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CONTENT

UNIVERSITIES OF APPLIED SCIENCES IN 2035: VISION-BASED APPROACH FOR FUTURE DEVELOPMENTS IN ESTONIA

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Annotation

This article analyzes the success factors that would ensure and support the future of professional higher education alongside (traditional) university education. The paradigm of the binary higher education system is changing, the key question is in which direction professional higher education should develop and who defines the needs of trends.

The purpose of the current article is to describe the development of professional higher education in Estonia in general, and in this context, the recent trends in labour market, skills and new knowledge necessary for graduates of universities of applied sciences (UAS), are examined.

The first part of the current article focuses on the general developments and trends of professional higher education in the 21st century, e.g. lifelong learning, more quick changes for professional requirements, and importance of access to education in regional centers. The second part describes the changes in the labour market, new skills and knowledge and emphasizes the close cooperation of universities of applied sciences and employers. The third part concentrates on the analysis of main factors influencing professional higher education in Estonia. It gives an overview of the legal environment, key performance indicators as the number of admissions, the number of students, the number of graduates as well as the dynamics of financial support for universities of applied sciences in 2014-2019 in the context of economical and legislation changes in Estonia. Presentation and understanding of current situation analysis of strengths and weaknesses is the foundation for the content and role of professional higher education in the future. In the end of the overview recommendations are given to guarantee the sustainable, competitive and high-quality professional higher education.

Key words: *university of applied sciences, future trends, key performance indicators, regional development, labour market.*

Introduction

The changes of the last 15 years on the higher education landscape have been more rapid than the changes of the previous 50 years combined. Some technological developments like digitalization and new forms of teaching and learning, e.g. distance learning and e-learning, and internationalisation appear to be here to stay. They all are having an increasing impact on social life. Automatisation leads to new and different types of employment. The learning economy is no longer just about acquiring and applying knowledge, but more about linking expertise to requirements in society. Professionals must be critical, entrepreneurial and innovative. They must have a definite direction to remain standing in a complex society. According to the vision document of Estonian Rectors' Conference of Universities of Applied Sciences (RCUAS), high-quality professional higher education must therefore contribute to the development of people, the regional competitiveness and development, and the development and improvement of the economy. It is crucial to understand, adapt and be ready for the technological changes, regional access and for the constant need for retraining (Professional Higher Education in 2035, 2019).

In 2014, the RCUAS presented a road map for professional higher education that included a vision for 2020 (Rakenduskõrgharidus Euroopa kõrgharidusruumis..., 2014). It gave an overview of the current situation of the member organizations and predicted their future based on the institutions' key performance indicators. Five years later, in 2019, the vision document Professional Higher Education in 2035 was compiled to analyse the development trends of professional higher education as well as the main factors and changes influencing professional higher education and the activities of universities of applied sciences (Professional Higher Education in 2035, 2019).

In a number of countries, the higher education system consists of two distinct sectors, one of which has a more academic orientation and the other a more applied orientation. Universities make up the sector with the more academic orientation, while the institutions in the more applied sector go by a variety of names, e.g., colleges of professional education, universities of applied sciences (UAS), institutes of technology, and polytechnics. In many countries, non-university postsecondary institutions concentrate on offering programs of an applied nature. Many students have found the opportunity to study in applied sector institutions attractive because of cost, employment prospects, the attractiveness of hands-on learning, and the emphasis on teaching that is common in such institutions (Skolnik, 2015, 363).

In many countries the initiatives have successfully established higher education institutions, such as the UAS, with the mission of providing bachelor programmes in technical, health care and professional areas. Some countries have realised synergies and economies of scale through careful orchestration of institutional mergers. Such institutions have often been extremely successful and have grown rapidly, frequently concentrating their research efforts on applied topics, and with a different teaching style from universities (OECD, 2014).

The Statutes of RCUAS as a social organisation were registered by the Estonian Ministry of Education and Research on March 2, 1993. The aim of the activities of RCUAS is to develop the joint activities of Estonian UAS, to form common positions and to represent common interests in promoting professional higher education and shaping education policy in Estonia. As a result of the work of RCUAS, the University of Applied Sciences Act entered into Law in Estonia in 1998.

The information presented in the current article is based on the vision document that was compiled from April to December 2019 by the members of RCUAS. The methodology of compiling the vision document is described by figure 1. The academic professionals of UAS, the employees of the higher education department of the Estonian Ministry of Education and Research and the participants of the RCUAS Vision Day were involved in compiling the vision document. The round table discussions involved 8 tables (2 tables in English) and 4 issues focusing on the future of professional higher education. The outcome has a significant impact on all the stakeholders due to their involvement and cooperation.

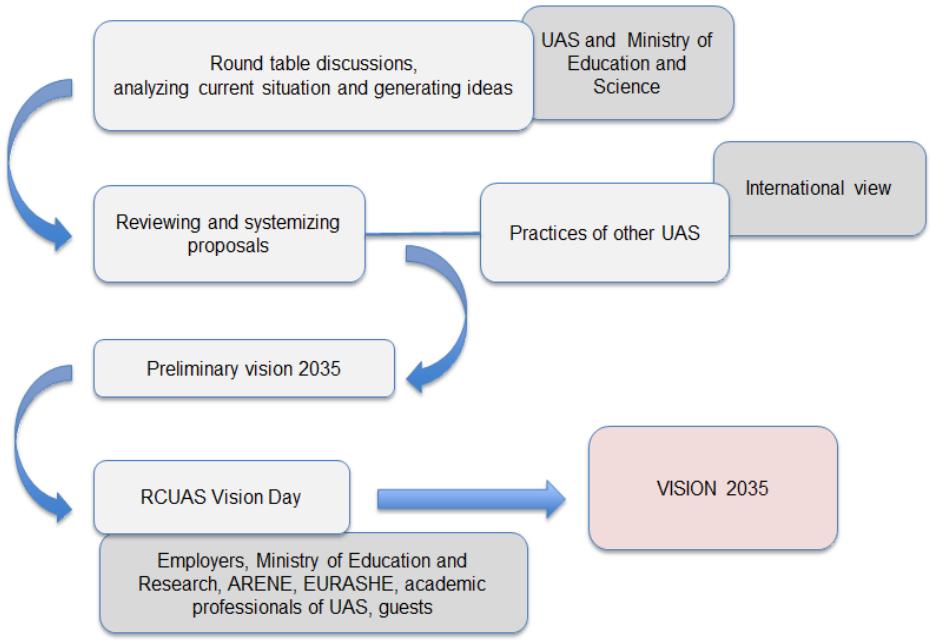


Fig. 1. The methodology of compiling the vision document (Professional Higher Education in 2035, 2019)

This document was preceded by a cooperation project of universities of applied sciences "Professional higher education in the European Higher Education Area: outputs, institutions and operating models 2020". In the course of the study, the dynamics of changes in the basic data of member councils of the RCUAS in 2008–2012 was analyzed by four categories: 1) general efficiency indicators (overheads, total area per student); 2) students (number and change of students, employment in the labor market), 3) academic and support staff, and 4) research, development and creativity (RDC) activities. In addition, an overview of curricula, study process, internationalization and applied research is given (Rakenduskõrgharidus Euroopa kõrgharidusruumis..., 2014).

In addition to the analysis of the performance indicators of Estonian UAS, data were collected from study trips to UAS in several countries and semi-structured interviews were conducted with members of the rectors' councils and higher education experts of European Union (hereinafter EU) institutions. The interviews identified the main developments in UAS and the reasons for them in the context of the higher education system as a whole. An overview article introducing the final report of the study was published in the journal Professional Studies: Theory and Practice in 2016 (Lend et al., 2016).

In February 2014, the Government of the Republic approved the concept of monitoring and forecasting the labor market and skills development coordination system. It aimed to link better the labor market needs and provision of training (Tulevikuvaade tööjõu- ja oskuste..., 2018, p. 13).

Furthermore, in 2018, a study was conducted by Estonian Labor demand monitoring and forecasting system OSKA “The future vision of labor and skills needs: education and research”. The study analyzed how the employment and skills required of the professions in the field will change over the next five to ten years, and what changes would need to be made in the training offer, etc., in order to better meet the changing needs. This applied research does not seek to predict the development trends of the workforce in the near future, but expert assessments are mediated desired future situations. Thus, this applied research provides support and specific assistance to policy makers on how to lead the future (Tulevikuvaade tööjõu- ja oskuste…., 2018).

The higher education institutions and the higher education landscape in general have changed over the past decades. In order to respond to the future development of higher education content and take into account technological, societal and labour market changes as well as the expectations of new generations, government and entrepreneurs, it is necessary to identify the reasons for the changes in professional higher education and then define the preconditions for implementing the changes. In accordance with the main goal set for this article, the following research tasks were formulated:

- What is the (professional) higher education landscape today and what are the transforming ideas and key influencers for the future?
- What are the main factors influencing professional higher education in Estonia?
- What could be the development goals of professional higher education, when taking into account the local and global drivers shaping professional higher education?

1. Theoretical basis - Transforming ideas of professional higher education

The development of the knowledge society in a learning economy will be the dominant development. The speed of economic and social development is constantly accelerating. Knowledge is available worldwide at any time, and new information is evolving faster and faster. Networks supported by digital technologies can operate quickly and affect the functions and processes of both society and professional practice. Long-term predictability is becoming increasingly difficult. In the 21st century knowledge-based society professional training of graduates and already gained professions are forced to alter constantly. Tomorrow's specialist will have to work longer than his/her parents and career will be much more diverse. Changing careers and jobs are already the norm rather than the exception. Organizations, systems and people need to adapt more and more to dynamic circumstances, and the circulation of knowledge is therefore becoming increasingly important. A complex, hybrid and diverse society is emerging. Due to the global epidemic, borders are already disappearing between the physical and virtual worlds. As a result, the confidence and predictability decrease even more. As stated in the vision document of The Hague University of Applied Sciences (2015) “*Every university of applied sciences is expected to play its part in the development of society, particularly the professional world, through education and research and by making knowledge available*”.

Future development trends and problems of UAS is a widely discussed topic in most countries. The implementation of rules following the Bologna process, recognition of foreign educational qualifications and studies are some examples of the harmonization of higher education. Concerning the content of professional higher education, the UAS have been

updating and innovating the curricula, improving the methodical approaches to better meet external stakeholders demands. For example, some universities have included entrepreneurship subjects or study modules in their study programme. However, the core question is: are these initiatives and changes sufficient, and in whose opinion this will be sufficient? (Camilleri, et al., 2014).

When to talk about higher education, it is also worth looking at the trends in the northern neighbors. E.g. Minister of Education and Culture Sanni Grahn-Laasonen, announcing the vision as part of the celebrations of 100 years of Finland's independence, said: "*Global competition for expertise is tightening. Finland has no other strategy for success than being the most capable nation. Finland should aim for the best-trained workforce in the world. It requires higher education, open educational provision and continuous learning, international networking, quality, effectiveness and strong inputs into RDI [research, development and innovation] activities.*" (Myklebust, 2017).

The task of influencing regional development can be highlighted as one of the main tasks of UAS (Rauhala, 2008, 95). Universities of applied sciences have the mission to train professionals with emphasis on labour market needs and conduct research and development which supports instruction and promotes regional development. The education emphasises co-operation with the business, health care, medicine, industry and service sectors at the regional level in particular.

The regional impact of UAS has been defined as follows (Käyhkö et al 2006, 13):

1) effectiveness of the strategy of UAS and regional participation and networking (eg. the participation in regional strategy work, in regional centre programmes, programmes of centres of expertise and other development projects in the area)

2) proactive role of UAS and influencing on the activities in the area (e.g. strengthening of knowledge in the area, increasing social capital, building innovation environment and anticipating proactive response on the needs of the area).

Over the past few years regional development and agreements between universities of applied sciences and employers have become more significant in education and training. As stated by Rauhala (2008, 98): "*The effectiveness of the programmes of centres of expertise should be based on specialization on strong top areas, formulating regional strategies and tying the different partners to realize the strategies. The target of the programmes is to promote division of labour between areas in developing the knowledge to international leve*l".

Universities of applied sciences have a very good opportunity to promote regional development in two ways: firstly, UAS plays an educationally important role in developing entrepreneurial skills, knowledge and cultures to ensure that the full potential of regional human capital is realized. Secondly, UAS can contribute to regional development through close links with local businesses and organizations. Many of these networks have been set up through regional business research and advisory services and include students doing their postgraduate studies or placements there. If these possibilities are followed, the institution of professional higher education or its unit can become a key resource for the economic development of its region (Jongbloed, 2010).

The continuing development of distance education and e-learning is an important factor that has so far received little attention in the context of regional development and access to higher education in regional communities. In the mainstream over the past decade, e-learning has been established as a central and critical way to serve students. In particular, e-learning helps community colleges move their goal of universal access "from promise to practice" (Web-Based Education Commission, 2000, p. iv). Bohland et al emphasized already in 2000 that *Online learning has opened doors to higher education for many students otherwise restricted by fixed schedules and geographic obstacles.* However, extending access to traditionally underserved citizens, such as working adults and people who are living outside major centers. Current spring 2020 highlighted the importance of the development of the distance learning skills in the universities of applied sciences.

2. Demands of the labour market and new knowledge and skills expected from graduates

Professional higher education was born in Germany in the 1970s based on the needs of industry and employers. People with vocational education did not have enough knowledge to work with new and more complex machines, and university graduates did not have enough practical skills. Moreover, relatively few people graduated from university and did not meet the needs of the German economy. The economy needed specialists with higher education with practical skills. Over the years, the level of lecturers in universities and professional colleges has harmonized. Universities of applied sciences have become more academic, applied

research and international cooperation have been launched, but more internships have been added to university curricula (McClelland, 1982).

Cooperation with companies is a criterion for success not only in terms of securing jobs for graduates, but also in terms of curriculum development and applied research. Today, professional higher education has become more popular in Europe than academic university education. In many European countries (e.g. Austria, Switzerland, Germany), admission to professional higher education is growing faster than to academic universities.

Globally, labour market demand for highly skilled workers is soaring as knowledge-work becomes essential for innovation, economic diversification and growth (OECD 2014). Economists and policymakers have identified higher education as a key mechanism to increase national productivity (Piketty 2014). Correspondingly, students and employers may attach greater value to the outcomes of the vocational higher education sector resulting in recognition that routes to widen access to new forms of hybrid higher vocational learning are reconfiguring the relationships between academic universities and applied universities (Deissinger, 2015; Webb et al., 2017).

Current major European policy concerns related to establishing the European Higher Education Area are closely related to supporting graduates' career success, international mobility, cooperation among higher education institutions and employers. Upcoming tasks in innovation policy are connected especially to the increasing participation of enterprises. One of the core strategies of UAS is technology and knowledge transfer, which is constantly structured to address partners' needs – especially those coming from the business, healthcare, industry world − in the sense of service commitment. This self-conception of these universities as service providers differentiate it from its strategies and other universities (Baaken & Schröder, 2008, 103).

Based on Figure 2, the most important factors influencing the development of professional higher education come from the world of work. It is based on the understanding that education policy is part of economic policy and education policy should be integrated with global economic trends. Thus, the development of professional higher education needs constant dialogue with the trends of the world of work.

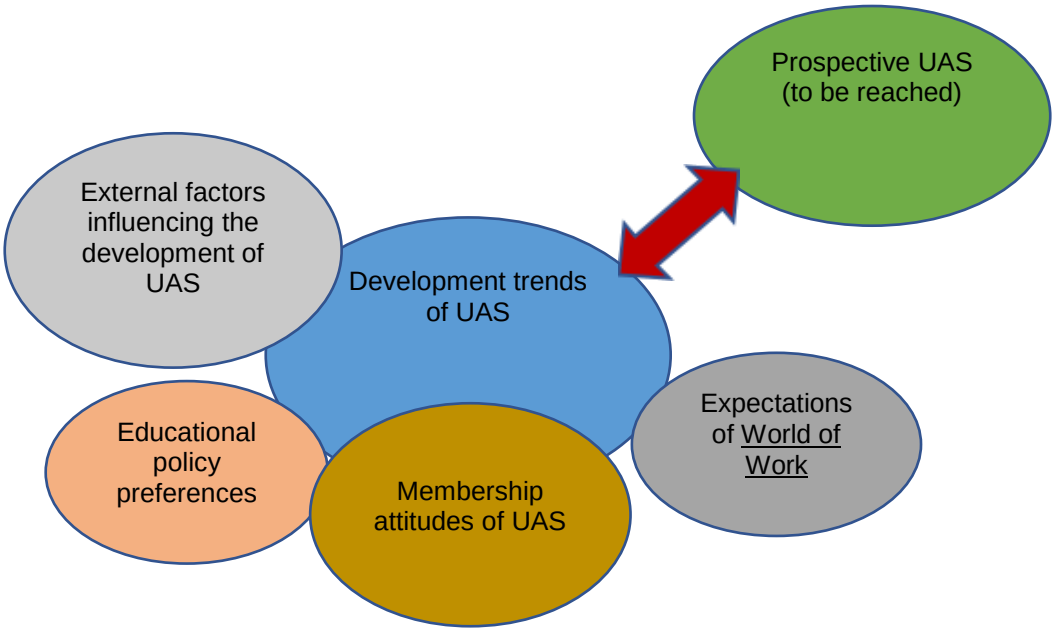


Fig. 2. The key factors of the development of universities of applied sciences

The diversity in the learning outcomes of curricula has been strongly influenced by the Bologna process. Many studies have been conducted on the effect of the Bologna reforms to educational policies and to the diversity of higher education institutions. E.g. Teixeira (2012) has analysed the sustainability of higher education systems and found that the most important competition factor today is the capability to offer contemporary study programmes compatible to the demands of the labour market, which may become huge challenges to higher education institutions when they are too focused on traditions. It is thought that diversification of tomorrow´s education market has to be implemented through learning outcomes and research and development activities (Lend et al., 2016).

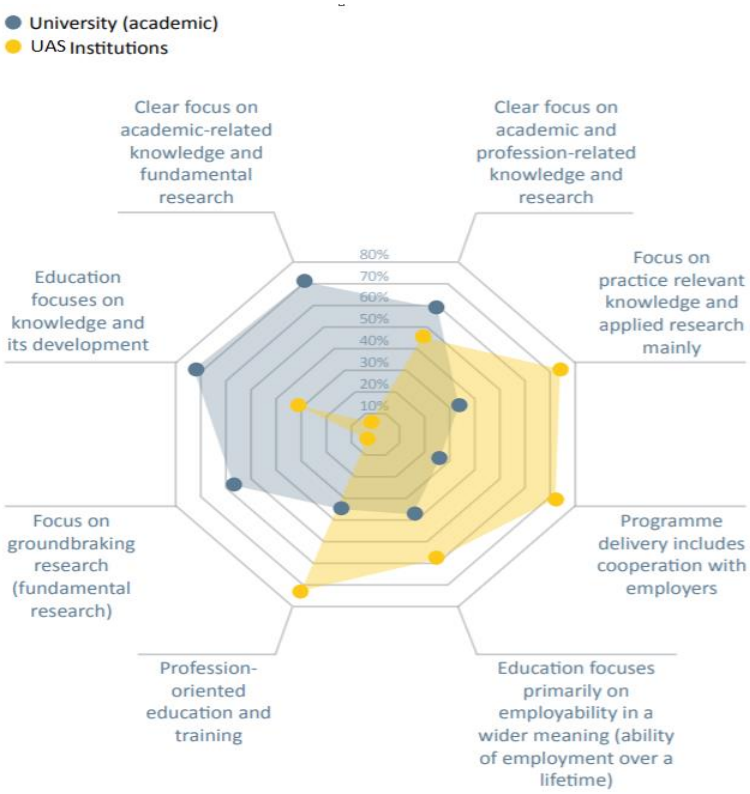


Fig. 3. Profiles of academic and professional higher education (Camilleri et al., 2014, p. 27)

The distinction between academic higher education and professional higher education dates back to the 1960s when employers started to need graduates with higher education and practical skills. The output of universities was not practical enough and the one of vocational institutions was not academic and professional enough. Considering the close cooperation of UAS and employers, the management system and curriculum development is rather flexible in UAS, and the learning outcomes comply with the expectations of the enterprises and support the high employment rate of graduates. In Figure 3 it is shown the well-established profile of UAS and the university sector from 2014 (Camiller et al., 2014).

In the post-knowledge era, the meaning of knowledge is changing. Knowledge is not viewed as the most important ingredient for action (to do something with it). Higher education institutions are traditionally seen as producers of new knowledge, technology and quality graduates. The Institute for the Future (IFTF) report analyzed in 2011 key drivers that will reshape the landscape of work and identified key work skills needed in the next 10 years. Rather than focusing on future jobs, this report looks at future work skills—proficiencies and abilities required across different jobs and work settings and which will be critical for success in the workforce (Davies et al., 2011, 8-12):

- Sense-making: ability to determine the deeper meaning or significance of what is being expressed.
- Social intelligence: ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions
- Novel & adaptive thinking: proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule based.
- Cross-cultural competency: ability to operate in different cultural settings.
- Computational thinking: ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning
- New-media literacy: ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication.
- Transdisciplinarity: literacy in and ability to understand concepts across multiple disciplines
- Design mindset: ability to represent and develop tasks and work processes for desired outcomes
- Cognitive load management: ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques

● Virtual collaboration: ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team (Davies et al., 2011, 8-12).

The common denominator of these ten skill descriptions is that they are based on relationships, the terms skills, knowledge and also competence. Knowledge in the context of application implies closer connections between different institutions and actors in the knowledge production system and requires universities to `reach out' and cooperate with industry and government to a far greater extent than before. At the centre of this cooperation is the evolutionary triple helix model which advocates strategic interactions and collaboration between universities, industry and government to foster economic and social development. The model emphasizes on boosting innovation for a development. It describes the role of university to join hands with industry and government (Leydesdorff, 1995; Leydesdorff & Etzkowitz, 1998; Etzkowitz & Leydesdorff, 2000).

The best example of Triple Helix is Silicon Valley. The government provided land, flexible financing, stretched tax holidays and fitting guidelines to the IT cluster in California, US. The small and big IT businesses thrived in this cluster. The world has seen success stories of Dell, HP, Oracle, Intel, Microsoft etc. The collaboration between universities and the industry is increasingly perceived as a vehicle to enhance innovation through knowledge exchange. This is evident by a significant increase in studies that investigate the topic from different perspectives (Ankrah & AL-Tabbaa, 2015, p. 386).

