage through gradual quality improvement). Many of these steps require special automation (for example, Continuous integration, Continuous delivery, Continuous testing).

Challenges in the application of this approach are mainly associated with inappropriate outdated technologies and areas of application, with outsourcing software components use, with the wrong focus on speed (“speed is meaningless without continuity”, (Ōno 1988)), with significant resistance to changes in organizations. The change agent is required: “a leader – someone who will take personal responsibility for change – is essential” (Womack and Jones 2003). In addition, creativity and innovation require unstable thinking – in some cases, a drastic, intermittent change rather than a gradual change is required; in terms of Lean, this is kaikaku, not kaizen (Fitzgerald and Stol 2017).

The study (Holmstrom-Olsson, Alahyari, and Bosch 2012) also revealed some barriers to the use of Continuous Development, such as a conservative business model, lack of communication and coordination with suppliers, lack of preparation of the testing process, a wide variety of tools used, network configuration and update complexity, lack of transparency, hardware-oriented thinking, process and others. The transition to continuous integration requires the introduction of automated testing and modular development. Finally, the movement towards continuous deployment requires organizational units, such as product management, to be fully involved and actively work with the customer to cooperate closely with further conceptualization.

When studying the relevant literature, researches with approaches comparison were identified. For example, the research of Peter Middleton (Middleton 2001), (Middleton, Flaxel, and Cookson 2005). These studies led to the conclusion that the goals of lean and agile are in agreement (customer oriented) and the principles of lean reflect those of agile, whilst stressing on the perspective of the end to end flow (Petersen 2011). Research also revealed that Lean methods had helped to provide faster feedback, which brought the emergence of defects to an early stage. In these studies, there was an interest in finding
information about how Agile and Lean concepts are related to each other and how they work together with each other. There is an interesting conclusion that “while the pursuit of agility might presume leanness, pursuit of leanness might not presume agility” (Narasimhan, Swink, and Kim 2006).

Research has also been conducted on the application of various approaches in the software industry – for example, “State of agile development” survey (Version One 2018), Agile Adoption Survey (Ambler 2014), North America, research of Asnawi et al. (Asnawi, Gravell, and Wills 2011), Malaysia, research of Rodríguez et al. (Rodríguez et al. 2012), Finland, and others. Some studies distinguished the use of Agile and Lean approaches. Other studies, such as Version One, consider all agile methods in general without distinguishing the approaches. These studies posed the following questions: What is the current state of adoption and use of methods and practices of different approaches in the software industry? What are the reasons why the approach is taken in a software development organization? What are the implications of using the chosen approach in terms of the benefits? What limitations and factors may impede the use of the approach? Why do not some organizations use modern approaches (Rodríguez et al. 2012)?

Research results showed that Agile/Lean usage and their application duration is increasing from 1-2 years in 2011 to 5+ years in 2018. 24% of respondents use Lean, mainly in combination with Agile (21%) (Rodríguez et al. 2012). Most agile practices are usually used without large differences in use between practices. The main goals of applying agile and lean methods are: to accelerate software delivery, to manage changing priorities, to increase productivity, to improve business/IT alignment, to increase software quality. In this case, goals change somewhat over time, and the focus shifts from increasing productivity and quality of products/services and reducing time of market entry to accelerate software delivery, manage changing priorities, improve business/IT alignment. The main benefits of using agile and lean methods are: changing priorities management, project visibility, business/IT alignment, delivery speed/time of market entry, team productivity. In this case, the same changes are observed as in the goals of applying. The main measures of success are customer satisfaction and user satisfaction, as well as on-time delivery of projects and business value. At the same time, the importance of such factors as velocity and iteration burndown decreases. In the future, this implies an active transition to CD. The most common
reasons that impede the success of agile and lean approaches include organizational culture at odds with agile values, general organizational resistance to change, inadequate management support and sponsorship. At the same time, the influence of factors such as a lack of knowledge and training becomes less explicit. The Scaled Agile Framework® (SAFe®) is reported as the most widely-used approach to scaling agile.

It is assumed that the results will help to identify the main advantages and problems of applying approaches to software development. Results can help organizations to choose an approach to apply.

Annual studies on the use of Agile were held in Russia. In these studies, no distinction is made between approaches. Researchers understand any modern approach of software development as an Agile methodology. From the results of the 2018 study (ScrumTrek 2018), the following data can be considered useful for this work:

1. the main goals of the transition to Agile: improving the management of changing priorities, improving the quality of the product, the speed of delivery/time of market entry, improving project transparency, increasing supply predictability;
2. the most noticeable benefits after the transition to Agile: improving the management of changing priorities, improving project transparency, increasing supply predictability, the speed of delivery/time of market entry, increasing the motivation of teams;
3. Agile implementation time: 2-3 years;
4. the main challenges in the application of Agile: lack of experience, incomplete/inconsistent practices and processes, lack of knowledge, traditional corporate culture, low involvement of the business/customer/product owner;
5. the most popular applicable Agile practices: Scrum, Scrumban, Kanban, Scrum/XP, own approaches;
6. the most popular applicable frameworks for scaling: Scrum/Scrum-of-Scrums (SoS), own approaches, Scaled Agile Framework® (SAFe®), Large-Scale Scrum (LeSS), Nexus.

Thus, the use of modern approaches in Russia is somewhat lagging behind world figures, both in time, goals and difficulties. The peculiarity of Russian companies in comparison with world indicators is the use of their own practices for software development and scaling.
In general, the analysis of the literature has shown that a common opinion on the definitions of approaches to software development and on the principles of their separation or non-separation has not been achieved. The focus of existing research is on the comparison of Agile and Lean. A wider range of studies is desirable, which would cover a larger set of approaches for analyzing their use in software development companies. Such studies will also be useful for characterizing the Russian specifics of the application and choice of approaches. The objective of this study is to conduct such research in Russian software development companies and to consider a larger set of approaches.
3 METHODOLOGY

3.1 Data collection

The objective of this study was to find answers to the questions about the application of approaches to software development in Russia, including which approaches the choice is made from and on what ground. It is also required to determine whether there is a difference in the application of approaches to software development between Russian companies and companies in other countries. In order to achieve these goals, a multiple-case study was used as a research method (Yin 1994). An interpretive research approach is also used. A case study is chosen because it studies contemporary phenomena in its natural context, including people and their interaction with technology (Runeson and Höst 2009). A case study allows to take into account the opinions of people with different values, different expectations and different strategies (Vidgen and Wang 2009). The interpretive paradigm was used in this study because it was good at taking individual subjective opinion into account. A semi-structured interview has also been applied (Robson 2009). Semi-structured interviews allow to improvise and fully explore objects.

A qualitative approach was chosen for data collection and analysis through interviews. This allows to explore different aspects of the study in detail and flexibly. The direct method of research was applied, that is, the communication was conducted directly with a company representative in real time.

The structure of the interview is designed so that at the end of the study it is possible to conduct a comparative analysis of the study results with the results of studies conducted earlier in other countries.

When conducting the interview, it was necessary to take into account the still lacking clear coherence of the definitions of approaches, the attribution of practices and principles to the approach.