Universities of applied sciences are supposed to provide the applied research on which industry builds commercial goods. According to Etzkowitz and Leydesroff (2000), the transfer of people between university and industry is a mode of transfer of knowledge. A university flourishes because of research, and industry grows on research in universities. But, as stated by Baaken and Schröder (2008, 113) more important in terms of success is to measure the effect of knowledge transfer performances achieved by looking at outcomes (level of increase of employees, less unemployed people in the region, market share of customers, newly established job positions, increase in turnover and growth in market share of customers (Baaken & Schröder, 2008, 113).

The motivations for universities to enter into relationships with industry are among others: the access to complementary expertise, state-of-the-art equipment and facilities, employment opportunities for university graduates, shift in knowledge based economy (growth in new knowledge), discover new knowledge/test application of theory, obtain better insights into curricula development, expose students and faculty to practical problems/ applied technologies, promote innovation (through technology exchange), and contribute to regional or national economy (Ankrah & AL-Tabbaa, 2015, p. 392).

For industrial sector the motivational factor for cooperation are access to students for summer internship or hiring, hiring of faculty members, enhance the technological capacity and economic competitiveness of firms, shift in knowledge based economy (growth in new knowledge), business growth, access new knowledge, cutting-edge technology, state-of-the art expertise/research facilities and complementary know-how and enhancement of corporate image (Ankrah & AL-Tabbaa, 2015, p. 392).

Therefore, the collaboration between universities and industry is largely seen as one approach to improve innovation in the economy by facilitating the flow and utilization of technology-related knowledge and experience across sectors (Perkmann et al., 2011).

According to the authors' positions of this paper, it is not necessary to change the profile of professional higher education, as long as there are no clear and formulated analyzes. After a deep investigation, through modifying and improving is possible to create a balanced system of relationships between different dimensions in the learning outcomes.

3. The positions of UAS and the main factors influencing professional higher education in Estonia

The purpose of this chapter is to look at what has happened in recent years and what have we accomplished. We have analysed the development trends of higher education, the questions concerning the funding of higher education, and the role of professional higher education and the universities of applied sciences in Estonian higher education landscape.

In 2014, the Estonian RCUAS had 12 members, and 14,000 students studied at the universities of applied sciences. In 2018, ca 11,000 students studied at the UAS, and the RCUAS had nine members (starting from September 1st, 2019, RCUAS has eight members). There are seven state UAS in Estonia (all are members of the RCUAS), and five private UAS (Estonian Entrepreneurship University of Applied Sciences being a member of RCUAS). Currently 8,545 students are studying at the state UAS (Professional Higher Education in 2035, 2019).

The number of students at the private UAS in 2018 was 2,131. In addition to this, professional higher education can be acquired at the colleges of the University of Tartu, Estonian University of Life Sciences, Tallinn University and Tallinn University of Technology (TalTech), where the total number of students studying in professional higher education curricula in 2018/2019 was 4,044 (https://www.haridussilm.ee/). When in average, the number of students in public state universities has decreased by 22% (in 2014/2015 there were 42,205 students and in 2018/2019, 35,343 students), then the number of students in state UAS has been relatively stable and has decreased only by 4% (in 2014/2015, 7,259 students and in 2018/2019, 6,974 students (https://www.haridussilm.ee/).

3.1 Updating the higher education legislation

In 2013 free state higher education through the higher education reform was implemented. The main goal of this reform was to ensure equal access to higher education, to make the higher education sector less fragmented and to minimize the doubling of curricula. The most significant and tangible change for universities and higher education institutions was that the intake of paying students was no longer allowed.

In 2016, the modernization of the Estonian higher education legislation began. In the process of modernisation, the legislative acts concerning higher education were reorganised. However, the main principles of the higher education system such as free higher education, the autonomy of higher education institutions and the tertiary system were not changed.

On September 1, 2019, The Higher Education Act took into force (https://www.riigiteataja.ee/en/eli/529082019022/consolide).

The most significant change for the UAS is that the students accepted in 2019/2020 will get a bachelor's degree at graduation. The system is clearer now, a uniform bachelor's degree is more easily understandable inside as well as outside Estonia. Under the new act, the same requirements apply to professional and academic higher education, though one point differs, namely that a student of professional higher education acquires not only basic knowledge, but also the skills to work in a certain field, which connects those students starting their work career easier in reality. In professional higher education, practical training must form at least 15% of the curriculum compared with academic universities, where the proportion of the practical training is not so clearly specified. The specialties of professional higher education are tightly connected to professional standards, which ensures that, in addition to overall knowledge competences, the students of professional higher education shall acquire professional skills needed for working in a certain profession. In addition, cooperation with employers and professional associations is important in the development and creation of professional higher education curricula, so that the training meets the expectations of the world of work.

3.2 Key performance indicators of applied universities under the RCUAS

For analysing the effects of the reform to the key performance indicators of the UAS, they were divided into two groups: the institutions governed by the Estonian Ministry of Education and Research (6), and the UAS belonging to the RCUAS (6+3) – the abovementioned plus the Estonian Academy of Security Sciences, the Estonian Military Academy and the Estonian Entrepreneurship University of Applied Sciences (Figure 4 and 5).

The cumulated number of admissions of the UASs belonging to RCUAS during the analysed period increased by 14.7%, and the general number of students decreased by 3.7%. The constant decrease of students lasted until the academic year 2017/2018. Last academic year, the general number of students started to increase. However, the number of graduates has dropped by 18.9%. The number of graduates during the analysed period was mainly influenced by the constant decrease of paying graduates (the last admission of paying students was in 2012/2013).

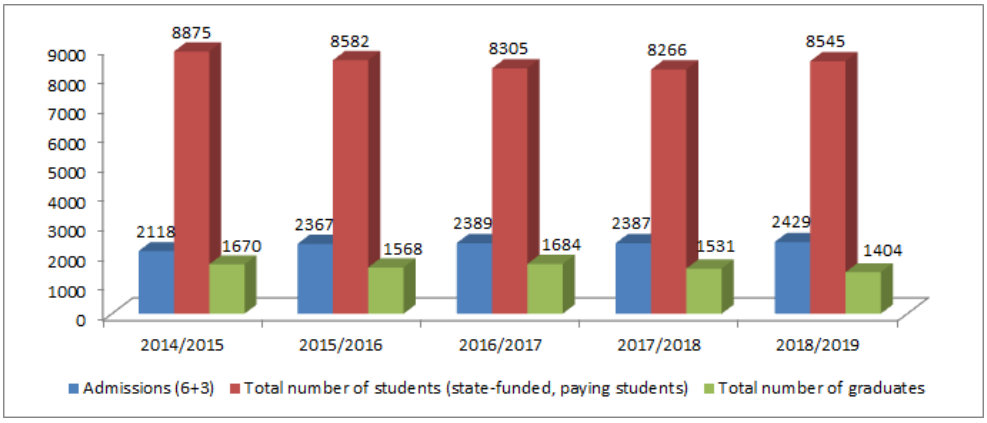


Fig. 4. The key performance indicators of the members of RCUAS in 2014-2018

The number of admissions of the six UAS has grown by 10.4% in the given period, the general number of students has increased by 5.2%, and the number of graduates has decreased by 14.7%. It is important to point out that in the academic year 2014/2015, 659 students had to reimburse study costs (as they failed to reach the full study load and were studying part-time), of them 468 (71%) being the students of TTK University of Applied Sciences. In the end of the period, 172 students reimbursed their study costs (80.1% being the students of TTK University of Applied Sciences). The study behaviour of paying students had an inevitable effect on the number of graduates.

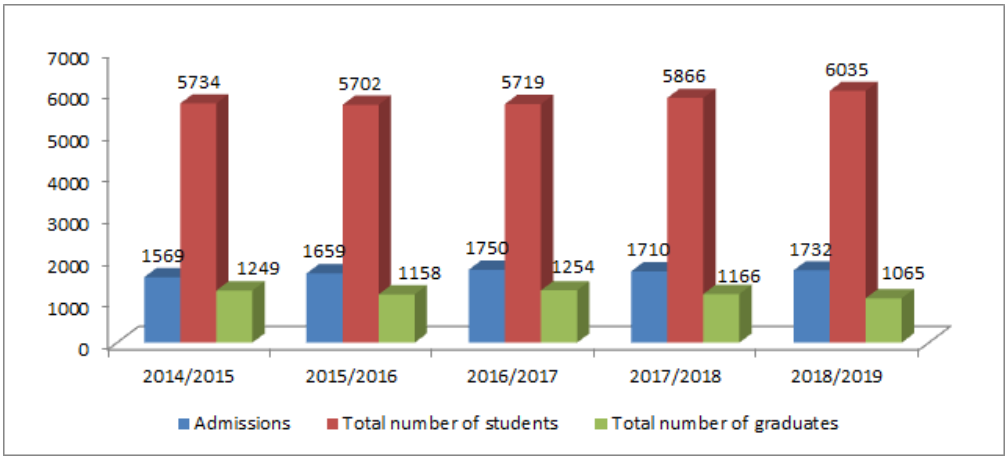
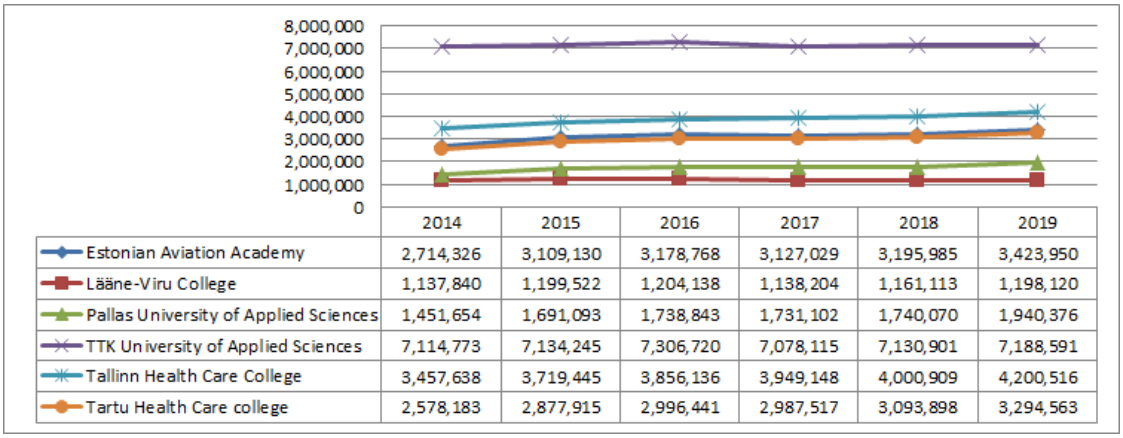


Fig. 5. The key performance indicators of the universities of applied sciences governed by the Estonian Ministry of Education and Research in 2014-2018

3.3 The principles of funding in higher education

In 2017, the new operational support model was implemented in Estonia. The model has two components – baseline funding and the changeable performance funding based on key performance indicators. The principles of the operational support are similar to UAS and universities (except for doctoral studies, research funding, etc.). With the new financing model that took into force on January 1, 2017, the obligation of annual reports that was connected to annual contracts was discarded. The new model introduced 3-year administration contracts for public state universities and activity support directives for state UAS. Six key performance indicators were determined. The indicator with the highest value is the share of students graduating with nominal time (NOM+1 or NOM+2) (https://www.hm.ee/sites/default/files/uus_rahastamismudel_0.jpg). The other key performance indicators are: share of graduates in employment, share of students participating in short term mobility (since 2019, also in long term mobility), share of enrolled international students, share of private funding and the operation of a higher education institution in their area of responsibility.

Due to the reform, comparing the data from the period of the beginning of the higher education reform with today's data in the context of higher education funding is not entirely adequate, as in addition to the changes in funding, the study behaviour of students has changed considerably during this time, and the higher education institutions have thoroughly analysed their principles of operation. Therefore, the comparison of the post-reform data of admission, student and graduate numbers, taught credit points and passed credit points to previous data needs further detailed analysis that was not possible in the scope of the present vision document. For example, the higher education institutions are still looking for the ultimate balance between the demand of graduates from enterprises (the need of specialists), the reasonable relation of admissions and graduates, and the key performance indicators of the operational support calculation model (Professional Higher Education in 2035, 2019).



	2014	2015	2016	2017	2018	2019
Estonian Aviation Academy	2,714,326	3,109,130	3,178,768	3,127,029	3,195,985	3,423,950
Lääne-Viru College	1,137,840	1,199,522	1,204,138	1,138,204	1,161,113	1,198,120
Pallas University of Applied Sciences	1,451,654	1,691,093	1,738,843	1,731,102	1,740,070	1,940,376
TTK University of Applied Sciences	7,114,773	7,134,245	7,306,720	7,078,115	7,130,901	7,188,591
Tallinn Health Care College	3,457,638	3,719,445	3,856,136	3,949,148	4,000,909	4,200,516
Tartu Health Care college	2,578,183	2,877,915	2,996,441	2,987,517	3,093,898	3,294,563

Fig. 6. The dynamics of financial support of the universities of applied sciences governed by the Estonian Ministry of Education and Research in 2014-2019, in Euros

Figure 6 presents the dynamics of state funding of the UAS governed by the Estonian Ministry of Education and Research. The biggest increase of operational support was achieved by Pallas University of Applied Sciences (33.4%), Tartu Health Care College (27.8%) and the Estonian Aviation Academy (26.1%). The operational support increased the least in TTK University of Applied Sciences (by 1%) and in Lääne-Viru College (by 5.6%). When looking at the cost of a student place at the universities of applied sciences governed by the Estonian Ministry of Education and Research in 2018/2019, the most expensive student place – 14,200 euros – was in the Estonian Aviation Academy, and the least expensive – 1,340 euros – in Lääne-Viru College. As the cost of a student place in the Estonian Aviation Academy differs considerably from others, we decided to analyse the dynamics of the cost of student places based on five universities of applied sciences (Table 1).

In conclusion, we can say that the direct impact of the development gap in operational support is expressed in the fall of competitiveness of the employees' salaries. As the share of staff costs in the budget of UAS is ca. 65-80%, we can say that the maximum capacity of staff costs has already been reached in most institutions. The increase of average salary in Estonia between 2014-2019 has been 44% (data from Statistic Estonia: https://www.stat.ee/stat-keskmine-brutokuupalk) and the consumer price index has risen by 10% (Statistics Estonia: https://www.stat.ee/stat-tarbijahinnaindeksi-muutus). Compared to the increase of the cost of a student place being only 2.5% (Table 1), it is clear this is not enough for maintaining the competitiveness of staff costs.

Table 1

The average cost of a student place based on the data of five universities of applied sciences governed by the Estonian Ministry of Education and Research, in Euros

Academic year	*2014/2015*	*2015/2016*	*2016/2017*	*2017/2018*	*2018/2019*
Average cost of student place	*2,883*	*3,052*	*3,127*	*2,997*	*2,956*

3.4 Current situation of universities of applied sciences

One of the strengths of UAS is the quick implementation of changes in the world of work and curriculum development. In addition, the flexibility of UAS is expressed by their willingness to open study groups near the employers' locations to ensure needs-based regional education and the recognition of employers' needs. This is enhanced by the support and feedback from the employers and their will to value graduates on different levels, e.g. specialists with professional diploma.

Another strength of UAS is the distribution of the fields of education – every institution has its clear role, which helps to avoid the doubling of curricula and train employees that are

needed by the state. As most of the UAS in Estonia are state-owned, the state can determine the student places according to the needs of the world of work. This gives the state the possibility to govern the UAS purposefully. However, the clear division of fields of education can also be seen as a weakness, because, for example, there is no input from the Ministry of Economic Affairs and Communications for educating engineers and technical workers. Other areas such as health care and aviation have a clear public procurement. However, in case of health care, the ministry that gives the main strategic input to the public procurement is the Ministry of Social Affairs, but the ministry is not contributing to the financing of health care education.

Compared to academic universities in Estonia, the number of international students in the UAS is relatively low. The essence of this question lies in the role of UAS in Estonia: is the purpose of UAS to prepare the workforce for the Estonian employment market, or to offer studies in English for international students? Unfortunately, fulfilling these two goals simultaneously is extremely difficult, as the graduates of UAS are expected to have high proficiency of Estonian language. Offering studies both in the national language and in English is resourceful.

However, the biggest weakness in relation to applied universities in Estonia lies in the lack of basic research funding. Nevertheless, UAS in Estonia have conducted applied research relatively successfully according to their own financial means. The state funding directed to applied research and development activities would create favourable conditions for an important and long-awaited development leap which would enable to conduct applied research on a much larger scale. The stable financing for applied research is expected both by the society and the world of work. In many European countries, basic funding for applied research is guaranteed for universities of applied sciences independent from the evaluation of research, and this could also be the first step in the Republic of Estonia in order to support the development of professional higher education.

In conclusion, we can say that the success factors of UAS are:

- Curricula and learning outcomes that are dynamically aligned with the world of work, vocational standards and with the needs of enterprises and professional associations;
- The teachers/lecturers of UAS have professional experience with skills and potential for research and development activities;
- Universities of applied sciences have the state-of-the-art infrastructure that supports the acquiring of skills, knowledge and experience, and participation in research and development activities.
- Practical training is considered a supervised purposeful activity in a real working environment. Before entering the real working environment, students pass simulation trainings;
- Applied research and product development projects have become an integral part of the learning process.
- It is flexible to transfer professional higher education to regions further away from the capital to train professionals with emphasis on labour market needs, to promote regional development in particular. Work-based learning offers many opportunities to ensure a good education outside the capital.

4. The content and role of professional higher education in 2035

When discussing the future of UAS, mostly the content and learning outcomes of the programmes are focused on rather than individual institutions. When we think of whether the development trends in professional higher education are Estonian-centred or international, we can say they are rather international. By 2035, the significance of professional qualification certificates, diplomas and other status proving regulations will probably decrease, and the formulation of learning outcomes in study programmes will become more dynamic. It may be possible that in 2035, we cannot talk about the differences between academic and professional higher education anymore, but of a new type of higher education (Professional Higher Education in 2035, 2019).

Apprenticeship studies are common in vocational education institutions, but this type of studies could also be integrated into higher education. Apprenticeship studies are highly effective at equipping individuals with valuable knowledge, skills, and work experience. It is also a great way for employers to address skill gaps and ensure they are getting the most from their training investments (Fuller & Sigelman, 2017). When employers depend solely on the education system to prepare their workforce, they often find that new hires are far from job ready. When they use apprenticeship instead and partner with a college for the related instruction, they can be more sure that trainees are learning firm-relevant skills as well as broad knowledge about the field (McCarthy et al., 2017).

Currently, the apprenticeship studies in professional higher education are being piloted in Estonia. It is important that employers also value this type of study programmes. One of the main points of future discussion will be whether universities of applied sciences continue to stand out in the higher education landscape or will the differences between professional higher education and baccalaureate programmes disappear.

Other important factors are **the expectations and needs of the employers**. Standing out in the future is possible, if: a) the employers still need graduates with different profiles (academic and practice-oriented); b) the students accept this trend and wish to stand out as students/graduates of professional higher education; c) the universities of applied sciences are flexible, able to reorient quickly and provide employers with the necessary curricula.

It is known that today, the companies are expecting and valuing specialists with professional higher education backgrounds - the people who have acquired certain skills and knowledge and who do not need additional training when entering the world of work. Today, the curricula of professional higher education are based on occupational qualification standards, and the students have a possibility to obtain a professional qualifications certificate when graduating. When an occupational qualification standard changes, so does the curriculum. The development of innovation and technology happens where it is supported by an educated workforce.

Today slightly problematic is the competition-based financing model for UAS governed by the Estonian Ministry of Education and Research. No funding for applied research is included in this model. Further analysis is needed, e.g. which activities could be jointly organised in the current system. Although the UAS prefer autonomy in their actions, jointly offered services and actions could be organised through a roof organisation (RCUAS).

The factors that will ensure the distinctive identity of UAS: a) lecturer/teacher profile; b) curricula (share of practical training); c) cooperation with employers; d) learning environment; e) practical and applicable in-service training; f) applied research and its funding; g) increase of life-long-learning programmes. The education system of the future should be more open and flexible. Creativity and individuality should be favoured and encouraged. Social skills and creativity are decreasing among young people. They should be taught to be more open and curious in order to find new possibilities. In today's system, young people are accustomed to preconditioned activities, the roots of which are in secondary school education. Generation Y (1982-2002 [also known as the Millennials]) is characterized as highly skilled according to the accessibility of technology, the internet, mobile phones, and social networking. Ransdell et al (2011) concluded that:

"Younger students groups show poorer knowledge application skills and are more self-reliant than older students. Older student groups were better at knowledge application, that go 'beyond the information given'. Older students' active participation and social reliance contributed to better knowledge application. Instructors teaching millennial-age students need to encourage active, meaningful participation in applying knowledge". Therefore, it is absolutely necessary to direct and encourage middle-aged and older people more towards professional higher education - either to continue the education that has never been completed or to acquire a new profession instead. Under the guidance of competent lecturers, their teaching should go smoothly and successfully.

Conclusions and further recommendations

For the future development trends in professional higher education we offer the following directions:

- Providing skills and knowledge connected to professional specialties and the needs of the world of work in the curricula of universities of applied sciences;
- Acknowledging the diversity of learning forms, including enhancing the broader use of apprenticeship study in higher education;
- Ensuring regional access to higher education, decreasing the role of location in entering higher education;
- Financing of applied research and creative activities, including achieving the steady state financing for research, development and creative activities in universities of applied sciences; having more flexibility and sources for financing research and development projects;
- Broadening the offer of life-long-learning (in-service training) programmes, supported by a suitable financing model and the needs of the world of work;
- Internationalisation and mobility of universities of applied sciences should be included to the key performance indicators: number and percentage of international students; number and percentage of international staff; number and percentage of students studying abroad and their destinations; participation in European programmes or other supranational programmes,

where relevant (in education, research and capacity building), capacity building in developing countries.

- Integration of EQF level 5 to professional higher education;
- Developing master programmes, incl. one-year master programmes primarily directed to area-specific specialisation;
- Networking of education institutions, piloting of an action-based consortium;
- Developing heterogenic financing models – considering the diversity of student profiles, e.g. a person entering professional higher education may already have a master's degree. The current model presupposes that a student follows a linear study path;
- Internationalisation and mobility of professional higher education for supporting and improving the quality of teaching, research and creative activities and for supporting smart immigration. Participation in European programmes or other supranational programmes, where relevant (in education, research and capacity building), capacity building in developing countries.
- Enhancement of digital/virtual learning and teaching. The findings of the several studies (e.g. Sarker et al, 2019) suggest that a majority of the students are found to be highly enthusiastic about the online courses. They are eager to participate and interact in the online platforms, which are somehow limited in the traditional classroom settings. E-learning can also contribute and ensure regional access to higher education.

For curriculum development we offer the following directions:

- Decreasing the fragmentation of subjects in curricula and enhancing the integration of subjects inside and over curricula;
- Finding a reasonable balance between general secondary education subjects and specialty subjects in the process of preserving the relevance of shorter study programmes;
- Taking into account the needs of the world of work (creating even more practical study programmes focusing on the development of specialty skills);
- Enhancing research, development and creative, as well as e-learning activities in universities of applied sciences and integration of research, development and creative activities to study process.

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EFFECT OF KINESIOLOGY TAPING AFTER ROTATOR CUFF TEAR

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Annotation

The purpose of this study was to compare clinical results utilizing two distinct physiotherapy protocols for pain, range of motion and muscle strength. The use of kinesiology tape has become an increasingly popular treatment aimed at reducing musculoskeletal pain and improving function. The novelty of this study is determined by the fact that the effect of physical exercises and kinesiology taping technique on individuals with rotator cuff injuries will be analyzed. Therefore, it was chosen as an intervention applied in conjunction with physiotherapy without kinesiology taping.

Keywords: *rotator cuff, kinesiology taping, rupture.*

Presentation of the problem: A rotator cuff tear is a common injury to the shoulder musculature. Although kinesiology taping is most commonly used in sports medicine, there is increasing of research proving the benefits of this method in the rehabilitation of orthopedic-traumatological injuries. There is still a lack of literature on the effects of including kinesiology taping in a physiotherapy program on shoulder joint function after rupture of a rotator cuff. [6;8]

The aim of the research: To determine the effect of kinesiology taping on shoulder joint function after rotator cuff tear.

Research objectives:

1. To assess pain, evaluate the active range of motion performed in the shoulder joint, evaluate manual and isometric muscle strength before and after physiotherapy, including kinesiology taping in the physiotherapy program, for individuals after tear of the rotator cuff.

Methodology

Organization of the study: An empirical study was conducted to compare the effect of different methods of physiotherapy on patients in the second rehabilitation period at 8 weeks after rotator cuff tear. Before the research, the purpose of the research and its benefits for the participants were explained to the respondents. In order to maintain a balance between the researcher's desire for objective information and the safety of the subject, the researcher undertakes to assess the information provided, the competence, volunteering and understanding of the participants. The investigator undertakes to strike a balance between ethical issues such as dignity, privacy and confidentiality at the end of the investigation. *Subjects*: 30 individuals (men and women) between the ages of 38 and 55 with primary rehabilitation after tear of the rotator cuff. The characteristics of the subjects are presented in Table 1. Patients were randomly divided into two groups. Control (N1) subjects (n = 15) underwent a 14-day physiotherapy program were performed active exercises to increase the range of motion and additional 3 times a week of water physiotherapy. For the study group (N2) respondents (n = 15), together with the physiotherapy program, kinesiology taping tapes are glued before each physiotherapy session in water, which are instructed to be kept until the next session. Applied functional correction technique to increase proprioreceptor stimulation, stimulate movement and muscle taping to regulate muscle tone and thus facilitate healing or recovery.

Table 1

Characteristics of the subjects

Research groups	N1 (n=15)	N2 (n=15)
Age (x ± SD)	48 ± 6.19	50 ± 3.16
Weight, *kg* (x ± SD)	78 ± 10.74	80 ± 11.89
Sex, *m/f*	7/8	10/5

Research methods: Subjective results of the assessment of the shoulder pain perception recorded twice, i.y. before and after the 14 – day physiotherapy program. A visual analog pain scale (VAS) was used to subjectively assess pain perception. Subjects were asked to rate perceived pain in the shoulder joint area on a VAS pain scale from 0 to 10 points [6]. During the study, the mobility of the shoulder joint was assessed with a standard goniometer. Goniometry is identified and widely used as a method of estimating the range of motion (ROM) of the "gold standard ". The estimation of active range of motion consist of: flexion, extension, abduction, internal rotation, external rotation [4]. The muscle strength of the injured arm was assessed by Manual Muscle Testing on a 5 – point scale according to the R. Lovett [2]. Isometric evaluation of muscle strength was performed using a manual dynamometer (*Lafayette Manual Muscle Tester, Model 01165, Lafayette Instrument Company, USA*) Tests were performed in standing and siting positions according to the muscle groups tested [7]. Statistical analysis was performed using SPSS 19.0 (Statistical Package for Social Sciences) and Microsoft Office Excel 2018 computer programs. Quantitative variables are presented as arithmetic mean (x) and standard deviation (± SD). The Stjudent t criteria was used to compare the means of the two dependent results. The level of significance was chosen to evaluate the reliability of statistical hypotheses when $p < 0.05$.

Analysis of results

Visual analog scale evaluation results

A visual analog scale was used to subjectively assess the effect of the applied physiotherapy on the perceived pain in the shoulder joint area before and after physiotherapy. It was found that in the group of subjects N1 the pain decreased significantly ($p < 0.05$) from 6.4 ± 1.07 to 5 ± 1.05 points. In the study group, N2 pain decreased significantly ($p < 0.05$) from 5.3 ± 1.56 to 2.9 ± 1.19 points. Assessing the results between the groups, it was found that the alteration in perceived pain was significantly ($p < 0.05$) higher in the N2 group treated with kinesiology taping compared to the N1 group treated with the physiotherapy program. Alteration in group N1 1.4 ± 0.84 points, in group N2 2.4 ± 1.26 points (Figure 1).

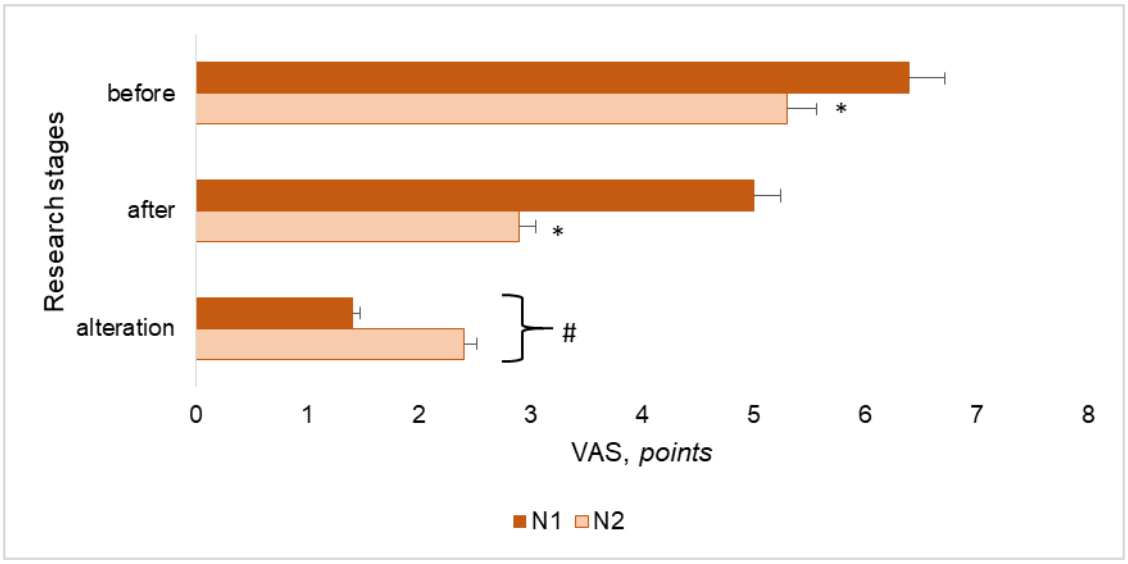

Fig. 1. Results of visual analog scale evaluation before and after the applied physiotherapy program.

*Note: * - significant difference between results ($p < 0.05$). # - significant difference between groups.*

Range of motion evaluation results

Table 2 presents data on the alteration of active ROM in the shoulder joint before and after the applied physiotherapy program. The amplitude of flexion increased significantly ($p < 0.05$) in both study groups: N1 alteration 25.5 ° ± 8.32, N2 alteration 34.5 ° ± 10.91. When evaluating the results between the groups, it was found that the increase in the flexion ROM was significantly ($p <0.05$) higher in the study group N2 compared to the study group N1.

ROM on arm extension increased significantly ($p < 0.05$) in both study groups: N1 increased by 13.5 ° ± 6.68, N2 increased by 15.5 ° ± 4.38. No significant differences ($p > 0.05$) were found between the groups when evaluating the results of the alteration in the extension ROM. The abduction ROM increased significantly ($p < 0.05$) in both study groups: N1 increased by 22.5 ° ± 9.51, N2 increased by 26.5 ° ± 7.83. No significant differences ($p > 0.05$) were found between the groups.

The ROM on internal rotation increased significantly ($p <0.05$) in both study groups: N1 increased by 10.5 ° ± 4.97, N2 increased by 12.5 ° ± 6.34. When evaluating the results of the change in the ROM of the internal rotation of the arm, no significant differences were found between the groups ($p > 0.05$).

The ROM on external rotation of the arm increased significantly ($p < 0.05$) in the N2 study group: 9.5 ° ± 2.83. There were no significant differences in the N1 study group 1.6 ° ± 2.36. When evaluating the results between the groups, it was found that the increase in the ROM of the external rotation of the arm was significantly ($p < 0.05$) higher in the study group N2 compared to the study group N1.

Table 2

Active range of motion in the shoulder joint results after physiotherapy

Movement	**N1**	**N2**
Flexion		
Before physiotherapy (x±SD) *(active movement with gravity eliminated)*	85.5° ± 18.32	97.5° ± 20.17
After physiotherapy (x±SD)	111.0° ± 17.91	132.0° ± 21.37
Alteration (x±SD)	25.5° ± 8.32*#	34.5° ± 10.91*#
Extension		
Before physiotherapy (x±SD) *(active movement with gravity eliminated)*	27.0° ± 8.88	28.5° ± 7.47
After physiotherapy (x±SD)	40.5° ± 7.97	44.0° ± 8.76
Alteration (x±SD)	13.5°± 6.68*	15.5° ± 4.38*
Abduction		
Before physiotherapy (x±SD) *(active movement with gravity eliminated)*	70.5° ± 17.86	73.5° ± 23.92
After physiotherapy (x±SD)	93.0° ± 24.51	100.0° ± 23.02
Alteration (x±SD)	22.5°± 9.51*	26.5° ± 7.83*
Internal rotation		
Before physiotherapy (x±SD) *(active movement with gravity eliminated)*	30.5° ± 5.98	38.5° ± 6.68
After physiotherapy (x±SD)	43.0° ± 8.56	49.0° ± 4.35
Alteration (x±SD)	10.5° ± 4.97*	12.5°± 6.34*
External rotation		
Before physiotherapy (x±SD) *(active movement with gravity eliminated)*	17.5° ± 2.63	18.0° ± 4.83
After physiotherapy (x±SD)	19.1° ± 3.84	27.5° ± 4.24
Alteration (x±SD)	1.6° ± 2.36#	9.5° ± 2.83*#

*Note: * - significant difference between results ($p < 0.05$). # - significant difference between groups.*

Results of manual muscle strength testing according to the R. Lovett scale

Manual muscle testing according to the R. Lovett scale was chosen to determine the muscle strength of arm flexors, extensors, abductors, and those involved in internal and external rotation. The results of the study group N1 are presented in Figure 2. After the analysis of the data, it was found that in the group of subjects N1, when applying the usual physiotherapy program, there was a significant ($p < 0.05$) increase in arm flexors (from 2.2 ± 0.42 points to 3.1 ± 0.73 points), extensors (from 2.2 ± 0.41 points to 3.1 ± 0.73 points), abductors (from 2.2 ± 0.42 points to 3.2 ± 0.63 points) and internal arm rotation (from 2.1 ± 0.31 points to 2.6 ± 0.52 points) of the participating muscles, but there are no significant ($p > 0.05$) differences in the alteration in the strength of the muscles involved in the external rotation of the arm (from 2.1 ± 0.32 points to 2, 3 ± 0.48 points).

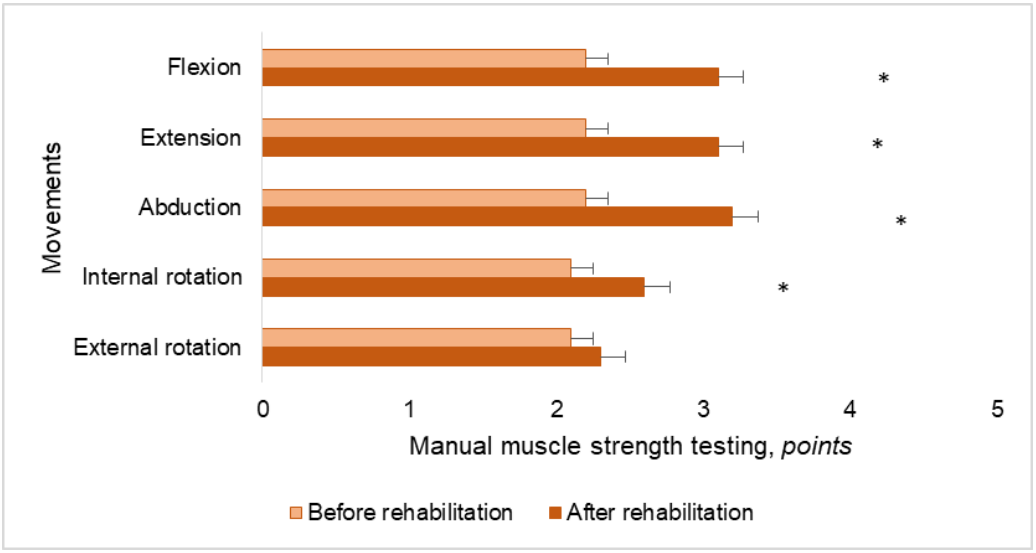

Fig. 2. Manual muscle strength according to the R. Lovett scale N1 group results

*Note: * - significant difference between results.*

The results of the study group N2 are presented in Figure 3. Analysis of the data showed that in the N2 study group, when physiotherapy combined with kinesiology taping, there was a significant ($p < 0.05$) increase in the strength of all muscles involved in shoulder joint movements: flexors (from 2.1 ± 0.32 points to 3.8 ± 0.42 points), extensors (from 2.1 ± 0.32 points to 3.9 ± 0.32 points), abductors (from 2.1 ± 0.32 points to 3.9 ± 0.32 points), muscles involved in the internal rotation (from 2.1 ± 0.32 points to 3.7 ± 0.48 points), muscles involved in the external rotation (from 2.1 ± 0.32 points to 3.3 ± 0, 48 points).

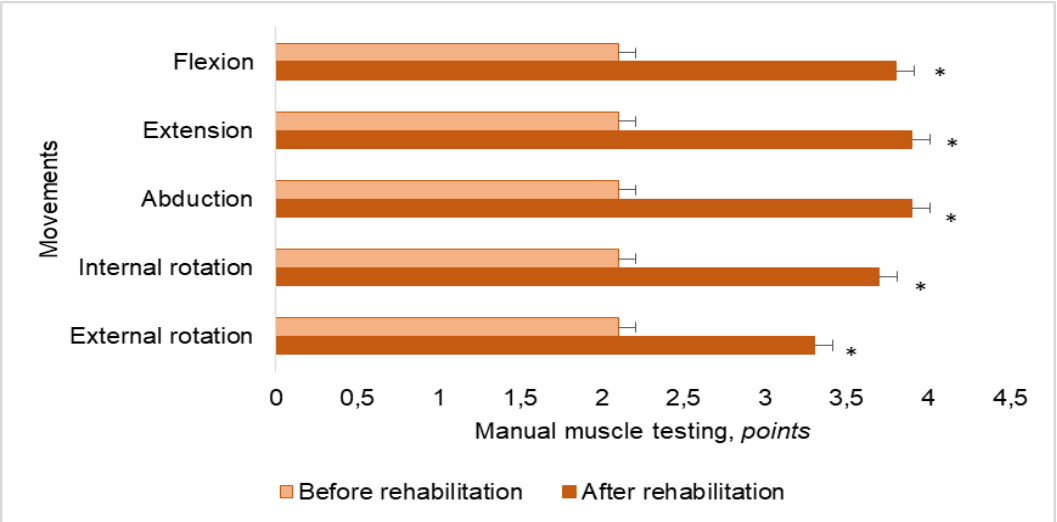

Fig. 3. Manual muscle strength according to the R. Lovett scale N2 group results

*Note: * - significant difference between results.*

Comparing the alteration of muscle strength between the groups, using manual muscle testing according to R. Lovett 's scale, it was found that the alteration of muscle strength was significantly ($p < 0.05$) higher in the N2 respondents compared to the N1 respondents (Fig. 4). The largest difference was found by analyzing the results of muscle strength of internal and external rotation. In the group of subjects N1, the strength of the muscles participating in the internal rotation increased on average by 0.5 ± 0.53 points, the change in muscle strength in the group of subjects N2 increased significantly ($p < 0.05$) by 1.6 ± 0.52 points. In the group of subjects N1, the strength of the muscles participating in the external rotation increased on average by 0.2 ± 0.42 points, the change in muscle strength in the group of subjects N2 increased significantly ($p < 0.05$) by 1.2 ± 0.63 points.

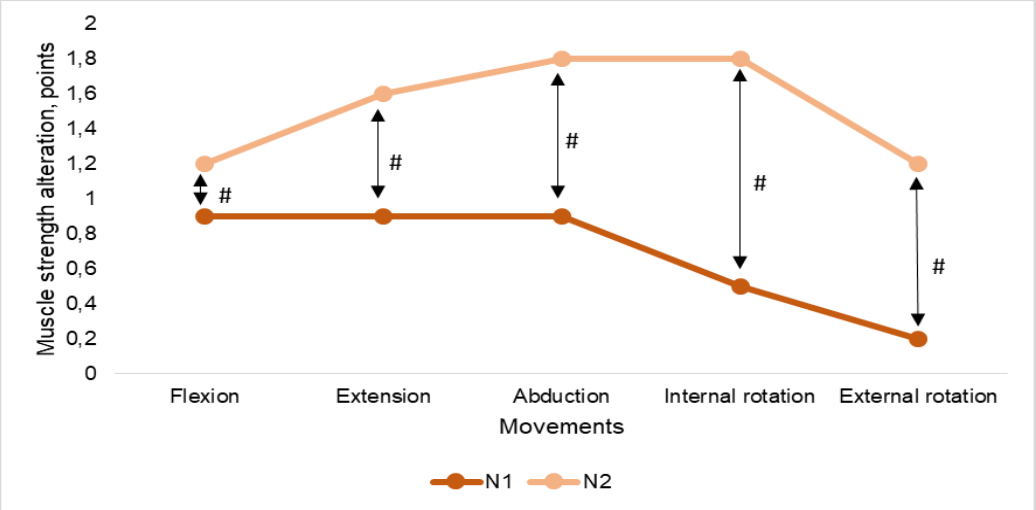

Fig. 4. Alteration differences between groups using manual muscle testing on the R. Lovett scale

Note: # - significant difference between groups.

Results of isometric muscle strength assessment

No significant ($p > 0.05$) differences were found in the evaluation of isometric muscle strength in the study group N1, but the analysis of the data shows that the isometric force has a tendency to increase. The results of isometric muscle strength before and after physiotherapy are presented in Table 3. The analysis of the data showed that in the study group N1 the largest alteration in isometric muscle strength during arm abduction: from 2.19 ± 0.42 kg to 3.53 ± 0.47 kg. The least changed in isometric muscle strength of the muscles involved in the external rotation of the arm, from 1.73 ± 0.32 kg to 2.36 ± 0.36 kg.

Table 3

Results of isometric muscle strength

	Before physiotherapy	After physiotherapy	Alteration
N1			
Flexion (x±SD), *kg*	2,79 ± 0,61	3,47 ± 0,52	0,68 ± 0,38
Extension (x±SD), *kg*	1,05 ± 0,57	1,72 ± 0,58	0,67 ± 0,25
Abduction (x±SD), *kg*	2,19 ± 0,42	3,53 ± 0,47	1,34 ± 0,44
Internal rotation (x±SD), *kg*	2,77 ± 0,52	3,61 ± 0,54	0,84 ± 0,32
External rotation (x±SD), *kg*	1,73 ± 0,32	2,36 ± 0,36	0,63 ± 0,25
N2			
Flexion (x±SD), *kg*	2,60 ± 0,31	5,21 ± 0,43	2,61 ± 0,61*
Extension (x±SD), *kg*	1,33 ± 0,59	2,34 ± 0,35	1,01 ± 0,39
Abduction (x±SD), *kg*	1,81 ± 0,11	5,44 ± 0,20	3,63 ± 0,31*
Internal rotation (x±SD), *kg*	2,78 ± 0,46	4,05 ± 0,55	1,27 ± 0,31
External rotation (x±SD), *kg*	1,78 ± 0,26	3,12 ± 0,22	1,34 ± 0,33

*Note: * - significant difference between results.*

Analyzing the results of the N2 study group, a significant increase in isometric muscle strength ($p < 0.05$) was found in the arm flexor and abductors muscle groups. The largest

change was found in the isometric force of the muscles involved in arm abduction from 1.81 ± 0.11 kg to 5.44 ± 0.2 kg, the least changed was found in the isometric force of the muscles involved in arm extension from 1.33 ± 0.59 kg to 2.34 ± 0.35 kg.

Comparing the results between the study groups, a significant ($p < 0.05$) difference in the isometric muscle strength alteration was found when assessing the isometric muscle strength of arm abductors (Figure 5). Alteration in the study group N1 1.34 ± 0.44 kg (from 2.19 ± 0.42 kg to 3.53 ± 0.47 kg). The alteration in the study group N2 was 3.63 ± 0.31 kg (from 1.81 ± 0.11 kg to 5.44 ± 0.20 kg).