The interview questions were designed in accordance with the research questions. The list of questions is given in Appendix 1. After processing the results of the initial interview, the
interlocutors were asked additional necessary clarifying questions for a deeper understanding of their opinion and the formation of confidence that their thought was correctly understood. The obtained results were compared with the previously obtained results of similar studies in other countries.

Questions were formulated as open questions (Cooper and Schindler 2014). This allows to get more information. Also the researcher may deviate from the list of questions to clarify and develop the important information that has arisen. It also helps to avoid limiting the opinions of the interviewees about various aspects. Freedom to make changes in the data collection process is a key feature of the theory-building case research. Additional adjustments may be made to these collection tools, such as adding questions to the interview protocol (for example, (Harris and Sutton 1986)). These adjustments allow the researcher to explore emerging topics or take advantage of special opportunities that may be present in a given situation (Eisenhardt 1989).

Schematically, the research process is presented in the Figure 1.
The overall structure of the study is presented in the Table 2. This structure is a modified version of the research program proposed by Kathleen M. Eisenhardt (Eisenhardt 1989).

**Table 2.** The overall structure of the study

<table>
<thead>
<tr>
<th>Activity</th>
<th>Reason</th>
</tr>
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<tbody>
<tr>
<td>Definition of the research questions</td>
<td>• Improved understanding of task scope</td>
</tr>
<tr>
<td>Milestone layout and its coordination with supervisor</td>
<td>• Understanding the calendar boundaries of the research</td>
</tr>
<tr>
<td>Drawing up a research plan</td>
<td>• Structuring research tasks</td>
</tr>
<tr>
<td>Search and analysis of literature related to the topic of the research</td>
<td>• Understanding other points of view about the topic</td>
</tr>
<tr>
<td></td>
<td>• Study of similar studies made in the world</td>
</tr>
<tr>
<td></td>
<td>• A better understanding of the topic</td>
</tr>
<tr>
<td>Definition of study type</td>
<td>• Selection of the most appropriate research method and research approach</td>
</tr>
<tr>
<td>Determining the sequence of the study</td>
<td>• Determining the order of data collection, data analysis and validation of results</td>
</tr>
<tr>
<td>Selecting cases</td>
<td>• Increases transferability</td>
</tr>
<tr>
<td>Conducting 5 interviews</td>
<td>• Data collection is partially combined with data analysis and allows, if necessary, to expand the range of research questions</td>
</tr>
<tr>
<td>Decoding and processing of results</td>
<td>• Getting confidence that the information is complete and properly understood</td>
</tr>
<tr>
<td>Within-case analysis and cross-case pattern search</td>
<td>• The preliminary generation of the hypothesis based on the data obtained,</td>
</tr>
</tbody>
</table>
During the interview, there is a difficult task of ensuring a balance between passivity and over-direction of interviews (Walsham 1995). The interviews were conducted on predefined topics, still taking into account openness and flexibility in these topics.

The interview procedure was organized as follows:

1. Contact with a company representative and arranging a meeting.
2. Meeting with a representative and conducting an interview using a voice recorder after requesting permission to record and keep notes. The interview was conducted by one researcher in the Russian language.
3. Deciphering the recording of the interview.
4. Highlighting additional questions and receiving answers via e-mail and messengers.

The process involves moving back and forth constantly between stages. For example, it is possible to move from comparing cross-cases to redefining research questions and collecting additional data.
The transcript of the interview is coordinated with the participants in order to preserve their confidence in the study and make sure that all data are recorded fully and accurately. This increases the reliability of the study. E-mail is used as a continuation of all interviews to clarify any misunderstandings in the transcription of the interview.

The sample for the study was formed as a theoretical sample. This allows to take into account the new data arising during the research. As indicated in (Kitchenham and Pfleeger 2002), those, who are in a position to answer the questions and to whom the results of the survey apply, are involved. As noted by (Pettigrew 1990), given the number of cases that can usually be studied, it makes sense to choose such cases as extreme situations and polar types, in which the process of interest is "transparently observable".

Further, it was required to determine the sample size. Ideally, researchers should stop adding cases when theoretical saturation has been achieved, that is, researchers are observing the phenomena seen earlier (Glaser and Strauss 2009). In practice, such factors as time and money should be taken into account. It is considered that from 4 to 10 cases are satisfactory. With less than 4 cases, it is often difficult to create a theory with great complexity, and its empirical justification is likely to be inconclusive. With more than 10 cases, it becomes difficult to cope with the complexity and volume of data (Eisenhardt 1989).

The following criteria were selected to form a sample of companies:

- Companies are implementing software development projects;
- Companies are located in St. Petersburg, which showed the best results in applying modern approaches in Russia (ScrumTrek 2018);
- Companies are ready to share information about their activities. Interviewees gave informed consent to the interview, to record the results and agreed on the level of information confidentiality.

A total of 5 interviews were conducted. General information about the interviews conducted is presented in the Table 3.
Table 3. Interviews overview

<table>
<thead>
<tr>
<th>№</th>
<th>Code</th>
<th>Date</th>
<th>Duration</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>31.01.2019</td>
<td>00:29:15</td>
<td>CEO</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>03.02.2019</td>
<td>00:35:54</td>
<td>Project Manager</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>06.02.2019</td>
<td>00:38:26</td>
<td>Lead programmer</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>08.02.2019</td>
<td>00:24:22</td>
<td>Developer</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>11.02.2019</td>
<td>00:32:46</td>
<td>Business consultant</td>
</tr>
</tbody>
</table>

3.2 Data analysis

The study was conducted using an inductive approach. The empirical data collected during the interviews were further jointly analyzed, which helped to develop new ideas in the field of research. For the analysis of the collected data, the within-case analysis is used, which allows a deep study of the data, phenomena, features in the framework of one particular case under study. The technique of cross-case analysis is also used, which allows to use data from different cases and mobilize them with the aim of forming a synthesis information. In this case, the accumulation, comparison, opposition of data from different cases allows the generation of a hypothesis (Seaman 1999). Taking into account the specifics of the study, an immersion approach was used for data analysis, which assumed a low level of structuring and the influence of the researcher's interpretation (Runeson and Höst 2009; Robson 2009). A distinctive feature of research for constructing a theory from case studies is frequent coincidence of data analysis with data collection (Eisenhardt 1989). Used among other things, cross-case searching tactics increase the likelihood of an accurate and reliable hypothesis that is closely related to data. In addition, the search tactic in the cross-case increases the likelihood that investigators will catch new discoveries that may exist in the data. Shaping hypotheses in theory building research are more judgmental because researchers cannot apply statistical tests (Eisenhardt 1989).
For questions that were answered with insufficient data in the result of the interviews, additional information was drawn from secondary sources.

The preliminary hypothesis formulated at the data analysis stage was compared with the existing research literature. It increases the credibility, general availability and the level of theory building based on case studies.