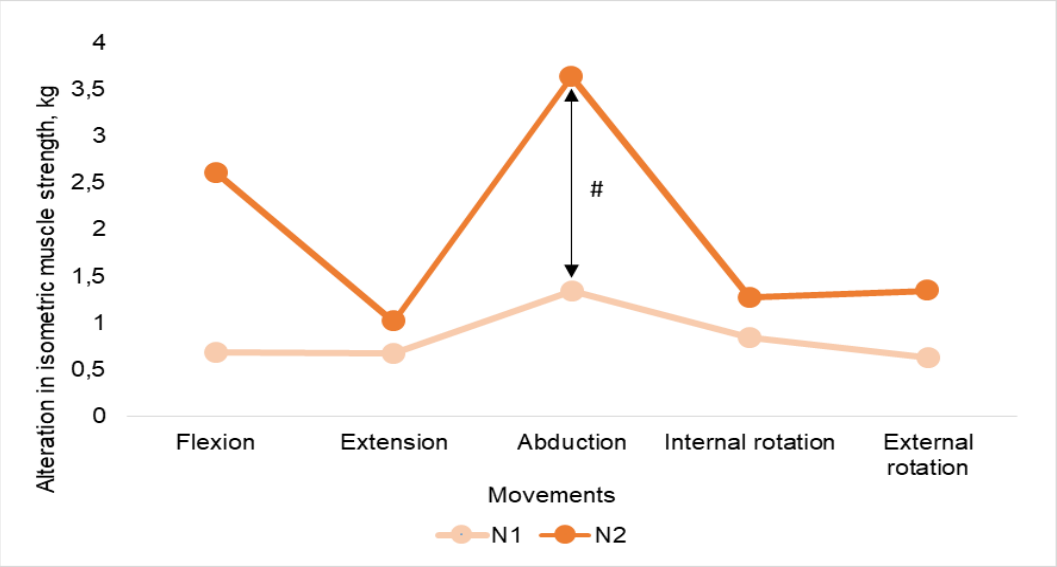

Fig. 5. Alteration differences between groups in isometric muscle strength.
Note: # - significant difference between groups.

Discussion

Kinesiology taping is most often used in sports medicine, but with the increasing number of studies proving the benefits of this method, it is increasingly used in the physiotherapy of orthopedic - traumatological injuries. physiotherapy protocols often recommend the application of kinesiology taping (KT) to decrease pain and enhance motion control. KT is an elastic acrylic adhesive tape, that supports and stabilizes muscles and joints without restricting the range of motion (ROM). The aim of the study was to determine the advantage of kinesiology taping in reducing pain by increasing the range of motion performed in the shoulder joint, restoring lost functionality compared to physiotherapy program in patients after rupture of the rotator cuff.

Injuries of rotator cuff muscles: supraspinatus, infraspinatus, subscapularis, teres minor are one of the many causes of pain in the shoulder arch region [1]. The study found that the inclusion of kinesiology taping in a physiotherapy procedure significantly reduced the pain. Bolach (2019) and co-authors compared perceived pain on the VAS scale to women who underwent physiotherapy procedures after a rotator cuff injury and were allowed to engage in active physical activity with women who restricted their activity to physiotherapy procedures only. The researchers found a significant reduction in subjective pain only in the group of active women. Compared to the results of our study, a greater reduction in pain is recorded in the traditional rehabilitation program by including kinesiology taping, so it can be argued that complex treatment when more methods are included in the rehabilitation program may have better results. The results of our study confirm the results presented by Coskun and co-authors (2018) that the application of kinesiology taping significantly reduces the perceived pain on the VAS scale compared to the traditional rehabilitation procedure.

Muscle damages also causes changes in biomechanics [1]. When assessing individuals after rupture of the rotator cuff, one of the main complaints during the survey was stiffness and decreased range of motion. The reduced range of motion performed in the shoulder joint impairs functional movements when the injured dominant arm is difficult to service. We evaluated the effect of traditional rehabilitation, and when rehabilitation treatment includes kinesiology tapings on the change in the range of motion of active movements in the shoulder joint. We found that concomitant application of kinesiology taping significantly increases the amplitude of arm flexion and external rotation compared to traditional rehabilitation, which does not significantly affect the change in amplitude of external arm rotation.

During the study, patients performed only active movements, no manual interventions were applied. Recent studies have shown that manual rehabilitation is included in the rehabilitation program 6 weeks after surgery and post isometric relaxation significantly increases the range of motion of passive movements within 2 weeks, and full amplitude can be recovered from 4 to 5 weeks by passive movements [6]. The findings of the analyzed research show that kinesiology taping increases the range of motion performed in the shoulder joint, and helps to restore functionality compared to normal rehabilitation. This may be related to the mechanisms of sensomotoric and proprioreceptive effects provided by the kinesiology band [3].

One of the reasons why it is difficult to assess the strength of the muscles surrounding the joint itself is the pain felt, which also limits the amplitudes of the movements performed. Decreased muscle strength and atrophy of the deltoid and supraspinatus muscles are secondary symptoms resulting from upper limb immobilization after injury [1]. Other authors hypothesize that the isometric force of the muscles that rotate the arm is lower due to patients 'fear of movement [5]. The results of our study confirm this hypothesis. Subjects in both groups showed lower than usual isometric external rotational muscle strength, but subjects in the first group who underwent a routine rehabilitation procedure were more likely to report fear of rotational movements due to possible instability and pain. Respondents subjected to kinesiology taping showed greater strength, but the difference is not significant. The subjects also indicated that they did not feel fear of instability, but there was muscle weakness. It can be stated that the study did not show a significant change in muscle strength due to the duration of rehabilitation, as the focus was on reducing pain and increasing the range of movements.

An analysis of the study data and scientific literature suggests that kinesiology taping can be integrated into a physiotherapy procedure for individuals experiencing rotator cuff rupture for faster function recovery and pain reduction.

Conclusions

The inclusion of kinesiology taping in a physiotherapy program significantly reduces subjectively perceived pain in the shoulder joint area, helps to significantly increase the range of motion of arm flexion and external rotation, exhibit significantly greater muscle strength on the Lovett scale show significantly higher isometric arm abductor muscle strength in individuals after tear of the rotator cuff compared to conventional physiotherapy.

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THE COMPARATIVE ANALYSIS OF INTERCULTURAL COMMUNICATION OF ŠIAULIAI CITY MUNICIPALITY PUBLIC LIBRARY AND JELGAVA CITY LIBRARY FROM THE EMPLOYEES' STANDPOINT

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Annotation

The comparative analysis of both institutions showed different ways of intercultural communication in libraries: ŠL cooperates with volunteers from abroad, JCL collaborates with trade unions of national minorities. Differences in intercultural communication are found in this case – different work style and language. Both libraries have been found to work together in joint project activities. Libraries did not have major conflicts in the process of intercultural cooperation, the biggest obstacle (difficulty) was the linguistic barrier.

Key words: *intercultural communication, library, employees, comparative analysis, similarities, differences.*

Introduction

Relevance of the topic. Taking into account the current-day actualities and processes driven by globalization, proper communication is one of the key aspects of cultural educatedness. It can be noticed that this phenomenon is becoming increasingly significant for the organizations involved in particularly frequent communication due to cooperation with foreign partners. Intercultural communication provides sufficient conditions for communication with each other at the international level. Communication between cultures provides an opportunity to comprehensively implement new ideas, projects, acquire new competencies or improve existing ones. However, as noted by L. Qili and C. Dong (2016), the area of intercultural communication often lacks knowledge of other cultures.

Not only the public but also many organizations involved in intense intercultural communication manifesting itself by cooperation, project activities, and similar forms with other foreign organizations become much more open and gradually more economically successful. Although, as stated by V. Pruskus (2012), intercultural communication as a field of research (subject) is relatively new, interculturalism is emphasized as one of the essential and most relevant aspects of work for many organizations, seeking successful performance. Based on the said context, it can be argued that intercultural communication is becoming an increasingly broad area of research for both researchers and practitioners seeking to find optimal ways for improving and ensuring efficient communication between individuals and organizations from different cultures.

It is noted that the topics of intercultural communication are analysed by foreign and Lithuanian authors: B. Gwiazda-Rzepecka (2017), A. Andreyeva et al. (2015), D. Baraldsnes (2012), V. Gudoniene (2013), V. Pruskus (2012), etc., who mainly analyse the conception of intercultural communication and its functions. The importance of intercultural communication competencies is highlighted by A. Srbinovska Donchevski and T. Ashtalkoska Baloska (2018), V. Pruskus (2012), D. Janavičienė and A. Gedvilaitė (2011). The topics of intercultural communication in the library are studied by both foreign authors (Eshleman, 2016; Gashurov, Kendrich, 2013; Verschore, Balestrin (2008)) and Lithuanian researchers (Dambrava, 2013; Janavičienė, Gedvilaitė, 2011; Neverauskas et al., 2009).

The research problem. Along with the growing communication flow and popularity of social networks, new opportunities emerge for information exchange, communication and

cooperation regardless of borders, countries, races, and nationalities. On the other hand, the increasing flows of information lead to additional challenges: it becomes increasingly important to understand the significance of intercultural communication, investigate new ideas, select the best practice, and look for meaningful opportunities for strengthening partnership and understanding in both daily and work environments. K. Gore (2007) states that business can be like a driving force, but one needs to understand the language and other people's culture. Similarly, according to N. Abayadeera et al. (2018), the ability to communicate effectively in all cultures increases success in the global market, enables productive interpersonal relationships, and reduces mutual misunderstanding. It must be emphasized that not only businesses but also other organizations such as libraries increasingly often understand and seek the benefit of intercultural communication.

The development of technologies and innovations is also accompanied by the change in societal habits and perception (Bing, 2017). According to A. Glosienė (2010), the essence of library activities lies in communication; i.e., transfer and dissemination of knowledge, information, and cultural values. Based on this principle, libraries of Scandinavian countries are recognized as one of the best in the world. The libraries of these countries surprise by the high and constantly growing quality standards of activities and various on-going intercultural cooperation projects. This only confirms that the library not only issues books to readers but also communicates important information and knowledge to the public, performs an important function of intercultural integration. The importance of intercultural communication is also confirmed by V. Pruskus (2012), whose research reveals that the library needs to maintain communicative relations with organizations from different countries.

Based on the said context, the following **problem question** is raised: How does intercultural communication of libraries of different countries take place?

The research object is intercultural communication of Šiauliai City Municipality Public Library and Jelgava City Library.

The research aim is to analyse intercultural communication of Šiauliai City Municipality Public Library (hereinafter, ŠL) and Jelgava City Library (hereinafter, JCL) from the standpoint of employees.

Research tasks:

1. To determine the influence of intercultural communication on the activities of ŠL and JCL;
2. To identify the most developed areas of intercultural communication in ŠL and JCL;
3. To define the forms of intercultural communication in ŠL and JCL;
4. To highlight differences of intercultural communication in ŠL and JCL.

Research methods and tools:

1. The analysis and synthesis of scientific literature.
2. A qualitative research (interview).
3. A comparative content analysis.

Literature Review

The conception of intercultural communication. O. A. Andreyeva, S. K. Tuleubayeva et al. (2015) name intercultural communication firstly as communication; similarly, communication is distinguished by D. Baraldsnes (2012) and G. Dubauskas (2006): in the first case, it is communication between personalities speaking different languages; in the second, communication between cultures; and in the third, interpersonal communication is indicated.

Other authors such as V. Gudonienė (2013) and V. Pruskus (2012) name intercultural communication as a field of science. V. Gudonienė (2013) states that this is the field of science, focusing on differences and similarities in communication of cultures of different countries, while V. Pruskus (2012) notes that intercultural communication constitutes theoretical interests of several fields of science.

Intercultural communication as information exchange is defined by D. Baraldsnes (2012), V. Baršauskienė and B. Janulevičiūtė-Ivaškevičienė (2005), all of them stating that it is the process of information exchange between people representing different cultures.

Thus, different authors define the conception of intercultural communication differently, but all definitions have the following features in common: different cultures, information exchange, and the communication process. Such variety of definitions of intercultural communication enables to highlight different existing approaches to the conception of intercultural communication.

According to V. Gudonienė (2013), the required knowledge about the main features of other cultures reduces surprises, provides advance insights and helps to communicate with the

representatives of other nations more successfully. In intercultural communication, knowledge of national peculiarities is particularly important for the representatives of international business. This is significant not only for organizations related to tourism, advertising, education and cultural exchanges but also in everyday life, as globalization and integration processes lead to an inevitable encounter with people from other cultures.

One of the most important factors, implementing all functions of intercultural communication, is acquisition of intercultural communication competencies enabling proper perception of the barriers to intercultural communication (Gwiazda-Rzepecka, 2017). Another very important function of intercultural communication is to identify and constructively solve different types of conflicts. D. Baraldsnes (2012) states that interest in intercultural conflicts has been especially increasing for more than fifteen years. Conflicts arise due to a wide range of reasons. According to V. Pruskus (2012), the main cause of intercultural conflicts is differences in nationalities, which can provoke certain contradictions. This explanation is supplemented by D. Baraldsnes (2012) who states that this is the emotional despair or non-fulfilment of expectations of persons from different cultures, when different values, norms, strivings, limited resources are incompatible in the intercultural interaction (p. 171). Because the modern society is not culturally homogeneous – it has different values and norms, tensions and misunderstandings are inevitable. Therefore, in order to maintain good intercultural relationships, intercultural communication recognizes arisen conflicts and looks for ways to manage and resolve them (Pruskus, 2012).

Thus, it is important in intercultural communication to recognize cultural differences and properly communicate with people from other cultures, identify and constructively resolve different types of conflicts, overcome communication barriers, identify peculiarities of interpersonal relationships in multicultural organizations, and analyse cultural similarities and differences.

According to L. Kazykhankyzy and A. Nuray (2019), perception is one of the most important things for acquisition of cultural communication and competence skills. There are three main kinds of intercultural competence – linguistic, communicative and cultural, which promote cross-border research, help to develop projects, organize transnational trainings, correct behaviour or cope with potential conflicts, and etc. These three competencies of intercultural communication are particularly necessary for a modern expert. Based on the principle of communication and tolerance, they form a basis for professional mobility, preparation for rapidly changing living conditions, increase opportunities for professional realization (Andreyeva et al., 2015; Dolan, Kawamur, 2015; Srbinovska-Donchevski, Ashtalkoska Baloska, 2018; Norhafezah et al., 2019).

Manifestation of intercultural communication in library activities. Employees are an important factor determining intercultural communication and its successful dissemination in public libraries. The IFLA Multicultural Library Manifesto (2010) accentuates that library employees are an active mediator between users and resources. Such employees mirror the community's cultural and linguistic type in order to ensure intercultural understanding, to reflect the community served by the library, and to promote communication. **This manifesto emphasizes that the diversity of cultures and languages is a common heritage of the humanity and must be nurtured and protected for the benefit of all. It says that it is a source of exchange, novelties, creativity and peaceful coexistence between people. Respect to cultural diversity, tolerance, dialogue and cooperation in an atmosphere of trust and common understanding are among the best guarantees of international peace and security. Therefore, all types of libraries must reflect, support and promote cultural and linguistic diversity at international, national and local levels, this way seeking intercultural dialogue and active citizenship.**

The IFLA Multicultural Library Manifesto also highlights that the key function of libraries is to serve various interests and communities. Libraries must act as centres of learning, culture and information. Given cultural and linguistic diversity, libraries must ground their services on the commitment to provide access to information and knowledge, based on the principles of fundamental freedoms and equal opportunities for all with regard to cultural identity and values.

Libraries can carry out intercultural communication by choosing not one but several areas of activities. There are quite many of them, but, according to D. Janavičienė and A. Gedvilaitė (2011), cooperation, project activities and digital services for non-nationals are the most important and most mentioned while developing the field of intercultural communication in libraries.

Today, cooperation between organizations is becoming increasingly important and is an essential feature of organizational life. It opens up opportunities to effectively pursue set goals, learn from others, acquire leadership knowledge and initiative in implementing various ideas. I. Gashurov and C. L. Kendrick (2013) name the reasons for cooperation: if we do not contribute

to building the future, the future may not accept us. Organizations or separate individuals working together can become an integral part of the future. Cooperation, like competition, always goes side by side. Implementation of various cooperation projects contributes to the focus on human factors: trust, commitment, culture of cooperation. By establishing and maintaining cooperation relationships, we can discover or increase new opportunities in the field of introducing innovations, creating new added value for both organizations and their employees individually (p. 36). It is important to emphasize that various companies and organizations increasingly become more open for cooperation not only in their own country but also on the international (intercultural) scale.

The library is one of the organizations that promotes uniting of different cultures by ensuring the availability of information and culture for everyone, regardless of the person's race, nationality, and culture. Another important factor determining successful intercultural communication in libraries is employees who are an active mediator between users and resources (Janavičienė, Gedvilaitė, 2011). Such employees reflect the community's cultural and linguistic type, seeking to ensure understanding of cultures, take into account the community served by the library, and promote interaction. Although libraries perform quite a number of intercultural activities, the main and most important distinguished activities are cooperation, project activities and digital services for non-nationals (Gashurov, Kendrick, 2013).

I. Gashurov and C. L. Kendrick (2013) point out that many initiatives of libraries have disappeared due to the lack of communication, due attention, and consistent leadership. Library cooperation is related to risks and reward, the benefit of which may be difficult to prove before beginning the project. It is difficult to justify the limited resources allocated for the project to support various initiatives. It is therefore important for organizations to know and seriously decide when to cooperate and when not to. Sometimes, excessively intense cooperation involving too many countries leads to low efficiency or overestimation of the project.

I. Gashurov and C. L. Kendrick (2013) present one of several successful examples of library cooperation through project activities – the BeCAP project. Having merged with Princeton and Columbia Universities, the New York Public Library sought to develop scientific research. This project allowed the partners to set up larger study spaces, preserve historical book collections, and etc. Although every party had different organizational styles, their strengths supplemented each other, provided knowledge and benefit, new experiences. Such division of labour management throughout the project was a very important factor that has led to great achievements. This example of cooperation through project activities demonstrates that libraries have great potential and a wide range of opportunities. Thus, proper communication, developing joint projects, becomes an integral part of the future.

Project activities are a popular form of cooperation carried out by libraries, because relevant problems of efficiency and quality of performance are solved and ways and methods of activities are developed or adjusted in a relatively short period of time. Libraries working together on the project find it easier to cope with many challenges and simpler to adapt to the competitive environment, introduce innovations and learn required competencies from each other.

One more important area of intercultural communication activities in the library is to ensure services not only for the citizens of one's own country but also to adapt them to foreigners' needs.

Libraries seek to expand intercultural cooperation not only with other organizations but also within library activities. According to D. Janavičienė and A. Gedvilaitė (2011), libraries often create information leaflets about library activities in English, Russian and other languages. Public libraries also often issue information publications providing information for foreigners where they can study, find a job, a place of residence, and inform about various cultural events. Cooperating with other institutions or centres that are concerned with foreigners' integration into the society, libraries compile lists of newly acquired books and periodicals, from which those institutions order certain publications, etc. Electronic services are also being expanded. This proves that libraries provide information to the population not only in Lithuanian, but also in the most popular foreign languages: English, Russian, and etc.

D. Janavičienė and A. Gedvilaitė (2011) distinguish the following main public library services for foreigners: electronic catalogues; International Interlibrary Loan (ILL); information resources; foreign language training courses; projects and programs; immigrant centres; elementary learners' dictionaries and their publishing; other library services encouraging foreigners' children to develop reading, writing and intercultural skills.

Thus, the library is treated as an institution that disseminates education and culture, shares information and knowledge, promotes personal development and integration of citizens of other nationalities into the life of the country's society. Therefore, it is required that the library should provide services not only to its country's citizens but also expand areas of services so

that the latter can be adapted to the needs of non-nationals as well. The following main library services for foreigners are distinguished: electronic catalogues, International Interlibrary Loan, information resources, foreign language training courses, projects and programs, immigrant centres, elementary learners' dictionaries and their publishing. It should be assumed that providing these services, libraries carry out intercultural communication, promoting cooperation between citizens of different cultures, using library services.

Methodology

The period of conducting the empirical research. The qualitative research was conducted on April 16-25, 2019. The results of the qualitative research were processed and analysed in April-May, 2019.

The empirical research method. Based on the analysed intercultural communication competencies and the library's main activity areas, it was sought to analyse the intercultural communication of libraries from employees' standpoint and to perform the comparative analysis of two similar institutions. It was selected to conduct the study in one Lithuanian library – Šiauliai City Municipality Public Library (hereinafter, ŠL) and one Latvian library – Jelgava City Library (hereinafter, JCL). These libraries were chosen because of the similar size of cities and the number of users, the number of stocks and cooperation between them.

Empirical research was carried out employing the qualitative research method, aiming to investigate intercultural communication in ŠL and JCL from employees' standpoint. The research instrument – the interview questionnaire – was compiled on the basis of the analysis of scientific literature. The interview questionnaire was created by the researcher herself.

The possibility of the quantitative (questionnaire survey) research was rejected, as it would not ensure full disclosure of manifestation of intercultural communication in the organization itself as a whole as well as the most important aspects of intercultural communication manifesting themselves in the position of each individual employee.

Organization of the empirical research. The sample of the qualitative research consists of 6 informants who encounter intercultural communication in libraries. The general population of this study encompasses the analysis of two cases – ŠL and JCL; therefore, in order to ensure the accuracy of the research results, all persons who could provide sufficient information about the investigated problem were surveyed. The sample was formed regardless of informants' age and gender. Therefore, it can be stated that the sample of the study is representative as it covers the entire population of both institutions under investigation.

The informants were surveyed individually, giving all informants the same questions. The informants were presented the interview questionnaire in advance in order to ensure a smooth interview process. During the presentation, the employees of JCL requested that the interview should be conducted in writing due to the lack of time and knowledge of oral English. In order to ensure equal interview conditions for both organizations under investigation, it was decided that written interviews would also be provided to informants of ŠL.

Planning of interviews and data recording was based on the recommendations provided by K. Kardelis (2016), V. Žydžiūnaitė (2011) and R. Tidikis (2003) and the main discussed aspects of interviews. After conducting all interviews, the comparative content analysis was performed.

Methodology of the empirical research data analysis. The content of the answers to the interview questions was analysed using the *qualitative content analysis method*. Based on K. Krippendorff (1980), V. Žydžiūnaitė et al. (2005) argue that the content analysis is a reliable method because the analysed text allows to draw specific conclusions.

In the initial stage, the qualitative content analysis of interview texts was performed. The text was interpreted in accordance with the research questions raised. The informants' speeches are not corrected and edited, except for grammatical or style errors in order to correctly understand the speaker's thoughts. The semantic elements singled out in the structure of the interview text and defined are divided into categories and subcategories. Categories are integrated into the context of the phenomenon under investigation and their content is described. By grouping the informants' answers assigned to individual questions and distinguishing frequently recurring statements, categories were formulated, which were later studied in the analysis of the results of the interviews.

One of the particularly important aspects in social research is adherence to research ethics. The following basic ethical principles are distinguished in the methodological literature: clarity, voluntariness, privacy, anonymity, confidentiality, goodwill, and the like (Kardelis, 2016; Žydžiūnaitė, 2011; Tidikis, 2003). In this study, based on the code of ethics identified in the methodological literature, the above-mentioned basic ethical principles were followed.

Results

The process of intercultural communication is characterised not only by its advantages but quite often also by various obstacles, difficulties, barriers that hinder successful communication, aggravate seeking common goals, which is emphasized by many researchers as a particularly important process in all intercultural communication. The qualitative content analysis revealed main advantages and shortcomings of intercultural communication in ŠL and JCL. Two qualitative categories were distinguished: *Advantages of intercultural communication* and *Shortcomings of intercultural communication*.

The following subcategories came to prominence in the qualitative category *Advantages of intercultural communication*:

• Knowledge of new cultures: “Advantages: the opportunity to communicate with the representatives of other nations <...>”, “Advantages: it is the opportunity to learn something new about other cultures, about human thinking <...>”.

• Experience, relations: “Advantages: opportunity <...> to expand relations, business opportunities, and the like”, “ <...> to gain new knowledge, perspectives and grow ”.

• Foreign language learning: “Advantages: foreign language development, proficiency <...>”.

In the qualitative category *Shortcomings of intercultural communication*, the interviewees distinguished the following subcategories:

• Language barrier: “Shortcomings: language barrier. The language barrier creates difficulties in communicating with foreigners, correct conveyance/perception of information”,“ In my opinion, the biggest problem is the language barrier”.

• Different attitude: “<...> it falls to encounter <...> different attitude towards the same thing, situation”.

• Slow communication: “Shortcomings/difficulties: <...> partners’ inefficiency, slow communication, delays, don’t hurry to reply to messages”.

• Different temperament, traditions: “Disadvantages: <...> different temperament, traditions, different work styles”.

The majority of respondents from both ŠL and JCL emphasized that one of the biggest advantages of intercultural communication in the organization was the opportunity to meet and interact with the representatives of other cultures, enabling to learning new things. Respondents from both investigated libraries presented expansion of contacts and acquisition of new experiences as a particularly important thing as well. The interviewee from JCL added that increasing tolerance contributed to personal growth. Another advantage distinguished by the employee of ŠL was the foreign language development; however, the representatives of JCL did not present this as an important advantage, although the problem of the language barrier came to prominence in the whole context of the study. The use of the foreign language always allows to learn new phrases and words, even if the skills are not the best, which means that one can learn a lot over time.

It should be emphasized that along with the advantages of intercultural communication in libraries the study also revealed its essential shortcomings. It has been found that the employees of both libraries singled out the language barrier as the biggest shortcoming (difficulty) in communication. ŠL and JCL unanimously agree that if one does not have a good command of the main foreign language (English), he/she faces difficulties in conveying the desired message correctly and communicating important information understandably. Interviewees of both libraries answered that the language barrier sometimes caused difficulties and miscommunications. The informants of ŠL added that it was sometimes difficult to interact when the attitude to one thing or another differed and when the approach to the speed of communication varied. The response is not always fast; sometimes, employees feel response delays. The informant from JCL named another difficulty affecting communication that is not always efficient – different temperaments of interacting persons or their groups, different work styles, and traditions.

In summary, it can be stated that the employees of ŠL and JCL envisaged the following main advantages of intercultural communication: knowledge of new cultures, relations, experience, foreign language learning. The employees of ŠL and JCL identified the following shortcomings: the language barrier, slow communication, different temperament, traditions, attitude to work, work style.

Seeking to find out the forms of communication with non-nationals and foreign partners, chosen by the employees of both libraries, it turned out that the following forms dominated:

1. Written communication: “Usually in writing, but I also have to communicate orally”, “By e-mails, messages”, “I mostly use e-mail <...> ”,“ <...> we communicate by writing and speaking”.

2. Face-to-face communication: “E-mails and directly”, “When you meet, live communication. In the foreign language (in English)”, “In the meeting, of course, we communicate face-to-face. And I think it’s the best form of communication <...>”, ”We communicate by writing and speaking. Of course, the best way is the dialogue.”

To sum up, it can be stated that the employees of both libraries distinguish both written and oral communication. The informants revealed that they usually communicated with foreigners in writing (by e-mails, via social media, and the like) and face-to-face when they met, although this happened much less frequently. The interviewees of JCL emphasize that such communication when they can see the person live is the best form of communication, because seeing another person makes it easier to understand whether the interlocutor has correctly understood what has been said to him/her. The interviewees of JCL note that face-to-face communication allows to see another person’s body language, which makes it even easier to understand others.

Finding out what intercultural communication in ŠL and JCL is like, the focus was to discover the obstacles of intercultural communication and cultural differences. The qualitative category *Differences of intercultural communication* was distinguished, which reveals barriers to intercultural communication in the studied libraries through subcategories proving differences: *Mentality* and *Language Barrier.*

Based on the informants’ answers to the questions “Have you noticed any cultural differences when communicating with the representatives of another culture? What obstacles, conflicts, misunderstandings have arisen? If so, how did you adapt to it, solve it? Give examples”, it can be seen that there were almost no such obstacles and conflicts in both institutions. The interviewee of ŠL, who works with volunteers from foreign countries, stated that sometimes obstacles due to differences in mentality occurred, but solutions were always sought: “It happens. It depends on the volunteers’ mentality, the ability to adapt. If there is a situation that needs to be solved, we are always looking for solution ways.” The informants of JCL have not encountered any significant barriers to intercultural communication too; however, they acknowledge that the communication process poses some problems due to the language barrier but ways are always being sought to address this: “Yes, sometimes we don’t understand each other, but this is a problem that we accept, we got used to it and we find other ways to present information”. The head of JCL emphasized that their institution liaised not only with European but also with US organizations; however, no big cultural differences occurred: “We liaised with European and US organizations. However, cultural differences are not so obvious. All obstacles can be solved and challenges, overcome. For example, we used an interpreter’s services to successfully communicate with our partners in France. Nevertheless, the encounter with another culture only brings an even more interesting and valuable experience”.

Summarizing and comparing the responses of informants from ŠL and JCL about barriers and differences in intercultural communication, it is obvious that the employees and managers of both libraries under investigation presented the same or similar barriers and differences of intercultural communication. ŠL singled out the mentality and JCL, the language barrier as a cultural difference constituting the biggest obstacle to intercultural communication.

The qualitative research also sought to find out what manifestation and assessment of intercultural cooperation in the libraries were like. The content of informants’ answers enabled to distinguish two qualitative categories: *Manifestation of intercultural cooperation* and *Assessment of intercultural cooperation*.

The comparison between ŠL and JCL reveals that the manifestation of intercultural cooperation in the organizations differs. Intercultural cooperation in ŠL manifests itself through volunteering, project activities, and events; while in JCL, through project activities and communication with the representatives of cultural minorities. In both libraries, the common aspect of manifestation of cooperation distinguished by the informants is project activities.

The assessment of intercultural cooperation in both libraries also did not vary, the informants unambiguously named it as the organization’s benefit. The benefits of intercultural cooperation in the investigated libraries are intercultural experiences (“Incoming volunteers from other countries “bring” their cultural experience to our institution, and, at the same time, they learn from us too. Such mutual communication (cooperation) that is useful to both parties”); improvement of language skills (“At the same time, not only job-related practice but also language skills are improved <...>”); new ideas, innovativeness (“Benefits – broadening of horizons, presentation of innovative, new ideas”).

In summary, it can be stated that intercultural cooperation is important and beneficial for the library’s activities. Intercultural cooperation of ŠL and JCL manifests itself in a range of ways: in ŠL, through volunteering practice, project activities, and events; in JCL, through project activities, cooperation and communication with the representatives of national minorities. Comparing two libraries from managers’ and employees’ standpoint, it was found that ŠL did

not cooperate with the representatives of national minorities and their groups, while JCL did not participate in events and did not engage in the integration of volunteers from abroad into their activities. It can be assumed that there are not many non-nationals who live in Šiauliai or address the library, compared to JCL; therefore, ŠL does not cooperate with various trade unions of national minorities. The common aspect of manifestation of intercultural cooperation of both ŠL and JCL is project activities that manifest themselves in implementation of international projects.

The interviewees of both institutions emphasize that intercultural cooperation is important and beneficial for the library's activities. It provides the organisation's employees with intercultural communication and cooperation experience, enables to improve language skills, job-related practice and create new, innovative ideas.

This study aimed to find out how intercultural communication takes place in two libraries in Lithuania and Latvia. It was found that one of the most important aspects of manifestation of intercultural cooperation in the library for both investigated organizations was project activities. According to the interviewees of SL, project activities in intercultural communication are important because this allows to improve competencies: "Joint intercultural projects allow to improve competencies <...>", attract funding: "It is therefore important because it helps to attract funds <...>" and because of new activities: "It is therefore important as it helps <...> to come up with new activities that are useful both for the library's employees and visitors".

The informants of JCL state that the importance of project activities in the library's intercultural communication manifests itself by acquiring new contacts: "We get new contacts that also open up new opportunities for our library's development <...>", experience: "<...> We acquire experience <...> become more flexible and resilient", and by gaining recognition:" <...> we become more recognized not only locally but also internationally".

Although the employees of both libraries emphasized the importance of project activities, it was noted that both parties named it differently. ŠL distinguishes the importance of project activities due to competence improvement, attracting funding, and new activities, while JCL envisages the advantages of project activities due to new contacts, experience and recognition.

Summarizing the duties, responsibilities and competencies of ŠL and JCL informants in the library's intercultural communication, it can be concluded that project activities constitute the most important part of intercultural communication of both libraries under investigation. On-going joint projects require that all interviewees should assume the main responsibility and duty – to communicate with foreign partners, pursuing common goals. It was distinguished that the area that needed to be improved most was the linguistic competence (to improve the foreign language – English).

Being asked "What area of intercultural communication activities could your organization improve and in what ways?", the interviewees gave ambiguously coinciding answers. The analysis of the research data demonstrates that the approaches of ŠL and JCL to the improvement of intercultural communication activities differ. The majority of employees of ŠL state that intercultural communication in their organization is good enough; only one interviewee emphasizes the necessity for improvement of the linguistic competence. The informants of JCL present a more critical view of their organization. This manifests itself through different responses of all three informants: improvement of linguistic, communicative and cultural competencies, improvement of the foreign language (English) skills, and expansion of the International Relations Department. It can be assumed that differences in the attitude of employees of investigated libraries towards certain organisational improvements and shortcomings are due to cultural and personal differences that manifest themselves through the approach to work, work style, and the like.

Conclusions

1. Intercultural communication affects the activities of ŠL and JCL by attraction of funding, introduction of innovations, knowledge of new cultures, establishing new contacts, acquisition of experience and recognition, learning foreign languages and improvement of professional competencies.

2. The most developed areas of intercultural communication in ŠL and JCL are project activities and cooperation; the least, the area of digital services for non-nationals.

3. The forms of intercultural communication in ŠL and JCL are direct oral and written communication. The biggest obstacle to intercultural communication of ŠL and JCL is language (the need for the improvement of the linguistic competence).

4. Intercultural communication differs in ŠL and JCL in that ŠL cooperates with volunteers from abroad, while JCL, with trade unions of representatives of national minorities.

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ABOUT METHODS FOR ANALYSIS OF SELF-SIMILARITY OF NETWORK TRAFFIC

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Annotation

The article research networks traffic self-similarity analysis methods. Applications of Hurst statistics for calculation of Hurst coefficient, frequency/wave features estimators methods - Periodograms, Whittle, Abby-Weich have been analyzed. Suitability of employed methods for analysis was tested by the way of computer-based simulation. The analyzed methods has been tested by applying Fractan programme's R/S statistics, Selfis programme by applying time analysis and frequency/wave features' estimation methods. R. Weron's (2004) algorithm of generation of random standard stable values has been used for forming self-similar network traffic time series, where stability index α=1.8 (H=0.56). The results obtained with Fractan and Selfis show that Hurst coefficient changes from 0.53 to 0.70, the stability index changes from 0.53 to 1.89.

Key words: *self-similarity, Hurst coefficient, α-stable distribution, traffic burstiness*.

Introduction

The self-similarity phenomenon is explained by a character of network service usage which is attributed with burstiness. In fact, data is inherently "bursty" in that it occurs in short bursts of communications followed by long periods of silence. Indeed, one can characterize data communication users who wish network resources to send their data as follows: users don't warn you exactly when they will demand access; one cannot predict how much they will demand, most of the time users do not need access to network; when users ask for it, they want immediate access (Kleinrock, 2002). Such situation is often met in distance learning networks when a learner receives tasks and sends one's answers only at the same time.

Empirical research of computer network packet traffic shows that it is attributed with self-similarity (Erramilli, Narayan, Willinger, 1996, Петров, 2004, Петров, 2003, Park, Willinger, 2000, Leland, Taqqu, Willinger, Wilson, 1994). After estimating the latter feature, it is possible to adequately prognosticate the change of traffic and to apply the prognosis results in increase of network throughput and improvement or its QoS quality of service, while regulating packet latency, fluctuation restriction and packet loss transportation on data and physical OSI layers (He, Gao, Hou, Park, 2004).

In contemporary university studies, computer networks are widely used; they usually undergo unprognosticated overloads. For effective network control, monitoring of network nodes is necessary to be carried out in order to prognosticate network node's loads and overloads. Researches have proved that classical Markov's models which are widely used in estimation of classical telephone network indexes are not suitable for modelling of contemporary computer network parameters. Network parameters' estimations obtained by a classical way are not exact and lead to unreasoned prognoses (Kaj, 2002). On the base of empirical research of 10 Mbps local area network Ethernet network flow carried out at Bellcore laboratory (120 people using network services, New Jersey State) by A. Erramilli, O. Narayan and W. Willinger in 1989, it was found out that Ethernet network flow characterisations bear some fractal features and are attributed with self-similarity with long-range dependence (Erramilli, Narayan, Willinger, 1996). I. Kaj (2002) in the monograph suggests a number of methods for statistical analysis of features of contemporary communication network flows by applying opportunities of contemporary mathematical modelling. V. V. Petrov (2003) analysis network flow as a fractal process attributed with a second-row statistical self-similarity characterised by a fractal measure. Lazaros K. Gallos, Chaoming Song, Herna´n A. Makse (2007) relate fractality with self-similarity of complex networks. For modelling and description of network processes methods of non-linear analysis of self-similar processes are applied, while estimating heavy-tails and regarding asymmetry, leptokurtosis and a short-long-range memory effect which are peculiar to distributions of network flows.

The parameter of self-similarity of flows is an important index of network's operation; and there are no worked out means for its dynamic monitoring in contemporary computer networks. Self-similarity of network flow impact the following: network Quality of Service (QoS), regulation of network flow, bandwidth, decreases loss of packets, decreases delay. Such flows are attributed with heavy tails, asymmetry and leptokurtosis. QoS refers to the capability of a

network to provide better service to selected network traffic over various technologies. These technologies allow you to measure bandwidth, detect changing network conditions (such as congestion or availability of bandwidth), and prioritize or throttle traffic. For investigation of peculiarities of self-similar flows, a big number of methods are proposed. Research of self-similarity of a network is a complex task for solution of which methods and technologies are being constantly improved. Design of network self-similarity analysers is an incompletely solved scientific problem, especially in analysis of a network flow in real-time mode. Technologies of self-similarity research is a multiply task encompassing both measurement hardware and software recording and accumulating information on the flow; also, it includes analysers of accumulated data and selection and estimation of theoretical models of a self-similar flow. Familiar computer programmes for network flow research operate with data files prepared in advance; for their management, a graphic interface without team management means, *Fractan*, *Selfis*, etc. is used. Data measurement and accumulation in a computer network must be carried out in real-time mode and not interfere computer's work. Analysis means also must be attributed with pace ensuring dynamic flow analysis. Thus, methods that are reliable but computer time consuming ones are not suitable for analysis as a maximum method; that is why it is best to apply robust analysis methods.

This work aim is by using freely distributed programmes to estimate parameters data flow of network node by applying the algorithm of simulation of time series for validation of results.

1. Methods for analysis of self-similarity

One of the most popular methods for calculation of self-similarity is application of *Hurst* statistics for estimation of *Hurst* coefficient. *Hurst* statistics are applied for time series x_t^{Θ} not satisfying normal distribution (Beran, 1998). According to G. Samorodnitsky (2006), stochastic process $Y(t), t \geq 0$ is self-similar if it is possible to find such H which would satisfy the equation for all *c>0*:

$$(Y(ct), t \geq 0) \stackrel{d}{=} (c^H Y(t), t \geq 0). \qquad \text{(Samorodnitsky, 2006)}$$

$\stackrel{d}{=}$ means that this equation is valid in all function's points except equality in distribution. If aggregated time series x_t^{Θ} have stationary increments, thus, partial sums $S_n = X_1 + X_2 + ... + X_n$, where *n=1,2,...,* when $n \geq 1$, o $X_i = Y(i) - Y(i-1), i = 1,2,...$ describe a stationary process $X = (X_1, X_2, ...)$, satisfying the equation $S_n = n^H S_1$. Here, the exponent *H* characterises significance of distribution of a stationary process *X* and is called *Hurst* coefficient. The value of *Hurst* coefficient characterises the type of time series memory. If *Hurst* coefficient *H=0.5*, then members of the sequence are random and every subsequent member does not depend on previous queue members; in an opposite case, we can state that previous events recorded in time series bear a constant impact on further processes, and this impact is the stronger the more event is closer to the past. Such series are invariant with regard to time.

If, then the process characterised by the time series is anti-dispersive, i.e. we can state that if increase is observed in one period, in other period decrease will definitely follow, and the probability is higher the closer *H* is to 0. In this case, correlation is negative and draws closer to 0.5. Such series usually bear a feature of high changeability and are formed of frequent increases and decreases.

If $0,5 < H < 1,0$, thus it is a persistent process with long-range memory, also called Markov dependence, i.e. if the process was bound to increase in the past, in the future it will retain this peculiarity with the bigger probability the closer *H* is to 1. Usually, such series are called trend resistant, when *H* gets closer to 0.5, more trends (noises) appear in the series. Therefore, while estimating self-similarity of a time series, the value of *Hurst* coefficient, i.e. an interval where it occurs, is very significant. For calculation of *Hurst* statistics, two methods for series estimation are usually applied: time analysis and estimators of frequency/wave features (Karagiannis, Faloutsos, Molle, 2003).

While investigating dependences of gradual selected sequence characteristics and special *m* size block, by applying specific statistics, the following methods are usually applied: absolute value (absolute moments), variance, R/S (rescaled adjusted range), variance of residuals (Taqqu, Teverovsky, 1998, Karagiannis, Faloutsos, Riedi, 2002).

Estimators of frequency/ wave features are grounded on frequency wavelet features. The following methods are usually applied for analysis: *periodograms* (Taqqu, Teverovsky, 1998,

Karagiannis, Faloutsos, Riedi, 2002), *whittle* (Karagiannis, Faloutsos, Riedi, 2002), *Abby-Veich* (Karagiannis, Faloutsos, Molle, 2003).

Fractan (2003) programme calculates *Hurst* coefficient only by employing *R/S* statistics. The designed programme *SSE* (Self-Similarity Estimator) employs robust methods of time series calculation; they bear some errors occurring in empirical data, capacities of filtering and high calculation pace: *FamaRoll* (Fama, Roll, 1971), *McCulloc* (1986), *regression* (Belovas, Kabašinskas, Sakalauskas, 2005, Koutrouvell, 1981) and *moments'* (Koutrouvell, 1981, Press, 1972). For calculation of *Hurst* statistics, 11 different methods are applied. We will shortly discuss them.

The oldest and most popular is the *R/S* statistics method grounded on analysis of time sequences, employed in programmes *Fractan* (Fractan, 2003) and *Selfis* (Karagiannis, 2002). Here, formed and aggregated time queues x_t^{Θ} in the network node M, *Hurst* coefficient is calculated according to the formula $H = \log(R/S)/\log(n/2)$, where *H* – *Hurst* coefficient, *R/S* – r/s statistics acquired according to the formula:

$$R/S = \frac{R(n)}{S(n)} = \frac{Max(\sum_{i=1}^{\tau}(x_i^{\Theta} - \overline{x_t^{\Theta}})) - Min(\sum_{i=1}^{\tau}(x_i^{\Theta} - \overline{x_t^{\Theta}}))}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i^{\Theta} - \overline{x_t^{\Theta}})^2}}$$, (Samorodnitsky, 2006)

here $1 \le \tau \le n$, where *n* – number of sequence members, $\overline{x_t^{\Theta}}$ – value of an average row x_t^{Θ}, and $\sum_{i=1}^{\tau}(x_i^{\Theta} - \overline{x_t^{\Theta}})$ – the formed cumulative row describing the sum of changes during time τ. According to *Hurst* (1951), it can be stated that majority of phenomena taking place in nature can be attributed with the right expression: $M\left(\frac{R(n)}{S(n)}\right) \sim cn^H, n \to \infty$, where *c* – constant (Park, Willinger, 2000). It was estimated that when a number of queue members (amount of observations) increases, *Hurst* coefficient gets closer to the value 0.5, i.e. the memory effect decreases.