### 3.3 Addressing validity

Qualitative interpretive research suggests the possibility of different interpretations from the point of view of each party participating in the research. It is advisable to take into account a number of aspects that need to be resolved carefully in order to make sure that the conclusions are plausible and justified. To assess the validity of current research as a qualitative interpretive research, it is advisable to accept the criteria proposed by (Wagner, Lukassen, and Mahlendorf 2010):

- **Credibility** - the plausibility of the results from the point of view of the issue being studied. This concept replaces the traditional concept of internal validity.
- **Transferability** - the ability to transfer research results for more general theoretical assumptions. This concept replaces the traditional concept of external validity.
- **Dependability** defines whether a study can be repeated with the same results. This concept replaces the traditional concept of reliability.
- **Confirmability** refers to the extent to which the interpretations and conclusions of the study can be confirmed by others.
- **Applicability** refers to the context in which the method should be used. The purpose of the researcher and the nature of the question being investigated determine the appropriate method of research (Shenton 2004).

The materials collected should really represent what the researcher has in mind and what had been researched on the research questions. The questions discussed in the interview must be interpreted equally by the researcher and the persons interviewed, otherwise, there is a threat to the validity of the design.
Transferability shows how it is possible to summarize the results, and to what extent the results are of interest to other people outside the study. In general, a case study will never provide conclusions with statistical significance (Runeson and Höst 2009), a statistically representative sample is not done. However, for a case study, the goal is to include analytical generalization, so that the results apply to cases that have common characteristics and, therefore, conclusions are relevant for them, that is, they define the theory.

Thus, it is necessary to ensure the impartiality of the cases selection, correctly produce a generalization of the conclusions and ensure the correctness of the results interpretation.

Dependability means the ability to come to the same conclusion if the same case study is repeated. Examples of ways to increase dependability are triangulation, development and maintenance of a detailed case study protocol, review of projects, protocols, etc.

To solve these issues within the framework of this study applied:

- Data (source) triangulation – using more than one data source or collecting the same data at different occasions (Runeson and Höst 2009).
- Reference adequacy: all interviews were recorded and transcribed.
- Participant verification: A final analysis was presented to each interviewee to discuss the results.

Pfeffer (Pfeffer 1982) suggested that a good theory is the same, verifiable, and coherent. It is assumed that a theory developed on the basis of case studies will have such strengths as novelty, testability and empirical validity, which arise from a close connection with empirical evidence (Eisenhardt 1989).
4 RESULTS

4.1 Case description

During the previous phases of the study, data was collected relating to five companies. The following summarizes the main data on companies participating in the case study.

Company A
Company A is a small, young software company. The company employs 4 people at the time of the interview. For different projects, they either constitute one team or are divided into two teams of 2 people. The conversation was conducted with the CEO of the company. He has two years of industry experience.

Company B
Company B is a large and long-growing company in the market in the field of accounting automation and business process reengineering for organizations. At the time of the interview, the company has about 100 employees geographically distributed throughout Russia. Around 70-80 of these people work in the head office. The standard size of the project team in the company is 6-7 people, but it is very dependent on the project. The conversation was conducted with a project manager. His experience in the industry is about 5 years.

Company C
Company C is a diversified company that has an IT service in its structure that executes software development orders for an internal customer. The company employs about 500-700 employees geographically distributed throughout Russia at the time of the interview. The conversation was conducted with a lead programmer. His experience in the industry is 3,5 years.

Company D
Company D is a company engaged in the development of electronic models and territorial planning. It offers its services on the market for 7 years. The company employs about 35 employees at the time of the interview. The size of the teams varies depending on the type
of project. The conversation was conducted with the developer. His experience in the industry is about 9 years.

Company E
Company E is a production company with an IT service in its structure that executes software development orders for an internal customer. The company had about 110 employees at the time of the interview. The conversation was conducted with a business consultant. His experience in the industry is 2.5 years.

4.2 Interviews analysis

Next, we analyze the records of interviews conducted on the questionnaire. In particular, the most important and characteristic quotes are revealed, showing important facts for the study. Interview analysis is required for a deeper understanding of the surveyed companies behavior.

Company A
The company is focused on startups in the field of IT and from the very beginning considered only Agile approaches for itself. As the company's CEO said, "I see no reason for a startup to use something else". At the same time, as follows from the interview, the interlocutor does not have complete information about the existing approaches and their differences. Approaches and practices that he knows are Waterfall, XP, Scrum. The principal position of the interlocutor is that there is only Agile; all the rest is only its subspecies. The interlocutor does not recognize any other approaches other than Agile, for example, lean development and continuous development.

The main objective of using Agile in the company was to increase work productivity. By productivity, the interlocutor understands the work done accurately and on time. The result of the application of Agile should be considered an increase in work productivity, but nevertheless, the productivity has not yet reached a given level. The main thing that has been achieved so far is an understanding of who is engaged in the certain task at the moment and when the desired result can be obtained. “Due to the fact that there is an understanding of who does certain task, the result is faster”.
The main difficulties in the application of agile are the unwillingness of stuff to use these techniques in full.

The main source of information on modern approaches is websites in English. At the same time, the interlocutor used techniques from different agile practices and formed his own approach. All projects use Kanban. The interlocutor believes that there are no differences in the use of modern approaches in Russia compared to the rest of the world, and these approaches are actively used.

The table below summarizes the results of interview with company A.

Table 4. The results of the interview with company A

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Results</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company size</td>
<td>Micro-enterprise</td>
<td></td>
</tr>
<tr>
<td>Time on the market</td>
<td>~1 year</td>
<td></td>
</tr>
<tr>
<td>Qualification of specialists</td>
<td>Sufficient</td>
<td></td>
</tr>
<tr>
<td>Desired flexibility</td>
<td>Aim at agile approaches</td>
<td>“I was originally set to Agile. I see no reason for a startup to use something else”</td>
</tr>
<tr>
<td>Type of customer</td>
<td>Private</td>
<td></td>
</tr>
<tr>
<td>Language skills</td>
<td>English, Russian</td>
<td></td>
</tr>
<tr>
<td>Willingness to change</td>
<td>In general, there is</td>
<td></td>
</tr>
<tr>
<td>Applicable practices</td>
<td>Own combination of practices</td>
<td>“I took techniques that fit our workflow from various agile subspecies”</td>
</tr>
</tbody>
</table>
Differentiation of approaches

| Differentiation of approaches | Modern approaches are not separated | “There is only Agile; everything else is only the subspecies” |

Company B

The interviewee has a sufficient understanding of the various approaches to software development and tries to apply modern approaches. At the same time, he unites under the concept of Agile all modern flexible approaches that are different from a waterfall, without separating them among themselves. But the fact of application depends not only on him, but also on the management of the organization departments, and on the projects customers. The customer can say: “I need a quick result”, “I don’t want to do the whole project, I want to do it iteratively”, “I need a fully documented process and I need a complete result at the end, the complete rejection of previous systems and the launch of a new system”. Depending on this, on the wishes, on the specifics, the mood of the customer, the approach is chosen. Also, the approach is chosen depending on the time required for the project and budget. “Since the intensity of the work is higher, the specialists should be more highly qualified and this is more expensive”. In reality, agile is used in less than half of the project though it has been used for about three years. The overall level of agile application is rated at “3-”, but in teams that use the approach, at “4”.

At the departmental management level, only waterfall or agile is discussed. The choice of approach depends on the project. In systems development projects, the agile approach is used more often when possible. Such projects are very difficult to conduct using the waterfall model. The choice of agile practice is made by the project manager. However, the waterfall model is used more often in software implementation projects from scratch. More innovative customers sometimes want agile. But many customers do not understand the importance of their participation in the project for its desired quality. “They do not understand that this is a tool for business, that it must constantly meet the needs, that its implementation may be in communication with them”. “We want implementation, we are ready to pay for it, we are not ready to participate in this”.
The company uses a cascade model based on the PM book, Scrum. The company also sometimes uses iterfall (a combination of waterfall and iterative development) – close to the OpenUp methodology. Separately, systems development projects are carried out according to Kanban. Usually, the company uses a combination of practices tailored to its specificity.

The company applies the following practices from Agile: prioritized work list, iteration/sprint planning, daily stand-up meetings, release planning, active customer participation, frequent and incremental delivery of working software, continuous integration, retrospectives (periodically, but not always during the sprint; several projects at a time are considered), refactoring. The qualifications of team members does not allow to apply such practices as, for example, self-organizing teams.

The company applies the following practices from Lean: focus on creating customer value, eliminate waste and excess activities, create a culture of continuous improvement, do it right the first time, minimize inventory or work in progress, pull from demand, root source analysis is done after problems are discovered, create trusted relationships with suppliers. However, these practices are really applied only by the project manager. Team members are not yet motivated to use them.

The interlocutor usually studies the information in English in scientific articles, since his knowledge of the language is quite good. He believes that the level of information supply in Russia is insufficient.

The main Russian specificity is the difficulty of concluding a financial and economic contract with the customer in the case of orientation to the agile approach when there is no possibility to fix the term, budget, and final characteristics of the product.

The interlocutor considers the main purpose of using agile methods to improve change management and overall process vision (including work with the customer).

While applying modern software development approaches, the company faced the following challenges:
1. Unwillingness of the staff to restructure and follow certain rules.
2. Lack of customer engagement.
3. The need to comply with regulatory requirements.
4. Complexity of project portfolio planning, ensuring the transparency and stability of the company as a whole.

The company also identified a number of constraints that affect the application of modern approaches to software development:
1. The level of knowledge and motivation of specialists.
2. The presence of a state customer (sometimes).
3. The specifics of the industry - includes more than just software development.

Accordingly, the structure of a team is different from the one described in methodologies. This knocks the work approach inside the team and complicates the implementation of agile.

The use of modern approaches to software development allows the company to achieve the following main benefits:
1. Increasing team motivation
2. Improving management of distributed teams
3. Improving change management
4. Strengthening market position

The table below summarizes the results of interviews with company B.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Results</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company size</td>
<td>Medium company</td>
<td>“About 100 workers geographically distributed. At the St. Petersburg office, about 70-80 people, the rest</td>
</tr>
<tr>
<td>Time on the market</td>
<td>~20 years</td>
<td>“are distributed in Russia, working remotely”</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Qualification of specialists</td>
<td>Project managers are highly qualified; the qualifications of the rest of the staff are insufficient for the qualitative application of flexible approaches.</td>
<td>“Since the intensity of the work is higher, specialists should be more qualified, and it is more expensive”</td>
</tr>
<tr>
<td>Desired flexibility</td>
<td>Depending on the type of project</td>
<td>“Depending on the project, we always think, search, select an individual approach”</td>
</tr>
<tr>
<td>Type of customer</td>
<td>Various</td>
<td>“Depending on the wishes, specifics, mood of the customer we select the approach”</td>
</tr>
<tr>
<td>Language skills</td>
<td>English, Russian</td>
<td></td>
</tr>
<tr>
<td>Willingness to change</td>
<td>At the level of company management and project managers</td>
<td>“But now the new department heads are also constantly thinking about it.” ”People who work longer than me are not ready for change.”</td>
</tr>
</tbody>
</table>
| Applicable practices | Most of the practices used are applied only by project managers. Its own combination of practices is applied. | “Most of the principles apply only at the level of project managers. It is very difficult for teams to convey this idea, as team members should be very focused on the result.” “We take one
Differentiation of approaches

| Modern approaches are not separated | “Usually two approaches are considered globally: waterfall or agile” |

Company C
The interlocutor tries to apply modern flexible approaches, as he has certain knowledge on this issue. He also has a task to plan work and distribute tasks. Basically, he uses Scrum quite accurately according to the methodology, but with its own characteristics. Literature was studied only on Scrum (due to lack of time to learn something else) in Russian. Also partially applied XP, Kanban. The basic version of the product is being executed and being finalized based on feedback from users. The approach takes about 1,5 years.

The interviewee believes that flexible approaches are more applicable in small and medium projects. In large projects of Russian and especially state-owned corporations, the use of flexible approaches should be hindered by the level of bureaucratization and documentation requirements. This is a Russian particularity of this matter – in world practice there is an experience of successful use of scrum in such companies. In addition, Russia as a whole is lagging behind in the use of such approaches and is less adaptable.

The company applies the following practices from Agile: prioritized work list, iteration/sprint planning, release planning, active customer participation, frequent and incremental delivery of working software, continuous integration, refactoring.

The company applies the following practices from Lean: focus on creating customer value, eliminate waste and excess activities, create a culture of continuous improvement, respect and empower people, focus on optimizing the whole system and not only local optimizations.
The company has set the following main objectives in the application of modern approaches to software development:

1. Improving change management.
2. Accelerate delivery of the product to the user.

The use of modern approaches to software development has allowed the company to accelerate the delivery of the product to the user.

While applying modern software development approaches, the company faced the following challenges:

1. Lack of motivation and conservatism of specialists.
2. Lack of understanding of the need to use modern approaches on the part of company management.
3. Language barrier.

The table below summarizes the results of interviews with company C.

Table 6. The results of the interview with company C

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Results</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company size</td>
<td>Medium company</td>
<td></td>
</tr>
<tr>
<td>Time on the market</td>
<td>~15 years</td>
<td></td>
</tr>
<tr>
<td>Qualification of specialists</td>
<td>Insufficient for the full application of modern approaches</td>
<td></td>
</tr>
<tr>
<td>Desired flexibility</td>
<td>No clear company policy</td>
<td>“Now the company clearly needs structuring, version history and task planning.”</td>
</tr>
<tr>
<td>Type of customer</td>
<td>Internal</td>
<td>“Many conflicts between departments, constant changes in the</td>
</tr>
</tbody>
</table>
Company D

The company uses a poorly organized waterfall. The company does not apply modern approaches. Last year the management of the company is actively discussing the issue of application.

The interviewee is interested in the practice of "eliminate waste", as there is a lot of work in progress. This does not allow developers to rationally organize their work.

The main reason to think about the new approach is serious problems with work planning. Poorly organized planning leads to significant economic losses.

The main reason for not applying the approach is a problem with the customer. Customers are municipal authorities who pay for work at the expense of the state budget. The contract with such customer must include the exact dates of closure of all stages. Wherein, the customer is not personally interested in achieving the result. He is not responsible for the

<table>
<thead>
<tr>
<th><strong>Language skills</strong></th>
<th>Russian</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Willingness to change</strong></td>
<td>No clear company policy</td>
</tr>
<tr>
<td><strong>Applicable practices</strong></td>
<td>Scrum combination with other methodologies</td>
</tr>
<tr>
<td><strong>Differentiation of approaches</strong></td>
<td>Modern approaches are not separated</td>
</tr>
</tbody>
</table>
accuracy of the source data and can constantly make changes, even at the last moment. Remarks to the work already done may appear at any time when new information appears at the customer.