In the programme *Selfis*, besides discussed *R/S* statistics, six more methods of calculation of *Hurst* coefficient are employed; we will discuss them.

The method of absolute moments (Taqqu, Teverovsky, 1998, Karagiannis, Faloutsos, Riedi, 2002, Taqqu, Teverovsky, 1998, Ilnickij, 2004) is based on *N* length time sequence division into blocks of *m* length, while forming partial sequences $X^{(m)}(k)$, where *k=1,2,...,[N/m].* Then, the n moment of the sequence is calculated:

$$AM_n^{(m)} = \frac{1}{N/m}\sum_{k=1}^{N/m} | X^{(m)}(k) - \overline{X} |^n, kur\,\mathrm{X}^{(\mathrm{m})}(k) = \frac{1}{m}\sum_{i=(k-1)m+1}^{km} X_i$$. (Ilnickij, 2004)

The sequence $X^{(m)}$ behaves asymptotically like $Cm^{n(H-1)}$ for high *m*, thus, the obtained moment $AM_n^{(m)}$ is proportional to $m^{n(H-1)}$.

The method of aggregate variance formed for the sequence $X^{(m)}(k)$ calculates sample variance (Beran, 1994):

$$Var(X^m) = \frac{1}{N/m}\sum_{k=1}^{[N/m]}(X^{(m)}(k) - \overline{X})^2 .$$

The sequence $X^{(m)}(k)$ behaves asymptotically like m^{H-1}, if it has a finite variance, thus, for high *N/m* the sequence of variances asymptotically is proportional to m^{2H-2}.

According to the method of variance of residuals proposed by Peng (Karagiannis, Faloutsos, Riedi, 2002, Taqqu, Teverovsky, 1998), variances of residuals of linear dependence are calculated by the least square method for m-length sequence subsets:

$$\frac{1}{m}\sum_{j=1}^{m}(Y(j) - a - bj)^2, \mathrm{kur}\,Y(j) = \sum_{i=1}^{j} X_i$$. (Peng, Buldyrev, Stanley, Goldberger, 1994)

For all obtained variances proportional to m^{2H}, a common median is calculated and log-log-type dependence is estimated between *m* and incline angle *2H*, if it is linear, then *H* is estimated by regression.

By the method of periodograms an iterative function is described:

$$I(\nu) = \frac{1}{2\pi N}\left|\sum_{j=1}^{N} X(j)e^{ij\nu}\right|^2$$, (Taqqu, Teverovsky, 1998)

where *v* – frequency, *N* – length of a sequence, *X(j)* – time queue. When *I(v)* has a finite variance, then an iterative function describes density of a sequence *X* which, in case of long-memory is proportional to $|\nu|^{1-2H}$, sequences close to the beginning of coordinates.

The method of whittle is based on minimisation of maximum probability of a periodogram when a function of spectral density is known (Kokoszka, Taqqu, 1996):

$$Q^*(\eta) = \sum_{j=1}^{[(N-1)/2]} \frac{I(\nu_j)}{f^*(\nu_j,\eta)}.$$

Here, η is a function value of a vector minimising the aim function Q^* by calculating which *Hurst* coefficient's value and the relied interval are obtained, when a function of spectral density is known.

By Abry-Veitch (Karagiannis, Faloutsos, Molle, 2003, Karagiannis, Faloutsos, Riedi, 2002, Abry, Veitch, 1998) method, *Hurst* coefficient is estimated while employing transformation of wavelet sequence.

$$\hat{H}(j_1,j_2) = \frac{1}{2}\left[\frac{\sum_{j=j_1}^{j_2} S_j j\eta_j - \sum_{j=j_1}^{j_2} S_j j \sum_{j=j_1}^{j_2} S_j\eta_j}{\sum_{j=j_1}^{j_2} S_j \sum_{j=j_1}^{j_2} S_j j^2 - \left(\sum_{j=j_1}^{j_2} S_j j\right)^2}\right]$$

Here $\eta_j = \log_2\left(\frac{1}{n_j}\sum_k |d_x(j,k)|^2\right)$, weights – $S_j = (n\ln^2(2))/2^{j+1}$, $|d_x(j,k)|^2$ – a measure of process energy during time $2^j k$ sequence $2^j\nu_0$, when ν_0 is selected from the so called mother wavelet, and *n* – length of a partial sequence. The method is widely described in the article by P. Abry and D. Veitch (1998).

According to Samorodnitsky, a self-similar symmetric process that is described by formula and attributed with infinite variance is an α-stable process (Samarodnitsky, Taqqu, 1994), if for every random process *Y(t)* heavy tails can be described according to the formula:

$$P(|Y(t)|> x) \sim cx^{-\alpha}$$ (Samarodnitsky, Taqqu, 2006),

here $x \to \infty$, o $c > 0$, thus, when $1 < \alpha < 2$ the mean is finite, and when $0 < \alpha \le 1$ – infinite.

While estimating any stable random value $S_\alpha(\beta,\sigma,\mu)$, it is recommended to estimate four stability parameters:

- *α* – stability index $\alpha \in (0,2]$, also called a tail index, defining burstiness of a process,
- *β* – asymmetry index $\beta \in [-1,1]$, defining shift of a process with regard to zero,
- *σ* – measure index, σ>0 and defines amount of process elements,
- *μ* – position index $\mu \in R$.

Robust time series estimation laws are peculiar with resistance to errors and high calculation pace. In this work, we employ empirical quantum methods in order to estimate parameters of aggregated queues.

One of the oldest employed methods (Fama, Roll, 1971) method based on estimators of stable law parameters *α*, *σ*, *β*, *μ*, when *β=0*, *μ=0*, o $1 < \alpha \le 2$. A stability index is estimated by evaluating a time queue stability index under a condition:

$$S_{\hat{\alpha}}\left(\frac{\hat{x}_p - \hat{x}_{1-p}}{2\hat{\sigma}}\right) = p$$

It was estimated that *p=0.95*, *0.96*, *0.97* were selected best.

In his works, McCulloch (McCulloch, 1986) has improved methods of estimation of stable values designed by FamaRoll, worked out interpolate tables. Two functions calculated by employing time queue quartiles are defined:

$$\nu_\alpha = \frac{x_{0.95} - x_{0.05}}{x_{0.75} - x_{0.25}} \; ir \; \nu_\beta = \frac{x_{0.95} + x_{0.05} - 2x_{0.05}}{x_{0.95} - x_{0.05}}$$

Stable parameters are calculated by interpolating values according to given rows.

The regression method for estimation of stable value parameters was proposed by Kotrouvelis (1981), I. Belovas, A. Kabašinskas and L. Sakalauskas described his applications for financial series more widely (2005). For calculation of α and σ the following sums are employed: $s_1 = \sum_{k=1}^{K} y_k w_k$, $s_2 = \sum_{k=1}^{K} y_k$, $s_3 = \sum_{k=1}^{K} w_k$, $s_4 = \sum_{k=1}^{K} w_k^2$, where the parameters employed in the sums are calculated as follows: $w_k = \log |t_k|$, $y_k = \log(-\log(|\phi_n(t_k)|^2, t_k = \frac{\pi k}{25}$. α and σ are calculated by applying formulas:

$$\alpha = \frac{K_{S_1} - s_2 s_3}{K_{S_4} - s_3^2}, \; \sigma = \tilde{\sigma}\left(0.5 \exp\left\{\frac{s_4 s_2 - s_1 s_3}{K s_4 - s_3^2}\right\}\right)^{1/\alpha},$$

here $\tilde{\sigma}$ an absolute deviation, *K* recommended value 10.

For calculation of *β* and *μ* the following sums are employed: $s_5 = \sum_{l=1}^{L} u_l^2$, $s_4 = \sum_{k=1}^{K} w_k^2$, $s_6 = \sum_{k=1}^{K} q_l g_n(u_l)$, $s_7 = \sum_{l=1}^{L} q_l u_l$, $s_8 = \sum_{l=1}^{L} q_l^2$, $s_9 = \sum_{l=1}^{L} u_l g_n(u_l)$, where the parameters employed in the sums are calculated as follows: $u_l = \frac{\pi l}{50}$, $q_l = |\sigma u_l|^\alpha \tan\left(\frac{\pi\alpha}{2}\right) sign(u_l)$, o *L=15*. *β* and *μ* are calculated by applying formulas:

$$\beta = \frac{s_5 s_6 - s_7 s_9}{s_5 s_8 - s_7^2}, \; \mu = \tilde{\mu} + \sigma\left(\frac{s_8 s_9 - s_6 s_7}{s_5 s_8 - s_7^2}\right) - h\pi.$$

A more thorough description of the calculation methods can be found in the article by Kotrouvell (1981).

The method of moments for estimation of stable value parameters was proposed by S. J. Press (1972), I. Belovas, A. Kabašinskas ir L. Sakalauskas described his applications for financial series more widely (Belovas, Kabašinskas, Sakalauskas, 2005). This method is based on calculation of a time series empirical characteristic function: $\hat{\phi}(t) = \frac{1}{n}\sum_{i=1}^{n} e^{itx_i}$, where *n* – number of series elements, x_i – the *i*-th series element, *t* – a selected series value. The stable parameters are suggested to be calculated by employing the following formulas (Press, 1972):

$$\hat{\alpha} = \frac{\log \frac{\log|\hat{\phi}(t_1)|}{\log|\hat{\phi}(t_2)|}}{\log\left|\frac{t_1}{t_2}\right|}, \; \log\hat{\sigma} = \frac{\log|t_1|\log(-\log|\hat{\phi}(t_2)|) - \log|t_2|\log(-\log|\hat{\phi}(t_1)|)}{\log\left|\frac{t_1}{t_2}\right|},$$

$$\hat{\beta} = \frac{\frac{\bar{u}(t_4)}{t_4} - \frac{\bar{u}(t_3)}{t_3}}{(|t_4|^{\alpha-1} - |t_3|^{\alpha-1})\hat{\sigma}^\alpha \tan\left(\frac{\pi\hat{\alpha}}{2}\right)} \; \hat{\mu} = \frac{|t_4|^{\alpha-1}\frac{\bar{u}(t_4)}{t_4} - |t_3|^{\alpha-1}\frac{\bar{u}(t_3)}{t_3}}{|t_4|^{\alpha-1} - |t_3|^{\alpha-1}}.$$

Here t_1, t_2, t_3, t_4 – selected values satisfying equations $t_1 \neq t_2$ and $t_3 \neq t_4$, and $\bar{u}(t) = \arctan\left(\frac{\sum_{i=1}^{n}\sin(tx_i)}{\sum_{i=1}^{n}\cos(tx_i)}\right)$. According to the suggestion by Kotrouvelis, the following values are to be selected best: $t_1 = 0.2$, $t_2 = 0.8$, $t_3 = 0.1$, $t_4 = 0.4$ (Koutrouvell, 1981).

2. Testing Analysis methods by Simulation

Suitability of employed algorithms for analysis was tested by the way of computer-based simulation. For simulation of random flows, formulas were applied for generation of standard stable values $S_\alpha(\beta,1,0)$, when $\alpha \neq 1$ (Weron, 2004):

$$X = \mu + \sigma \cdot S_{\alpha\beta}\frac{\sin\{\alpha(V+B_{\alpha\beta})\}}{\{\cos(V)\}^{1/\alpha}}\left[\frac{\cos\{V-\alpha(V+B_{\alpha\beta})\}}{W}\right]^{(1-\alpha)/\alpha},$$

here $B_{\alpha\beta} = \frac{\arctan\left(\beta\tan\frac{\pi\alpha}{2}\right)}{\alpha}$, $S_{\alpha\beta} = \left\{1+\beta^2\tan^2\left(\frac{\pi\alpha}{2}\right)\right\}^{1/(2\alpha)}$, o V uniformly distributed on $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ and an independent exponential random variable *W* with mean 1. The programme has a foreseen possibility to indicate amount of generated files and amount of elements in every file.

For simulation, series attributed with self-similarity were selected with parameters: *α=1.8 (H=0.56)*, *β=0*, *σ=1*, *μ=0*. Obtained time series were estimated by *Fractan* and *Selfis. Fractan* measures auto-correlation coefficient, *R/S* statistics, fractality, visualises data (draws dependence graphs and attractors). *Selfis* measures *Hurst* coefficient by employing time analysis methods for investigated gradual dependence of selected sequence characterisations and a special m size block by applying specific statistics. The following methods are usually employed for analysis: *absolute value* (*absolute moments*), *variance*, *R/S* (*rescaled adjusted range*), *variance of residuals* (Taqqu, Teverovsky, 1998). Estimations of frequency/wave features are grounded on frequency features of wavelets. The following methods are usually employed for analysis: *periodograms*, *whittle*, *Abby-Veich*.

As we can see in Table 1, *Hurst* coefficient varies from *0.61* to *0.79*; thus, the process of passed data described by aggregated series is a persistent long-range memory process. It can be stated approximately two thirds of received series are attributed with long-term memory. After analysing results of analysis of *Hurts* coefficient obtained by *Fractan* programme, we can state the following:

1. obtained results factually do not depend (matched 98% of the results) on the way of series aggregation (the methods of sum and medium were employed);

2. obtained results do not depend on a size of selected time interval $\Delta t \in$*[100ms, 500ms, 1s]* and *89.4%* of obtained results matched;

3. obtained results do not depend on a data flow (minimum, medium, maximum ones were selected) and 88% of obtained results matched.

These conclusions show that analysed aggregated series describe a self-similar process attributed with short-range or long-range memory.

In Table 2 one can see that approximately 43% of measured series are attributed with long-range memory, and the medium of coefficient *0.56* shows a weak dependence, approximately 47% of series are attributed with short-range memory, and the medium of coefficient *0.28* shows medium dependence. With regard to obtained results, we can state that the programme *Selfis* estimated that the vast majority of series are attributed with short-range or long-range memory; this proves self-similarity of series. It can be observed that obtained results depend on neither the method of aggregation of series nor time interval; this also proves their self-similarity. Analysis by applying Selfis programme shows the following:

4. obtained results factually do not depend (matched 98% of the results) on the way of series aggregation (the methods of sum and medium were employed);

5. a very weak dependence of obtained results from a size of a selected time interval $\Delta t \in$*[100ms, 500ms, 1s]* (matched 65.63% of the results) was estimated;

6. a very weak dependence of obtained results from a data flow when minimum, medium, maximum flow is selected (matched 63.5% of the results) was estimated.

Table 1

Distribution of Hurst coefficient values

	0.5<H<1.0									$0 \le H < 0.5$									$1.0 \le H$								
x_t^{Σ}	81.92%									11.30%									6.78%								
	100ms			**500ms**			**1000ms**			**100ms**			**500ms**			**1000ms**			**100ms**			**500ms**			**1000ms**		
	81.36%			76.27%			88.14%			10.17%			15.25%			8.47%			8.47%			8.47%			3.39%		
	Minimal	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**
	88.24%	70.37%	93.33%	70.59%	74.07%	86.67%	76.47%	85.19%	93.33%	11.76%	14.81%	0.00%	11.76%	18.52%	13.33%	23.53%	11.11%	0.00%	0.00%	14.81%	6.67%	17.65%	7.41%	0.00%	0.00%	3.70%	6.67%
x_t^{Δ}	80.23%									12.43%									7.34%								
	100ms			**500ms**			**1000ms**			**100ms**			**500ms**			**1000ms**			**100ms**			**500ms**			**1000ms**		
	83.05%			76.27%			81.36%			13.56%			15.25%			8.47%			3.39%			8.47%			10.17%		
	Minimal	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**
	88.24%	81.48%	80.00%	70.59%	74.07%	86.67%	88.24%	77.78%	93.33%	11.76%	14.81%	13.33%	11.76%	18.52%	13.33%	5.88%	11.11%	0.00%	0.00%	3.70%	6.67%	17.65%	7.41%	0.00%	5.88%	14.81%	6.67%

It can be stated that the investigated series describe the self-similar process attributed with short-range or long-range memory.

Between *Hurst* coefficient and the parameter alfa, the proportion *H=1/α*, when *1<α<2, β=0* was set by G. Samarodnitsky (2006). In order to more precisely estimate obtained calculation results, values of aggregated *Hurst* coefficient were divided into five intervals: *0<H* of $H \ge 1.0$ – non-defined values, *0<H<0.5* – a series describes the self-similar process with short-range memory, *H=0.5* – a series describes noise, $0.5 < H \le 0.6$ – a series described the self-similar process with weakly expressed long-range memory, *0.6<H<1.0* – a series described the self-similar process with long-range memory. In order to highlight suitability of applied methods for estimation of time series in the worked out programme, obtained results by every method are displayed in a graph, and calculation results obtained by *Fractan* and *Selfis* programmes are generalised by applying percentage estimations.

Table 2

Distribution of Hurst coefficient values

	$0 \le H < 0.5$									**0.5<H<1.0**									**H=0.5**								
x_t^{Σ}	47.07%									42.82%									8.63%								
	100ms			**500ms**			**1000ms**			**100ms**			**500ms**			**1000ms**			**100ms**			**500ms**			**1000ms**		
	Minimal	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**	**Minimal**	**Medium**	**Maximal**

	42.86%	52.38%	51.43%	64.29%	48.35%	40.00%	47.62%	45.24%	31.43%	42.86%	33.33%	37.14%	25.00%	43.96%	54.29%	47.62%	44.05%	57.14%	14.29%	14.29%	11.43%	10.71%	7.69%	5.71%	0.00%	10.71%	2.86%
x_t^{Δ}	47.05%									45.05%									7.90%								
	100ms			500ms			1000ms			100ms			500ms			1000ms			100ms			500ms			1000ms		
	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal	Minimal	Medium	Maximal
	42.86%	44.90%	34.29%	64.29%	48.35%	40.00%	47.62%	53.57%	47.62%	46.43%	45.92%	60.00%	25.00%	42.86%	54.29%	52.38%	38.10%	40.48%	10.71%	9.18%	5.71%	10.71%	8.79%	5.71%	0.00%	8.33%	11.90%

Conclusions

Applications of Hurst statistics for calculation of Hurst coefficient analyzed and tested by using freeware programme Fractan, the methods of frequency/wave features estimators - Periodograms, Whittle, Abby-Weich have been analyzed and tested by using freeware programme Selfis.

The carried out research show that simulated random flow (α=1.8, H=0.56) investigated by Fractan and Sefis have a Hurst coefficient of which varied from 0.53 to 0.70; this corresponds to variation of the stability index from 1.43 to 1.89.

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THE FORMED IMAGE OF ŠIAULIAI CITY: THE ASPIRATION OF THE CITY MUNICIPALITY AND ITS REFLECTION IN THE LOCAL MEDIA

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Annotation

The essence of the research topics is that Šiauliai does not have the city-specific image: the aspiration is to form the vision of the city of the Sun, linking it with the idea of a safe, open, and vibrant city. Therefore, it was sought to find out what image of the city was formed by Šiauliai city municipality and what image of the city was revealed in the local media. It turned out that the directions of the image of Šiauliai city formed by Šiauliai city municipality and the weekly "Etaplius" coincided. It was found that the weekly "Etaplius" formed a positive image of Šiauliai city in the press; therefore, it can be assumed that the local media itself seeks to contribute to the formation of the city's favourable image in the public space.

Key words: *city, image, formation, municipality, local media.*

Introduction

Relevance of the topic. The development of the city's image in the modern society is significant in many aspects. The image is particularly important for the city's development, as this way new and profitable investments are attracted, local residents' needs are met, and the tourists' flow is increasing, which leads to the development of the successful city (Richards, 2015). As H. Hassan et al. (2018) point out, one of the best channels for image formation and building is the media. The media representatives describe and present the city's disadvantages and advantages to the public: they analyse political activities, publish the achievements of the city's athletes, present cultural news, and inform what is relevant to the residents (Hanson, 2016, p. 92-93). Articles are presented in newspapers, online and social websites, this way reaching audiences of different ages and needs; therefore, the media representatives make a major influence in shaping public opinion about the overall image of the city. J. A. F. Fernandez et al. (2015) state that the image can be influenced by many factors: the opinion of authoritative individuals and representatives of the public, media announcements in the public space as well as attractive and famous places to visit.

A properly represented city can become one of the factors that make the city famous; therefore, emphasis must be placed on the importance of the media in the image-building process. Media representatives present relevant events related to the city in the newspapers by publicizing information in the city and beyond its boundaries. It can be observed that the image is also created by itself due to naturally occurring situations as well as on the basis of correct or incorrect information. The ever-changing environment forces the authorities of the city and other responsible persons to plan activities more carefully, to purposefully project such activities that improve various areas of life, and at the same time, to maintain the image of the city. It is purposeful for the city's authorities to analyse activity processes and to take into account residents' needs when making necessary decisions, because the media as the representative of the society points local residents in a positive or negative direction (Hassan, 2018).

Research problem. The strategic development plan of Šiauliai city municipality for 2015-2024, focuses on the topics of the city's image, noting that Šiauliai does not have a common image of the city. This plan emphasizes the aspiration to maintain the image of the city of the Sun, linking it with the idea of a safe, vibrant and open city. Based on the above-mentioned context, the following problem question is raised: What image of Šiauliai city is formed by Šiauliai city municipality and what image of the city is revealed in the media?

The research object: the formed image of Šiauliai city.

The research aim: to analyse the image of Šiauliai city formed by the city municipality and local media.

Research objectives:

1. To define the conception of the city's image.
2. To distinguish the elements forming the city's image in the media.
3. To investigate what image of Šiauliai city is formed by Šiauliai city municipality and local media.

Research methods and tools:

1. Analysis of scientific literature;
2. Content analysis of documents;
3. Media monitoring;
4. Comparative content analysis.

Literature Review

Factors shaping the image of the city. In the scientific literature, A. Acedo (2018), C. Kizil and A. Atalan (2015), D. Gunina et al. (2018), J. A. F. Fernandez et al. (2015) distinguish different definitions of the city's image as well as present different factors affecting its formation. There are many different elements that significantly shape the image and perception of the city. These elements described by E. Zača (2016) include the city's geographical location, crime threat and safety assurance, high or low living standards, economic relations with foreign countries, the city's position in the country and the world, its history, famous films and series filmed in that city, attractive recreation areas, whether active or passive tourism is developed, and the appearance of the city itself.