The company is trying to introduce at least global planning. Now they are introducing electronic document management and interaction management system. They tried to introduce Kanban boards, but there is a constant return of already completed tasks back to the rework. The application of this practice at this stage was inconvenient.

The team is interested in changes, at least theoretically, since it is very difficult to work now.

The interviewee did not specifically read the literature, but he saw some materials on Kanban in Russian. Some information about new ideas comes from the project manager.

The table below summarizes the results of interviews with company D.

**Table 7. The results of the interview with company D**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Results</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Company size</strong></td>
<td>Small company</td>
<td></td>
</tr>
<tr>
<td><strong>Time on the market</strong></td>
<td>~7 years</td>
<td></td>
</tr>
<tr>
<td><strong>Qualification of specialists</strong></td>
<td>Does not meet the requirements for agile approaches</td>
<td></td>
</tr>
<tr>
<td><strong>Desired flexibility</strong></td>
<td>Can not afford</td>
<td>“Last year, the issue of applying modern approaches has been discussed”</td>
</tr>
<tr>
<td><strong>Type of customer</strong></td>
<td>State</td>
<td>“The customer is not personally interested in”</td>
</tr>
</tbody>
</table>
achieving the result. He is
not responsible for the
accuracy of the source data.
He can constantly make
changes, even at the last
moment.”

<table>
<thead>
<tr>
<th>Language skills</th>
<th>Russian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to change</td>
<td>There is a need for change, but there is still no implementation</td>
</tr>
<tr>
<td></td>
<td>&quot;The team is interested in changes, at least theoretically, because it's very difficult to work now.”</td>
</tr>
<tr>
<td>Applicable practices</td>
<td>Do not apply</td>
</tr>
<tr>
<td></td>
<td>“We tried to introduce Kanban boards, but there is a constant return of already completed tasks back to the rework. Not convenient yet.”</td>
</tr>
<tr>
<td>Differentiation of approaches</td>
<td>Did not think about it</td>
</tr>
</tbody>
</table>

**Company E**

The uncontrolled flow of tasks and missed deadlines forced to think about the application of modern approaches to software development. There was information on Scrum, Kanban, XP, Prince2. In addition, company management welcomed the introduction of modern approaches. The company has been applying modern approaches for 2nd year.

“It is believed that we are working on Scrum, but I do not think that this is exactly the case. Indeed, we work flexibly; first, we make the basic version and refine it based on feedback”. That is, the approach is applied with its own specifics. Information on approaches was studied in Russian and English through scientific articles and lectures.
Applied practices from Agile are used: prioritized work list, iteration/sprint planning, unit testing, release planning, active customer participation, frequent and incremental delivery of working software, automated builds, continuous integration, test-driven development (TDD), burn-down charts, refactoring, collective code ownership.

Applied practices from Lean are used: focus on creating customer value, create a culture of continuous improvement, respect and empower people, focus on optimizing the whole system and not only local optimizations, continuous flow of small batches in the development process, root source analysis is done after problems are discovered, look simultaneously for multiple solutions, create trusted relationships with suppliers.

The use of modern approaches to software development allows the company to achieve the following main benefits:

1. Increase team motivation.
2. Improving product quality.
3. Distribution of functions in the team.

The main challenge in applying modern approaches was a low level of collaboration in teams, which prevented the exact and full implementation of the chosen approach.

The interlocutor considers unstable economic conditions and inconsistency of civil law to be specific Russian features. This requires more flexibility and adaptability.

The table below summarizes the results of interviews with company E.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Results</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company size</td>
<td>Medium company</td>
<td></td>
</tr>
<tr>
<td>Time on the market</td>
<td>~18 years</td>
<td></td>
</tr>
<tr>
<td>Qualification of specialists</td>
<td>Project managers are highly qualified; the</td>
<td>“When the number of tasks grows, the process is no</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Desired flexibility</strong></td>
<td>Flexibility is desirable</td>
<td>“The uncontrolled flow of tasks does not ensure the integrity of the system without the use of modern agile approaches.”</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Type of customer</strong></td>
<td>Private</td>
<td></td>
</tr>
<tr>
<td><strong>Language skills</strong></td>
<td>English, Russian</td>
<td></td>
</tr>
<tr>
<td><strong>Willingness to change</strong></td>
<td>At the level of company management and project managers</td>
<td>“Everyone understands why this is necessary, but no one has a stable organization to do it.”</td>
</tr>
<tr>
<td><strong>Applicable practices</strong></td>
<td>Scrum with its own modification</td>
<td>“It is believed that we are working on Scrum, but I do not think that it is exactly on it. Indeed, we work flexibly, first, we make the basic version and refine it based on feedback”  \n“You can’t just take a methodology, apply it to a project and then everything will work perfectly”</td>
</tr>
<tr>
<td><strong>Differentiation of approaches</strong></td>
<td>Modern approaches are not separated</td>
<td></td>
</tr>
</tbody>
</table>
4.3 Within-case analysis

In order to further analyze the data, search for the cross case of patterns and the possible formation of preliminary hypotheses, the analysis was carried out. To begin with, the within-case analysis was conducted. The results of this analysis are presented below.

Company A is a micro enterprise initially aimed at applying modern approaches to software development. However, not all employees of the company are ready to use modern approaches to software development in full. In addition, the ideologists of the use of modern approaches do not have complete information about them. This prevented the company from fully achieving its goals at the moment.

Company B has experts with the qualifications sufficient to apply modern approaches to software development at the level of project managers. At the same time, the motivation of a significant part of ordinary workers is insufficient for the correct application of these approaches. In addition, company B has customers of various types of financing and must choose an approach depending on the project. Many customers have no interest in applying modern approaches and do not provide an opportunity to document the execution of work in an agile way.

Company C does not have a specific policy at the level of the company's management regarding the application of modern approaches to software development. The question of their use is the choice of specialists. At the same time, not all developers are ready to apply modern approaches (some – due to insufficient qualifications, others – due to insufficient motivation). Since the customer for software development projects is an internal customer, there is no customer motivation required.

Company D works with state-funded customers. Difficulties in working with such customers and in drawing up contracts with them do not allow company to apply modern approaches. At the same time, there is a need for their application, as the company faces great difficulties in organizing work planning.
Company E works with different customers and chooses approach depending on the type of project. The need to apply modern approaches is clear; otherwise, the company cannot cope with the planning of work. However, the level of workers organization still does not allow the use of modern approaches in full.

4.4 Cross-case analysis

In order to continue the analysis of the results, a cross-case analysis of the obtained data was carried out. Table 9 shows results of cross-case analysis.
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Company size</strong></td>
<td>Micro-enterprise</td>
<td>Medium company</td>
<td>Medium company</td>
<td>Small company</td>
<td>Medium company</td>
</tr>
<tr>
<td><strong>Time on the market</strong></td>
<td>~1 year</td>
<td>~20 years</td>
<td>~15 years</td>
<td>~7 years</td>
<td>~18 years</td>
</tr>
<tr>
<td><strong>Qualification of specialists</strong></td>
<td>Sufficient</td>
<td>Project managers are highly qualified; the qualifications of the rest of the staff are insufficient for the qualitative application of flexible approaches.</td>
<td>Insufficient for the full application of modern approaches</td>
<td>Does not meet the requirements for agile approaches</td>
<td>Project managers are highly qualified; the qualifications of the rest of the staff are insufficient for the qualitative application of agile approaches.</td>
</tr>
<tr>
<td><strong>Desired flexibility</strong></td>
<td>Aim at agile approaches</td>
<td>Depending on the type of project</td>
<td>No clear company policy</td>
<td>Can not afford</td>
<td>Flexibility is desirable</td>
</tr>
<tr>
<td><strong>Type of customer</strong></td>
<td>Private</td>
<td>Various</td>
<td>Internal</td>
<td>State</td>
<td>Private</td>
</tr>
<tr>
<td><strong>Language skills</strong></td>
<td>English, Russian</td>
<td>English, Russian</td>
<td>Russian</td>
<td>Russian</td>
<td>English, Russian</td>
</tr>
<tr>
<td><strong>Willingness to change</strong></td>
<td>In general, there is</td>
<td>At the level of company</td>
<td>No clear company policy</td>
<td>There is a need for change, but there is</td>
<td>At the level of company</td>
</tr>
<tr>
<td><strong>Applicable practices</strong></td>
<td>management and project managers</td>
<td>still no implementation</td>
<td>management and project managers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------</td>
<td>-------------------------</td>
<td>---------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Own combination of practices</strong></td>
<td>Most of the practices used are applied only by project managers. Its own combination of practices is applied.</td>
<td>Scrum combination with other methodologies</td>
<td>Do not apply Scrum with its own modification</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Differentiation of approaches</strong></th>
<th>Modern approaches are not separated</th>
<th>Modern approaches are not separated</th>
<th>Modern approaches are not separated</th>
<th>Did not think about it</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Do they reveal Russian specifics?</strong></th>
<th>Not reveal</th>
<th>Reveal</th>
<th>Reveal</th>
<th>Reveal</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Main goals of application</strong></th>
<th>Increase productivity</th>
<th>Improving change management</th>
<th>Improving change management</th>
<th>Improving change management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Improving overall project vision</td>
<td>Accelerate delivery of the product to the user</td>
<td>Business and IT alignment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Improving overall project vision</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Improve team motivation</td>
</tr>
<tr>
<td><strong>Main benefits of application</strong></td>
<td>Accelerate delivery of the product to the user</td>
<td>Increase team motivation</td>
<td>Accelerate delivery of the product to the user</td>
<td>Not applicable</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Improving overall project vision</td>
<td>Improving management of distributed teams</td>
<td>Improving change management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Productivity is increased, but not enough</td>
<td>Strengthening market position</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Main challenges of application</strong></th>
<th>The unwillingness of staff to use approaches in full</th>
<th>The unwillingness of the staff to restructure and follow certain rules</th>
<th>Lack of motivation and conservatism of specialists</th>
<th>Not applicable</th>
<th>Low level of collaboration in teams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The unwillingness of the staff to restructure and follow certain rules</td>
<td>Lack of customer engagement</td>
<td>Weak support from company management</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lack of customer engagement</td>
<td>The need to comply with regulatory requirements</td>
<td>Language barrier</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Main constraints in the application | No data | Level of knowledge and motivation of specialists  
State customer (sometimes)  
Inconsistency of civil law | Lack of management policy | State customer  
Inconsistency of civil law  
Language barrier  
Customer unwillingness | Inconsistency of civil law |
4.5 Results of the analysis

As a result of the analysis of the obtained data, we can draw the following conclusions.

From the application of modern approaches to software development, the surveyed companies expected to achieve the following main goals:

1. Improving change management.
2. Improving overall project vision.
3. Increase productivity.
4. Business and IT alignment.
5. Increase team motivation.
6. Accelerate delivery of the product to the user.

Figure 2 represents the cases studied and the conclusions that were made according them.

As a result of the application of modern approaches to software development, the surveyed companies obtained the following main benefits:

1. Accelerate delivery of the product to the user
2. Improving overall project vision
3. Increase team motivation  
4. Improving management of distributed teams  
5. Improving change management  
6. Strengthening market position  
7. Improving product quality

Figure 3 represents the cases studied and the conclusions that were made according them.

Figure 3 – Main benefits from agile transformation

For convenience of analysis, the challenges and constraints in the application of modern approaches to software development were combined. As a result, the main problems that hinder the use of modern agile software development methods are formulated:

1. Staff unwillingness  
2. Weak support from company management  
3. Customer unwillingness  
4. Inconsistency of civil law  
5. Language barrier
Here, the staff unwillingness includes insufficient qualification, insufficient motivation, inability to apply the approach completely, inability to follow certain rules, lack of readiness for restructuring work, insufficient knowledge of approaches, insufficient ability to cooperate, conservatism.

Figure 4 represents the cases studied and the conclusions that were made according them.

![Diagram of cases]

**Figure 4 – The main problems in the application of modern approaches to software development**

The results of the study showed that Russian companies choose an approach to software development depending on the project, type of customer, capabilities and motivation of specialists, level of interest in applying modern approaches from company management (RQ1).

At the same time, most specialists do not distinguish approaches and believe that there is only Agile and its minor modifications (RQ2). Therefore, the choice of the applied approach, if any of the modern approaches is applied, usually does not depend on a detailed comparison of the pros and cons of the project. Usually when choosing an approach, practices that are more known to specialists and most popular in Russia are considered. Usually it turns out to be a Scrum methodology and Kanban based practices (RQ3). Information on many other more flexible methodologies is often not presented in detail in Russian.
Differences in the application of approaches between Russia and other countries have been identified. In Russia, there is a general lag in the application of modern approaches. The number of specialists who are able to apply the most flexible methodologies is not sufficient to apply such methodologies in companies that would like to. Also, the application of modern approaches in Russia is influenced by the peculiarities of civil law, especially manifested when working with customers with state participation (RQ4).
5 DISCUSSION

5.1 Hypothesis making

Based on a summary of the information received, it is possible to formulate the following hypotheses:

1. Application depends on customer.
2. The larger the company, the more flexibility is possible and profitable.
3. The language barrier prevents the acquisition of knowledge.
4. Employees prevent changes.
5. Specialists do not see the difference between the approaches.
6. The more flexibility you want, the more highly qualified specialists are needed.
7. Companies do not apply the approach exactly according to the methodology but use their own combination of practices.

Hypothesis 1 is based on data from most of the cases that the decision on the feasibility and applicability of flexible approaches was taken depending on the customer's interest in participating in the project and the willingness to properly arrange the economic contractual relationship. At the same time, in all these cases there was a desire of the company to apply agile approaches.

Hypothesis 2 is based on information received that maximum flexibility requires expensive resources for continuous product deployment. Involving such resources may not be beneficial for a small company.

Hypothesis 3 is based on data from many cases that the interlocutors studied information only in Russian. Based on the fact that the information obtained mainly concerned only the most common methodologies (usually Scrum), it can be assumed that the possibility of studying sources in English would expand their horizons.