The image of the city is also created by positive or negative feedback in face-to-face communication, sharing experiences on social networks, publication of various articles about the city's events, in TV programmes or documentaries – all these elements together create public perception of the city's image (Zača, 2016). All elements shaping the image of the city can be divided into 8 notional groups.

The first group – the group of natural features includes the main elements of nature, creating the initial image of the city. These are climate, landscape, and fauna. Climate indicates low or high local temperature, drought or heavy rain; the landscape, a mountainous or wooded area, beaches or deserts in the defined area; and fauna, animal species prevalent in that area. These attributes shape the city's image in the person's subconsciousness and evoke positive or negative emotions.

The content of the second group elements forming the city's image reflects the importance and impact of infrastructure. It is noted that the totality of interrelated structural elements, enabling or supporting the whole structure and its functioning, is particularly significant for the formation of the positive image. This element consists of airports and ports, road development, quality of the public transport, the level of health protection, communication services and the physical condition of buildings. This whole emphasizes the purposeful structure of elements, seeking to identify the quality of results.

The third group, which is defined as tourism, distinguishes the most important areas influencing the flow of tourists: famous hotels and restaurants, popular bars, popular tourist destinations, well-functioning information services reaching the target audience and active organisation of trips and excursions.

The fourth group accentuates the importance of leisure. This ensures happier residents and good practices are passed on to others. Hobbies and self-expression, places for leisure, parks, nature reserves, recreation and sports areas create an active society and determine the process of forming the city's positive image.

The fifth group is distinguished as elements uniting residents and indicating their way of life – the element of shaping the image of history, culture and art. The constituents describing the essence of this formation are related to the human mentality and perception of the world. These are museums, famous monuments, festivals, concerts, dominant crafts and folklore, as well as religion, traditional food and culture.

The sixth group contributing to the development of the city's image consists of political and economic factors. Political trends, economic factors and safety are attributes demonstrating the city's face and promoting confidence in residents' consciousness.

The seventh group includes the social environment in which the most intense human interactions take place. This element consists of topics sensitive to the public like poverty, discrimination, and quality of life and shapes customers' image about the city. The city's hospitality to residents, the language barrier, cleanliness, residents, air pollution and noise level are also attributed to this element.

Well-balanced constituents of the eighth group attract tourists, improve the city's image, and create the identity of a cultural and educated society. These are luxurious, famous, exotic places, the prevailing fashion, places for family rest or spaces intended for relaxation as well as the beauty of the city. All of this creates and shapes the city's image.

In summary, it can be stated that the city's image is shaped by the following factors: natural peculiarities, infrastructure, tourism, leisure, history, culture and art, political and economic factors, social environment, and the city's atmosphere. The initial, temporary image of the city is formed in the minds of individuals by natural features (climate, landscape and fauna) as well as infrastructure elements (airports and ports, road development, quality of public transport, the level of health protection, communication services, and the physical condition of buildings). It is noted that the defining deeper perception of the city and its identity is created by the elements of history, culture and art (museums, famous monuments, festivals, concerts, dominating crafts, and folklore as well as religion, traditional food, and culture), political and economic factors (political trends, economic factors, and safety), and social environment (poverty, discrimination, quality of life, the city's hospitality to population, language barrier, cleanliness, residents, air pollution, and noise level).

The analysed components of the mentioned concept emphasize the importance of the city's external and internal activities, which highlight the peculiarities of nature, history and culture, political and economic trends, and social environment. Hence, the above-mentioned aspects of image building reflect the conception of image formation.

Types of images of the city, formed by the media. The media that has a significant influence on shaping the person's attitude can either positively or negatively affect the members of the society and local residents in decision-making. As P. Berrone, J. E. Ricart (2015) emphasise, it can be noted that when the media focuses on negative events such as crime, violence and social problems, it harms the image of the city, while highlighting positive news such as sporting events and cultural events, it has a positive effect on the image of the city. Thus, the view constructed by the media can influence people's thinking and change the attitude related to the city; this way the media takes active part in the stereotype formation process. Hence, it is concluded that the media analysis is an appropriate way to evaluate the image of the city.

A strong image can be a strong and distinctive competitive brand for a modern and developing city. Y. H. Chuang (2015) points out that it is particularly difficult to create an attractive and universally acceptable set of values, which would reach its potential users. The author emphasizes that striving to make the city as a product visible requires the development of an extremely strong and good system. It is stressed that cities need to create particularly strong brand names that would attract target audiences and survive for a long time. It is concluded that cities are like large corporations resembling each other, which try to use various tools and different ways to make a city visible.

The image of the city is made up of an interrelated network of elements, indicating what we know about that place and what feelings it evokes. The analysed scientific literature emphasizes that the media plays a key role in the process of shaping the city's image. This means that the representation of the city in the media is the factor determining the city's image. Three main types of the city's image are distinguished: positive (favourable); negative (unfavourable) and neutral.

The positive image of the city is the most important factor promoting the favourable public attitude, this way evoking only positive emotions and strengthening the city's reputation. The favourable image of the city is not accidental, it is consistently created until the desired result is achieved; besides, it needs to be constantly managed and controlled. C. Villar and F. Rey (2016) point out that the city's positive image presented to members of the society must correspond to everything that actually exists. The author also emphasizes that cities compete with each other; therefore, every city has to present exceptional activities, places of interest or recreation areas, which would become the centres of attraction for the target audience and promote to visit them as often as possible. P. Foroudi et al. (2016) emphasize that the presented image of the city must have an easily recognizable form in the customers' minds, but it is equally important that it should be able to adapt to an ever-changing environment. The positive image of the city is what people see and perceive as positive and beautiful structures in the city: they are attracted by the city's architecture, tree-lined alleys, tidy and clean environment, and rich historical heritage. Positive visual change such as renovation of old historic buildings, established strong corporations, maintained parks, streets, and an abundance of enterprises on the streets spread the message about a safe and well-run city.

The neutral image is beneficial for every city because this type is open, does not cause any emotions or resistance and therefore allows to avoid a natural rejection reaction. J. A. F. Fernández et al. (2015) describing the neutral image, point out that members of the

public must be provided with a wide flow of information: politics, social and cultural phenomena, important historical facts – all of this is aimed at highlighting the city's individuality. It is also pointed out that the information disseminated about the formed city's image must be presented without fictitious facts, as this can lead to doubts and the feeling of mistrust. It is better to provide less information, but it should be purposive and corresponding to reality. This author is also supported by Y. Wang and P. Zhang (2015) who emphasize that those features of the city that are clear and easily understood by the addressee must be highlighted. A simple and clear view of the city, created in the minds of customers, ensures trust.

The negative image is formed when the city's constructed image does not meet expectations and does not correspond to reality. No one purposefully forms the negative image, but it emerges when the needs of members of the society are not met and when they are disappointed. The favourable image can easily turn into unfavourable if the city is not able to adapt, be flexible, and does not distinguish itself by originality.

In summary, it can be stated that the media forms a positive, negative and/or neutral image of the city. Each city strives to create a positive image, highlighting the attractive features of the city, as such city is identified as economically stable, innovative and caring about the well-being of the city's residents. However, the construction of the favourable image is not always successful: if the negative image is formed in people's consciousness, the city becomes unpopular, does not attract investments and a low standard of living prevails in it. The neutral image is universal, does not cause a rejection reaction and therefore is the aspiration of every city. It can be stated that positive, negative and neutral image types can be intertwined: overlap each other and form various combinations. For the mentioned reasons, the aspiration to construct and maintain the positive image of the city, which ensures benefit in various areas, shows up.

Methodology

A quantitative (content analysis of documents and content analysis of the media) method was applied to conduct the study, aiming to investigate what image of Šiauliai city is formed in the strategic development plan (2015-2024) of Šiauliai city municipality, what image of the city is constructed by the local media and whether the image of Šiauliai city presented in the media corresponds to the city's real image.

Conducting the research, initially, it was planned to perform the analysis of only half-year content of the weekly "Etaplius" of the public institution "Šiauliai plius", but after going deep into the topic, it was decided to analyse the strategic development plan (2015-2024) of Šiauliai city municipality: to analyse the city's image created in this document and to compare these formed images.

The quantitative research was conducted in February-April of 2019. The results of the quantitative research were processed and analysed in February-April of 2019.

The content analysis of the strategic development plan (2015-2024) of Šiauliai city municipality was performed by applying the content analysis of documents, distinguishing positive and existing negative features of the city's image that is sought to be created.

The content analysis of the weekly "Etaplius" was first performed after distinguishing the investigated period – from June 1 of 2018 until January 1 of 2019. After defining the period, articles related to various news of Šiauliai city were selected. These included articles on politics, sports achievements, city problems, socio-cultural activities, and etc.

According to L. B. Berg (2011, p. 4-5), by combining methods reflecting the problem under investigation from different perspectives, researchers can form a much more realistic and deeper picture of the reality under investigation. Analysing what image of Šiauliai city is formed, the following objectives were set:

1) to analyse what image of Šiauliai city is created in the strategic development plan (2015-2024) of Šiauliai city municipality;
2) to investigate what image of Šiauliai city is revealed in the local media.

According to B. Berg (2011, p. 27-28), the content analysis of documents is a systematic procedure for reviewing and assessing printed or electronic documents. This method requires that the data should be investigated and interpreted, seeking to highlight the meaning of the material, gain understanding, and develop empirical knowledge. The document analysis is characterized by the parameters of search, selection, assessment, and synthesis of the elements of information material (Bowen, 2009, p. 27-28). According to A. Atalan, C. Kizil (2015, p. 3-5), M. M. Manuel, et al. (2016), when applying the method of the content analysis of documents, the most important aspects are authenticity, reliability, and representativeness of the analysed material. According to this researcher, the analysis of the documentary material reveals the content of the data and reflects the significance of investigated processes with regard to the raised problem question. The method was applied to find out what image of

Šiauliai city was formed by Šiauliai city municipality, what image of the city was revealed in the media, and whether these images coincided.

The content analysis of the media revealed an array of publications that are divided by frequency, thematic groups and the type of publications. It is namely the results of the content analysis that enable to judge about the prevailing media releases constructing the image of the city. First, grouping of articles by frequency reflects in which periods the highest and lowest number of publications was published. Based on these data, the stages in which the media showed the greatest and the least interest in Šiauliai city are distinguished.

This study employs grouping by thematic groups, which E. Začа (2016) indicates in the theoretical part: based on the distinguished elements of the image, the content analysis of the media, aimed at measuring the image of Šiauliai city, was performed.

The assessment of the content of publications according to the type of publications was determined using L. Ulevičius' (2006) method: three main emotional positions of the content of reports were distinguished – positive, negative, and neutral. Assessment was performed applying 7 criteria serving as a basis for establishing types of articles. Explaining the process of assessing the content of articles, L. Küng (2008) accentuates that positive aspects promote the use and development of the latest technologies, the stability of the country's economy and the formation of the country's image. The said author also points out that negative assessments divide the society, drive out usual standards, and the information provided is not always correct.

The method of monitoring of the media (content analysis) was applied in order to compare the aspiration of the image formed by Šiauliai city municipality and the image of Šiauliai city, constructed by the weekly "Etaplius", finding out whether the directions of the constructed image of Šiauliai city coincided.

Results

Content analysis of the strategic development plan of Šiauliai city municipality for 2015-2024. In order to investigate the image of Šiauliai city, the selected strategic development plan of Šiauliai city municipality for 2015-2024 was analysed. First, strong areas of Šiauliai city were identified in this document. The main priorities were found out, the information was systematized and analysed (see Table 1).

Table 1

Strong areas of Šiauliai city, which form the positive image of the city

No.	Strong areas	Statements
1.	**OPEN CITY**	"<..> there are educational institutions that are innovative, open to change, and employ highly qualified teachers and education services providers in Šiauliai"
		"There is an infrastructure of various sports bases <..> coaches' qualifications enable to train highly skilled athletes representing Šiauliai and Lithuania"," Šiauliai city distinguishes itself by integration of sports for the disabled into the community of Šiauliai city".
		"Šiauliai city is dominated by creative potential with abundant diversity of cultural events <..> and one can feel concentration and initiative to act for a common goal – to strengthen cultural life in Šiauliai".
2.	**VIBRANT CITY**	"Attractive investment environment prevails in Šiauliai city <..> and old export-oriented industrial traditions"
		"<..> is conveniently located <..> for tourist flows"
		"It is also characterized by an abundance of different profile museums in which visitors can see expositions and prepared educational programs"
3.	**SAFE CITY**	"<..> Šiauliai city distinguishes itself by unique nature, green areas"
		"This city is geographically convenient and can be reached by various means of transport"
		"Municipal public services enterprises ensure optimal ratio of service quality and price"
		"The established and systematically developed municipal waste management system prevails"

Source: compiled by the authors of the study on the basis of the strategic development plan of Šiauliai city for 2015-2024 (2016).

Based on the data in Table 1, the strong areas of Šiauliai city with separate descriptions forming the positive image are presented. Analysing the first direction, to which the image of the open city is attributed, the creative potential in various fields is emphasised. It is underlined that social protection is developed, distinguishing high-quality services for various groups of clients – the network of social services is well developed. It is considered an advantage that there are different types of enterprises providing various social services, located in different parts of the

city. In addition, higher educational institutions educate social field specialists with various specializations.

The strategic development plan of Šiauliai city municipality for 2015-2024 also includes distinguished weak areas forming the negative image (see Table 2).

Table 2

Weak areas of Šiauliai city, which form the negative image of the city

No.	Weak areas	Statements
1.	**OPEN CITY**	"There is no cultural identity, no common image of the city"
		"Lack of continuity and targeted management in strategic management, the public sector is not open to community"
		"Insufficient promotion and coordination of volunteering"
2.	**VIBRANT CITY**	"Absence of targeted cooperation to promote business"
		"Shortage of qualified workforce"
		"Insufficient features of a metropolitan city"
3.	**SAFE CITY**	"Unsafety in the city"
		"Irrational development of residential areas, poor quality of public spaces and territories"
		"Insufficient development of public transport by non-motorized vehicles"

Source: compiled by the authors of the study on the basis of the strategic development plan of Šiauliai city for 2015-2024 (2016).

After identifying strengths, the strategic development plan of Šiauliai city municipality for 2015-2024 also provides for the areas for improvement and the main problems in every of the priorities of Šiauliai city. A particularly important problem is distinguished with regard to the first analysed priority to be improved – Šiauliai city does not have cultural identity, there is no common formed image of the city, there is a lack of common agreement of all institutions on priority development directions.

The city's strategic management lacks directionality; it is noted that the public sector is not open to community. It is observed that there is a lack of cooperation and competition prevails; besides, promotion and coordination of volunteering are insufficient, there is no volunteer centre where persons could volunteer, certificates would be issued and social environment would be improved.

Distinguishing other weak areas in the priority of the vibrant city of Šiauliai, it is pointed out that there is still a lack of unified cooperation in promoting business, mutual agreement and search for alternatives between business associations and the municipality; besides, there is no responsible institution that would care about direct foreign and material investments. Weaknesses of Šiauliai as a vibrant city also include factors influencing business creation and development, emigration, lack of skilled workforce, and low wages. Most importantly, the document emphasizes the lack of targeted strategy for the city.

The third direction is the weak areas of the city's safe image. The strategic development plan of Šiauliai city municipality for 2015-2024 points out that the city lacks safety, especially at the crossings requiring more lighting. This document indicates that the quality of public spaces and territories in Šiauliai city is poor: non-adapted spaces and unused natural resources, non-developed park infrastructure, deteriorating condition of forests and irrational development of residential areas, which results in inappropriately developed engineering infrastructures, appearance of polluted areas, and management of residential areas is carried out individually. Besides, weak areas include insufficient development of types of public transport in the city for bicycles, pedestrians, and electric cars – the city lacks coherent street network and essential internal connections.

Summarizing the weak areas of Šiauliai city, which form the city's negative image, it has been found that entrepreneurship in Šiauliai city is still low and there is a lack of investment attraction, emphasis is placed on the lack of safety in the city, irrational development of residential areas, poor quality of public spaces and territories, and absence of a sustainable mobility plan. It is also accentuated that there is a growing shortage of skilled workforce, which may result in the increase of the number of recipients of social services and unemployment benefits; therefore, it is very important to maintain continuity and targeted management while the public sector is becoming increasingly open to community, in promoting volunteering, and creating the city's common image and cultural identity.

After analysing strengths and weaknesses of the strategic development plan of Šiauliai city municipality for 2015-2024, the document distinguishes the pursued directions to be implemented by 2024 (see Table 3), which constitute the formed vision of the Šiauliai city.

Table 3

The vision of Šiauliai city strategic development plan until 2024

No.	Pursued directions	Proving statements
1.	**OPEN CITY**	"An optimal network of the city's enterprises, open to change and innovation"
		"United concentration of the society to strengthen creative, cultural, sports and healthy life while developing the society's spirituality and values"
		"A friendly city where everyone enjoys equal rights and duties"
2.	**VIBRANT CITY**	"Innovative engineering industry and logistics services, which create high added value, attract local and foreign investments"
		"A professionally prepared and competent person who creates competitive products is educated"
3.	**SAFE CITY**	"Balanced territorial development, maintaining the common cultural identity and image of the city"
		"Safe and convenient urban infrastructure for residents and businesses"
		"Urban environment attractive for rest and leisure, exploiting natural conditions"

Source: compiled by the authors of the study on the basis of the strategic development plan of Šiauliai city for 2015-2024 (2016).

Based on the data presented in Table 3, it was found that the vision of Šiauliai city strategic development plan consisted of three main priorities that were analysed earlier: the open, vibrant, and safe city. All these three components form the aspiration of the image of Šiauliai city unitl 2024, maintaining continuity.

The analysed document accentuates that it is attempted to create Šiauliai that is recognizable by the image of the city of the Sun and has active, creative and responsible community, competitive business environment, and nature-friendly and high-quality living environment.

The emphasis is placed on the improvement of priorities in Šiauliai city until 2024, seeking that economic benefit does not overshadow the social, environmental and cultural environment and that the modern and economic city grows following the main principles of sustainable development, in which full-fledged members of the community would live. In addition, the strategic development plan includes the details of the vision:

1) Open: an optimal network of the city's enterprises, which is open to change and innovation; the united concentration of the society to strengthen creative, cultural, sporting and healthy life while developing spirituality and values of the society; a friendly city where everyone enjoys equal rights and duties;

2) Vigorous: innovative engineering industry and logistics services, which create high added value, attract local and foreign investment; a professionally prepared and competent person developing competitive products is educated;

3) Safe: balanced territorial development, maintaining common cultural identity and image of the city; safe and convenient urban infrastructure for residents and businesses; urban environment attractive for rest and leisure, exploiting natural conditions of nature.

After performing the content analysis of documents, three priorities are analysed: the open, vigorous, and safe city. The plan identifies strong and weak areas of Šiauliai city and the vision of the strategic plan. Thus, the performed analysis of the strategic development plan of Šiauliai city municipality for 2015-2024 has revealed the following:

1) Summary of the first priority – the open city: Šiauliai is dominated by the creative potential with a wide variety of cultural events; concentration and proactiveness in strengthening cultural life, but there is no cultural identity and the common image of the city; the aspiration is to retain the image of the city of the Sun; however, so far, this is only a vision; the city operates the infrastructure of various sports bases where by using the promotion system and employing coaches' qualifications, highly skilled athletes representing Šiauliai and Lithuania are trained; besides, Šiauliai city distinguishes itself by integration of sports for the disabled into the Šiauliai city community; there are educational institutions in Šiauliai, which are innovative, open to change, and employ highly qualified teachers and education services providers; however, it is indicated in the plan that it is necessary to improve the teaching environment and infrastructure of educational institutions, strengthen the potential of Šiauliai as a university city, and activate

cultural life; strengthen partnership and community of all mentioned areas: the interaction of the city's community at various levels, putting more emphasis on promotion of volunteering.

2) Summary of the second priority – the vibrant city: attractive investment environment prevails in Šiauliai and old export-oriented industrial traditions are fostered; there is a lack of consensus on developing targeted cooperation to promote business and investments; convenient geographical location for tourist flows and the abundance of museums of different profiles, where exhibitions and educational programs are waiting for visitors; the lack of qualified workforce; undeveloped tourism strategy that would be oriented to cognitive and active tourism; and absence of implemented innovative performance management standards.

3) Summary of the third priority – safe city: Šiauliai distinguishes itself by unique nature, green areas; the city lacks safety; is located in a geographically convenient place and is accessible by various means of transport; irrational development of residential areas, inappropriate development of engineering infrastructure, improper control of emerging polluting areas and individually managed residential areas; prevailing established and systematically developed municipal waste management system and close inter-institutional cooperation; insufficiently good ambient air quality due to the concentration of particulate matter in the ambient air; underdeveloped network of public transport modes.

In summary, it can be stated that Šiauliai city municipality is purposefully seeking the priorities set out in the strategic development plan 2015-2024. The above-mentioned strategic document distinguishes the following strengths of Šiauliai city: operating innovative and open to change educational institutions, developed infrastructure of various sports bases, prevalence of creative potential and attractive investment environment, the city distinguishes itself by unique nature, is in a geographically convenient location, which create the positive image of Šiauliai city. Weak areas are: the lack of cultural identity, the lack of continuity and purposeful management in the strategic management, insufficient promotion and coordination of volunteering, absence of targeted cooperation in promoting business, lack of qualified workforce, insufficient features of a metropolitan city, poor quality of public spaces and territories; these areas create the negative image of the city. It has been analysed that the aspiration of Šiauliai city municipality in the future is the city open to change and innovations, united in terms of concentration of the public in various fields, the city that has innovative engineering industry and logistics services creating high added value, attracting local and foreign investments, where professionally prepared and competent person is educated, the city with balanced territorial development retaining common cultural identity and image of the city and with safe and convenient urban infrastructure for residents and business. The idea of the open, vibrant, and safe city until 2024 is related to the aspiration to maintain continuity and to form the positive image of Šiauliai city. It turned out that prevailing elements in this strategic document forming the positive image; therefore, Šiauliai city municipality seeks to construct a diverse innovative and transparent image of the city.