Hypothesis 4 is based on the fact that in all the studied cases the interlocutors mentioned that at the level of, for example, project managers there is a great desire to apply modern agile approaches. At the same time, employees are accustomed to working using traditional
approaches. They do not have enough motivation, knowledge and organization to apply an agile approach in full.

Hypothesis 5 is based on the fact that all the interviewed experts did not think about the expediency of separating the approaches. They did not know about the existence of a position that considers approaches such as, for example, Agile, Lean development, and Continuous development as different approaches.

Hypothesis 6 is based on the opinion that the most flexible approaches require the presence of highly qualified specialists in the company who possess the required set of knowledge.

Hypothesis 7 is based on the fact that all of the surveyed companies that had experience in applying any agile approaches used their own combination of methodologies based on using the most appropriate practices from different methodologies.

5.2 Comparison to published cases

As a result of the case study conducted, the main objectives that the polled companies set were identified when deciding on the application of modern approaches to software development. The most commonly called was the goal of improving change management. It is advisable to compare these results with the results of surveys conducted in 2018 in the world and in Russia. According to a Russian survey (ScrumTrek 2018), the goal of accelerating software delivery turned out to be called a little more often. The global survey participants called the acceleration of software delivery as the main goal of Agile, and the goal of improving change management ranks second.

As the main benefits received in the result of the application of modern approaches to software development, the surveyed companies named accelerated software delivery and increase in team motivation. According to the Russian survey, the effect of improving the transparency of project management is in the first place, and the benefits obtained in the case study are, respectively, in fourth and third place. In the global survey, the main benefit is change management; accelerated software delivery is in fourth place, and the increase in the team motivation has not hit the top. Most likely, this happened due to the fact that
modern approaches are used longer in the world and similar effects have been achieved earlier. Thus, in general, the expectations and the obtained benefits of the companies interviewed during the case study coincide with the results of the available surveys.

The problems arising from the case study related to agile transformation generally coincide with the data from the Russian survey. At the same time, the differences from the survey data in the world are significant. For instance, in the global survey problems associated with staff unwillingness no longer fall into the top. Most likely, it is also associated with extensive experience in applying agile approaches. Also, the problem associated with regulatory and civil law in the world survey is in last place. It is possible to assume that this problem in Russia is specific. The problem of the language barrier, noted by some participants of the case study, was also specific.

Since none of the interlocutors mentioned the experience of using Continuous Development, it became necessary to turn to additional sources of information. In particular, the fact of using the Continuous Development approach can be illustrated by the use of DevOps practice. Three published interviews with Russian experts in the field of study were analyzed.

The first interview (Ogloblin 2016) was conducted with a DevOps engineer of one of the largest Russian companies. He believes that DevOps is to some extent suitable for any company. It is suitable for large companies, because it will speed up the development, testing, and product releases, and for small companies, because everyone will be involved in the process and there will be some semblance of employee interchangeability.

The lack of application of the Continuous development approach is due to the fact that there is no understanding of the essence of the approach and it is unclear how to take into account the peculiarities of the company when applying it in Russia. In addition, the associated automation involves a lot of work. Often it is associated with new technologies, sometimes unknown to people at all. It is also important that companies have conservative-minded specialists who are satisfied with the existing state of affairs and they resist changes. The specialist believes that the approach is quite widely spread in companies leading in the Russian IT market.
The second interview (Potapov 2016) was conducted with the CEO of an IT company. He believes that if we talk about a culture of interaction between development and operation, the programmers understand how systems work and have system administration skills, and administrators understand development principles, then any company will definitely need Continuous development, since such close contact ensures simplicity of interaction and the speed of solving problems that often lie on the border of these areas. If we talk about a set of specific practices related to virtualization, containerization and automation of infrastructure management, then the most important thing is that the company (and most importantly the project itself) should reach a size where the overhead for organizing these practices will be lower than overhead for managing infrastructure without them. Often, the overhead for introducing and supporting automation practices is such big that they do not even accelerate, but slow down the processes within the company. For small projects, the ability to lay out the code every day, dozens of times a day most likely will not be necessary, while the human and monetary costs of maintaining this feature are quite large. At the same time, in his opinion, the understanding of the Continuous development approach in Russia is sufficient, there is only some lag in the start time of new technologies application.

It follows from reports in open Russian sources that the largest banks, well-known social networks, and the largest IT companies use Continuous development and DevOps in Russia. But in any case, these are mainly companies from B2C segment. In B2B segment, the use of this approach is more difficult from a financial and legal point of view. The conclusion of a contract with the customer company is a difficult task for the supplier company because it requires not only a high degree of the development team professionalism (both from a technical and business points of view) but also a high level of trust between companies.

The third interview (Tsyganov 2016) was conducted with the Vice-President for Information Technologies of a large Russian bank. He believes that Agile's flexible development methodology is best suited for small companies that create a product from scratch. Large companies can also work on Agile, but limited, for example, when working on a dedicated project or business line. The main condition is the willingness of the team to
work on Agile. This methodology allows to start working on a project earlier when the requirements are not yet fully understood and formalized. However, management must be prepared for the fact that the number of iterations and resources in the process may change significantly. Developers must be prepared for the fact that the same product will have to be refined several times. Moreover, many of banks often call Agile such thing which isn’t Agile. Developers use individual elements of an agile methodology, mixed with traditional cascade development. In this case the conservatism of credit institutions is only a benefit for the quality of the software. In addition, banks do not apply Agile too "deep". Agile is more common in frontend that is rapidly developing and rapidly changing to the requirements of users, and almost never occurs in the backend. It's one thing to describe mobile retail banking with user stories, another thing is to describe the database. Many say that they are about to start using Agile in the development of critical backend systems, but so far there are no successful cases. At the same time, DevOps is actively used in the bank, which allows to solve two main tasks: automating the development, assembly and publication of tasks and increase the creation speed of environments for rapid piloting of the technology for a specific new task. Nowadays, there is no need to set and customize a complete environment for testing new technologies. With DevOps, we can quickly set up several different environments, compare them and choose the best one. Continuous feedback that runs almost in real time from operational services not only speeds up development, it also allows to respond effectively to real customer needs. Unlike agile-techniques, administrators and support service specialists are actively involved in DevOps. They directly deal with the users of the product and know exactly what they need from the product. One of the disadvantages of DevOps is that the methodology requires a deeper IT restructuring in the organization than Agile. The deeper the bank implements the methodology of agile development, the more it needs to develop the DevOps culture.

5.3 Clarification of hypotheses

Comparison of the results obtained in this paper with data from other published cases showed that, in general, the hypotheses formulated above regarding the subject of study are confirmed.
For example, regarding hypothesis №5, annual studies on the use of Agile in Russia (ScrumTrek 2018) do not make differences between approaches. Agile refers to any modern approach to software development. The same studies confirm the validity of hypotheses 4 and 7.

The study about agile and lean usage in Finnish software industry (Rodríguez et al. 2012) showed that organizations that are more mature are switching to Lean. When considering a wider range of approaches, we can conclude that the use of a more flexible approach requires a certain level of development of the organization. With regard to this study, the most flexible of the approaches considered is the Continuous development approach. It requires a certain level of development of the organization and qualifications of specialists. These conclusions are related to hypothesis 6.

The transition to a more flexible approach requires introduction of a variety of engineering practices that continuous integration (CI) and automated acceptance testing are impossible without, and, accordingly, frequent and inexpensive releases are not possible. An additional effect from the introduction of Continuous Development is the increased customer satisfaction.

Studies (for example, Holmstrom-Olsson, Alahyari, and Bosch 2012) show that after 3 and more years from the start of Agile-transformation, top managers begin to take a direct part in this process. Employee engagement becomes the main focus. The company develops its own agile approach in the process.

The most discussed hypothesis is №2. On the one hand, Agile has always been positioned as suitable for small teams. The successful implementation of Agile for small companies is usually quite simple and requires the full application of the essence and principles of the approach and sufficient training of specialists. Large companies are required to solve problems of changing corporate culture and simplifying various processes on the path to flexibility. But on the other hand, approaches such as Continuous Development are difficult to apply in small companies. They require certain resources, highly qualified specialists in various fields and fairly large cross-functional teams. That is, at present, the
greatest flexibility is theoretically possible and beneficial in the largest companies if they are ready to use such approaches.

5.4 Suggested recommendations

Based on the study, we can formulate the following recommendations for Russian organizations that are interested in moving to modern approaches to software development.

1. Companies with a government customer
Currently, the state customer does not allow organizations in Russia to fully apply modern approaches in full compliance with the methodologies. In this regard, the following options are possible:

1) Work at the state level to promote knowledge of existing approaches and the benefits of their application among organizations funded from the state budget. In this work it is possible to use examples of successful application of such approaches in similar organizations in other countries (for example, the experience of the FBI (Sutherland 2014)).

2) Use own modifications of the methodology in the organization of work within the company. Lean practices such as eliminate waste, respect and empower people, make decisions as late as possible, as well as Agile practices such as prioritized work list, burn-down charts may be the most popular. The use of these practices will improve work planning, optimize the workload of workers and improve product quality.

2. Companies interested in Continuous development
Such companies should be prepared for the need to attract highly qualified specialists with a certain set of competencies. Also the use of Continuous Development requires large investments in software products. In this case, the company must take into account its features, features of the project and the customer.

3. For a more informed application of modern approaches, a better level of foreign language skills is required. At least English is necessary, since not all required literature and software products are russified.
4. A wider familiarization of software development specialists in Russia with existing modern software development approaches is required. This will allow them to get more information about the difference between approaches. It will also reduce resistance to change, as specialists will see a wider range of benefits from the use of modern approaches. As part of this familiarization, it may be necessary to translate some important scientific works on this topic into Russian.

5. The general principles of application of modern approaches to software development do not depend on the size of the company. For successful application of the approach, all other characteristics of the company, project and customer should be taken into account. And also it is necessary to formulate correctly the goals facing the company and the goals of applying the approach to software development.

5.5 Limitations

This study has some limitations. First, the number of cases investigated is small. With an increase in the number of cases investigated, the results may change somewhat. Secondly, all the companies that participated in the study are located in the St. Petersburg. Expanding the geographical representation of companies may make some changes to the results. Thirdly, the expansion of the number of representatives of companies participating in the study and the expansion of the range of positions of specialists in the project can also make changes to the results of the study.

In addition, the results of the study could be influenced by the fact that there are no precise definitions of software development approaches and the differences between them in the studied literature are not completely consistent. The interlocutors also did not see the difference in approaches. If it is difficult to name the practices used, the interlocutors were offered options that were initially distributed according to the approaches. But during the interviews, the interlocutors did not limit and did not incline to any specific definition.
5.6 Further research

For a start, it is advisable to conduct a study with a large sample size, with the expansion of the geographical representation of research participants and with an increase in the number of options presented positions in the company.

Further, it is advisable to carry out the information and study work proposed in this study, aimed at increasing the level of knowledge about modern approaches to software development in Russia. After this, a new similar study will be required, which will show the nature of the changes obtained.

In addition, it is advisable for companies to conduct additional research into the practical use of the recommendations on the application of modern approaches to software development proposed in this study.

It would also be interesting to introduce, at least in the Russian scientific literature, coordinated definitions of software development approaches, methodologies and practices for a better understanding of the issues discussed.
6 CONCLUSION

The purpose of this research was to study the state of affairs with the use of modern approaches to software development in Russian companies. For this, a series of interviews were conducted with software development specialists. As a result, conclusions were drawn about the main expectations and benefits of the agile transformation and about the main problems encountered on the way of such a transformation. The general trends of the findings are similar to the results of other studies conducted in other countries, for example, (Rodríguez et al. 2012), and in Russia but in a different, narrower context, for example, (ScrumTrek 2018).

The study showed that specialists in Russia did not distinguish approaches to software development (for example, Agile, Lean development, Continuous development). In particular, this is due to the fact that they do not possess a sufficient amount of information that covers modern approaches in this way. Accordingly, companies do not make a choice of a specific approach for application in full, but use a combination of methodologies and practices from different approaches, forming their own combination of practices. In addition, the surveyed companies do not apply Continuous development. This is mainly due to the fact that they have not reached the desired degree of maturity in the application of modern approaches. The study also revealed a number of modern approaches application features to software development in Russia compared with other countries.

In the “results” section, the hypotheses formulated after analyzing the collected data are presented and some recommendations that are desirable to use in Russia are suggested. The revealed data on the features of the application of modern approaches to software development in Russia is desirable to use for positive changes in this area.

The practical value of this study lies in the fact that based on the recommendations proposed in it, it is possible to plan work on a wider introduction of modern software development approaches in Russia. Implementation of recommendations for companies with a government customer can include a larger number of companies in the scope of using modern approaches to software development.
REFERENCES


Dingsøyr, T., and C. Lassenius. 2016. ‘Emerging Themes in Agile Software Development: Introduction to the Special Section on Continuous Value Delivery’. Information


APPENDIX

Appendix 1. Interview Questions

1. background information:
   - name of the organization,
   - the number of employees in the organization,
   - position in the organization,
   - years of experience in software development,
   - typical team size.

2. usage of methods:
   - Have you ever thought about which approaches to software development to use?
   - If so, what made you think about it?
   - What approaches do you know?
   - Was there information about the features, pros, and cons of the approaches?
   - Has the practice shown the correctness of this information?
   - What approaches were considered for the organization/project and why?
   - Which approach was chosen and why?
   - If used approach, then where did you get the literature? In which language? Was it clear written? Used exactly according to the literature or with its own characteristics?
   - Do you think there are any differences in the application of approaches in Russia, and if so, what can they consist of?
   - Did the experience of the application show the correctness of the choice?
   - How much time do you use modern approaches (if you use)?
   - Level of application of the approach in the organizational unit

3. usage of specific methods, practices, and principles:
   - What practices of the approach do you use (if you know the names)?
   - How systematically (rank)?
   - What principles of approaches do you apply?

4. goals, challenges, limitations, and effects in adoption:
   - What were your goals?
- What are the challenges you met?
- What were your limitations? What was the effect of the approach?

5. non adopter’s reasons and plans to adopt agile and lean methods:
- Reasons for non-use
- Is it planned to introduce something?
- What?
- When?
- For what reasons?