The analysis of the image of Šiauliai city, formed in the weekly "Etaplius". After conducting the research, the dynamic analysis of mentions performed by weekly "Etaplius" of the media group public institution "Šiauliai plius" is presented, distinguishing the essential changes according to individual elements. In order to analyse the publications of the weekly "Etaplius" about the city of Šiauliai, the articles were analysed by frequency: the month with the highest and the lowest number of reports was singled out. The chosen analysed period is from July 1, 2018 to January 1, 2019.

Most publications are from July 1, 2018 until January 1, 2019; most of them were published in July, August and September; least, in October, November and December. Based on the presented results, it is noted that in July of 2018, the media group provided increasingly more news related to Šiauliai city – the number of publications grew until September. It is concluded that during this period, there were most events related to city's life, change and activities relevant to the members of the public. However, although the increase in the number of articles published in November is observed, in December, the least number of articles related to the city of Šiauliai was published. Hence, it can be assumed that there was a lack of activeness in the city; therefore, interest of the media decreased.

To investigate the image of Šiauliai city in the media, 149 articles of the weekly "Etaplius" of the public institution "Šiauliai plius" were analysed. According to the scholar E. Zača (2016), the elements that significantly shape the image and the perception of the city were distinguished: natural features; infrastructure; tourism; leisure; history, culture and art; political and economic factors; social environment; and urban atmosphere. The mentioned elements were employed to measure the image of Šiauliai city. Analysing the content of articles according to E. Zača (2016), 6 of the 8 factors were applied. These were infrastructure; tourism; leisure; history, culture and art; political and economic factors; and social environment. These elements significantly form the image and perception of Šiauliai city.

Articles were grouped by types using the method of L. Ulevičius (2006, p. 246-247): according to three main distinguished emotional positions of the content of reports – positive, negative, and neutral. The types of assessing the content of the article and the criteria for identifying the content determined three main emotional positions of the content – positive, negative, and neutral. Every assessment was carried out according to 7 criteria on the basis of which the types of articles were identified and content assessments were provided. This method allows to assess the report clearly and objectively, understanding the essence and why it is so evaluated.

The weekly "Etaplius" contains a total of 149 articles analysing the image of Šiauliai city during the selected period from June 1, 2018 until January 1, 2019 (see Table 4).

Table 4

The number of publications on the image of Šiauliai city and assessment by thematic groups

Topics	Positive assessment	Negative assessment	Neutral assessment	In total:
Infrastructure	**15**	**9**	**2**	**26**
Tourism	**13**	**-**	**-**	**13**
Leisure	**5**	**-**	**-**	**5**
History, culture, art	**43**	**-**	**-**	**43**
Political and economic factors	**9**	**9**	**1**	**19**
Social environment	**25**	**14**	**4**	**43**
In total:	**110**	**32**	**7**	**149**

Source: compiled by the authors of the research.

Most attention is paid to two thematic groups. The first is history, culture, and art. Of 43 articles, all are classified as positive. This shows that the cultural identity of Šiauliai city is growing, Šiauliai residents take active part in the city's public life and form good reputation of Šiauliai city. Most of publications on social environment (25 articles out of 43 publications about Šiauliai city) were evaluated positively, while the remaining 14 were identified as negatively assessed publications. It can be stated that the quality of life in Šiauliai is improved and the needs of the community members are taken into account, seeking to meet them, but the articles with the negative connotation point to the shortcomings of Šiauliai city, indicating the need to improve areas encompassing the social environment. There are also quite many articles related to the topics of infrastructure – 26 publications were distinguished. More than half are positively rated articles (15), while a smaller share (9) consists of negatively assessed articles and only a few (2) are neutral. There is a trend that the majority of the analysed articles during the specified period (110 publications) are assessed as positive, a smaller share (32 articles) are classified as negatively assessed; and 7, as neutral.

During the selected period under analysis; i.e., from June 1, 2018 until January 1, 2019, the analysed weekly of the public institution "Šiauliai Plus" contains 26 articles attributed to the topics of infrastructure. After analysing published articles, it was found that most of them contained information reflecting the positive assessment – 15 positive assessments were identified. The articles contain positive descriptions related to renewing infrastructure, traffic changes, and repaired city streets, the reader is informed about a better quality life. Nine articles using critical descriptions are seen as negative. In addition, this is evidenced by the negative headlines of the articles, such as "Kaštonų alėja – dar viena varnelė valdininkų sąrašuose" (*Kaštonų Avenue – One More Tick in the Lists of Officials*), "Duobėtą arteriją „užlopė" (*Pitted Artery Was "Patched*"). Such headlines make the reader negatively biased or even hostile. Conducting the study, 2 neutral articles were identified, which do not contain either exceptionally positive or negative information, only facts are presented in the reports. Thus, after analysing the articles related to the city of Šiauliai and attributed to the topics of infrastructure, the majority of articles are positive, but it is observed that quite a few articles are assessed negatively and only several are neutral.

The analysed articles on tourism related to Šiauliai city distributed favourably: out of 13 assessed reports all were positive. All articles provide particularly positive information, residents of Šiauliai and other cities are invited to participate in various activities, and new places to visit are announced. The headlines arouse the reader's interest and bias positively. For example, "Šiauliuose grįžta tarptautinės žirgų konkūrų varžybos" (*International Show Jumping Competition Returns to Šiauliai*), "VeloFano ištvermės varžybos – po savaitės" (*VeloFano Endurance Competition – in a Week*), "Paveikslo „Lietuvos aušra dieninio ir naktinio vaizdo demonstracijos vyks Šiaulių arenoje" (*Day and Night Video Demonstrations of the Picture*

"Lithuanian Dawn" will Take Place in Šiauliai Arena). The analysed articles on tourism distributed unambiguously: all articles are assessed positively, which forms a positive image of Šiauliai city.

During the specified period, there were 5 articles attributed to the topic of leisure, and all reports were assessed positively. The articles were evaluated this way because positive photos were presented, which pleasantly bias readers, the text contains a lot of positive information that does not create the sense of bias: "A new playground for board games was opened in Šiauliai birch park on Tuesday evening", "Giedrius Vainauskas, a senior specialist of Informatics and Communications Division of Šiauliai County Police Headquaters, amazes his colleagues by various items from beads, and Vaidas Kazlauskas, the head of the Criminal Investigation Service, creates various models from used bullets and tubes". After analysing the articles on the topic of leisure, only positively evaluated reports were indicated and no negative or neutral ones were found. It is concluded that self-expression, different pastime activities are favourably assessed in Šiauliai, but the number of publications is small compared with other topics, showing the lack of activeness, proactiveness and activity of members of the society; therefore, this area needs to be improved.

The highest number of articles written from June 1, 2018 until January 1, 2019 cover the topics of history, culture and art. In total, there are as many as 43 articles all of which contain positive information about the cultural life of Šiauliai city, high sports achievements of the city residents, and the works of art created by local people. Reports such as "Metų mokytoja: Dar neišsižadėkime kreidos" (*The Teacher of the Year: Let's not Renounce Chalk Yet*), "Regbio džentelmenas iš Šiaulių" (*The Gentleman of Rugby from Šiauliai*), "Egidijui Valčiukui debiutas Europos čempionate suspindo bronza" (*Egidijus Valčiukas' Debut Shines Bronze in the European Championship*) make us proud of Šiauliai residents who create and shape the cultural identity, make the city's name known, and construct the positive image of Šiauliai.

After analysing the articles in the weekly "Etaplius", which are attributed to the topics of politics and economy, the majority of reports are positive: 9 out of 18 articles contain positive information. There is a trend that positive assessments cover slightly more than half of the investigated articles. The reports provide information on funding, thank-you letters distributed by the mayor. Negatively assessed articles also cover a large share – a total of 8. This can be identified straight away according to headlines such as: "Didžiųjų miesto šventės mugės biudžeto nepapildė" (*The Fairs of the Great City Festivals have not Replenished the Budget*), "Užkrėsta kiauliena kvepia politika" (*Infected Pork Has an Odour of Politics*), "Tarybos nario akibrokštas – primityvu ir kvaila" (*Council Member's Slap in the Face – Primitive and Stupid*). Such articles are full of negative descriptions that cause public distrust and divide it. There is also one article that is assessed neutrally. It contains facts and does not evoke any positive or negative feelings in the reader. Based on presented results, it is concluded that articles about Šiauliai city on the topic of politics and economy tend to be more positive and are quite favourably assessed by the public, but negative articles enable to assume that trust is falling.

The number of the articles analysed in the weekly "Etaplius" on the topic of social environment within the indicated period little differed from the number of articles on history, culture and art – 43 articles were investigated. Basically, these were positive articles – 25 articles were attributed to this group. Fourteen were negative; 4, neutral. Positively rated articles contained positive headlines: "Nuo liepos – kraiteliai Šiaulių naujagimiams" (*From July – Trousseaus for Šiauliai Newborns*), "Saulės Raimedos Bučinskytės svajonei – finansinė „Rotary" parama" (*Saulė Raimeda Bučinskytė Receives Rotary Financial Support to Fulfil her Dream*), "Inovatyvios paslaugos skatins gyventojų socialinę integraciją" (*Innovative Services will Promote Residents' Social Integration*). The negative assessment of articles, many of which belong to the analysed topic, is proved by the use of negative headlines and critical descriptions used in the report; for example, "*For some time now, young families have not received the promised trousseaus for newborns*", "Nėra vietų išgirdo tris kartus" (*Heard "No Vacancies" for Three Times*)", "Gaisro nebuvo – ugniagesius šokdino melagis" (*There Was no Fire – the Firefighters were Cheated by a Liar*), "*A 72-year-old resident of Šiauliai district lost the savings kept in a bank account*". Neutral articles provide information on vaccinations, water quality, and tips how to behave in different situations.

In summary, it can be stated that after analysing 149 articles about the city of Šiauliai, attributed to the indicated topics during the specified period, positive assessment of articles dominates (110), significantly less publications are assessed negatively (32), and several are neutral (7). It is noticeable that articles attributed to the topics of history, culture and art, social environment and infrastructure are mostly assessed positively, but articles about politics and economy as well as the same topics of social environment and infrastructure are evaluated negatively. It has been identified that the publications attributed to the thematic groups of history, culture and art, social environment, and infrastructure are reflected in the strategic

development priorities set in strategic development plan of Šiauliai city municipality for 2015-2024. Three main directions emphasised by Šiauliai city municipality – the open, vibrant, and safe city – are also envisaged in the articles published in the weekly "Etaplius".

Conclusions

1. The city's image is the totality of the individual's knowledge, obtained experience and feelings about a particular area. The image of the city is formed on the basis of the following elements: natural features, infrastructure, tourism, leisure areas, history, culture and art, political and economic factors, social environment, and urban atmosphere. The image of the city is based on the following components: brand, visual image, reputation, perception, and identity.

2. The media forms a positive, negative and/or neutral image of the city. Three steps of the media, which influence public behaviour, are distinguished: drawing attention, communication of information, and attitude. The impact of the media report, related to public decision-making, is based on informational, perceptual, interactive and attention-diverting levels.

3. It has been found that the weekly "Etaplius" forms a positive image of Šiauliai city in the media. It has turned out that the articles related to building the positive image of the city include thematic groups of history, culture, art, and infrastructure; while the negative image of Šiauliai city is presented in the articles on social environment, politics as well as infrastructure. The strategic development priorities of Šiauliai city municipality – the open, vibrant, and safe city – are reflected in the articles published by the local media. The directions of the image constructed by the weekly newspaper "Etaplius" and Šiauliai city municipality coincide – the positive image of the city is formed.

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TRANSFORMER MAINTENANCE USING IR THERMOGRAPHY

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Annotation
This work attempts to show some case studies through IR thermography involvements in the industrial maintenance. Initially critical points of the essential or very important machines and electrical circulation units for the production have to investigated. The points where we observed abnormal temperature variations further analysis, using other advanced tools, like vibration analyzer, Laser alignment tool, Oil analyzer and Ultrasonic detector, was carried out. The main objective is to prove that by implementing a good scheduled thermography survey, one can decrease major expenses and save time. In addition, it has the capacity to contribute to the reliability of maintenance and minimize unexpected plant shutdowns dramatically in small and large scale industries.
Keywords: *Infrared (IR) Thermography, reliability, maintenance, conductivity, reflection*.

Introduction

Nondestructive testing (NDT) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage. Infrared (IR) technology is widely used in the oil and gas industry as an inspection tool for condition monitoring and predictive maintenance. IR thermography is a form of nondestructive testing that measures temperature variances of a component as heat (i.e. thermal radiation) flows through, from, or to that component. IR thermography is also generically known as IR testing, thermal testing, thermal imaging, and IR thermometry. The scope of the infrared thermography survey is confined to the production facility of the selected apparel and rubber sectors in the industrial estate in Sri Lanka. The focus of this assessment is on costs, energy intensive materials and electricity also because of countable wastage of the resources. The main objective of conducting the inspection is to reduce the unnecessary maintenance costs on wastage of material and electricity. Through this study, we investigate the savings and effectiveness of the Infrared thermography technologies.

The aim of the article is to investigate the cost-efficiency and effectiveness of the Infrared Thermography in the industrial maintenance sector.

Research objectives:

- Understand the IR Thermography and its value for the Industrial maintenance.
- Examine the highly critical locations or machineries in the production line.
- Analyse the collected IR images with the aid of software and pinpoint the abnormal situations.
- Calculate the various parameters for the perfect output.
- Estimate and compare the output results.
- Pinpoint and repair the defects before their occurrence with the aid of Infrared mechanical and electrical surveys.

Internal and external defection of equipment: for example, loose joint, loose contact, overload, unbalanced load, and improper installation. These defections usually cause excessheat, which could be harmful to equipment. Equipment failure needs high maintenance cost and maintenance staff which are risky for any accidents or life threatening. Temperature is a vital factor in status evaluation of electrical equipment. Therefore, temperature monitoring is considered to be one of the best maintenance methods [1]. An infrared scan can substantially improve profitability and reduce the operation and maintenance cost by the following ways [2, 3 5, 7, 8, 9, 10]:

- Instantly pinpointing the defects.
- Testing under the load conditions help to avoid costly shutdowns.

- Reducing the downtime and prevent catastrophic failures.
- Easy to allow for the pre repairing.
- Improve the reliability of maintenance efficiency.

The exact maintenance plan can solve both costs and downtime, so improving efficiency allows the plants to keep running their productions and operations smoothly. Industrial maintenance has many definitions in different approaches such as:

- Corrective / Reactive maintenance.
- Preventive maintenance.
- Predictive maintenance.
- Proactive maintenance [3].

Reactive / corrective maintenance operates on the run to failure strategy.

Preventive maintenance requires more on-going efforts but when executed properly it can reduce the costs in both short and long term. Still there is risk of machine failure occurring, it has a higher chance of identifying and correcting defects before they become a major disaster.

Predictive maintenance involve routinely inspecting machines with various developments including infrared and ultrasound technology. The national aeronautics and space administration (NASA) reported that this technique works to eliminate unexpected breakdowns and scheduled maintenance down time that would otherwise be used to inspect a machine piece by piece [2, 5, 6, 10].

Proactive maintenance differs from the above three modes because it addresses many more systematic elements of a maintenance program, rather than examine the machine itself. This approach provides much more control to the problems that can lead to machine wear and tear as opposed to the deterioration itself.

Instrumentation for IR Thermography

In order to interpret the thermal images perfectly the thermographer needs to know how different materials and circumstances influence the temperature readings from the thermal imaging camera. Some of the most important factors influencing the temperature readings are emissivity, conductivity, reflection, ambient and temperature [4, 5, 8, 9].

Six key requirements are important to assess when investigating a suitable combination of thermal imaging camera, software and training: Camera resolution / image quality, Thermal sensitivity, Accuracy, Camera functions, Software handling and Training demands.

In practical measurement application, the radiant energy leaves a target surface, passes through some transmitting medium, usually an atmospheric path, and reaches a measuring instrument. Therefore when making measurements or producing a thermos gram, three sets of characteristics must be considered:

1. Characteristics of the target surface
2. Characteristics of the transmitting medium
3. Characteristics of the measuring instrument

It is very difficult to determine the spectral sensitivity of an infrared radiometer such as an infrared camera. Consequently, the link between the effective blackbody radiance and the blackbody temperature cannot be established by integration. Furthermore, the sensitivity varies with time and a calibration is necessary – at least once a year or when the detector or an electronic component is replaced. During such a calibration procedure, the correlation between the temperature and the radiances is experimentally established using a laboratory blackbody, situated at the calibration distance of one meter from the camera.

An infrared camera measures the flux of the incoming radiation. Thus, a radiometer in front of an object detects not only the emitted radiance but also a part of exigent radiance due to the reflection of the ambient fluxes by the object surface. It is called noise of thermography. Noise is generally undesired signal and in IR it can be Electronic (shot noise, thermal noise, flicker), optical (random fluctuation of the incident radiation like Heating or Illuminating) and Environment (EMI caused by the Heavy Machinery, whirring, radio broad casting and of course heavy power lines) However, the quantitative error of the measurement has been difficult to evaluate precisely and systematically – not only in high temperature conditions but also in conditions near ambient. Errors impair the minimum detectable size and the noise equivalent temperature difference of the mechanical scanning of the IR system.

Cost Analysis

There are various benefit analysis for loose terminal connections. In this case we test the connection failure on transformer terminals.

The monthly Infrared thermography survey confirmed that the transformer connection bolt is loose. Further investigation revealed that the transformer was increasing the heat in the terminal point. Hot connection indicates a loose connection. Current transformer is having bar

primary with air core, and secondary, the coil with large number of turns, hence very high voltage will be induced if secondary is open or the connection on secondary side with load (meter/relay) are not tightened properly or loose. The high "independent" primary apertures will induce high secondary voltage, and will damage the load or the secondary winding. In order to avoid that the secondary of current transformer must be shortened when not in use normally, at low currents as a transformer has good insulation and air has a very high breakdown this will do no damage to the CT itself but if for some reason breakdown occurs it can create damage and arcing. However, at very high amps this can create significant damage and even prove fatal.

Table 1

Maintenance cost analysis with actual cost

Material cost		**No of units**	**Cost per unit (EUR)**	**Total (EUR)**
Galvanize bolt (16x75 mm)		6	0.25	1.50
Nut (16 mm) – (Mild steel)		6	0.09	0.54
Spring washer (Stainless Steel)		6	0.08	0.48
Plat washer (Stainless Steel)		12	0.08	0.96
Cu plate for flag (240x180x6mm) with drill hole		1	4.10	4.10
Sub Total				7.58
Man Hour Calculation	**No of Persons**	**No of Hours**	**Cost per Hour (EUR)**	**Total (EUR)**
	3	2.5	1.36	10.20
Total Cost for the repair (EUR)				**17.78**

Table 2

Opportunity cost analysis (Production Lost)

	Material Cost		**No of units**	**Cost per unit (EUR)**	**Total (EUR)**
	LV Transformer bushing and seal kit		1	980.73	980.73
	500mm cabel (meter)		30	48.59	1457.7
	Lug (500mm)		2	11.56	23.12
	Sub Total				2461.55
	Man Hour Calculation	**No of Persons**	**No of Hours**	**Cost per Hour (EUR)**	**Total (EUR)**
		4	6	1.36	10.2
	Total Cost for the repair (EUR)				**2471.75**
Production lost		**No of Hours**	**Production for one hour (kg)**	**Outsource compound cost per one kg**	**Total (EUR)**
Line 01		6	2430	0.06	931.63
Line 02		6	2910	0.06	1047.6
Line 03		6	4850	0.06	1746.0
Line 05		6	2490	0.06	896.4
Sub Total					4621.63

Table 3

Opportunity cost analysis (saving)

Man Hour Calculation	**No of Persons**	**No of Hours**	**Cost per Hour (EUR)**	**Total (EUR)**
Line 01	7	6	1.29	54.18
Line 02	7	6	1.29	54.18
Line 03	7	6	1.29	54.18
Line 05	7	6	1.29	54.18
Sub Total				216.72
Total Cost for the repair (EUR)				**4838.35**

Table 4

Total cost analysis

Total Cost for the repair (EUR)	**7310.10**
Total Saving (EUR)	**7292.32**

In order to save the transformer that should be immediately tightened at the terminal points with proper torque. Otherwise overload would lead to premature failure. The failures would result in approximately EUR 2,500 repair cost (Tab.2), and EUR 4,800 loss of production including the labour cost (Tab.3). If it would fail before taking the predictive actions failures would amount to a loss of EUR 7,300 (Tab.4). However, the failure was discovered using thermal camera and immediate actions were taken with the cost of just EUR 20 (Tab.1) for the

maintenance. Vast amount of unnecessary maintenance budget was saved due to this small detection and immediate clever action (Tab. 4).

Conclusions

The diagnostic capabilities of maintenance technologies have increased in recent years with advances made in sensor technologies. These advances, breakthroughs in component sensitivities, size reductions, and most importantly costs, have opened up an entirely new area of diagnostics to the O&M practitioners. Infrared thermography technology is applied at the major power consuming machines and critical machines for the production in the plant. The report clearly shows the essential of the maintenance methodology. This research might be helpful to the Sri Lankan engineers who are struggling in handling the maintenance costs with the top-level management. The following facts noted at the end of this process.

1. Improving the equipment effectiveness.
2. Prove the energy savings through the proper maintenance techniques and making improvements.
3. Minimize the unexpected machine shutdowns and reduce the downtime period for maintenance.
4. Introduce effective maintenance plans in Sri Lankan plants.
5. Solution providing and suggesting procuring more effective equipment by evaluating the costs of operating and maintaining the new equipment throughout its life cycle, long-term costs will be minimized.

The expected savings are possible if the recommended measures are implemented. Some of the measures are qualitative and would mitigate wastage of energy whilst others give direct benefits to the bottom line. If an energy management and reporting system would be implemented it could continually improve the energy consumption practices but also ensure a commitment from the staff which is vital for managing energy cost which would result to profitability of the company. Apart from initial purchasing expenses, warranty, speed, size and memory were also some factors, which have been taken into account. In addition, various instruments and training features are available in the world market. Thus, engineers have to take responsibility and should be able to discuss with top-level management in order to move to another step beyond the predictive maintenance. Most industry experts would agree (as well as most reputable equipment vendors) that this equipment should not be purchased for in-house use if there is not a serious commitment to proper implementation, operator training, and equipment monitoring and repair.

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